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Achieving Social and Economic Development Through Ecological and Organic Agricultural Alternatives

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EDITORS
GEROLD RAHMANN
TIMOTHY IPOOLA OLABIYI
VICTOR IDOWU OLOWE

Gerold Rahmann (Editor)
Thunen-Institut fur Okologischen Lanbau
Trenthorst 32
23847 Westerau
E-mail: gerold.ramann@ti.bun.de

Timothy Ipoola Olabiyi (Editor)
Department of Crop and Enviromental Protection,
Ladoke Akintola University of Technology,
P.M.B. 4000, Ogbomoso, Nigeria.
E-mail: tiolabiyi@lautech.edu.ng

Victor Idowu Olowe (Editor)
Institute of food Security,
Environmental Resources and Agricultural Research (IFSERAR),
Federal University of Agriculture,
Abeokuta, Nigeria.
E-mail: owebaba@yahoo.com, olowevio@funaab.edu.ng

"Achieving Social and Economic Development Through Ecological and Organic Agricultural Alternatives"

FOREWORD

The first (1AOC) and second (2AOC) editions of the African Organic Conference were successfully hosted by Uganda and Zambia in 2009 and 2012, respectively. The third edition of the continental conference (3AOC) is holding in Nigeria October 5 – 9, 2015 with the theme **"Achieving Social and Economic Development Through Ecological and Organic Agricultural Alternatives".** This conference is coming up in the continent when the call for need to improve rural livelihoods of Africans is becoming louder by the day. A veritable tool through which the livelihood of an average African can be improved is Organic Agriculture because it has an inherent potential to reduce production costs regularly incurred by small-medium scale farmers (principal actors in African agriculture), reduce debts, increase income, mitigate the vagaries of climate change, cope with market fluctuations, sustain soil fertility, minimize health hazards etc. Little wonder, ecological organic agriculture (EOA) has been recognized as a catalyst to redress food crisis in the continent by mainstreaming ecological organic agriculture into the agricultural production systems of member states of the African Union Commission by year 2020 as directed by their Heads of States in January, 2011 on organic farming (EX.CL/Dec.621 XVI).

Africa is the world's second largest continent after Asia and the world's second most populous with about 1.1b people corresponding to 15% of the world's total population. According to the organic agriculture data on 170 countries worldwide, there were 43.1 million hectares of land under organic in 2013 in the world with Africa accounting for just 1.2 million hectares (3 %) and 29% of the entire producers in the world. Furthermore, the global market reached 72 billion US$ in 2013 with the United States of America and the European Union (EU) accounting for 43 and 40%, respectively. The question that readily comes to mind is where is Africa in the global picture of organic agriculture?. In deed Africa is gradually emerging as a potential continent that will soon embrace organic farming as a tool to tackle food insecurity. To this effect, the International Federation of Organic Agriculture Movements (IFOAM) is collaborating with relevant stakeholders in the African Organic sector, African Union Commission (AUC) and others in its framework of "Organic Alternative for Africa Initiative" aimed at facilitating the integration of organic agriculture into the core of African policies and the agricultural development agenda. A very key player in the initiative is the African Organic Network (AfrONet), established in 2012 at Zambia, with headquarters in

Tanzania. AfroNet is ably coordinating the organic agriculture related activities of the national movements in the continent and actively participates in organic agriculture related activities globally.

It is envisaged that the 3AOC will provide an excellent platform to exchange ideas on the role ecological and organic agricultural alternatives can play in achieving social and economic development in the continent. A total of fifty six (56) papers were accepted for presentation as oral (52) and four (posters) in the conference. Papers were sent from nine (9) countries namely Nigeria, Uganda, Tanzania, Kenya, Ghana, Sudan, Germany and the United States of America. The papers cover different disciplines, such as agronomy, livestock production, aquaculture, economics, rural sociology etc. We expect the papers to give insight into:

- evolving concept of ecological organic agriculture as an organic alternative
- emerging knowledge, information and research results in the organic sector
- how organic agriculture can alleviate poverty, improve income generation, redress food
  insecurity and guarantee sustainable food production

The 3AOC scientific track is hereby documented as Book of Proceedings for the first time since inception in 2009. This exercise has been facilitated by International Centre for Research in Organic Food Systems (ICROFS) through the organic e-print platform for the submission of papers, The International Society of Organic Agriculture Research (ISOFAR), Swiss Aids and the African Organic Network for funding the production of the Proceedings. Hopefully, a download of the Proceedings shall be made available for ISOFAR members under the webpage of ISOFAR (www.isofar.org) after the conference.

We are most grateful to all the organizations (international, national and local) that have contributed to the organization of the 3AOC and scientists that volunteered to assist in manuscript review. The authors take full responsibility of the content of their papers as the editors only edited the manuscripts submitted.

Prof. Dr. Gerold Rahmann (Germany)
Dr. Timothy Ipoola Olabiyi (Nigeria)
Prof. Victor Idowu Olowe (Nigeria)

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EDITORS:
GEROLD RAHMANN
TIMOTHY IPOOLA OLABIYI
VICTOR IDOWU OLOWE

LIST OF REVIEWERS

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Dr.	M.O.	Ipinmoroti	Department of Fisheries and Wildlife Management, Osun State University, Osogbo.	Nigeria

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Nursery Establishment of *Moringa Oleifera* as Affected by Pre-Sowing Seed Treatments in a Coarse Textured Soil

Oshunsanya, S. O[1]., Fagbenro, J. A[2]., Aliku, O[1]. and Oke, O. A[1].
[1]Department of Agronomy, University of Ibadan, Nigeria
[2]Department of Crop Production, Soil and Environmental Management, Bowen University, Iwo, Nigeria.
Corresponding Author: soshunsanya@yahoo.com

Keywords: Pre-sowing Treatment, Moringa, Germination Percentage, Growth, Biomass

Abstract

Pre-sowing seed treatments have been reported to have influence on the germination percentage and growth performance, which could affect crop yield when transplanted to the field. Replacing chemically expensive and laborious pre-treatment with physically pre-treated seeds could reduce the cost of producing moringa by resource-poor farmers. Therefore, a screen-house experiment was conducted at the Department of Agronomy, University of Ibadan to examine effects of six pre-sowing seed treatments – dry seed with complete coat (DSCC), dry cracked seed coat (DCS), dry de-hulled seed (DDS), soaked seed with complete coat (SSCC), soaked cracked seed coat (SCC) and soaked de-hulled seed (SDS) on the germination percentage and growth indicators of moringa plant. The treatments were replicated eight times in a completely randomized design. The results indicated that DSCC had significantly higher (p=0.05) seed germination percentage than SCC, SSCC, DCS, DDS and SDS by 12, 43.5, 50, 56 and 75%, respectively, at 1 week after sowing (WAS). However, DDS had significantly higher (p=0.05) total biomass weight than DSCC, DCS, SSCC, SCC and SDS on fresh basis by 1.86, 2.17, 2.40, 4.51 and 3.03 g pot^{-1}. Conclusively, pre-sowing treatments have no significant effect on germination percentage, although, de-hulling dry moringa seeds before sowing enhanced its growth performance.

Introduction

Moringa oleifera is a fast growing perennial tree which can grow on a wide range of soil types, especially well drained sandy or loamy soil (Oshunsanya *et al*., 2014; Fagbenro *et al*., 2015).

The seeds could be planted at a depth of 1 – 3cm and germination usually occurs within 1- 2 weeks of sowing. Moringa seeds have no dormancy period so they may be sown as soon as they are matured. The average weight of each seed is between 0.3-0.4 g. The seeds can be sown without previous treatment. The peeling is not necessary; it may even weaken the germination process Padilla *et al*. (2012). They further stated that soaking the seed in water for 24 hours at room temperature is recommended, and moringa germination is rapid if new seeds are used. However, the percentage diminishes as their obtainment time passes. They further reported that the germination is between 70 and 98% and it diminishes when the sowing height surpasses the 1,200 m above sea level.

In view of these, only little criteria have been defined with respect to pre-seed treatments before sowing. With some researchers exploring the use of inorganic chemicals and other agronomic practices to enhance seed germination and plant growth (Mossler and Dunn, 2009), Nwangburuka *et al.* (2013) stated that many of the inorganic chemicals to an extent have been proven effective but show significant side effects on the crops such as inhibition of germination and retardation of plant growth). In addition, Nwangburuka *et al.* (2012) reported that high concentrations of 5 to 10% inorganic chemicals did not significantly improve germination, seedling length and seedling vigor index. However, Anon (2011) reported that the necessity of soaking the seeds before sowing while Perez *et al*. (2010) and Carballo (2011) do not consider necessary the treatments previous to the sowing to achieve a good germination.

In order to ascertain which schools of thought could be adopted into our tropical environment, this experiment was conducted to assess the effects of six pre-sowing seed treatments on the germination percentage and growth indicators of moringa in a controlled environment.

Materials and Methods

The experiment was conducted in the Screen-house of the Department of Agronomy, University of Ibadan, Nigeria. The experiment was laid out in a completely randomize design. The pre-sowing treatments were: (i) dry seeds with complete coat (DSCC), (ii) dry cracked seed coat (DSC) – seed coats were cracked using pliers before sowing, (iii) dry de-hulled seeds (DDS) – dry coats were completely removed before sowing, (iv) soaked seeds with complete coat (SSCC) – seeds were soaked with water in a container for 24 hours prior to sowing, (v) soaked cracked seed coat (SCC) – seeds were cracked using pliers and soaked with water for 24 hours before sowing and (vi) soaked de-hulled seeds (SDS) – seed coats were removed completely and subsequently soaked with water for 24 hours before sowing. The sowing was done in poly-bag, 2 kg soil capacity. The treatments were replicated eight times in a screen-house. Sowing was done with the aid of a calibrated stick to ensure uniform sowing depth of 3 cm for all treatments.

Results

Germination Percentage and Biomass Production

The seed germination percentage as affected by the various pre-sowing seed treatments as presented in Figure 1. The germination percentage per treatment was significantly ($p<0.05$) higher under SCC (88%) than DCS (50%), DDS (44%), SSCC (56.5%), and SDS (25%). However, the highest seed germination percentage (100%) was observed under DSCC.

The biomass on fresh and dry weight basis is depicted in Table 1. The above- and below-ground biomass on fresh and dry weight basis were significantly ($p=0.05$) influenced by pre-sowing seed treatments (Table 1). Results indicated that DSCC had higher above-ground biomass (4.85 and 1.15 kg $plant^{-1}$) on fresh and dry weight basis as compared to SCC (2.81 and 0.65 kg $plant^{-1}$), respectively. However, DDS produced the highest above-ground biomass on fresh (5.67 kg $plant^{-1}$) and dry (1.35 kg $plant^{-1}$) weight basis, while SDS recorded the lowest above-ground biomass on fresh and dry weight basis, respectively as 3.25 and 1.29 kg $plant^{-1}$.

Below-ground biomass on fresh weight basis washighest (5.60 kg $plant^{-1}$) under DDS, while the lowest below-ground biomass on fresh weight basis (3.95 kg $plant^{-1}$) was registered by SCC. Moreover, DSCC, DCS, SSCC and SDS produced 4.56, 4.85, 4.73 and 4.99 kg $plant^{-1}$ below-ground biomass on fresh weight basis. Significantly ($p=0.05$) higher below-ground biomass on dry weight basis was recorded for DDS (1.19 kg $plant^{-1}$) over DSCC (0.82 kg $plant^{-1}$). However, SDS produced the highest below-ground biomass (1.44 kg $plant^{-1}$) on dry weight basis while the SCC produced the lowest value of 0.76 kg $plant^{-1}$.

Table 1. **Physico-chemical Properties of the Experimental Soil**

Parameter	Values
pH	6.5
Organic Compound(g/kg)	32.9
Total Nitrogen (g/kg)	1.2
Phosphorus (mg/kg)	11.4
Exchange bases (cmol/kg)	
Potassium	1.5
Calcium	1.8
Sodium	1.13
Magnesium (mg/kg)	2.70
Manganese (mg/kg)	2.40
Iron (mg/kg)	2.30
Copper (mg/kg)	1.24
Exchangeable acidity (cmol/kg)	0.3
Cation exchange capacity (cmol/kg)	2.64
Sand (g/kg)	834
Silt (g/kg)	116
Clay (g/kg)	50
Textural class	Sandy loam

Table 2. **Effect of Seed Treatments on Moringa Biomass Production**

Treatment	Above-ground biomass (kg)		Below-ground biomass (kg)	
	Fresh weight	Dry weight	Fresh weight	Dry weight
DSCC	4.85ab	1.15a	4.56ab	0.82c
DCS	4.25bc	1.02ab	4.85ab	0.91bc
DDS	5.67a	1.35a	5.60a	1.19ab
SSCC	4.14bc	1.07a	4.73ab	0.98bc
SCC	2.81d	0.65b	3.95b	0.76c
SDS	3.25cd	1.29a	4.99ab	1.44a

Means with the same letter(s) in a column are not significantly different at p=0.05

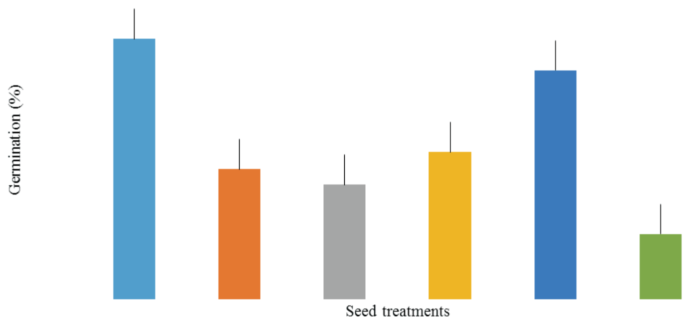

Figure 1: **Germination percentage as affected by seed treatments**

Discussion

In spite of the fact that results from scientific research shows that certain pre-sowing seed treatments are good options for improving moringa seed germination (Nouman *et al*., 2012), some others consider this practice unnecessary (Medina *et al*., 2007). This study indicated that moringa seeds without pre-sowing treatment (DSCC) fastened the seed germination. This allowed for the occurrence of optimum (100%) germination percentage of moringa seeds. This confirms that moringa seeds, in spite of the treatments, achieve high germination percentage. This result supports the claim that considers pre-germination seed treatments unnecessary (Medina *et al*., 2007). Soaked cracked seed coat (SCC) treatment which produced 88% seed germination after sowing resulted in lower number of the various growth indicators. This shows that this treatment weakens the potential of the plant during its developmental growth stages. This trend is contrary to the findings of Padilla *et al*. (2012) who reported that pre-germination treatment for 24 hours which allowed for 86% seed germination also propitiated the young plant to accelerate growth.

Conclusion

This study provides information about pre-sowing seed treatments (physical techniques) of *Moringa oleifera* which could replace chemically expensive and laborious pre-sowing seed treatment techniques for optimal *Moringa* biomass production. In terms of germination, pre-sowing seed treatments have no significant effect on *Moringa* seed germination percentage. This indicates that resource–poor farmers need not to treat *Moringa* seeds before sowing into coarse texture soil. However, dry de-hulled seeds (DDS) produced higher above – ground biomass than other pre-sowing seed treatments suggesting that dry coat removal could enhance vegetative growth parts of *Moringa*, which possess both medicinal and nutritive values. Further studies should be carried out on a wide range of soil texture, which could affect seed germination and field establishment.

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Growth Response of *Garcinia kola S*eedlings to Organic and Organomineral Fertilizers

ADEJOH O.P., YAKUBU F.B., AFOLABI J.O AND OFORDU C.S
Forestry Research Institute of Nigeria,
P.M.B. 5054, Ibadan, Nigeria,
Corresponding Author: bumexd@yahoo.com

Keywords: *Garcinia kola*, organic manure, organomineral fertilizer, growth parameters

Abstract

Growth responses of Garcinia kola seedlings to organic manure and organomineral fertilizers at three different levels were examined. Seven treatments were applied: T1- 2t/ha of Leucaena leucocephala compost (LLC), T2- 4t/ha LLC, T3- 6t/ha LLC, T4- 2t/ha of organomineral fertilizer (OMF), T5- 4t/ha OMF, T6- 6t/ha OMF and T7- control. Garcinia kola seedlings of same size were selected and transplanted from germination trays after 6weeks into medium sized (polypots) filled with 2kg topsoil after 6months from germination tray. The experimental design was a completely randomized design (CRD) with five replicates. The growth parameters assessed include plant height, collar diameter, number of leaves and biomass production for a period of twenty weeks. The results showed that there were significant differences among the growth parameters. Garcinia kola seedlings treated with 6t/ha Leucaena leucocephala compost and 2t/ha organomineral fertilizers have highest plant height(22.8±1.24cm)and collar diameter(5.02±0.16mm) respectively. Treatment containing 2t/ha Leucaena leucocephala compost (9.2±1.74) had the highest leaf number, weight and dry weight respectively. Correlations coefficient between the growth parameters and total biomass production was positive. Organic and organomineral fertilizers with optimum growth in this study are recommended for raising good and healthy Garcinia kola seedlings in the nursery for plantation establishment.

Introduction

*Garcinia kola (*Heckel), commonly called "Bitter kola" belongs to the family Guttiferae. It is highly valued multi-purpose tree for its fruits, seeds, stems, roots and barks that are used in Western and Central African regions (Hutchinson and Dalziel, 1954).In Nigeria, it is known by various names such as bitter kola, male kola (English name), orogbo (Yoruba), Aku ilu (Igbo) and Mijin goro (Hausa). It is also known as male kola due to its reported aphrodisiac properties(Adebisi, 2004; Adesuyi *et al*., 2013).*G. kola* seeds are chewed as a mastocatory substance to stimulate the flow of saliva, and widely consumed as snackunlike other kola nuts (*Kola nitida, Kola acuminata*), *G. kola* is thought to have the property of cleaning the digestive system without abdominal problems, even when a lot of the nuts are eaten (Adebisi, 2004**)**. *The seed is* culturally very important to the Yoruba and Igbo tribes in Nigeria and for many other people living in sub Saharan Africa(Ofusori *et al*., 2008). *Garcinia kola* seedlings are slow growing at the nusery stage. Organic based fertilizer such as organomineral fertilizer improves soil structure, reduces soil erosion, lowers the temperature at the soil surface, and increases soil water holding capacity (Roe et al., 2008). Resource poor farmers are faced with limited resources to purchase mineral fertilizers, resort to use of organic fertilizer. Similarly, the detrimental effects of mineral fertilizers on soils necessitated the need for testing the effectiveness of organic and organomineral fertilizers to *Garcinia kola* seedlings in this study. Besides they are are readily available, cheap, sustainable and environmentally friendly. Therefore, this study examined the growth responses of *Garcinia kola* seedlingsto organic manure and organomineral fertilizer at three different levels in the nursery in order to find the best level to use for plantation establishment of *Garcinia kola*.

Materials and Methods

Experimental Site

The study was conducted in the greenhouse of the Soils and Tree Nutrition Section, Department of Sustainable Forest Management of Forestry Research Institute of Nigeria (FRIN), Ibadan, Nigeria. FRIN lies within latitude $07^0$23'N and longitude $03^0$51'E with the mean total rainfall of 1148.1 mm, falling in approximately 87 days with the minimum temperature of 24.4^{0}C, and maximum temperature of 31.5 °C and with high relative humidity of 79.4% (FRIN 2014).

Collection and Analysis of Soil

Top soils (0–15 cm) were randomly collected with soil auger from the arboretum of Forestry Research Institute of Nigeria.Particle size analysis was carried out using hydrometer method (Bouyoucos, 1962). The pH was determined in water (ratio 1:1, soil:water). Organic carbon was determined by wet dichromate method (Nelson and Sommers, 1975) and available phosphorus was determined by Bray extraction method (Anderson and Ingram, 1993). Total nitrogen was determined by Kjeldahl method. Exchangeable cations (potassium, calcium, and magnesium) were extracted with ammonium acetate. Potassium was determined by flame photometer method, while calcium and magnesium were determined by atomic absorption spectrophotometer. Copper, zinc, manganese, and iron were also determined by the method used by IITA(1979).

Seed Source, Data Collection and Analysis

Matured fruits of *Garcinia kola* were collected from the mother tree at Uromi, Esan North East Local Government Area (LGA) in Edo State, Nigeria. The seeds were extracted according to the method of Yakubu *et al*., (2014). The study was carried out with a Completely Randomized Design (CRD) with five replications.The experiment consisted of T1- 2t/ha of *Leucaena leucocephala* compost (LLC), T2- 4t/ha LLC, T3- 6t/ha LLC, T4- 2t/ha of organomineral fertilizer (OMF), T5- 4t/ha OMF, T6- 6t/ha OMF and T7: control.Two months after transplanting, data were collected for twenty four weeks on agronomic parameters, while biomass weights were determined at the end of the experiment.Data obtained were subjected to statistical analysis of variance and means were separated Using Duncan's Multiple Range test (Duncan, 1955) at 5% probability level.

Results

The experimental soil was sandy loam in texture and slightly acidic, medium in organic carbon and Nitrogen. The P^H, Organic carbon, total N, Available P and K values were 6.2, 5.30%, 1.17%, 4.05%, 0.17% respectively. Most of the nutrients in this soil were low and below the critical level Adeoye and Agboola (1985). The Nitrogen content of the organomineral fertilizer and *Leucaena leucocephala* compost applied were higher than that of the experimental soil. This justifies the application of soil amendment in form of organic and organomineral fertilizers to *G. kola* seedlings (Table 1).The plant heights of *Garcinia kola*seedlingswere not significantly different between treatments at 4weeks After Transplanting Planting (WAT), 8WAT, 12WAT,16WAT, 18WAT and 20WAT respectively. At 24WAT, 6t/ha LLC recorded the highest mean plant height of 22.8cm while the control recorded the least plant height of 14.01cm at 24WAT. The stem diameter did not show significant differences among treatments except at 16, 20 and 24 WAT, while control recorded the least. Treatment containing 2t/ha OMF recorded significantly higher stem diameter than other treatments.

Table 1. **Soil, Organomineral Fertilizer and *Leucaena Leucocephala* Compost Analysis**

Soil Sample	Value	Organomineral Fertilizer	Value	*L. leucocephala* Compost	Value
Soil P^H	6.20	P^H	6.46	N	3.86
		Organic matter	69.96		
		Organic carbon	29.76		
		Total N(%)	3.54		
Organic C (%)	5.30	P(%)	1.68	P	0.08
		Parameter(mg/kg)	VALUE		
Total N (%)	1.17	Cd	1.36	K	1.29
		Cr	11.18		
		Cu	4.20		
		Ni	9.3		
		Pb	19.65		
		Zn	328.00		
Avail P (mg/kg)	4.05			Ca	1.09
Exchangeable Cations (cmol/kg)				Mg	0.41
Ca	1.53			Zn(ppm)	37.05
Mg	0.75				
Na	0.10				
K	0.17				
Exchangeable Acidity	0.57				
Base Saturation (%)	67.91				
CEC	3.26				
Available Micronutrient $(Mgkg^{-1})$					
Mn	20.59				
Fe	9.72				
Cu	7.17				
Zn	4.41				
Physical Analysis (%)					
Sand	74.53				
Silt	21.07				
Clay	4.40				
Textural Class	Sandy Loam				

Table 2: **Height (cm) of *Garcinia kola* Seedlings at Different Intervals**

TREATMENTS	4WAT	8WAT	12WAT	16WAT	20WAT	24WAT
2t/ha LLC	10.08	11.20	12.58	15.10	15.76	17.78
4t/ha LLC	9.82$^{a\ a}$	10.90^{a}	11.97^{a}	12.56^{a}	12.74^{a}	16.40^{ab}
6t/ha LLC	9.98^{a}	11.53^{a}	12.48^{a}	15.30^{a}	16.40^{a}	22.80^{a}
2t/haOMF	10.02^{a}	11.94^{a}	12.98^{a}	15.04^{a}	16.60^{a}	20.40^{ab}
4t/haOMF	9.80^{a}	10.55^{a}	10.54^{a}	11.72^{a}	12.50^{a}	15.20^{b}
6t/haOMF	9.30^{a}	10.94^{a}	11.80^{a}	14.90^{a}	16.06^{a}	19.16^{ab}
Control	10.36^{a}	8.94^{a}	9.13^{a}	10.04^{a}	12.90^{a}	14.01^{b}

Means followed by the same letters within the same column are not significantly different ($p< 0.05$) T1: 2t/ha *Leucaena leucocephala* compost (LLC), T2: 4t/ha LLC, T3: 6t/ha LL, T4: 2t/ha organomineral fertilizer (OMF) T5: 4t/ha OMF T6t/ha OMF and T7: control.

Table 3. **Collar Diameter (mm) of *Garcinia kola* Seedlings at Different Intervals**

TREATMENTS	4WAT	8WAT	12WAT	16WAT	20WAT	24WAT
2t/ha LLC	3.26^{a}	3.54^{a}	3.74^{a}	3.66^{a}	4.24^{a}	4.60^{ab}
4t/ha LLC	2.89^{a}	3.16^{a}	3.97^{a}	3.53^{a}	4.20^{a}	4.51^{ab}
6t/ha LLC	2.91^{a}	3.56^{a}	3.56^{a}	3.66^{a}	4.28^{a}	4.38^{ab}
2t/haOMF	3.19^{a}	3.62^{a}	3.43^{a}	3.69^{a}	4.77^{a}	5.02^{a}
4t/haOMF	2.68^{a}	2.86^{a}	3.09^{a}	3.26^{a}	4.40^{a}	4.43^{ab}
6t/haOMF	3.07^{a}	3.58^{a}	3.65^{a}	3.41^{a}	4.28^{a}	4.50^{ab}
Control	2.69^{a}	2.94^{a}	3.13^{a}	2.99^{b}	3.04^{b}	3.92^{b}

Means followed by the same letters within the same column are not significantly different ($p< 0.05$) T1: 2t/ha *Leucaena leucocephala* compost (LLC), T2: 4t/ha LLC, T3: 6t/ha LL, T4: 2t/ha organomineral fertilizer (OMF) T5: 4t/ha OMF T6t/ha OMF and T7: control.

Table 4. **Number of Leaves of *Garcinia kola* Seedlings at Different Intervals**

TREATMENTS	4WAT	8WAT	12WAT	16WAT	20WAT	24WAT
2t/ha LLC	3.8^{a}	4.0^{a}	5.2^{a}	5.8^{a}	7.6^{a}	9.2^{a}
4t/ha LLC	3.8^{a}	4.4^{a}	4.2^{a}	5.0^{a}	6.2^{ab}	6.8^{ab}
6t/ha LLC	4.6^{a}	4.6^{a}	5.2^{a}	5.8^{a}	6.2^{ab}	8.0^{ab}
2t/haOMF	3.8^{a}	4.6^{a}	5.4^{a}	5.4^{a}	6.4^{ab}	7.4^{ab}
4t/haOMF	3.8^{a}	4.0^{a}	4.6^{a}	4.6^{a}	5.0^{b}	6.0^{b}
6t/haOMF	4.0^{a}	5.2^{a}	5.4^{a}	5.8^{a}	6.2^{ab}	6.8^{ab}
Control	3.6^{a}	4.2^{a}	5.6^{a}	6.0^{a}	6.8^{ab}	7.6^{ab}

Means followed by the same letters within the same column are not significantly different ($p< 0.05$) T1: 2t/ha *Leucaena leucocephala* compost (LLC), T2: 4t/ha LLC, T3: 6t/ha LL, T4: 2t/ha organomineral fertilizer (OMF) T5: 4t/ha OMF T6t/ha OMF and T7: control.

Table 5. **Height (cm) of *Garcinia kola* Seedlings at different Intervals**

TREATMENTS	4WAT	8 WAT	12WAT	16WAT	20WAT	24WAT
2t/ha LLC	10.08^{a}	11.20^{a}	12.58^{a}	15.10^{a}	15.76^{a}	17.78^{ab}
4t/ha LLC	9.82^{a}	10.90^{a}	11.97^{a}	12.56^{a}	12.74^{a}	16.40^{ab}
6t/ha LLC	9.98^{a}	11.53^{a}	12.48^{a}	15.30^{a}	16.40^{a}	22.80^{a}
2t/haOMF	10.02^{a}	11.94^{a}	12.98^{a}	15.04^{a}	16.60^{a}	20.40^{ab}
4t/haOMF	9.80^{a}	10.55^{a}	10.54^{a}	11.72^{a}	12.50^{a}	15.20^{b}
6t/haOMF	9.30^{a}	10.94^{a}	11.80^{a}	14.90^{a}	16.06^{a}	19.16^{ab}
Control	10.36^{a}	8.94^{a}	9.13^{a}	10.04^{a}	12.90^{a}	14.01^{b}

Means followed by the same letters within the same column are not significantly different ($p< 0.05$) T1: 2t/ha *Leucaena leucocephala* compost (LLC), T2: 4t/ha LLC, T3: 6t/ha LL, T4: 2t/ha organomineral fertilizer (OMF) T5: 4t/ha OMF T6t/ha OMF and T7: control.

Table 6: **Collar Diameter (mm) of *Garcinia kola* Seedlings at Different Intervals**

TREATMENTS	4WAT	8WAT	12WAT	16WAT	20WAT	24WAT
2t/ha LLC	3.26[a]	3.54[a]	3.74[a]	3.66[a]	4.24[a]	4.60[ab]
4t/ha LLC	2.89[a]	3.16[a]	3.97[a]	3.53[a]	4.20[a]	4.51[ab]
6t/ha LLC	2.91[a]	3.56[a]	3.56[a]	3.66[a]	4.28[a]	4.38[ab]
2t/haOMF	3.19[a]	3.62[a]	3.43[a]	3.69[a]	4.77[a]	5.02[a]
4t/haOMF	2.68[a]	2.86[a]	3.09[a]	3.26[a]	4.40[a]	4.43[ab]
6t/haOMF	3.07[a]	3.58[a]	3.65[a]	3.41[a]	4.28[a]	4.50[ab]
Control	2.69[a]	2.94[a]	3.13[a]	2.99[b]	3.04[b]	3.92[b]

Means followed by the same letters within the same column are not significantly different ($p < 0.05$) T1: 2t/ha *Leucaena leucocephala* compost (LLC), T2: 4t/ha LLC, T3: 6t/ha LL, T4: 2t/ha organomineral fertilizer (OMF) T5: 4t/ha OMF T6t/ha OMF and T7: control.

Table 7. **Number of Leaves of *Garcinia kola* Seedlings at different Intervals**

TREATMENTS	4WAT	8WAT	12WAT	16WAT	20WAT	24WAT
2t/ha LLC	3.8[a]	4.0[a]	5.2[a]	5.8[a]	7.6[a]	9.2[a]
4t/ha LLC	3.8[a]	4.4[a]	4.2[a]	5.0[a]	6.2[ab]	6.8[ab]
6t/ha LLC	4.6[a]	4.6[a]	5.2[a]	5.8[a]	6.2[ab]	8.0[ab]
2t/haOMF	3.8[a]	4.6[a]	5.4[a]	5.4[a]	6.4[ab]	7.4[ab]
4t/haOMF	3.8[a]	4.0[a]	4.6[a]	4.6[a]	5.0[b]	6.0[b]
6t/haOMF	4.0[a]	5.2[a]	5.4[a]	5.8[a]	6.2[ab]	6.8[ab]
Control	3.6[a]	4.2[a]	5.6[a]	6.0[a]	6.8[ab]	7.6[ab]

Means followed by the same letters within the same column are not significantly different ($p < 0.05$) T1: 2t/ha *Leucaena leucocephala* compost (LLC), T2: 4t/ha LLC, T3: 6t/ha LL, T4: 2t/ha organomineral fertilizer (OMF) T5: 4t/ha OMF T6t/ha OMF and T7: control.

Control had the lowest stem diameter(3.92mm) at the end of the experiment.The total number of leaves followed similar trend with the stem diameter. No significant differences were recorded from 4WAT to 16WAT. At 20WAT treatment containing 2t/ha *Leucaena leucocephala* compost (LLC) was significantly different from recording (5.0) mean total number of leaves. At 24WAT the leaf number was in the range (6.0 to 9.20). Treatment with 2t/ha LLC had the maximum number of leaves (9.20) while treatment of 4t/ha OMF recorded the least value of 6.0.Total biomass assessment at the the end highest wet weight 10.58g was recorded by 6t/ha OMF, was followed in this order 2t/ha LLC > 2t/ha OMF > 6t/ha LLC > 4t/ha LLC > 4t/ha OMF > Control. Dry weight was in the order 2t/ha LLC > 6t/ha OMF > 2t/ha OMF > 6t/ha LLC > 4t/ha LLC > 4t/ha LLC > Control.

At 24 weeks after transplanting, correlation coefficients of plant diameter and height (0.577), diameter and number of leaves (0.551), height and number of leaves (0.441) were positive and statistically significant at 1.0%. Plant diameter increases together with height and number of leaves. Similarly plant height also increases with number of leaves. Plant height increases with wet weight (0.342) and dry weight (0.394) at 5.0% significant level. Wet and dry weights are positively and significantly correlated (0.961) at 1.0% significant level, they increase at the same rate (Figure 1). The vegetative growth of *Garcina kola* seedlings were significantly influenced by application of 6t/ha Leucaena leucocephala compost (22.8±1.24cm). However 2t/ha organomineral fertilizer (5.02±0.16mm) recorded the highest plant height and collar diameter respectively. 2t/ha *Leucaena leucocephala* compost (9.2±1.74) gave the highest leaf number.

Discussion

For centuries, the nuts have been an important part of traditional ceremonies, marking special events like births, marriages, and conferring chieftaincy titles. A *G. kola* nut tree may be planted when a baby is born with the child becoming its lifelong owner. Seedlings with good vigour at the nursery stages tend to perform better when taken to the field after culling and hardening up.

Matured fruits of *Garcinia kola* were collected from the mother tree at Uromi, Esan North East Local Government Area (LGA) in Edo State, Nigeria. The seeds were extracted from the fruits, washed and air dried at room temperature for three (3) days in line with the method of Yakubu *et al*., (2014). The effect of compost and other organic amendment on the growth of *Garcinia kola* may be as a result of the interaction between the nutrient present and growth of *Garcinia* seedlings, as organic manure has been found to contain auxins, gibberellins, and cytokinis (Miezah, 2008; Stoffella *et al*., 1997). Similar results were observed by previous workers on application of organic and organnomineral fertilizer on tree crops (Dania *et al*., 2014; Shodeke *et al.,* 2012).

Conclusion

In this work, increased growth of *Garcinia kola* seedlings was enhanced mostly by 6t/ha of *Leucaena leucocephala* compost. The highest plant height and collar diameter were obtained with (22.8±1.24cm. Treatment containing 2t/ha organomineral fertilizer (5.02±0.16mm) respectively. 2t/ha Leucaena leucocephala compost (9.29, 10.58g and 4g) gave the highest leaf number, wet and dry weights of seedlings respectively.

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Optimum Returns in Irrigated Groundnut as Influenced by Poultry Manure Rates at Kadawa in the Sudan Savanna Ecological Zone of Nigeria

USMAN IBRAHIM[1] AND SHEHU ABDUL RAHMAN[2]
[1]Samaru College of Agriculture, Ahmadu Bello University, Zaria, Nigeria
[2]Department of Agricultural Economics, Federal University Gashua, Yobe State, Nigeria
Corresponding Address: ibrusman2007@yahoo.com

Keywords: Regression, Gross Margin, Cost Benefit Analysis Groundnut, Poultry manure.

Abstract

Groundnut has been reported to be one of the most important oil crops in the world. It plays an important role in the diets of rural populations, livestock feeding and soil fertility particularly in developing world. The yield from farmers' field has been low due to several factors. Increased groundnut production can be achieved through irrigation to complement the rainy season production while its productivity can be enhanced by the use of a safer and available alternative source of nutrients like the poultry manure. This work was therefore undertaken to determine economic optimum level of poultry manure in groundnut production under irrigation. To achieve this objectives field trials were conducted during the 2012/2013 and 2013/2014 dry seasons at the Irrigation Research farm of the Institute for Agricultural Research, Kadawa (Latitude, 11° 39' N, Longitude 08° 27' E, 500 meter above sea level) located in the Sudan Savanna ecological zone of Nigeria. The treatments consisted of three varieties of groundnut (SAMNUT 11, SAMNUT 22 and SAMNUT 23) and three levels of poultry manure (0, 1.5 and 3 tonnes ha^{-1}). The treatments were laid out in a split- plot design, poultry manure rates were allocated to the main plot while the varieties were allocated to the subplot. The treatments were replicated three times throughout the period of experimentation. ***.*** *Yield data collected were subjected to analysis of variance, where significant differences existed, the Duncan multiple range test was used to separate the means. Result from regression analysis showed that the optimum rates of 1.94 tonnes ha^{-1} and 1.90 tonnes ha^{-1} were obtained in 2012/2013 and 2013/2014give a yield of 2,557kg ha^{-1} and 2,409kgha^{-1} respectively. When these rates were subjected to gross margin and cost-benefit analysis with respect to the rates used in this experiment it was found that application of 1.5 tonnes ha^{-1} gave the highest gross margin and cost- benefit ratio. It can be concluded that the application of 1.5 tonnes ha^{-1} which gave the highest yield from the trials was more profitable; therefore, farmers are advice to adopt the use of 1.5 tonnes ha^{-1} for groundnut production in the study area.*

Introduction

Groundnut *(Arachis hypogaea L.)* plays an important role in the diets of rural populations, particularly children, because of its high contents of protein and carbohydrate. It is also rich in calcium, potassium, phosphorus, magnesium and vitamin E. Groundnut meal, a by-product of oil extraction, is an important ingredient in livestock feed. Groundnut haulms are nutritious and widely used for feeding livestock (Mukhtar, 2009). The production of groundnut is concentrated in Asia and Africa, where the crop is grown mostly by smallholder farmers, under rain-fed conditions with limited inputs and low income, making it difficult for them to buy inorganic fertilizers.

Fertilizer has been recognized as one of the most important agrochemical input responsible for about 60% of increment output to crops, while 40% was expected from hecterage expansion. However, the use of inorganic fertilizer has been declining because of scarcity and high cost of the inorganic fertilizer making it unaffordable to most peasant farmers. Furthermore the increasing concern about the effects of inorganic fertilizers on the environment makes organic manure a safer and better available alternative source of nutrients to crop. Adeleye *et al*. (2010) reported that inorganic fertilizer has not been helpful under intensive agriculture because it is often associated with reduced crop yield, acidity, and soil nutrient imbalance. It is a known fact that achieving global food security whilst reconciling demands on the environment is the greatest challenge faced by mankind therefore there is the need to source for a safer and available alternative source of nutrients like the poultry manure.

Poultry manure is an excellent source of organic manure, as it contains high nitrogen, phosphorous, potassium and other essential nutrients. In contrast to inorganic fertilizer, it adds organic matter to soil which improves soil structure, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksisssa *et al.,* 2008).To obtain maximum economic value of plant nutrients in poultry manure, poultry manure should be applied to match nutrient needs of crops (Mitchell, 2012). The need to avoid wastage and over fertilization is also important, considering the fact that poultry manure is used for other purposes such as in feeding animals such as cattle, pigs and fishes and most recently for biogas production. Poultry manure is available to farmers in the study area but it is usually used without any scientific recommendation (Ibrahim *et al*., 2013). Thus, it is important to avoid wastage by ensuring that only the required quantities of poultry manure are applied to the crop. Rahman, (2006) concluded that in order to boost crop production poultry manure has to be adequately supplied to meet its demand by the farmers.

Traditionally in Nigeria, groundnut is usually grown during the rainy season however; environmental factors for successful groundnut production found during the rainy season also prevail during the dry season in the savanna, while moisture requirements can be adequately met by the supply of water through irrigation (Mukhtar, 2009).Increased groundnut production can be achieved through irrigation to complement the rainy season production while its productivity can be enhanced by the use of a safer and available alternative source of nutrients like the poultry manure. This work was therefore undertaken to determine economic optimum level of poultry manure in groundnut production under irrigation.

Material and Methods

Field trials were conducted during the 2012/2013 and 2013/2014 dry seasons at the Irrigation Research farm of the Institute for Agricultural Research, Kadawa (Latitude, 11° 39 ' N, Longitude $08^{\circ}27'$ E,500 meter above sea level) located in the Sudan Savanna ecological zone of Nigeria. The treatments consisted of three varieties of groundnut (SAMNUT 11, SAMNUT 22 and SAMNUT 23) and three levels of poultry manure (0, 1.5 and 3 tonnes ha^{-1}). The treatments were laid out in a split- plot design, poultry manure rates were allocated to the main plot while the varieties were allocated to the subplot. The treatments were replicated three times throughout the period of experimentation. Poultry manure was applied three weeks before planting. It was uniformly spread on the ridge and lightly worked into soils with hoe. Irrigation was carried out using furrow method and water was supplied at 10 days intervals, and was stopped a week before harvesting each varieties, although the amount of water used to irrigate was not quantified.

The land was harrowed twice and ridged to obtain a fine tilt. The gross and net plot sizes were 18.0 m^2 (4.5 x 4) m and 6.0 m^2 (1.5 x 4) m respectively, with 1.0m spacing between blocks and 0.5m spacing between plots. There were 6 ridges in gross plot and 2 ridges in net plot. Hoe weeding was carried out at 3 and 6 WAS. Assessment of yield component was carried out at harvest. Weight of pods per plot was determined by measuring the weight of the total number of pods in each net plot using E2000 electronic mettler balance. The pod yield (Kg) per net plot was extrapolated to per hectare basis and the value obtained was then recorded and were subjected to analysis of variance, where significant differences existed, the Duncan multiple range tests was used to separate the means. The yield data was subjected to regression analysis using the scatter diagram techniques as described by Gomez and Gomez (1984). Both the yield data and the results obtained from regression analysis were subjected to economic analysis using the gross margin and the cost benefit analysis. The gross margin analysis is the difference between the total revenue and the total variable cost i.e. GM= TR-TVC Where GM= Gross margin. TR= Total revenue TVC= Total variable cost. The cost- benefits analysis which is also known as the profitability index, measures the rate of return on investment. It gives the amount of profit on any Naira invested under the factors considered. It is expressed as thus; Cost-benefit ratio = GM/ VC Where GM= Gross margin and VC = variable cost of each of the factors considered. The revenue from groundnut was obtained as a product of farm gate price of one kilograms of the crop and the yield measured in kilogram. Farm gate price of ₦100/Kg was used in computing the revenue for pod yield. Total variable cost is the summation of all the cost incurred for each treatment. In determining the profitability of groundnut, the variable costs are the cost of poultry manure (₦10,000 per tonnes) and cost of application (₦5000 per hectare). Where $1=₦166 during the period under review.

Results and Discussion

The polynomial equation that best described the relationship between yield and poultry manure is shown in the Figure 1 and it gave an R^2 value of 1 in both years and the combined. The optimum rates of 1.94 tonnesha^{-1}and 1.90tonnesha^{-1}were obtained in 2012 and 2013 to give a yield of 2,557kg ha^{-1}and 2,409kgha^{-1}respectively. When these rates were subjected to gross margin and cost-benefit analysis with respect to the rates used in the experiment it was found that application of 1.5 tonnes ha^{-1}gave the highest gross margin and cost- benefit ration as shown in Tables 1 and 2.

The result from gross margin and cost benefit analysis indicated that groundnut production was profitable in both seasons. The highest gross margin obtained by the application of 1.5 tonnes ha^{-1} of poultry was due to the high pod yield produced when compared to the other treatments and this was why the gross margin of plots applied with 1.5 tonnes ha^{-1} was highest. Similarly the lowest gross margin produced by the control was due to lower pod yield obtained. Cost- benefit analysis was highest when 1.5tonnes ha^{-1} of poultry was applied. This is because the cost of poultry manure was twice in plots where 3.0 tonnes ha-^{1}of poultry manure was applied and this did not translate to double yield. The cost-benefit analysis for the control was higher than that of 3.0 tonnes even though the yield was lower, this is because there was no variable cost incurred in the control plot. The cost of investment for the control treatments was only on fixed operations thereby minimizing its cost.

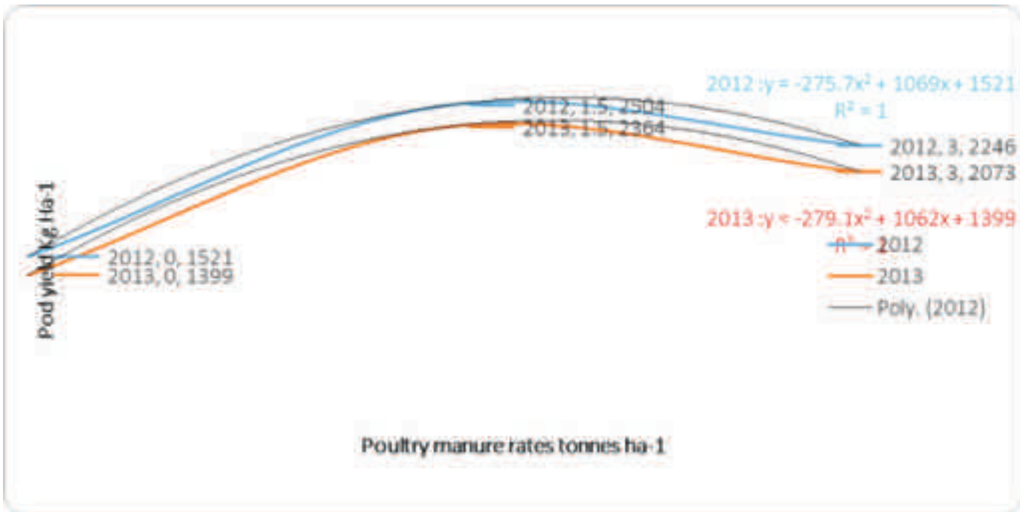

Figure 2: **Polynomial response of pod yield to poultry manure rates at Kadawa during the 2012/2013 and 2013/2014 dry seasons at Kadawa**

Table 1. **Economic analysis of the polynomial result at Kadawa during the 2012/2013 dry season**

Treatments	Pod yield	Revenue (pod)	Total variable cost	Gross margin	Cost benefit ratio
Poultry manure (t ha-^{1})					
0	1521	152,100	51,000	117,615	2.30
1.5	2504	250,400	71,000	225,060	3.16
3.0	2246	224,600	86,000	198,465	2.30
1.94	2557	255,700	75,400	180,300	2.39

Table 2. **Economic analysis of the polynomial result at Kadawa during the 2013/2014 dry season**

Treatments	Pod yield	Revenue (pod)	Total variable cost	Gross margin	Cost benefit ratio
Poultry manure (t ha-^{1})					
0	1399	139,900	51,000	104,725	2.05
1.5	2364	236,400	71,000	207,280	2.91
3.0	2073	207,300	86,000	173,455	2.02

Conclusion

It can be concluded that the application of 1.5 tonnes ha^{-1} of poultry manure increased both yield and profitability of groundnut. Therefore farmers are advice to adopt the use of 1.5 tonnes ha-^{1} of poultry manure to improve yields and profitability of groundnut.

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Effects of Phosphocompost on Acidity Indices in an Acidic Soil in Ilesha, Southwestern Nigeria

OYEYIOLA Y.B.[1], OMUETI, J.A.I. [2] AND KOLAWOLE, G.O.[1]
[1]Department of Crop Production and Soil Science, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria.
[2]Department of Agronomy, University of Ibadan, Ibadan, Nigeria.
Corresponding Author: yboyeyiola@lautech.edu.ng

Keywords: Phosphocompost, chemical fertilizer, lime, acidity, base saturation.

Abstract

A field work was carried out to investigate the effect of phosphocompost (PC) on soil acidity indices and cowpea yields in an acidic soil in Ilesha Southwestern Nigeria. A total of eight treatments were studied. They were made up of two phosphocompost types (bone meal fortified compost from rice bran and poultry manure (C1) and bone meal fortified compost from sawdust and poultry manure (C2)) applied at 2.5 and 5.0 t/ha tagged 2.5C1, 5C1, 2.5C2 and 5C2; two chemical fertilizer treatments including NPK 15:15:15 (NPK) applied at 80 kg/ha and a blend of Urea (applied at 30 kg N/ha) and Single super phosphate (applied at 40 kg/ha) tagged Urea+SSP. Plots that received only lime at 1 t/ha and an untreated plot tagged (AC) were included. All the PC treatments improved soil pH from initial 4.8 to as high as 5.7 in 5C1 while NPK gave a pH range of 4.0 – 4.5 and Urea+SSP 4.3 – 4.8. Available P range of 44.8 – 144.5 and 13.2 – 14.5 mg/kg were observed from PC and chemical fertilizer plots respectively. 5C2 gave highest calcium saturation percentage (68.6%) similar to lime (59.7%) but superior to NPK (21.3). Acidity saturation percentage (ASP) was higher in NPK treated plot (66%) above the untreated soil (54%). ASP were lower (11 – 20.3%) in PC plots similar to lime (20%).

Introduction

Acidification is a major soil chemical condition limiting optimum crop production in humid tropical soils. Acidic parent materials (Oke *et al*., 2013) and leaching of basic cations from soils under the influence of high torrential rainfall (Sahrawat *et al*., 2000; Franklin, 2012) are prominent natural factors in the development of acidity in soils. Anthropogenic factors such as continuous cropping without replacement of nutrients taken up by crops (Tang and Rengel, 2003) and indiscriminate use of chemical fertilizers had been implicated to contribute to poor soil reactions (Anetor and Akinrinde,2007; Lungu and Dynoodt, 2008; Oyeyiola et al., 2014). This poor cropping system encouraged faster depletion of basic cations in soil solution and those retained on the soil exchange sites. The result is increasing concentrations of H^+ exchanged for the lost basic cations with drastic reduction in soil pH. Occurrence of this encourages dissolution of Aluminum ions from stabilized forms with increasing toxicity effects on plant roots as well as macronutrients deficiencies (low base saturation, available phosphorus).

Chemical fertilizers such as urea, single super phosphate and NPK have been instrumental in increasing crop yield on high organic carbon soils in Nigeria (Ojeniyi, 2012), but their continuous use have been detrimental to soil productivity. Fast soil organic carbon depletion , increasing concentration of

H^+, basic cation nutrient imbalance, low base saturation and increasing Aluminum saturation percentage are evidences of their effects on tropical soils characterized by low activity clay (Bachmann, 2000, Amlinger at al., 2007; Ojeniyi 2012, Oyeyiola et al., 2014). The very high acidity equivalent of these chemical fertilizers is a major contributory factor (Tan, 2011). Lime ($CaCO_3$) is an important liming material that has been found to be effective in the management of acid soils for decades. Nevertheless, its indiscriminate use has been reported to accelerate organic matter decomposition (Siqueira and Moreira, 1997) and loss of soil aggregate stability (Zeigler et al., 1993). Its caustic nature and relative scarcity could limit its use on soils. The practice of liming is expensive and can greatly increase cost of crop production. It is extremely difficult to maintain high crop yield by correcting both nutrient losses and acidification by inorganic materials alone such as chemical fertilizers and conventional liming materials (FAO, 1994).

Compost has been used for improving soil reaction, fertility and increasing crop productivity (Oyeyiola *et al*., 2014). Compost fortification with nitrogen and phosphorus (phosphocompost) is a tool to improving the nutrient composition and release intensity in compost (Oyeyiola *et al*., 2014). This research was conducted to evaluate the effect of phosphocompost on acidity indices in an acidic soil. Conventional chemical fertilizers and lime which have been used for managing acid soils for decades were also evaluated to make for comparative study.

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Materials and Methods

Experimental Sites Description: The field work was carried out at the arable farm of the Leventis Foundation School of Agriculture and Training, Imo, Ilesha, Osun State (N07°36", E04°46"). Ilesha falls within a schist belt with rich alluvial deposits which form part of the Precambrian basement rock notable for clay rich weathered horizons (Oke *et al*., 2013). The experimental site has been used continuously for more than two decades for the cultivation of maize and cassava using mainly NPK 15:15:15 for soil fertility management. The field was randomly sampled using soil auger at 0 – 20 cm depth. Prepared soil was subjected to routine analysis for determination of initial soil pH, organic carbon, available P, total nitrogen, exchangeable bases and acidity.

Treatments and Experimental Design: The field was ploughed twice, harrowed and laid out into plots of 2 m by 2 m with 1m inter plot spacing and 2m spacing between replicates. There were eight treatments with three replications laid out in a randomized complete block design. The treatments included two phosphocompost types tagged C1 and C2 applied at 2.5 and 5.0 t/ha: 2.5C1 (2.5 t/ha C1) 5C1 (5 t/ha C1), 2.5C2 (2.5 t/ha C2), 5C2 (5 t/ha C2). Plots that received NPK 15:15:15 at 80 kg NPK/ha tagged (NPK), Urea at 30 kg N/ha mixed with single super phosphate 40 kgP_2O_5/ha tagged (U+SSP), only $CaCO_3$ tagged (Lime) at 1 t/ha and an absolute control (AC) that received no amendment was included for comparison. All the plots were amended with freshly chopped *Gliricidia sepium* leaves at the rate of 30 kg N/ha except the NPK, Urea+SSP and absolute control plots and cowpea was the test crop.

Data Collection: Three random soil samples (0-20 cm depth) were taken from each plot for the determination of available P, exchangeable base, acidity and aluminum .The ECEC, base, Al, Ca, Mg and K saturations were estimated using:

ECEC = Exchangeable bases (Ca, Mg, K, Na) + Exchangeable acidity (H, Al)

$$\text{Base Saturation (BS)} = \frac{\text{Exchangeable bases (Ca, Mg, K, Na)}}{\text{ECEC}} \times 100$$

$$\text{Acidity Saturation Precentage (ASP)} = \frac{\text{Exchangeable acidity (H, Al)}}{\text{ECEC}} \times 100$$

$$\text{Calcium saturation} = \frac{\text{Exchangeable Ca}}{\text{ECEC}} \times 100$$

$$\text{Magnesium saturation} = \frac{\text{Exchangeable Mg}}{\text{ECEC}} \times 100$$

$$\text{Potassium saturation} = \frac{\text{Exchangeable K}}{\text{ECEC}} \times 100$$

At harvesting (12 WAS), data were collected on grain yield and dry shoot weight (Data not presented).
Data Analysis: Data collected were subjected to analysis of variance using Genstat discovery edition 3 statistical package and means separated using DMRT at $p<0.05$.

Results and Discussion

The Chemical and Particle Size Analyses of the Soil
The soil is strongly acid (pH (H_2O, 4.8) with generally low concentrations of total nitrogen (1.3 g/kg), available phosphorus (3.6 mg/kg) and exchangeable calcium (0.98 cmol/kg) when compared with critical levels for south western Nigeria soils (Agboola and Ayodele, 1985; FFD, 2012). Exchangeable acidity was high and it formed the bulk of effective cation exchange capacity (ECEC). The soil is characterized by high clay content (320 g/kg) (Table 1). The chemical properties of the amendments used are shown in Table 2. All the amendments were alkaline in nature. Phosphorus and nitrogen contents were higher in C1 and not detected in $CaCO_3$.Calcium was however higher in $CaCO_3$.

Effects of Chemical Fertilizers, Lime and Phosphocompost on Acidic Cations Concentrations in the Soil: The phosphocompost treatments reduced exchangeable acidity concentrations from the initial 2.1 cmol/kg to as low as 0.5 cmol/kg in 5C2 and 2.5C2 treated soil (Fig. 1). Amongst the chemical fertilizers, NPK was poorer in exchangeable acidity management with value increasing to 3.4 cmol/kg whereas 0.7 cmol/kg was recorded for the Urea+SSP treatment which was statistically similar to the value recorded for the lime treatment. NPK again recorded the highest exchangeable Al (0.4 cmol/kg) which was statistically the same with values from untreated (0.36 cmol/kg) and Urea+SSP (0.33 cmol/kg) plots. Lower application rate of each of the PC significantly reduced exchangeable Al with comparable performance with the conventional lime. In 2.5C1, exchangeable Al was completely absent.

Table 1. **Initial Physical and Chemical Properties of the Soil Studied.**

Parameters	Values
pH (water)	4.8
OC (g/kg)	13.2
Total N (g/kg)	1.30
Bray P (mg/kg)	3.60
Exch. Cations (cmol/kg)	
Ca	0.98
Mg	0.48
K	0.20
Na	0.20
Acidity	2.10
ECEC	3.96
Micronutrients (mg/kg)	
Zn	2.67
Cu	166
Mn	37.0
Fe	
253	
Particle size (g/kg)	
Sand	530
Silt	150
Clay	320

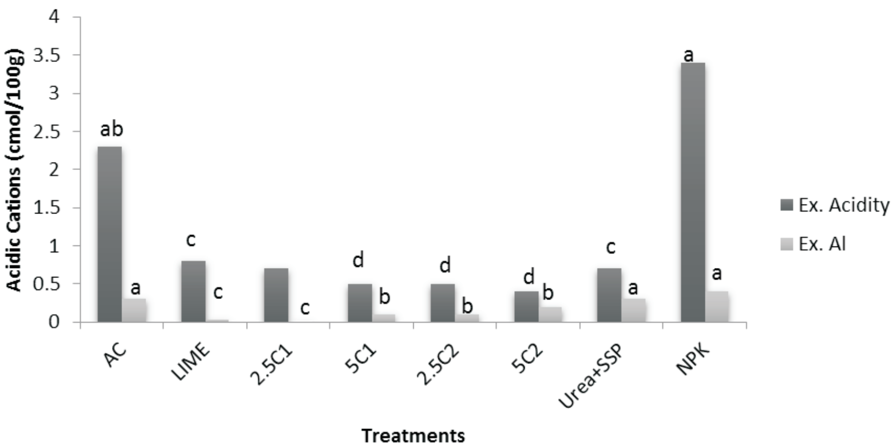
The observed reduction in exchangeable acidity and Al with application of the PC could be due to formation of complexes by organic acids produced during decomposition and mineralization. The ability of the functional groups of the organic acid in organic fertilizers to form complexes via ligand exchange has been reported (Hue *et al*,1986; Tan, 2011). The absence of such mechanism in chemical fertilizer and untreated plots kept exchangeable Al concentrations at higher levels in such plots.

Table 2. **Chemical Composition of the Compost Types and Conventional Lime**

Parameters	C1	C2	$CaCO_3$
pH (1:4 water)	9.1	9.4	12
Macronutrients (g/kg)			
N	5.5	5.2	0
Carbon	260	294	8
P	84	68	0
Ca	65	65	530
Mg	5	5	10
K	6	8	0
Micronutrients (mg/kg)			
Mn	277.8	243.6	55.1
Fe	281	284.3	1076
Cu	11.9	12.9	2.3
Zn	38.7	41.3	9.3

C1= Bone meal fortified Compost prepared from Rice bran and Poultry manure

C2= Bone meal fortified Compost prepared from Sawdust and poultry manure

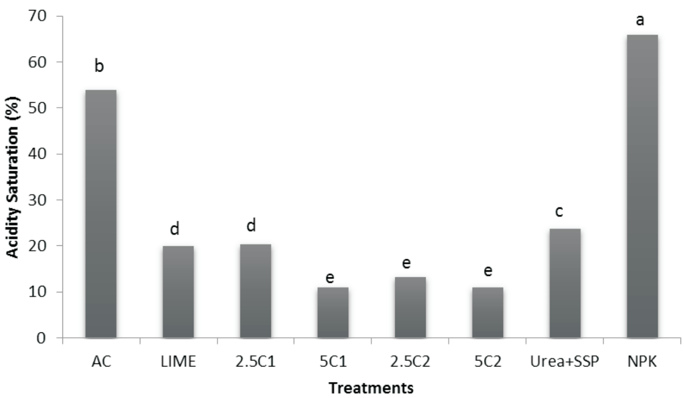


Bars followed by same letters are not significantly different by DMRT at p<0.05.
Figure 1: **Acidic Cation Concentrations in Phosphocompost, Lime and Chemical fertilizer Treated Soil.**

Conventional fertilizers contributed to increasing acidity saturation percentage (ASP) in the soil under study. NPK fertilizer was responsible for as high as 66% of acidic cations proportion in the soil exchange sites over 54% observed in untreated soil (Fig 2). The higher concentrations of exchangeable acidity and Al released into the soil solution from these treatments were responsible for this high Aluminum saturation percentage (ASP). The implication is higher chance of plant sown to such soil taking up more acidic cations (66%) over basic cations (34%) with increasing chance of toxicity to the plant roots.

Urea+SSP proved better in basic cation release over NPK where ASP of 23.7% was recorded. The Ca minerals in the SSP fertilizer might have contributed to this observation.

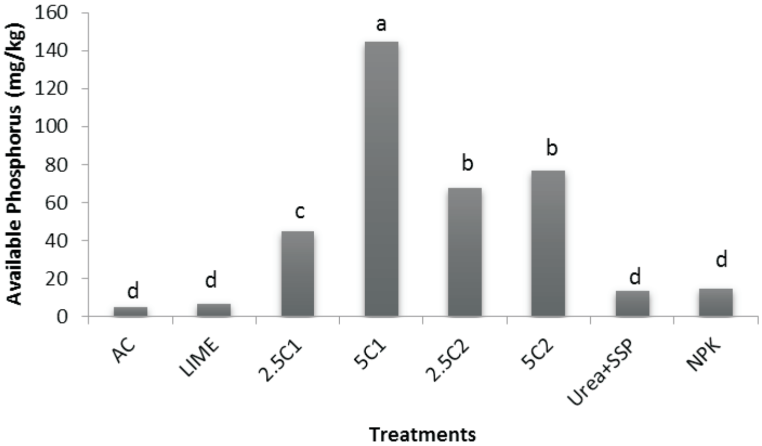
Phosphocompost and lime were responsible for ASP values of 20% and below with the least value from higher phosphocompost application rate. This provided the cowpea roots with higher chance of taking up more basic cations over acidic cations at every nutrient absorption time.



Bars followed by same letters are not significantly different by DMRT at p<0.05.
Figure 2: **Acidity Saturation Percentage in Phosphocompost, Lime and Chemical Fertilizer Treated Soil.**

Available Phosphorus Status in Chemical Fertilizers, Lime and Phosphocompost Treated Plots: Available P in the soil was improved by the entire PC treatments. This improved with increasing rate of application. A range of 44.8 – 144.5 and 13.2 -14.5 mg/kg was recorded in PC and chemical fertilizer plots respectively (fig. 3). The values recorded under chemical fertilizers were not statistically superior to untreated and lime plots. The available P in lime treated plot however, was very low (6.8 mg/kg) below the critical value (10 mg/kg) for Southwestern Nigeria soils. There is therefore the need for further input of external P to this soil even after amelioration with lime. The improved soil pH from initial 4.8 to values above 5 alongside complexation reaction of the carboxylic and phenolic functional groups of the phosphocompost with the monomeric Al synergistically increased phosphorus desorption from fixed state with soil acidic cations. (Hue et al.,1986; Tan,2011).

The mineralization products of the inorganic nutrients in the PC which were high in phosphorus and basic cations (as reported in Table 2) contributed to improved available P.



Bars followed by same letters are not significantly different by DMRT at $p<0.05$.
Figure 3: **Available Phosphorus Concentrations in Phosphocompost, Lime and Chemical Fertilizer Treated Soil.**

All the PC improved soil reaction from initial 4.8 to as high as 5.3, 5.4 and 5.7 at 2,8, and 12 WAS in 5C1 followed closely by 5C2 and 2.5C2 at 12 WAS (Table 3). At every observation time, soil pH from PC plots were comparable to values from lime plots and were superior to observations from the chemical fertilizers. PC treated plots maintained pH values of above 5.0 at every observation time except at lower application rate at 2 WAS. These values were better with increasing weeks after sowing except at week 6 and 10 which marked the onset of flowering and peak of pod filling where very high basic cationic nutrients were taken from the soil solution. These temporal depletion of basic cationic nutrients were however replenished from the continued mineralization of the nutrients from the PC in subsequent week. Chemical fertilizer treatments were responsible for lower soil pH with values dropping below that of the untreated plot. Soil reaction from NPK were lesser than U+SSP all through the observation time. NPK gave a range of 4.0 – 4.5 while Urea+SSP gave 4.3 – 4.8.

Table 3: **Effects of Chemical Fertilizer, Lime and Phosphocompost on Soil pH**

	Soil pH					
Treatments	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
AC	4.4 cde	4.4 cde	4.7 b	4.8 b	4.8 bc	4.9 bc
LIME	4.7 bcd	4.7 bcd	5.1 a	5.5 a	5.1 ab	5.4 a
2.5C1	4.9 bc	4.8 bc	5.2 a	5.6 a	5.1 ab	5.3 ab
5C1	5.3 a	5.3 a	5.3 a	5.4 a	5.2 a	5.7 a
2.5C2	4.9 ab	4.9 ab	5.1 a	5.4 a	5.0 ab	5.5 a
5C2	5.0 ab	5.0 ab	5.1 a	5.6 a	5.2 a	5.5 a
Urea+SSP	4.3 de	4.3 de	4.4 bc	4.8 b	4.6 c	4.7 cd
NPK	4.1 e	4.1 e	4.2 c	4.5 b	4.5 c	4.5 d

Means followed by the same letter (s) in the same column are not significantly different by DMRT at $p<0.05$

Effects of Chemical Fertilizer, Lime and Phosphocompost on Saturation Percentage of Basic Cations: The K saturation percentage values from all the treatments were within the range 2-5% considered optimum for legume production (Eckert, 1987) (Fig.4). Therefore K was not deficient in the experimental soil. Mg saturation percentage from all the PC were above this critical value (17.23 – 19.9%) while NPK, AC and lime fell below the critical value with 8.27, 11.23 and 14.00% respectively. Urea+SSP (17.00 %) was however sufficient in magnesium saturation. Mg saturation of 15% has been reported satisfactory for most annual crops (Eckert, 1987).

Generally, all the PC produced the best calcium saturation percentage with 5C2 giving the highest calcium saturation percentage (63.6%) which was statistically better than lime (59.7%). NPK treatment aggravated calcium depletion with 30% reduction when compared with untreated plot (Fig. 4).

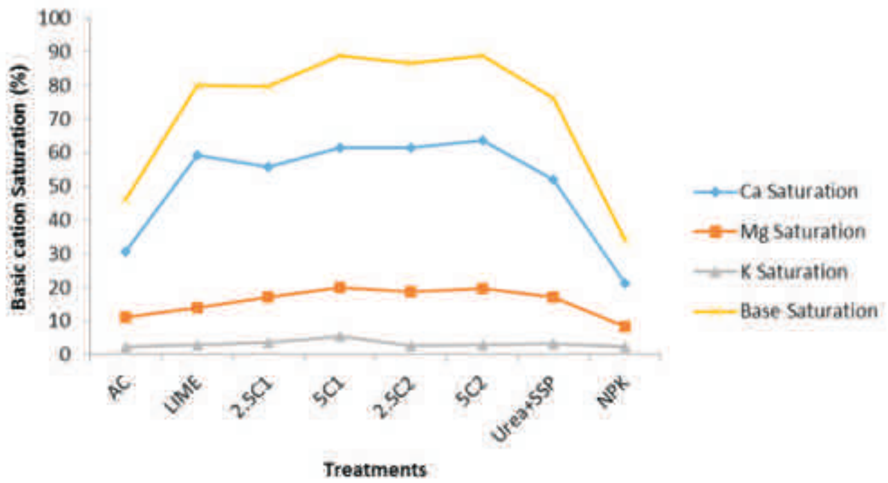


Figure 4: **Basic Cation Saturation Distribution in Phosphocompost, Lime and Chemical Treated Soil.**

Conclusion

The improved soil reaction in PC treated and lime plots encouraged significantly higher cowpea grain yield over untreated and chemical fertilizer plots (grain yield data not presented). Amelioration of acidic soil with lime though improved soil reaction but did not lead to pronounced availability of soil P thus making application of external input of P inevitable.

From the foregoing, two soil conditions are needed for higher cowpea grain yield:

– Improved soil reaction in terms of increasing pH to optimum range.
– Improving soil nutrient status such as total nitrogen, available phosphorus and exchangeable bases which will help improve base saturation, reduce acidity saturation and removal of toxic minerals like the soluble Al.

Both soil conditions were attained in the phosphocompost treated plots, only the former was attained in lime treated plot and the later in chemical fertilizer plots.

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Agronomic Performance and Seed Quality of Advanced Breeding Lines of Soybeans (*Glycine max* (L.) Merrill) as Influenced by Organic Fertilizer Application

CHIDOZIE TOBECHI ONYENALI[1] AND VICTOR IDOWU OLOWE[2*]
[1]Department of Plant Physiology and Crop Production, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.
[2*] Institute of food Security, Environmental Resources and Agricultural Research (IFSERAR), Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria, www.funaab.edu.ng
Corresponding Author: owebaba@yahoo.com

Keywords: Grain yield, oil and protein contents, soybean, yield attributes

Abstract

Sixteen soybean entries (three released varieties: TGx 1448-2E (check), TGx 1440-1E and TGx 1019-2EB, 13 advanced breeding lines: TGx 2007 – 1F, TGx 2010 – 1F, TGx 2008 – 1F, TGx 2004 – 4F, TGx 2010 – 7F, TGx 2006 – 2F, TGx 2003 – 1F, TGx 1987 – 10F, TGx 2010 – 2F, TGx 2007 – 4F, TGx 2006 – 3F, TGx 2008 – 3F, and TGx 1835 – 10E) were cultivated during the late cropping season (June – Nov.) of 2014 to assess their agronomic performance and seed quality as affected by organic fertilizer application. The experiment was laid out in a randomized complete block design using a split plot arrangement and replicated three times. Organic fertilizer was the main plot and soybean entries sub plot. Data were collected on grain yield, yield attributes and quality (oil and protein contents) of the entries. Organic fertilizer application did not affect any of the agronomic traits evaluated, except number of seeds per plant. However, variety effect was significant ($p<0.05$) for all the traits, height to first pod and weight of seeds per plant. Fertilizer × Variety effect was not significant on nay trait. All the sixteen entries recorded grain yields (2092.2 – 4076.5 kg.ha^{-1}) which compared favorably well with world average (2250 kg.ha^{-1}). Thus, confirming the huge potential of soybean in the transition zone.

Introduction

Soybean (*Glycine max* (L.) Merrill) is the world's leading oilseed crop in terms of production (265.31 m tones) and consumption (255.3m tones) (CTA, 2011). The crop is mainly grown for its seed that contains 17 – 26% oil and 32 – 45% protein (Ustimenko-Bakumovsky, 1980). Unfortunately, less than 50 percent of the installed capacity (700,000 metric tones) of the Nigerian processing sector is met through local production despite the suitability of the transition zone for large scale production of the crop (Olowe et al., 2006; Olowe and Adebimpe, 2009). Consequently, this study was initiated to evaluate the agronomic performance of these soybean entries with a view to recommending those with high grain yield potential coupled with good seed quality for cultivation.

Materials and Methods

The study was carried out at the Research Farm of Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR)of the Federal University of Agriculture, Abeokuta (7° 23' N, 3° 39' E) during the late cropping season (June – November) of 2014. The experiment was laid out in a randomized complete block design (RCBD) using a split plot arrangement and replicated three times. The main plot was organic fertilizer application and sub plot 16 varieties (three earlier released varieties: TGx 1448-2E, TGx 1440-1E and TGx 1019-2EB, and thirteen (13) advanced breeding lines: TGx 2007 – 1F, TGx 2010 – 1F, TGx 2008 – 1F, TGx 2004 – 4F, TGx 2010 – 7F, TGx 2006 – 2F, TGx 2003 – 1F, TGx 1987 – 10F, TGx 2010 – 2F, TGx 2007 – 4F, TGx 2006 – 3F, TGx 2008 – 3F, and TGx 1835 – 10E). Sowing of seeds was done on June 24, 2015 on the flat at a spacing of 60 x 5 cm (333,000 plant/ha). The experiment was conducted on a loamy sand soil with pH of 6.3, Total nitrogen 0.80 $g.kg^{-1}$, available phosphorus 8.00 $mg.kg^{-1}$, potassium 0.45 $mol.kg^{-1}$, clay 88 $g.kg^{-1}$, silt $g.kg^{-1}$ and sand 858 $g.kg^{-1}$. Gateway Organic fertilizer (2.58% N, 0.77% P, 0.04% K) was applied at the rate of 1 $t.ha^{-1}$ equivalent to 25 $kgN.ha^{-1}$ which is the recommended starter dose rate of nitrogen for legumes at three weeks after sowing, WAS. Hoe weeding was done at 3 & 6 WAS. Data were collected on phenology (number of phenological days to flowering and physiological maturity)grain yield, yield attributes (number of branches, pods and seeds per plant, weight of seeds and pods per plant, above ground plant weight, harvest index, height at flowering and physiological maturity) and seed quality (protein and oil contents) on plot basis.All data collected were subjected to analysis of variance and the means of significant treatments were separated using the least significant difference method.

Results

Data on the main effects of organic fertilizer and variety are presented in Table 1. All the agronomic traits evaluated in the study, except number of seeds per plant were not affected by organic fertilizer application. On average, application of organic fertilizer resulted in 48.5% higher number of seeds per plant (*significant at* $p<0.05$) on fertilized soybeans than the control. The sixteen entries of soybeans were significantly ($p<0.05$) different from each other for all the traits, except height to first pod and weight of seeds per plant. Five out of the sixteen entries exhibited early maturity (<100 days) while the remaining eleven were medium maturing (100 – 120 days). The grain filling period (GFP) of the entries ranged between 10 and 17 days. Fertilizer application × variety effect did not affect any of the agronomic traits measured. Table 2 contains data on grain yield and seed quality of the ten top yielders of soybean. The check variety (TGx 1448-2E) ranked fifth among the entries.

Table 1: **Effect of organic fertilizer application on grain yield, some yield attributes and seed quality of sixteen soybean entries in 2014**

Treatment	NDR8	GFP	Seeds		Pod weight yield	Grain
			Number	Weight (g)	(g)	kg.ha^{-1}
OF						
F0	105.6	12.7	38.3	6.8	10.9	3045.6
F1	105.2	12.9	50.8	7.1	12.4	3661.1
LSD 5%	ns	ns	3.40	ns	ns	ns
Variety						
TGx 1448-2E	107.0	13.7	43.2	10.3	16.0	3714.9
TGx 1440-1E	113.0	13.2	53.5	7.1	10.0	3361.5
TGx 1019-2EB	112.0	11.7	28.2	3.8	5.6	3566.1
TGx 2007-1F	104.5	10.8	28.6	5.6	8.6	2763.7 TGx 2010-1F
113.0	10.7	68.6	9.1	13.1	3019.3	
TGx 2008-1F	100.5	12.7	40.3	7.4	10.8	4076.5
TGx 2004-4F	97.5	12.8	48.5	8.9	14.4	2711.2
TGx 2010-7F	107.0	14.8	74.4	10.9	16.3	3647.0
TGx 2006-2F	99.5	10.0	49.0	6.0	11.7	3632.1
TGx 2003-1F	99.2	16.7	35.0	7.4	11.5	2961.1
TGx 1987-10F	109.7	11.3	35.7	5.1	7.3	3739.9
TGx 2010-2F	112.0	17.2	48.9	6.5	11.3	3933.9
TGx 2007-4F	107.0	13.2	34	7.0	12.2	3507.1
TGx 2006-3F	99.8	13.7	41.0	6.0	9.2	3945.4
TGx 2008-3F	107.0	11.3	32.7	6.1	18.2	2981.5
TGx 1835-10E	98.2	11.8	54.0	10.3	5.8	2092.2
LSD 5%	2.92	3.38	22.77	ns	ns	945.66 FXV
ns	ns	ns	ns	ns	ns	

OF – organic fertilizer; Fo – Control; F1 – Organic fertilizer applied;
Ns – not significant; NDR8 – Number of days to physiological maturity;
GFP – Grain Filling Period

Table 2: **Ten top soybean yielder and their seed quality, 2014**

Variety	Grain Yield (kg.ha^{-1})	Oil content (%)	Protein content (%)
TGX 2008-1F	4076.5	17.04	34.79
TGx2006-3F	3945.4	15.22	31.06
TGx 2010-2F	3933.8	16.99	34.89
TGx 1987-10F	3739.9	16.26	33.18
TGx 1448-2E	3714.9	16.08	32.81
TGx 2010-7F	3647.0	14.89	30.39
TGx 2006-2F	3632.0	15.59	31.83
TGx 1019-2EB	3566.0	14.42	29.43
TGx 2007-4F	3507.0	1445	29.50
TGx 1440-1E	3361.52	15.53	31.69
LSD 5%	945.66	0.511	0.966

Discussion

All the soybean entries exhibited tremendous potential in the transition zone by producing grain yields higher than average values recorded on research plots in Nigeria (1700 kg/ha), USA (2000 kg/ha), Brazil (1800 kg/ha) (RMRDC, 2004), potential average of TGx 1448-2E (1700 – 2300 kg/ha) (Asafo-Adjei and Adekunle, 2001). Only five advanced breeding lines (TGx 2008-1F, TGx 2006 – 3F, TGx 2010 -2F and TGx 1987-10F) produced higher grain yield than the TGX 1448-2E (check). Although, the superior yield advantage was not significant. Number of seeds per plant and weight of seeds per plant are two agronomic traits closely related to soybean grain yield (Pandey and Torrie, 1973). However, TGX 2010-7F that recorded the highest seed weight and number per plant only produced the six highest grain yield. Oil and protein contents of the ten top entries were relatively high ranging between 14.42 and 17.04%, and 29.43 and 34.89%, respectively. These values compare favourably with the worlds reported values for oil (17 -26%) and protein (32 – 45%) by Ustimenko-Bakumovsky (1980). The entry with the highest grain yield (4076.5 kg.ha^{-1}) combined high oil (17.04%) and protein (34.79%) qualities. These findings confirmed the huge potential of the advanced breeding lines in this zone and the ten top yielders will be further evaluated.

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Effect of Organic Fertilizer Types and Rates on the Performance of Pineapple Suckers

ATANDA, T. T. AND OLANIYI, J. O.
Crop Production and Soil Science,
Department, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
Corresponding Author: atandatoyin85@gmail.com

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Abstract

Field trial was carried out to improve pineapple production by investigating the effects of organic fertilizer types and rates on the performance of pineapple suckers in Ogbomoso, Nigeria. The treatments included three fertilizer types namely; Aleshinloye grade A, Aleshinloye grade B and Sunshine grade A applied at five rates (0, 50, 100, 150 and 200 kg Nha^{-1}) each. The 3 x 5 factorial experiments were laid out in a randomized complete block design replicated three times. Data were collected on plant height, number of leaves, number of sprouted suckers, dry matter yield and plant nutrient uptake. Data obtained were analyzed using ANOVA.The growth parameters of pineapple suckers were significantly ($P \leq 0.05$) increased by the organic fertilizer types. The pineapple suckers that received Aleshinloye grade B recorded higher height (20.75 cm) and number of leaves (13.41) compared to other fertilizer treatments, irrespective of the fertilizer rates. The growth parameters of pineapple suckers increased with increase in fertilizer application from 0 up to 150 kg Nha^{-1}, thereafter declined. The dry matter yield and nutrient uptake of pineapple suckers were significantly affected by organic fertilizer types and rates. The highest dry matter yield and nutrient uptake of pineapple suckers were obtained from Aleshinloye grade A closely followed by Aleshinloye grade B treated plants while the least value was obtained from Sunshine grade A regardless of the fertilizer rate.In conclusion, rapid multiplication as well as growth and nutrients uptake of pineapple suckers can be improved by the application of organic fertilizer at 150 kg Nha^{-1} and Aleshinloye grade B organic fertilizer type produced the best pineapple suckers.

Introduction

Pineapple *(Ananas comosus)* is a tropical plant with edible multiple fruit consisting of coalescent berries which belong to the family Bromeliaceae (Freddy, 2003). It is said to have been originated from Brazil and Paraguy, however, little is known about the origin of the domesticated pineapple (Preston *et al*., 2003). Total pineapple production worldwide is around 16 to 18 million tons (Carvalho *et al.,* 2005; Fermandes *et al.,* 2008). Pineapples can be propagated vegetative and generatively. Plant materials for vegetative propagation can be in form of shoot, slip, crown and stem cutting. The generative propagation tends to be intended for breeding purposes (Py *et al.,* 1987). Only through cross-pollination between different cultivars will seeds be produced (Sri Hadiati *et al.,* 2011).

Pineapples are largely consumed around the world in fresh or processed food as canned pineapple, slices, chunk and dice, pineapple juice, fruit salad, sugar syrup, alcohol, citric acid, pineapple chips and pineapple puree. Sixty percent of fresh pineapple is edible (Samson, 1986) and exported as a fresh product. The ripe pineapple has diuretic properties. Its juice also kills intestinal worms, relieves intestinal disorders and soothes the bile. Pineapple produces Bromelain which is an enzyme that helps the body's digestive system and also has anti-inflammatory properties. It is of great importance in the treatment of a number of medicinal problems, including heart diseases, arthritis and upper respiratory infections (Morton *et al.,* 1987). Pineapple contains water, carbohydrates, sugar, vitamins A, C and carotene beta. It contains low amount of protein, fat ash and fibre. It has an antioxidant called flavonoids, vitamin A and these anti oxidants reduce oxidative change damage caused by free radicals and chelating metals (Tochi *et al.,* 2008). It contains micro-nutrients that experts believe protects against cancer and these micro nutrients also break up blood clots and are beneficial to the heart. Pineapple juice contains chemicals that stimulates the kidney and aids in removing toxic element from the body (Morton *et al.,* 1987).

Pineapple requires a good nutrient for it to realize its growth potential. The nutrient requirement of pineapple plant varies across different regions. Plant growth depends mainly on nitrogen nutrition and the nitrogen balance (Bartholomew *et al*., 2003). There is a constant depletion in amount of available nitrogen in the soil through absorption by plants, fixation in the soil, leaching and volatilization. Nitrogen is essential to the increase of pineapple fruit and total yield. On poor soils, nitrogen and potassium levels of the plants may become low towards the end of the crop season; this must be avoided by application of nutrients. Fertilizer application plays a very important role in crop management (Stewart *et al.,* 2005). The application of organic fertilizers which are made from animal excreta or other agricultural wastes contributes to the sustainability of agriculture systems and is usually used to improve soil structure and stability in addition to enhancing the yield and the quality of plants (Tejada and Gonzalesz, 2003; Chang *et al.,* 2010). The objective of this experiment was to investigate the effects of organic fertilizer types and rates on the performance of pineapple suckers.

Materials and Methods

The experiment was carried out at the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The treatments were three organic fertilizer types which were; Aleshinloye grade A (3%N), Aleshinloye grade B (1%N) and Sunshine grade A (3.5%N). These were applied at 0, 50, 100, 150 and 200 kg Nha^{-1} each. The experimental site was manually cleared and 45 sunken beds were made. There were three replicates and each replicate consisted of fifteen beds. Each bed measured 0.5 m spacing in between beds and 1 m among replicates for easy movement during cultural operations. Pineapple stems were obtained from the pineapple plot of the Agronomy Department, LAUTECH, Ogbomoso. The stems were cut into 7.5 cm long sett sizes and used as propagules, six setts were planted per bed. The 2 x 3 factorial experiments were arranged in a randomized complete block design with three replications. The planting materials were treated with 5 ml furadan diluted with 10 litres of water overnight, to prevent diseases and pest infestations in the field. Six planting materials were planted on each bed irrespective of the treatments applied.

Watering was done to supplement the water supplied by the rainfall to ensure proper growth of the pineapple. Regular weeding was done manually to control weeds on the plots. Organic fertilizers were applied at 0, 50, 100, 150 and 200 kg Nha^{-1} each to their respective beds three weeks after planting. Data collection commenced from eight weeks after planting (8WAP) and continued fortnightly on growth parameters such as plant height by measuring with tape rule and number of leaves by counting. Also, the number of sprouted suckers were counted in all plots and recorded. Data collected were subjected to analysis of variance and means compared by the least significant difference (LSD) at 5% probability levels.

Results and Discussion

The plant height of pineapple sucker was significantly ($P \leq 0.05$) influenced by organic fertilizer types and rates. Organic fertilizer type positively improved the plant height of pineapple. The highest plant height (26.17 cm) was recorded from Aleshinloye grade B followed by sunshine grade A (25.27 cm) irrespective of the fertilizer rate. Although, the plant height increased as the fertilizer rate increases from 0 up till 200 kg Nha^{-1} but there was no significant difference between the values obtained from 150 kg and 200 kg Nha^{-1} fertilizer levels. The interactive effects of organic fertilizer type and rate improve the plant height of pineapple suckers.

The best value (26.17 cm) was obtained from plant receiving combined treatment combination of Aleshinloye grade B fertililizer type and at optimum rate of 150 kg Nha^{-1}. The mean number of leaves of the pineapple sucker is represented in table 1. The number of leaves was significantly ($P \leq 0.05$) affected by the fertilizer type and rate at 16 weeks after planting. The number of leaves of pineapple suckers increased from 0 up till 150 kg Nha^{-1} and thereafter declined. Aleshinloye grade B gave the highest number of leaves of pineapple suckers irrespective of fertilizer rates. The interactive effects of organic fertilizer type and rate significantly increased the number of leaves of pineapple sucker.

Although the highest value (16.54) was obtained from Aleshinloye grade A and at 150 kg Nha^{-1} treatment combinations there was no significant difference between the values recorded from Aleshinloye grade B at 150 kg Nha^{-1} and Aleshinloye grade A at 200 kg Nha^{-1}.

Table 1. **The mean growth parameters of pineapple suckers as affected by organic fertilizer types and rates (kg)**

F.rate	Fert types	No of leaves	Plant ht(cm)	dry wt(g)
0	AleshA	9.5	17.51	5.81
50		12.34	20.06	5.89
100		10.42	20.58	7.69
150		16.54	20.84	9.26
200		11.38	21.42	9.12
0	AleshB	12.17	17.22	3.96
50		12.5	18.98	6.08
100		12.92	22.13	7.29
150		14.47	26.17	10.01
200		16.42	21.27	8.43
0	SunshA	8.83	14.75	4.04
50		9.11	18.34	4.58
100		9.97	20.56	4.63
150		13.75	21.92	7.25
200		13.58	25.27	5.08
LSD (0.5)				
FT:		2.35	ns	0.34
FR:		3.04	2.34	0.43
FTxFR		3.04	ns	0.15

Key: FT=fertilizer type, FR=fertilizer rate, A.A=aleshinloye grade A, A. B=Aleshinloye grade B, S.A= Sunshine grade A

The dry weight of the pineapple sucker is represented in table 1. Dry weight of the pineapple sucker was significantly (P ≤0.05) influenced by the fertilizer types and rates. Aleshinloye grade B fertilizer type recorded the highest dry weight of the pineapple plant (10.01 g) closely followed by Aleshinloye grade A fertilizer type (9.26 g) while the Sunshine grade A recorded the lowest dry weight of 7.25 g among the three organic fertilizer types used. The combined effects of organic fertilizer type and rate had significant (P ≤0.05) influenced on the dry mater yield of pineapple sucker. The highest (10.01 g) dry matter yield was obtained at Aleshinloye grade B fertilizer type and 150 kg Nha^{-1} fertilizer rate treatment combinations.

Table 2. **The nutrient uptake (g/plant) of oil palm seedlings as affected by organic fertilizer rates and types**

F.rate (kg/ha)	**F.types**	**NUTRIENT UPTAKE (g/plant)**				
		K	**Ca**	**Mg**		**N P**
0	AleshA	O.11	0.98	13.01	3.62	1.62
50		0.12	1.20	38.31	5.77	1.74
100		0.21	1.58	41.71	8.76	1.99
150		0.42	2.05	56.07	12.13	2.78
200		0.45	1.64	45.74	10.97	2.55
Mean		**0.26**	**1.49**	**38.97**	**8.25**	**2.14**
	AleshB					
0		0.11	0.61	7.35	2.21	0.97
50		0.18	0.92	22.47	4.03	1.25
100		0.51	2.21	57.83	11.17	3.01
150		0.47	1.45	33.86	8.35	2.05
200		0.29	1.22	27.96	6.39	1.56
Mean		**0.31**	**1.28**	**29.89**	**6.43**	**1.77**
	SunshA					
0		0.02	0.20	2.81	0.66	0.31
50		0.04	0.28	5.05	0.87	0.39
100		0.10	0.90	20.92	2.46	1.13
150		0.37	2.34	57.07	11.48	2.90
200		0.65	2.82	72.56	14.51	3.75
Mean		**0.24**	**1.31**	**31.68**	**6.00**	**1.70**
LSD (0.05)						
FT		0.06	0.08	0.20	0.19	0.08
FR		0.07	0.11	0.26	0.24	0.10
FT*FR		0.00	0.01	0.05	0.05	0.01

Key: FT=fertilizer type, FR=fertilizer rate, A.A=aleshinloye grade A, A. B=Aleshinloye grade B, S.A= Sunshine grade A

The nutrient uptake (N, P, K, Ca and Mg) of pineapple sucker was affected by fertilizer types and rates (Table 2). The applied fertilizer types and rates had significant (P ≤0.05) influence on the nutrient uptake of pineapple sucker. The nitrogen uptake by the pineapple sucker was significantly (P ≤0.05) influenced by the fertilizer types and rates. The pineapple sucker raised in only soil as propagation medium recorded the highest nutrient uptake value of 0.31%, irrespective of the fertilizer rate. The general better performance in terms of growth and yield derived from this study reconfirmed the result obtained from the findings of Tejada and Gonzalez; 2003; Change *et al.,* 2010 who concluded that application of organic fertilizer which are made from animal excreta or other agricultural wastes contributed to the sustainability of agricultural system and is usually used to improve soil structure and stability in addition to enhancing the yield and quality of plants.

Conclusion

In conclusion, the growth parameters, nutrient uptake assessed under this study and the dry matter yield were significantly ($P \leq 0.05$) influenced by the various treatments. It can be deduced from the results obtained that Aleshinloye grade B produced the highest plant height, number of leaves, nutrient uptake and dry matter yield at 150 kg Nha^{-1} application rate but the results obtained are not significant from the results obtained from Aleshinloye grade A fertilizer application at 150 kg Nha^{-1}. Therefore, both Aleshinloye grade A and Aleshinloye grade B and 150 kg Nha^{-1} organic fertilizer rates can be recommended for maximum performance of pineapple suckers.

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Evaluation of Animal Manures on the Yield of Solanum Macrocarpon L. and Chemical Properties of Soil

OLOWOKERE, F. A.[1], DARE, M. O. [1], OLASANTAN, F. O.[2] AND AKANJI, M. A.[1]
[1]Department of Soil Science and Land Management, Federal University of Agriculture, Abeokuta Nigeria.
[2]Department of Horticulture, Federal University of Agriculture, Abeokuta Nigeria.
Corresponding Author: olowokerefa@funaab.edu.ng

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Abstract

Animal manures regarded as wastes could be channeled towards improving the fertility of the soil and crop production. A field experiment was conducted at the Federal University of Agriculture, Abeokuta Nigeria in 2013 to evaluate the effect of animal manures on yield and chemical properties of soil grown with Solanum macrocarpon. Treatments used were: goat manure at 10, 20 and 30t/ha (GM 10, GM 20 and GM 30 respectively), poultry manure at 10, 20 and 30t/ha (PM 10, PM 20 and PM 30 respectively), cow dung at 10, 20, 30t/ha (CD 10, CD 20 and CD 30 respectively) and control. Application of GM 30 significantly ($p<0.05$) increased the height (25.90 cm), number of leaves (65), leaf yield (248.65 g/plant) of S. macrocarpon and post harvest soil K (0.08 cmol/kg)above the control. Highest post harvest soil available phosphorus (54.58 mg/kg) and magnesium (2.47 cmol/kg) were recorded on PM 30 treated plots. S. macrocarponcould be grown with either goat manure at 30t/ha or poultry manure at 30 t/ha for higher yield and improved soil quality on soils similar to the experimental site.

Introduction

Giant egg plant *(Solanum macrocarpon* L.*)* is a vegetable crop cultivated for its various uses. The young leaves are consumed while the fruits and roots have a variety of medicinal uses, the fruit is used as a laxative and the leaves are used to ease throat pain. *S. macrocarpon* was reported by Olaniyan *et al*, (2006) to be frequently grown in Nigeria on soils which lack the ability to supply necessary nutrients. The use of chemical fertilizer on such soils has been discouraged due to high cost and non availability at the right time (Chude, 1999). This informed the investigation into the use of cheaper materials which could be sourced locally and regularly for *S. macrocarpon* production.

Materials and Methods

The study was carried out at the Organic Farm of the Federal University of Agriculture, Abeokuta in 2013. The soil in the area was classified by FDALR (1990) as Oxic Paleustal.

The experimental plot measured 3 m x 2 m (6 m^2). Soil samples were taken at six points on the site before treatment application and analysed. Treatments applied were: Poultry manure at 10, 20 and 30 t/ha (PM 10, PM 20 and PM 30), Goat manure at 10, 20 and 30 t/ha (GM 10, GM 20 and GM 30), Cow dung at 10, 20 and 30 t/ha (CD 10, CD 20 and CD 30) and Control.

S. macrocarpon seeds were sown at 30 cm x 45 cm and at the rate of four seeds per hole on the 23rd of

January, 2013. Thinning was done to one seedling per stand at two weeks after sowing. Weeds were manually controlled at 4 and 8 WAS.

Data were collected on plant height and number of leaves at 8 WAS, fresh yield was determined by cutting the plant at 10 cm above soil level at 10, 12 and 14 WAS and these were weighed. Soil samples (0-15 cm layer) were randomly collected at four points on each plot with the aid of a soil auger at the end of the experiment, bulked and sub-sampled for analysis.

Post harvest soil total nitrogen, available phosphorus and exchangeable potassium were determined by Kjeldahl method, Bray 1 method and flame photometry respectively. Calcium and magnesium were determined by atomic absorption spectrophotometry. Organic carbon was determined by wet oxidation method and pH by glass electrode method.

Data was subjected to the analysis of variance using SAS 2002 package and significant means were separated by Duncans Multiple Range Test at 5% level of probability.

Results and Discussion

The experimental soil was low in nitrogen and potassium, goat manure was highest in potassium but lowest in C/N while poultry manure contained the highest nitrogen, organic carbon phosphorus, calcium and magnesium contents (Table 1). Plant height ranged from 4.15 cm to 25.90 cm, application of GM 30 significantly ($P < 0.05$) increased *S. macrocarpon* height above all other amendments and the control with the shortest plants (Table 2). Plants grown on plots treated with GM 30 and GM 20 recorded significantly ($p<0.05$) higher number of leaves than the control and plants on plot amended with CD 30. The highest percentage increase in yield over control (78.73 %) resulted from GM 30 application. Percentage increase in yield over control relative to amendment application followed this order: GM 30 (78.73 %) > PM 30 (73.30) > PM 10 (62.70 %) > CD 10 (61.47 %) > PM 20 (61.35 %) > CD 30 (59.62 %) > GM 10 (57.04) > GM 20 (56.96 %) > CD 20 (49.13 %) (Table 2). This observation may be due to early release of nutrients by GM as a result of its low C/N. Moyin – Jesu *et al,* 2012 reported quick release of nutrient by manure with low C/N.

Table 1. **Properites of pre-planting soil and organic amendments**

Property	Soil	Poultry manure	Goat manure	Cow dung
O. C. (%)	1.62	15.57	10.56	9.25
N (%)	0.08	3.45	2.89	2.37
P (mg/kg)	32.63	0.32	0.11	0.06
K	0.05 cmol/kg	0.49 %	0.63 %	0.55 %
Ca	4.10 cmol/kg	14.15 %	1.98 %	0.41 %
pH	6.80	-	-	-
Mg	1.69 cmol/kg	1.58 %	0.82 %	0.44 %

Table 2. **Effect of animal manures on agronomic yield of *S. macrocarpon* and post harvest soil chemical properties**

Treatment /ha	Plant height (cm)	Number of leaves	Yield (g/plant)	TN (%)	Avail. P (mg/kg)	Exch. K (cmol/kg)	Ca (cmol/kg)	Mg (cmol/kg)	pH	O. C. (%)
Control	4.15b	12.50c	52.88b	0.77	20.24g	0.04b	2.61	1.02b	6.80	1.54
GM 30	25.90a	65a	248.65a	0.81	38.68c	0.08a	6.21	1.47ab	7.20	2.41
GM 20	7.25b	33b	122.86ab	0.85	31.42e	0.05ab	5.06	1.37ab	7.10	2.31
GM 10	11.35b	23bc	123.09ab	0.81	34.84de	0.05ab	2.66	1.11b	6.85	2.39
PM 10	8.10b	27bc	141.76ab	0.82	37.92cd	0.06ab	6.25	1.27b	7.10	2.32
PM 30	9.90b	25.5bc	198.24ab	0.82	54.58a	0.06ab	6.40	2.47a	7.30	2.02
CD 10	6.65b	21.5bc	137.26ab	0.79	20.89g	0.06ab	4.30	1.05b	6.85	2.07
CD 20	9.80b	23bc	103.96ab	0.81	23.78fg	0.05ab	2.69	1.05b	7.25	1.75
PM 20	6.75b	24.5bc	136.81ab	0.86	43.12b	0.06ab	5.57	1.42ab	7.20	2.14
CD 30	5.35b	13c	130.96ab	0.79	24.60f	0.05ab	2.96	1.13b	6.90	2.27
				NS			NS		NS	NS

GM – Goat Manure PM – Poultry Manure CD – Cow Dung NS – Not Significant

Post harvest soil nitrogen contents were similar in all plots. Phosphorous contents ranged from 20.24 mg/kg to 54.58 mg/kg. The highest value which is significantly ($p<0.05$) higher than control resulted from PM 30 application. Potassium was highest in plots amended with GM 30, this was significantly ($P < 0.05$) higher than the control plot (0.04 cmol/kg). Application of PM 30 increased the magnesium content significantly ($p<0.05$) above PM 10, GM 10, CD 10, CD 20, CD 30 and control. This is in agreement with the findings of Aboutayeb *et al,*2014 who reported that chicken manure significantly increased post planting soil P above control. Adeleye *et al,*(2010) also observed that poultry manure increased magnesium content of soil planted with yam.

Conclusion

Application of goat manure at 30 t/ha (GM 30) significantly increased the height, number of leaves of *S. macrocarpon* and post harvest soil K above the control. Highest post harvest soil P and Mg resulted from the application of Poultry manure at 30 t/ha (PM 30). *S. macrocarpon* could be planted with either goat manure at 30 t/ha or poultry manure at 30 t/ha for higher yield and improved soil quality on similar soils.

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Response of Fluted Pumpkin (*Telfairia occidentalis*, Hook f.) to Different Levels of Poultry Manure Application in an *Ultisol* of Southeastern Nigeria

O. B. IREN, I. D. UWAH AND V. E. EKPENYONG
Department of Soil Science, University of Calabar, Calabar
Cross River State, Nigeria
Corresponding Author: myirenlady@gmail.com

Keywords: Fluted pumpkin, Telfairia occidentalis, poultry manure, *soil properties*, fresh yield.

Abstract

A field experiment was conducted at the University of Calabar Teaching and Research Farmin 2011 and 2012 planting seasons to evaluate the effects of different levels of poultry manure application on the performance of fluted pumpkin in a degraded Ultisol. Randomized complete block design with three replications was used for the study. Five levels of poultry manure (0, 60, 90, 120, 150 kg N/ha)were used, with the 0 kg N/ha(without amendment) serving as control. The levels of applied poultry manure significantly (p<0.05) enhanced the growth and fresh yield of fluted pumpkin. The longest mean vine length (168.3 cm) and highest number of leaves (79.6) were produced by plants on plots treated with 150 kg N/ha PM whereas the respective shortest vine length (104.9 cm) and lowest number of leaves (48.0) values were recorded on the control plots. The fresh yield of fluted pumpkin was significantly (P < 0.05) increased across all stages of growth as a result of the levels of poultry manure applied when compared with the control. The highest mean yield of 442.19, 648.12 and 683.24 kg/ha obtained at 4, 7 and 10 weeks after planting (WAP) respectively, was obtained from plots treated with 150 kg N/ha PM. The study showed that poultry manure applied at 150 kg N/ha (equivalent to 6 t/ha of poultry manure) best supports the performance of fluted pumpkin in a degraded Ultisol.

Introduction

Fluted pumpkin (*Telfairia occidentalis*, Hook f.)is classified as a member of the Cucurbitaceae family and is one of the most widely and intensively cultivated leafy green vegetable in the rainforest zone of south eastern states of Nigeria. The tender leaves and vines are consumed as vegetables while the young seeds are eaten as food and snacks (Badifu and Ogunsua, 1991). The leaves have also been discovered to be blood purifiers (Aletor *et al*., 2002) and could therefore be useful in health maintenance most especially among poor resource persons.

Continuous cultivation which had replaced the traditional shifting cultivation causes soil nutrient depletion thus, crop production is not profitable without additional nutrient supply. Poultry manure contains nutrient elements that can support crop production and enhance the physical and chemical properties of the soil (Iren *et al*., 2011a & b, 2012 John *et al*., 2013).This study, therefore, evaluates the response of fluted pumpkin to different levels of poultry manure application as well as establishing its optimum rate of application for fluted pumpkin production in an *Ultisol* of south eastern Nigeria.

Materials and Methods

Field experiment was conducted at the Teaching and Research Farm of the University of Calabar, Calabar(5° 32' and 4° 27' N and 7° 15' and 9° 28' E) in a degraded rainforest vegetation zone of Nigeria. The soil is classified as an *Ultisol* based on USDA system of classification (Soil Survey Staff, 1999).The experimental site was manually cleared, tilled and flat beds measuring 3m x 1.5m made. The experiment was laid out in a randomized complete block design with three replications. The experiment comprised of five levels of poultry manure (0, 60, 90, 120, 150 kg N/ha) with the 0 kg N/ha(without amendment) serving as control. The various rates of poultry manure were applied in dry form one week before planting (WBP) by broadcasting with incorporation method. The chemical composition of poultry manure used for the study is presented in Table 1.

Fluted pumpkin seeds were separated from the pulp and dried before planting. Two seeds of the fluted pumpkin were placed flat in the soil per hole at a spacing of 75 x 75 cm. It was later thinned down to one plant per stand few days after emergence giving a plant population of 17,777 plants/ha. The experimental plots were kept weed free throughout the period of the experiment.

Soil samples were taken from the experimental site before and after experiment using soil auger at a depth of 0-15 cm and analysed.

Two plants were randomly selected, tagged and used in growth measurements. Growth parameters measured include vine length and number of leaves per plant. These parameters were assessed after 3 weeks of planting and continued at weekly interval till the end of the experiment. Weight of freshly harvested vine was taken at 4WAP, 7WAP and 10WAP.

The soil and poultry manure samples were analyzed in the laboratory following standard procedures as outlined by Udo *et al*. (2009).

Data collected were analyzed according to the procedures outlined by Gomez and Gomez (1984) for randomized complete block design and significant means were compared using Fisher's least significant difference (FLSD) at 5 % level of probability.

Results

The soil of the experimental site was strongly acid (pH 4.5), loamy sand with very low total nitrogen and organic carbon as shown in Table 2. The soil was high in available phosphorus.

Table 3 shows the effects of poultry manure rates on soil chemical properties. Results obtained indicated that there were significant differences ($P < 0.05$) in the soil pH among the various treatments and control. The 150 kg N/ha poultry manure rate significantly increased soil pH from initial value of 4.5 before experiment and from the value of 4.57 obtained from control to 5.31. Total nitrogen (N), organic carbon, exchangeable bases and effective cation exchange capacity (ECEC) contents in the soil were not significantly affected by rates of application of poultry manure, although higher values were recorded as the rate of application increased. Soil available phosphorus was significantly influenced by the treatments with the 150 kg N/ha poultry manure treated plot having the highest value as against the value obtained from control.

Application of different rates of poultry manure had significant effects on vine length of fluted pumpkin at all the growth stages measured except the 3 weeks after planting (WAP) stage of growth (Table 4). The longest mean vine length was produced by plants treated with 150 kg N/ha of poultry manure while the shortest mean vine length was produced by the unfertilized plants. Similar effect was observed on number of leaves of fluted pumpkin (Table 5).

The fresh yield of fluted pumpkin was significantly ($P < 0.05$) increased across all stages of growth as a result of the levels of poultry manure applied when compared with the control, with higher yields obtained at higher levels of poultry manure application (Table 6). Relative yield increase from the 150 kg N/ha PM treated soil when compared with control was 49.4, 64.0 and 71.9 % at 4, 7 and 10 WAP, respectively.

Table 1. **Nutrient composition of poultry manure used for the study**

Parameter	Value
Total nitrogen (%)	2.47
Total phosphorus (%)	1.44
Total potassium (%)	1.48
Calcium (%)	3.20
Magnesium (%)	1.90
Organic carbon (%)	29.30

Table 2. **Properties of the soil before experiment**

Properties	**Value**
pH (H_2O)	4.50
Total N (g/kg)	0.40
Organic carbon (g/kg)	8.30
Av. P (mg/kg)	33.50
Exch.Ca (cmol/kg)	1.20
Exch. Mg (cmol/kg)	1.80
Exch. Na (cmol/kg)	0.04
Exch. K (cmol/kg)	0.06
Exch. H^+ (cmol/kg)	5.23
Exch. Al^+ (cmol/kg)	1.01
ECEC (cmol/kg)	9.34
BS (%)	33.19
Sand (%)	88.3
Silt (%)	18.0
Clay (%)	6.0
Texture	Loamy sand

Table 3. **Effects of poultry manure rates on soil chemical properties**

Poultry manure levels (kg N/ha)	pH (H_2O)	Total N (g/kg)	Organic carbon (g/kg)	Av. P (mg/kg)	**Exchangeable bases** (cmol/kg)				**Exchange acidity** (cmol/kg)		(ECEC cmol/kg)	BS (%)
					Ca	Mg	Na	K	H^+	Al^{3+}		
0	4.57	0.6	8.40	35.90	0.80	0.81	0.05	0.06	2.59	1.25	5.56	30.94
60	5.00	0.9	9.71	49.70	1.00	0.87	0.05	0.07	1.19	1.09	4.27	46.60
90	5.02	0.9	9.80	49.85	1.13	1.20	0.05	0.08	1.01	1.07	4.54	54.19
120	5.16	1.00	10.2	53.30	1.20	1.23	0.06	0.08	1.13	0.83	4.53	56.73
150	5.31	1.10	11.2	67.40	1.33	1.30	0.06	0.09	0.85	0.64	4.27	65.11
LSD (0.05)	**0.13**	**NS**	**NS**	**16.01**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.78**	**NS**	**8.10**

BS = Base saturation

Table 4. **Effects of poultry manure rates on the vine length (cm) of fluted pumpkin**

Poultry manure levels (kg N/ha)	**Vine length (cm)**								
	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP	9WAP	10WAP	**Mean**
0	42.1	44.4	63.6	89.2	117.1	134.6	166.0	182.0	104.9
60	51.0	53.9	80.8	107.0	144.7	186.0	206.0	226.0	131.9
90	51.0	55.2	86.6	107.9	142.4	185.0	204.0	223.0	131.9
120	57.6	61.8	86.6	121.8	168.2	220.0	247.0	274.0	154.6
150	61.8	65.8	99.5	131.6	190.4	241.0	266.0	290.0	168.3
LSD (0.05)	**NS**	**8.4**	**12.1**	**19.4**	**23.1**	**20.3**	**18.7**	**25.1**	

Table 5. **Effects of poultry manure rates on the number of leaves per plant of fluted pumpkin**

Poultry manure levels (kg N/ha)	**Number of leaves per plant**								
	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP	9WAP	10WAP	**Mean**
0	16.1	20.7	28.3	30.8	45.0	67.5	76.8	88.8	48.0
60	16.3	23.0	35.0	50.7	68.3	85.7	93.8	102.2	59.4
90	18.0	24.0	34.5	49.8	66.2	86.0	94.8	103.3	59.6
120	21.3	29.8	42.2	53.3	71.7	92.5	103.0	113.5	65.9
150	22.6	33.0	48.2	66.5	88.8	114.0	126.2	137.7	79.6
LSD (0.05)	**NS**	**NS**	**8.8**	**10.2**	**11.8**	**16.3**	**8.9**	**9.4**	

Table 6. **Effects of poultry manure rates on fresh yield (kg/ha) of fluted pumpkin**

Poultry manure levels (kg N/ha)	4WAP	7WAP	10WAP
0	223.89	233.42	192.00
60	342.63	523.48	548.00
90	376.06	561.78	602.10
120	413.49	585.82	635.11
150	442.19	648.12	682.90
LSD (0.05)	**30.4**	**35.6**	**41.9**

Discussion

The general increase in soil pH with increased poultry manure rates obtained in this study was similar to the result obtained by Iren *et al*. (2014) when different pig manure rates were used as soil amendment in fluted pumpkin cultivation. The ability of poultry manure to increase soil pH could be due to the presence of basic cations. The finding in this study of having higher contents of soil organic carbon in manure treated plots than control contradicts that obtained by Ano and Agwu (2005) who reported higher value of organic carbon from control than from manure treated plots, but agrees with the findings of Eneji and Uzoukwu (2012)and Iren *et al*. (2013) who reported significant increase in soil organic carbon with increasing rates of manure.

The non-significant increase in vine length of fluted pumpkin by the treatments at 3 WAP could be attributed to the slowly released pattern of nutrient from poultry manure. Similar results were obtained by Iren *et al*. (2012) and Ndor *et al*. (2013) as they observed no significant increases in vine length of fluted pumpkin at the initial stage of growth. The significant increases in growth parameters observed as growth stage advanced shows that poultry manure has the potential to sustain the growth of plant for a long period of time than planting without amendment. The noticeable differences that existed at higher rate of poultry manureas the growth stage advanced are in line with the findings of Aderi *et al*. (2011), Ndor *et al*. (2013) and Iren *et al*. (2013). They worked on the influence of organic manure rates and inorganic fertilizer formulations on some quantitative parameters of fluted pumpkin, and reported significant differences at higher rates of application as the growth stage advanced.

Several studies have confirmed that increasing the rate of application of organic manure significantly increased the performance of crops (Schippers, 2000; John *et al*., 2011; Akande *et al*., 2012;Iren *et al*. (2013)). In this study, the highest response of fluted pumpkin by 150 kg N/ha (equivalent to 6 t/ha) of poultry manure rate indicated that the ceiling rate beyond which there is a decline had not been attained. This is in line with the findings of Aderi *et al*. (2011) who observed no ceiling rate from the highest rate of 16 t/ha of chicken manure used in their study for fluted pumpkin production.

The increase in all the parameters assessed in this study reconfirmed the report of Schippers (2000), Iren *et al*. (2012, 2013 and 2014) and Ndor *et al.* (2013) that there is a significant increase on the growth and yield of fluted pumpkin by application of organic fertilizers. Thus, there is always a proportional increase in all the parameters assessed when additional nutrients are applied. The study showed that poultry manure applied at 150 kg N/ha (equivalent to 6 t/ha of poultry manure) best supports the performance of fluted pumpkin in a degraded *Ultisol*. Therefore, for sustainable and better performance of fluted pumpkin in the study area, 150 kg N/ha of poultry manure is recommended.

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Effect of Accelerated Compost on Soil Physical and Chemical Properties of an Alfisol

*AYANFE OLUWA O. E.[1], O. O. ADEOLUWA[2], S. O. OSHUNSANYA[2] AND V. O. ADURAMIGBA-MODUPE[3]
[1]Department of Crop Production, Federal College of Agriculture, Moor Plantation, Ibadan, Nigeria.
[2]Department of Agronomy, University of Ibadan, Ibadan, Nigeria.
[3]Institute of Agricultural Research and Training, Ibadan, Nigeria.
*Corresponding Author: ayanfeoluwaolufemi@gmail.com

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Abstract

Accelerated compost (AC) is a newly developed commercial compost from market organic wastes and animal manure with composting accelerated within twenty one (21) days using a specific microorganism. However, information on effect of AC on soil properties is scarce. Therefore a field experiment was conducted in Ibadan to assess the effect of an AC on the properties of an Alfisol using maize (Zea mays L.) as a test crop. The experiment was laid out in a randomized complete block design with three replications. The treatments were AC at the rates of 60, 90, 120, 150 and 180 kgN/ha; while NPK 15-15-15 mineral fertilizer and conventional compost (CC) at 60 kgN/ha and an absolute control (no soil additive) were used as checks. Data collected on post cropping soil physical and chemical properties were subjected to analysis of variance (ANOVA) with the means separated using Duncan Multiple Range Test (DMRT). The study revealed that the AC improved the physical (bulk density, total porosity and volumetric moisture content) and chemical (pH, organic carbon, N and P) properties of the soil with the 60 kgN/ha as the optimum rate.

Introduction

The regular addition of organic fertilizer to the soil increases soil organic matter, decreases soil bulk density and enhances the soil structure and water holding capacity (Agele *et al.*, 2005; Adeleye *et al.*, 2010; Adeyemo and Agele, 2010). The use of compost as soil amendment has been reported to improve crop yields and quality (Achieng *et al.,* 2010; Adeleye and Ayeni, 2010; Ibrahim and Fadni, 2013); this is in addition to documented positive impacts on post soil chemical properties (Kayode *et al*. 2013, Ibrahim and Fadni, 2013; Šimon and Czakó, 2014).

Relative to the conventional composting where the decomposition of organic materials could take six weeks to several months (Cooperband, 2002), the same process could be fast tracked by the introduction of artificial catalytic microorganism agents like *Trichodirma sp* and *Penicellum sp*. making such compost (otherwise known as accelerated compost) to mature within twenty one days (Rotor, 2008). This technology has the tendency to address the problem of lack of organic fertilizer in developing countries thereby enhancing the rate of adoption of organic agriculture. However, there is a paucity of information on the effects of accelerated compost on the soil properties. Therefore the objective of this study was to assess the effect of an accelerated compost (AC) on the properties of an Alfisol.

Materials and Methods

This trial took place at the experimental site of the Federal College of Agriculture, Moor Plantation, Ibadan (7° 22' 27.95" N and 3° 50' 20.62" E), Nigeria. The site is a well drained greyish brown Alfisol in the derived savannah agro-ecological zone. The pre cropping physical and chemical analysis of the site carried out showed low N (0.9 g/kg), P (4 mg/kg), organic carbon (9.1 g/kg) and medium K (0.4 cmol/kg) which justified the need for fertilizer application.. The textural class was loamy sand according to the USDA textural triangle. The bulk density was 1.65 and 1.79 g/cm^3 at 0-15 and 15-30 cm soil depth respectively. The total porosity was 37.74 and 32.45 % at 0-15 and 15-30 cm soil depth respectively. While the volumetric moisture content was 0.167 and 0.21 cm^3/cm^3 at 0-15 and 15-30 cm soil depth respectively.

The experiment was laid out in a randomized complete block design, replicated three times. The treatments were accelerated compost (AC) at the rates of 60, 90, 120, 150 and 180 kgN/ha; NPK 15-15-15 mineral fertilizer and conventional compost (CC), both at the rate of 60 kgN/ha as well as the absolute control (no soil additive) were used as checks. AC is a newly developed commercial compost from market organic wastes and animal manure with composting accelerated within twenty one (21) days using a specific microorganism. The brand of CC used was Alesinloye compost. The depth of treatment application was 10-15 cm. Each plot size was 3.3m x 3.3m planted to *TZEE1 14 X TZEE1 57 X TZEE1 12* (extra early maturing Hybrid)variety of maize at a spacing of 75cm x 25cm. The maize plants were thinned to one plant per stand giving a plant population of 53, 333 plants/ha. The compost treatments were applied one week before sowing while the mineral fertilizer was applied at two weeks after sowing (WAS). The soil samples were collected from 0-15 and 15- 30 cm depth. The post cropping soil physical and chemical analyses were carried out after the second cropping. Data were subjected to analysis of variance (ANOVA) and means separated using Duncan Multiple Range Test (DMRT).

Results

The proximate composition of the composts (Table 1) showed that both the accelerated compost (AC) as well as the conventional compost (CC) contained plant nutrients and carbon appreciably.The AC treatments had significant effect on soil physical properties after the second cropping of maize (Table 2). The 120 kgN/ha AC had the least bulk density (BD) value (1.55 g/cm^3) at 0-15 cm soil depth, which was not significantly different from other levels of AC, while the 60 kgN/ha NPK and the control gave the highest values of 1.68 and 1.67 g/cm^3 respectively. At 15-30 soil depth, the 120 kgN/ha AC treated soil gave the lowest significant bulk density (BD) value of 1.58 g/cm^3, followed by the 150 kgN/ha AC (1.60 g/cm^3), 180 kgN/ha AC (1.65 g/cm^3), 60 kgN/ha CC (1.63 g/cm^3), 60 kgN/ha AC (1.68 g/cm^3) while the 60 kgN/ha NPK gave the highest significant mean value of 1.69 g/cm^3. All the AC rates; 60 -180 kgN/ha and 60 kgN/ha CC therefore resulted into significantly higher values of total porosity of 40.38 - 41.57 % and 38.87 % respectively than the control (36.98 %) and NPK mineral fertilizer (36.60 %) at 0 - 15 cm soil depth. The result followed the same trend at 15 - 30 cm soil depth.

In terms of the volumetric moisture content (VMC) at 0-15 cm soil depth, the 60 kgN/ha CC treated soil gave the highest mean value of 0.081 cm^3/cm^3 which was not significantly different from all the AC levels except the 180 kgN/ha AC (0.058 cm^3/cm^3), while the 60 kgN/ha NPK and the control gave the lowest values of 0.048 and 0.044 cm^3/cm^3 respectively. At 15-30 cm soil depth, the 90 kgN/ha AC treated soil resulted into the highest mean value of VMC (0.110 cm^3/cm^3), followed by the 60 kgN/ha CC (0.095 cm^3/cm^3) and other levels of AC (0.084-0.077 cm^3/cm^3), while the 60 kgN/ha NPK gave the least value (0.074 cm^3/cm^3).

The results showed that the fertilizer treatments applied had significant ($p<0.05$) effect on the soil chemical properties after the second cropping (Table 3). The soil treated with 180 kgN/ha AC had the highest pH value of 6.5, which was not significantly different from other AC levels (except 60 kgN/ha;AC; 6.3) and 60 kgN/ha CC, while the 60 kgN/ha NPK gave the lowest significant value of 6.1. The 60 kgN/ha AC gave the highest mean organic carbon (14.5 g/kg) which was not significantly different from the 180 kgN/ha AC (14.1 g/kg) but higher than others, followed by the 90 kgN/ha AC (12.3 g/kg), while the control gave the lowest value (9.2 g/kg) which was not significantly different from the 60 kgN/ha NPK (9.4 g/kg). In terms of total N, the 180 kgN/ha AC treated soil gave the highest mean value of 1.5 g/kg, which was not significantly different from 60 and 150 kgN/ha AC treatments (1.3 g/kg each), while the 60 kgN/ha NPK resulted in the lowest significant mean value of 0.9 g/kg. The 150 kgN/ha AC treated soil resulted into the highest value of available P (70 mg/kg) which was significantly higher than others except the 60 kgN/ha AC (62 mg/kg), followed by the 180 kgN/ha AC (55 mg/kg), 120 kgN/ha AC (49 mg/kg), 90 kgN/ha AC (38 mg/kg), 60 kgN/ha AC (37 mg/kg), while the 60 kgN/ha NPK and the control treatments gave the lowest significant mean values of 16 and 10 mg/kg P respectively. There was no significant difference among the treatment means in terms of the exchangeable bases.

Table 1. **Proximate composition of the composts used for the study**

Parameter	pH (H_2O)	Total Carbon	N	P	K	Ca	Na	C:N ratio	Fe	Cu	Mn	Zn
		--------------------- (g/kg) ----------------							----------- mg/kg -----------			
AC	5.9	150	10.9	10	3	140	1	14	1321	61	405	146
CC	9.7	170	12	8	17	240	4	14	6053	11	393	1.5

AC; Accelerated compost, CC; Conventional compost

Table 2. **Effects of the different levels of accelerated compost on some soil physical properties after the second cropping**

Treatment	Bulk density (g/cm^3)		Total porosity (%)		Volumetric moisture content (cm^3/cm^3)	
	0-15 soil depth	15-30 soil depth	0-15 soil depth	15-30 soil depth	0-15 soil depth	15-30 soil depth
Control	1.67a	1.68b	36.98c	36.60f	0.044d	0.077c
60 kg N /ha NPK	1.68a	1.69a	36.60c	36.23g	0.048d	0.074c
60 kg N /ha CC	1.62b	1.63c	38.87b	38.49e	0.081a	0.095b
60 kg N / ha AC	1.58bc	1.68b	40.38ab	36.60f	0.069abc	0.078c
90 kg N / ha AC	1.58bc	1.67d	40.38ab	36.98d	0.077ab	0.110a
120 kg N / ha AC	1.55c	1.58g	41.51a	40.38a	0.064bc	0.083bc
150 kg N / ha AC	1.56c	1.60f	41.13a	39.62b	0.069abc	0.077c
180 kg N / ha AC	1.57c	1.65e	40.75a	37.74c	0.058cd	0.084bc

Means with same letter(s) in a column are not significantly different at 5% level of probability by Duncan Multiple Range Test (DMRT). NPK; NPK 15-15-15, AC; Accelerated compost, CC; conventional compost.

Table 3. **Effects of the different levels of accelerated compost on soil chemical properties after the second cropping**

Treatments	pH (H_20) 1:1	Org. C (g/kg)	Tot. N (g/kg)	P (mg/kg)	Ca (cmol/kg)	Mg	K	Na
Control	6.3bc	9.2e	1.2bc	10e	0.3	0.4	0.2	0.7
60 kg N / ha NPK	6.1d	9.4e	0.9d	16e	0.3	0.4	0.2	1.0
60 kg N / ha CC	6.4ab	10.0d	1.0cd	62ab	0.3	0.4	0.2	0.6
60 kg N / ha AC	6.3bc	14.5a	1.3ab	37d	0.3	0.3	0.2	0.9
90 kg N / ha AC	6.4ab	12.3b	1.2bc	38d	0.3	0.5	0.2	0.8
120 kg N / ha AC	6.4ab	11.2c	1.1cd	49c	0.3	0.4	0.2	1.2
150 kg N / ha AC	6.4ab	10.4d	1.3b	70a	0.3	0.4	0.1	1.5
180 kg N / ha AC	6.5a	14.1a	1.5a	55bc	0.4	0.5	0.2	1.0
					ns	ns	ns	ns

Means with same letter(s) in a column are not significantly different at 5% level of probability by Duncan Multiple Range Test (DMRT). NPK; NPK 15-15-15, AC; Accelerated compost, CC; conventional compost, ns; not significant.

Discussion

The AC treatments increased the soil pH, organic carbon, N and P relative to the control and NPK mineral fertilizer. The AC improved these soil properties relative to the initial soil status even when applied at 60 kgN/ha. This could be attributed to quick mineralization of the AC to release nutrients to the soil. The result confirmed the findings of Kayode *et al*. (2013) andŠimon and Czakó (2014) that organic fertilizers improved post cropping soil pH, organic carbon, available P and N. The result also showed that the AC at 60 kgN/ha decreased the bulk density and consequently increased the total porosity as well as the volumetric moisture content at 0-15 cm depth which is the rooting zone for most of the arable crops.Relative to the initial soil status at the two soil depths, the AC improved the bulk density and the total porosity comparable to that of conventional compost. This result is in support of the report of Adeyemo and Agele (2010) that farmyard manure improved the volumetric moisture content of an Alfisol in southwestern Nigeria. The improvement in the soil bulk density might be possibly due to increase in the proportion of macro-aggregates and soil organic matter (Agele *et a*l., 2005). The ACat 60 kgN/ha and at higher levels improving the bulk density and consequently the soil volumetric moisture content is in accordance with the report of Adeleye *et al*. (2010), that the addition of organic fertilizer improved the soil physical conditions mainly by improving the soil structure and decreasing soil bulk density.

Conclusion

The data from the study showed that the accelerated compost improved both the soil physical and chemical properties comparable to that of conventional compost at the same rate of 60 kgN/ha of application. Thus the short duration of composting for accelerated compost does not pose limitation to its ability to improve the soil properties at the optimum rate of 60 kgN/ha.

Table 6. **Effects of poultry manure rates on fresh yield (kg/ha) of fluted pumpkin**

Poultry manure levels (kg N/ha)	4WAP	7WAP	10WAP
0	223.89	233.42	192.00
60	342.63	523.48	548.00
90	376.06	561.78	602.10
120	413.49	585.82	635.11
150	442.19	648.12	682.90
LSD (0.05)	**30.4**	**35.6**	**41.9**

Discussion

The general increase in soil pH with increased poultry manure rates obtained in this study was similar to the result obtained by Iren *et al*. (2014) when different pig manure rates were used as soil amendment in fluted pumpkin cultivation. The ability of poultry manure to increase soil pH could be due to the presence of basic cations. The finding in this study of having higher contents of soil organic carbon in manure treated plots than control contradicts that obtained by Ano and Agwu (2005) who reported higher value of organic carbon from control than from manure treated plots, but agrees with the findings of Eneji and Uzoukwu (2012)and Iren *et al*. (2013) who reported significant increase in soil organic carbon with increasing rates of manure.

The non-significant increase in vine length of fluted pumpkin by the treatments at 3 WAP could be attributed to the slowly released pattern of nutrient from poultry manure. Similar results were obtained by Iren *et al*. (2012) and Ndor *et al*. (2013) as they observed no significant increases in vine length of fluted pumpkin at the initial stage of growth. The significant increases in growth parameters observed as growth stage advanced shows that poultry manure has the potential to sustain the growth of plant for a long period of time than planting without amendment. The noticeable differences that existed at higher rate of poultry manureas the growth stage advanced are in line with the findings of Aderi *et al*. (2011), Ndor *et al*. (2013) and Iren *et al*. (2013). They worked on the influence of organic manure rates and inorganic fertilizer formulations on some quantitative parameters of fluted pumpkin, and reported significant differences at higher rates of application as the growth stage advanced.

Several studies have confirmed that increasing the rate of application of organic manure significantly increased the performance of crops (Schippers, 2000; John *et al*., 2011; Akande *et al*., 2012;Iren *et al*. (2013)). In this study, the highest response of fluted pumpkin by 150 kg N/ha (equivalent to 6 t/ha) of poultry manure rate indicated that the ceiling rate beyond which there is a decline had not been attained. This is in line with the findings of Aderi *et al*. (2011) who observed no ceiling rate from the highest rate of 16 t/ha of chicken manure used in their study for fluted pumpkin production.

The increase in all the parameters assessed in this study reconfirmed the report of Schippers (2000), Iren *et al*. (2012, 2013 and 2014) and Ndor *et al.* (2013) that there is a significant increase on the growth and yield of fluted pumpkin by application of organic fertilizers. Thus, there is always a proportional increase in all the parameters assessed when additional nutrients are applied. The study showed that poultry manure applied at 150 kg N/ha (equivalent to 6 t/ha of poultry manure) best supports the performance of fluted pumpkin in a degraded *Ultisol*. Therefore, for sustainable and better performance of fluted pumpkin in the study area, 150 kg N/ha of poultry manure is recommended.

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Evaluation of Soil Fertility and Plant Nutrient Status of Two Organic Farms: Case Study of University of Ibadan and Ogungbade Village, Ibadan, Oyo State, Nigeria

E.A. AREMU, G.O. ADEOYE AND S.A. ONI
Department of Agronomy, University of Ibadan, Ibadan, Nigeria
Corresponding Author: aremzoneyomi@yahoo.com

Keywords: Soil fertility, plant nutrients, soil analysis, judgment sampling, organic farm.

Abstract

Two organic farms (I) Ogungbade village and (II) University of Ibadan were evaluated for their soil fertility and nutrient status. Deficiency symptoms were assessed using Judgment sampling technique on fifteen (15) different plant species from farm I and three (3) from farm II while soil samples were collected beneath each of the plant sampled at 0-15cm and 15-30cm depths. Soil and plant analyses were compared with their respective established critical nutrient levels to make diagnosis and recommendations. The study revealed sufficient nutrients in the soil but deficient in the plants indicating that the soils are fertile but not productive. Beyond diagnostic survey, an effective plant analysis should accompany soil testing programme.

Introduction

The management of nutrients in organic farming systems presents a formidable challenge, as the use of synthetic fertilizers is not permitted (Bello, 2008). Therefore organic farmers must optimize a range of soil, crop, rotation and manure managements to ensure a nutrient supply which will guarantee optimum crop yield and minimize losses to the environment. The foundation of organic farming lies in the health of the soil. A fertile soil provides essential nutrients to a growing crop/plant and helps support a diverse and active biotic community (Mellisa, V.T., 2003).Plants require 16 essential elements for normal growth and reproduction. Each of these nutrients has a function in plants and is required in varying amounts in plant tissue, (Akinrinde, 2006). An important part of crop farming is being able to identify and prevent plant nutrient deficiencies and toxicities. Conventional soil testing is inadequate in evaluating the ability of organically managed soil to supply nutrients throughout the growing season.

This system needs a different form of soil testing. Such a soil testing system would likely be a complex measurement of the soil organic matter and the ability of the soil to re-cycle the nutrients from organic matter into plant available forms (Ian Cushon, 2003).

Evaluation of organic matter in soil should be based on trends over several years of tests. There can be considerable variation among individual years because of cropping history or climate change or fluctuations.

Materials and Methods

The study was carried out in 2013 at two locations. (I) Ogungbade village situated along Ibadan-Ife express road while the second site was University of Ibadan (Latitude 3^0 48' and $4^0$0'E and between 7^0 25' and 7^0 30'N) organic garden, situated on the teaching and Research farm University of Ibadan. Judgment sampling technique was adopted in the collection of the samples of the deficient plants as well as the soil samples on the two sites. Soil samples were collected at two different depths 0 – 15 cm (topsoil) and 15 – 30cm (subsoil) into well labelled sampling bags using an auger. Samples of fifteen plant species were collected from farm I and three (3) from farm II. The soil and plant samples were then prepared for routine analyses. Other parameters analyzed for were pH, ECEC, exchangeable bases, exchangeable acidity, organic carbon, Micronutrients, Particle size distribution.

Results and Discussion

The soil nutrient analysis conducted on farms I and II topsoil revealed that the soil PH ranges from moderately acidic to slightly alkaline (5.7 – 7.5) which is adequate for crop production in tropical soils (Aduayi *et al*;2002.). the average soil Nitrogen for farms I and II are 2.4g/kg (moderately high) and 0.6g/kg (low) respectively with respect to their critical levels (Chude *et al*; 2012). The low N level indicates that additional N input (weather synthetic, organic or organomineral) is required for optimum plant production whereas little or no N input is needed in high N level soil. The average P value for farm I is very high (52.26mg/kg) while that of farm II is low (6.04mg/kg) with respect to critical level of high >20mg/kg and low 3-7mg/kg respectively. P element (which is next to the most important element N is deficient in most of the tropical soils) is needed in large amounts by the plants to complete their life cycles (Osiname, 2000; Obigbesan, 2000; Uponi and Adeoye, 2000 and Omueti *et al*., 2000). High level of P in farm I indicates no need of additional input as crop response is unlikely, while low P soil requires further P input. Also, the micronutrient contents of the soils from both farms are high, hence, further addition of micronutrients may not be necessary as crop response to the fertilizer applied is unlikely and the average ECEC values for farm I 39.29 cmol/kg (high) and farm II 11.77 cmol/kg (adequate) with respect to critical levels according to Mark (2012).

The N and P values generally range from low to high when compared with their respective critical ranges. Calcium (Ca) and Magnesium (Mg) which are part of the CEC of the soil, fall between medium to high when compared with their established critical ranges. The exception to this is Potassium (K) which is generally low in both farms and this revealed that these secondary macronutrients (Ca and Mg) are usually enough in the soil (Akinrinde, 2006) therefore, their addition as fertilizer is not always necessary. Among the accompanied exchangeable cations only Potassium was found to be low except in samples 7 and 8 where it is adequate, having values greater than 0.45 cmol/kg.

The average ECEC in farms I and II are high and adequate respectively.

The soil textural classes range from sandy loam to loamy sand.

Table 3 shows the Chemical and Physical characteristics of the subsoil of the two study sited. The soil PH ranges from moderately acidic and slightly alkaline (6.0 – 7.5) for farm I, while farm II PH is slightly acidic (6.6 – 6.7). However, the soil PH for the two organic farm is adequate for crop production in the South western region.

Farms I and II had averages of 28.71 g/kg and 24.40 g/kg of organic carbon content respectively which indicates the two farms were high in organic carbon with respect to the critical range (10-14 g/kg) for an alfisol (Chude *et al,* 2012). The high organic carbon content is as a result of the farms being left fallow for a period of time with an accumulation of decayed plant residues as this will promote microbial population, improves physical properties and aeration. The average values of each element from farm I as shown above reveals that total Nitrogen (2.34g/kg) and available P (59.0 mg/kg), were high above the critical ranges of 1.6 – 2.0g/kg and 7-20mg/kg respectively given by Aduayi *et al* 2002: Chude *et al* (2012), while in farm II, total N (1.6g/kg) and available P (18mg/kg) are adequate.

The potassium content of the top soil in the farms is generally low (0.19cmol/kg) compared with their critical level of 0.3 - 0.6 cmol/kg as stated by Chude *et al* (2012). This is in contrast to the general believe that tropical soils are rich in potassium according to Enwenzor (1989); Osiname (2000).

Table 1. **List of the selected plants from the two Organic farms**

S/N	Plants	Scientific Names
1	Plantain	*Musa paradisiaca*
2	Sweet potato	*Ipomoea batatas*
3	Sesame	*Sesamumindicum*
4	Pepper	*Capsicum spp*
5	Ewedu	*Olitoruscochorus*
6	Moringa	*Moringaoleifera*
7	Chaya	*Cnidoscolusaconitifolius*
8	Cocoyam	*Colocasiaesculenta*
9	Okro	*Abelmoschusesculentus*
10	Coconut	*Cocosnucifera*
11	Oil palm	*Elaeisguineensis*
12	Pawpaw	*Carica papaya*
13	Eggplant	*Solanummelongena*
14	Cocoa	*Theobroma cacao*
15	Guava	*Psidiumguajava*
16	Ewedu	*Olitoruscochorus*
17	Green vegetable	*Cellosia spp.*
18	Okro	*Abelmoschusesculentus*

Samples 1-15 from Farm I and 16-18 from farm II

Table 2. **Comparison of Macro and Micronutrient contents of farms I and II topsoils (0-15cm depth) with the established critical ranges**

Sample	N	P	Ca	Mg	K	Mn	Fe	Cu	Zn
1	M	M	M	L	L	H	H	H	H
2	M	M	M	M	L	H	H	H	H
3	H	H	M	L	L	H	H	H	H
4	M	L	H	M	L	H	H	M	H
5	M	H	H	H	L	H	H	M	H
6	H	H	H	H	L	H	H	H	H
7	H	H	H	H	M	H	H	H	H
8	H	H	H	H	M	H	H	H	H
9	M	H	H	M	L	H	H	H	H
10	L	M	H	M	L	H	H	H	H
11	M	M	H	M	L	H	H	H	H
12	H	M	H	M	L	H	H	H	H
13	L	L	H	L	L	H	H	H	H
14	L	M	H	M	L	H	H	H	H
15	H	H	H	M	L	H	H	H	H
16	L	L	M	L	L	H	H	H	H
17	L	L	M	L	L	H	H	H	H
18	L	L	H	M	L	H	H	H	H

H = High, M = Medium and L= Low

Table 3: **Comparison between the Macro and Micronutrients contents of the subsoils (15-30cm) and the Established critical ranges**

Sample	N	P	*Ca*	Mg	K	Mn	Fe	Cu	Zn
1	M	H	H	M	L	H	H	H	H
2	M	L	M	L	L	H	H	H	H
3	H	H	H	M	L	H	H	H	H
4	H	M	H	M	L	H	H	H	H
5	H	H	H	M	L	H	H	M	H
6	H	H	H	H	L	H	H	H	H
7	H	H	H	H	L	H	H	H	H
8	M	H	H	H	L	H	H	H	H
9	H	H	H	M	L	H	H	H	H
10	M	L	H	H	L	H	H	H	H
11	L	L	H	M	L	H	H	H	H
12	H	L	H	H	L	H	H	H	H
13	L	L	H	M	L	H	H	H	H
14	L	M	H	M	L	H	H	H	H
15	H	H	H	M	L	H	H	H	H
16	L	L	H	M	L	H	H	H	H
17	L	L	H	M	L	H	H	H	H
18	H	M	H	M	L	H	H	H	H

H = High, M = Medium and L= Low.

Table 4. **Comparison of the Macro and Micro nutrients content of the selected field crops with the established critical nutrient range**

Crops	**N**	**P**	**K**	**Ca**	**Mg**	**Na**	**Mn**	**Fe**	**Cu**	**Zn**
Plantain	L	L	H	H	M	M	M	H	L	M
Sweet potato	L	L	M	M	M	-	L	H	-	-
Pepper	L	L	.	.	.	.	.	.	.	.
Cocoyam	L	L	M	M	M	.	L			.
Okro	L	L	L	L	H	.	.	.	.	.
Coconut	L	H	H	H	L	H	L	L	L	L
Oil palm	L	H	H	L	M	.	L	.	L	H
Pawpaw	H	H	L	M	M		L	L	L	M
Egg plant	L	L	L	M	L	·	M	L	·	·
Cocoa	L	M	M	.	.	.	.	L	.	.
Guava	L	L	L	L	L	.	.	.	.	.

H= High, M= Medium, L = Low and - = not available

Conclusion and Recommendation

From diagnostic survey, soil analysis of top and subsoils were compared with nutrient content of the plant and it was discovered that most of the nutrients were sufficient in soil but were below critical level in plants, reflecting that the soils are rich while the plants are manifesting hidden hunger. On the other hand, the soils are fertile but not productive. This discrepancy revealed that soil environmental constraints are often responsible for why the sufficient nutrient in the soil was not reflected in the plant absorption.

Conclusively, a holistic approach from nutrient diagnosis, soil analysis and plant analysis should be carefully interpreted with the soil environment and management of the cropping system. Critical levels of some of the plant nutrients in some crop species are scanty in literature; therefore it is recommended that research should focus on this knowledge gap.

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Evaluation of Velvet-Fallow and Compost Amendments on Corchorus (*Corchorus olitorus* l.) yield and Soil Properties in an Organic Farming System

AdeOluwa, O. O. and A. Bello
Department of Agronomy, University of Ibadan, Ibadan, Nigeria.
Corresponding Author: adeoluwaoo@yahoo.com

Keywords: Corchorus, Ibadan brewery waste based compost, Nitrogen, Residual soil fertility, Velvet bean.

Abstract

Legumes can play an important role in management of nitrogen (N) for vegetable production, especially in tropics where low native fertility is a major constraint to crop production. Thus, this report therefore presents evaluation of the influence of velvet bean-fallow (residual fertility) and compost on the yields of corchorus (Corchorus olitorus), as well as the post-harvest soil fertility quality. Corchorus was used as the test crop. Six treatments IBBW1 (Ibadan brewery waste based grade A), IBBW2 (Ibadan brewery waste based grade B), IBBW1 compost + Velvet residual fertility, IBBW2 compost + Velvet residual fertility, Velvet residual fertility (Sole) and no fertilizer treatment as a control were investigated. The compost was applied at 100 kgN/ha. The experimental was laid in a complete randomized block design, replicated four times. The results of this experiment showed that the fertilizer sources had significant effects on dry yield of corchorus. The sole velvet fallow resulted into the best dry yield of 7.22 t/ha of corchorus and treatment IBBW1 + velvet fallow left the soil with better pH, total nitrogen and available phosphorus status. In general, sole velvet plus compost proved better fertilizers in the production of Corchorus olitorus. Thus, these treatments could be useful in organic production system for corchorus.

Introduction

The interest to preserve soil fertility for crop production through the use of legumes as cover crops or green manures has been known since time immemorial. This management approach is often used by organic farmers, because it is perceived to be more environmentally sound and less expensive than the use of inorganic fertilizers (Edmeades, 2003). Cropping without fallow and proper restoration of soil fertility could greatly lead to decrease in soil fertility, reduced levels of soil organic matter, and lead to soil acidification. Thus, achieving food security for a rapidly growing population will require intensification of food production through improving soil fertility management and improved agronomic practices without environmental degradation experienced through the uncontrolled use of inorganic fertilizers.

There is a wide range of technological options for improving soil conservation and land management that are economically viable, ecologically sound, and socially acceptable. These options include organic fertilizers, crop residue management, green manure, composting, farmyard manure, agroforestry technologies, alley farming, planted fallow, cover crops, and cereal legumes intercropping or rotation (Herencia *et al.,* 2007).Composts are widely used assoil amendments to improve soil structure, provide plant nutrients and facilitate the re-vegetation of disturbed soils (Brady and Weil, 2005).*Velvet bean (Mucuna pruriens)* is a legume cover crop that is an efficient, low-cost source of nitrogen with considerable potential to improve soil fertility in intensified cropping systems (Carsky *et al.,* 1998). Gaskell, 2004 reported that pepper (as a vegetable) without prior cover crops require 90 kg of nitrogen per acre to reach yield similar to pepper with a prior cover crop. However, information available on the influence of velvet bean fallow on some indigenous crops like corchorus is almost none existing.

Corchorus olitorus is a vegetable food to many families in Africa, Asia and in the Middle East, it is also used for fibre production in the Americas, known by the common name; jute or hemp. It has a potential to become one of the major vegetables and can be grown either on its own or intercropped with other common food crops such as maize and sorghum (Masarirambi *et al.,* 2011). Despite the benefits of manures, such as enhanced N_2-fixation (GrM), high subsequent crop yields, and other positive effects on soil physical and chemical properties, there is still dearth of information on Velvet fallow (residual fertility), augmented with compost amendments in the production of corchorus. The objectives of this report therefore are to evaluate the single and combined effects of Velvet bean-fallow and compost on the yields of corchorus and also on the post-harvest soil fertility quality.

Materials and Methods

This study was carried out on the field of the Organic Vegetable Garden, of the Teaching and Research Farm of the University of Ibadan, Nigeria at latitude 7^0 $24^{'}$N and longitude 30^0 $54^{'}$E between January and March 2014. It is located in the derived savannah of South West Nigeria. The treatments consisted IBBW1 Ibadan brewery waste based grade A, IBBW2 Ibadan brewery waste based grade B, IBBW1 compost + Velvet residual fertility, IBBW2 compost +Velvet residual fertility, Velvet residual fertility (residue of velvet planted on the soil before planting of the vegetables), and a control treatment (no fertilizer).The compost were obtained from organic section of Teaching and Research Farm University Ibadan and the cochorus seeds was obtained from a commercial seed outlet. Each treatment was replicated four times, in a randomized complete block design. The experimental plot consisted of thirty-two 2 m x 1.5 m in all with the total land area of 456.8m^2 (24m x 19.8 m). The seed were sown, using drill method with 3 cm apart and 0.5m inter-bed spacing and the corchorus plants were thinned to a planting density of about 1.8 million plants per hectare, two weeks after planting.

Surface soil samples (0-15 cm depth) were collected from experimental field before and after the investigation. The soil samples were air dried and sieved (<2 mm). Composites soil samples were processed for laboratory analyses. At harvesting (4 weeks after sowing), fresh shoot and root weight were determined using destructive samplings. Plant samples were later oven dried at 70^0C till constant weight and weighed to determine the dry shoot and root weights. Data generated were analysed statistically by analysis of variance (ANOVA) using GENSTAT and Duncan Mutiple Range Test (DMRT) was used to seperate treatment means at 0.05 significant level.

Results

The pre planting chemical and physical soil properties are shown in Table 1. The pH of the soil was moderately acidic (6.8). Soil total nitrogen and exchangeable potassium (K) of 0.1 g/kg and 0.2 cmol/kg obtained respectively were lower than the critical ranges. The soil was also low in organic carbon (2.81g/kg) and loamy sand in texture. The available phosphorus (P) of the soil was 14 mg/kg. These pre-planting soil properties made the experimental plot suitable for the fertilizer experiment. Details of nutrient compositions of the brewery based waste compost A and B revealed that total nitrogen ranged from 0.93 % - 0.98%, while the phosphorus ranged from 0.92 % - 0.94 % ,as well as potassium which ranged from 0.74% - 1.12%. Table 2 showed the comparative effects of different organic amendments on dry yields of corchorus. The treatments had a significant effect at (P< 0.05) on all the yield parameters collected. The Velvet + IBBW1 treatment resulted into the highest dried shoot weight (6.50 t/ha), Velvet fallow resulted into the highest total dry weight (7.22 t/ha), followed by IBBW2 treatment (7.16 t/ha).

Comparative effect of Organic Amendments on the Soil Properties

Table 3revealed that fertilizer treatments significantly affect the post fertility status of the soil. The IBBW1 + Velvet (residual fertility) increased the soil organic carbon, nitrogen, available phosphorus, calcium and potassium, when compared with other treatments used, as well as the initial fertility status.

Table 1. **Soil chemical properties and particle size distribution before planting**

Parameters	pH	O C	N	Av. P	Ca	K	Na	Mn	Fe	Cu	Sand	silt	Clay
	◄	g/kg	►	mg/kg	◄cmol/kg		►	◄ mg/kg		►	g/kg◄		►
Values	6.8	2.8	0.1	14	3.1	0.2	0.5	65	67	11	650	236	114

Table 2. **Comparative effects of organic fertilizer amendments on the yields of corchorus (t/ha) after 5 weeks of sowing**

Treatment	Dry shoot weight	Dry whole weight
Control	3.48b	4.17b
IBBW1 + Velvet residual fertility	5.46ab	6.08ab
IBBW2 + Velvet residual fertility	5.62ab	6.29ab
IBBW 1	6.50ab	7.16ab
IBBW 2	5.46ab	6.15ab
Velvet	6.50a	7.22a

Table 3. **Post harvest soil analysis for corchorus**

Treatments	pH	O C g/kg	N	Av. P mg/kg	Ca cmol/kg	K	Na	Mn mg/kg	Fe	Cu
Control	6.3	1.7	0.2	13	2.4	0.1	0.5	471	144	9
IBBW1 + Velvet residual fertility	6.5	3.5	0.4	72	4.9	0.6	0.7	532	210	12
IBBW2 + Velvet residual fertility	6.1	2.8	0.4	53	4.1	0.4	0.7	664	431	14
IBBW1 Compost	6.5	2.3	0.3	52	3.5	0.2	0.6	504	234	13
IBBW2 Compost	6.5	2.4	0.3	15	3	0.2	0.6	557	145	13
Velvet residual fertility	5.9	2.7	0.3	23	2.9	0.1	0.7	548	250	10
Mean	6.3	2.6	0.3	38	3.5	0.3	0.6	546	236	12
SD	0.2	0.5	0.1	21	0.8	0.2	0.1	56	89	2

Legend: SD: Standard deviation, IBBW 1 – Ibadan Brewery Waste Based Grade A Compost,
IBBW 2 - Ibadan Brewery Waste Based Grade B Compost

Discussion

The effects of organic fertilizers were significantly different on the yield of Jute as evident in parameters evaluated. The least performance of the plants in the control was a reflection of soil nutrients deficit. This result is similar to one observed by Okpara *et al. (*2007).

Ibeawuchi *et al.* (2006) reported that organic fertilizers increased the nutrient status of the soil through gradual release of nutrients to the soil. Similarly, Olanikan (2006) reported that organic fertilizers increased organic matter status of the soil and enhanced crop production. This could have resulted into the significant difference observed in the dry yield of corchorus. However, the appreciable and significant difference ($P \leq 0.05$) in dry weight of corchorus (7.22 t/ha) by velvet bean fallow treatment may be due to the fact that velvet bean has the potential to improve the soil quality by N-fixation. Ayeni *et al. (*2008) attributed improvement in soil health to the nutrient content and the amount of material applied. Thus, the improvement in soil fertility by the velvet fallow and IBBW composts could have led to increase in photosynthate accumulation (Siemonsma, 1991). Thus, the results of this trial showed velvet bean fallow resulted in the highest yield of corchorus, while its combination with IBBW1 increased soil fertility properties.

Conclusions

Organic farming is one of the ways to maintain soil health while retaining the productivity levels. The result revealed velvet (residual fertility) had significant influence on the yield of corchorus and it performed better compared to the control treatment (no fertilizer), this indicates that velvet bean fallow is good for sustaining soil health and organic production. Post-harvest soil with velvet bean fallowplus IBBW 1 compost treatments had better nutrient status compared to the untreated plots in terms of nitrogen, phosphorus and organic matter contents, these maybe useful of crop rotation practices and intercrops with other fruiting vegetable crops.

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Efficacy of Compost, NPK and Organomineral Fertilizers on Growth and Yield of *Celosia argentea* L.

OLOWOAKE, A.A.
Department of Crop Production, Kwara State University,
P.M.B. 1530, Ilorin, Kwara State, Nigeria.
Corresponding Author: aolowoake@yahoo.com

Keywords: *Celosia argentea,* NPK, organic fertilizer, organomineral fertilizers, shoot yield.

Abstract

A pot trial was conducted in the screen-house of Kwara State University, Malete, Nigeria during 2014 planting season to examine the efficacy of compost, NPK and organomineral fertilizers on growth and yield ofCelosia argentea as well as residual effects. The treatments comprised of Aleshinloye Grade A (Organomineral fertilizer), Aleshinloye Grade B (Un-amended compost), Sunshine Grade A(Organomineral fertilizer), Sunshine Grade B (Un-amended compost), NPK and control. The experiment was laid out in a completely randomized design (CRD) with three replicates. All the treatments (except the control of no soil additive) were applied at the rate of 45 kgNha-^{1}. Measurements of agronomic parameters were taken and data collected were subjected to analysis of variance (ANOVA) using the statistical analysis system (SAS).The parameters assessed were significantly influenced ($p<0.05$) by the applied fertilizer types. The results showed that dry shoot yield values of Celosia argentea were 2.5 and 2.4 g respectively with Sunshine Grade A and Aleshinloye Grade A. Residual effect of Celosia fresh shoot yield values obtained from Sunshine Grade A (5.3 g) and Aleshinloye Grade A (5.6g) were significantly ($p<0.05$) higher than that of the NPK treatment (3.6 g). The yield of celosia in Guinea Savanna zone of Nigeria can be significantly improved with application of organic fertilizers fortified with mineral fertilizer.

Introduction

Celosia argentea an edible species of the genus *Celosia* of the Amaranthaceae family is widely grown in gardens and other parts of West Africa. This leafy vegetable is an essential component of people's diet in Nigeria and other parts of West Africa. The leaves and young shoots are used in soups and stews. The leaves contain high levels of calcium, phosphorus and iron. This plant is an important source of proteins, calories, vitamins and minerals (Sanni *et al*, 2014). The vegetable is predominantly produced in Nigeria by resource-poor farmers and compound gardens where it is intercropped with arable starchy staples to produce enough food to satisfy their dietary and cash requirements and to minimize the risk of crop failure (Akinyemi and Tijani-Eniola, 1997). Continuous cropping of soils with leafy vegetables is usually associated with loss of organic matter, since almost all parts of the crop are harvested and crop residues are removed from the field or burned. The practical way to improve the quality of soils with low organic matter is through addition of organic materials to the soil either fresh, composted or farm yard manures. Organic matter possesses many desirable properties such as highwater holding capabilities, cation exchange capacity, sequester contaminants (both organic and inorganic), enhanced nutrient uptake, and beneficial effects on the physical, chemical and biological characteristics of soil (Oroka, 2012 and Asgharipour, 2012).The use of inorganic fertilizer to increase yield has been found to be effective as a short term solution which demands consistent use on a long-term basis. The hazardous environmental consequences and high cost of inorganic fertilizers makethem not only undesirable but also uneconomical and out of reach of the poor farmers (Olowoake, 2014). Therefore, it is important to investigate the use of locally sourced organic materials which are cheap, environment friendly and probably an effective way of improving and sustaining the productivity of soils and arable crops such as *C. argentea.* Some attempts have been made to investigate the effect of cowdung, poultry manure and organo mineral fertilizer on *Celosia argentea* (Akinyele, *et al*., 2012) and *Amarantus cruentus* (Makinde *et al*., 2010 and Olowoake, 2014), but the effect of these fertilizers on the growth and yield of *C. argentea* has not been widely investigated in Ilorin, Southern Guinea Savanna of Nigeria. Therefore, the objective of this study is to investigate efficacy of compost, NPK and organomineral fertilizers on growth and yield of *Celosia argentea*.

Materials and Methods

The potted experiment was set up in a screen-house at Kwara State University (Latitude 80 71'N and Longitude 40 44'E), Malete. The experiment was carried out to study the efficacy of compost, NPK and organomineral fertilizers on the growth and yield of *Celosia argentea.* Eighteen pots were filled with 5.5kg of soil from Kwara State University Teaching and Research Farm. The treatments used were: Aleshinloye Grade A (compost amended with mineral fertilizer); Aleshinloye Grade B (un-amended compost); Sunshine Grade A (compost amended with mineral fertilizer); Sunshine Grade B (un-amended compost); mineral fertilizer (NPK 15-15-15); and control. The treatments were arranged in a completely randomized design (CRD) with three replicates. The soils and compost were left to mineralize for two weeks before planting while the mineral fertilizer was applied two weeks after planting. The pots were perforated at the bottom to allow for easy drainage and facilitate aeration. Celosia seeds were broadcasted and thinned to two (2) seedlings per pot at two weeks after planting. Sunshine Grade A, Sunshine Grade B, Aleshinloye Grade A and Aleshinloye Grade B were composted commercial organic fertilizer manufactured by Ondo State Government and Aleshinloye fertilizer plant in Ibadan, Nigeria, respectively. All the treatments except the control were applied at the rate of 45 kg Nha-^{1} as recommended by Olaniyi and Ojetayo (2012) for the optimum growth of *Celosia argentea*. The experiment was repeated without any fertilizer application at the second planting which started after the first cycle. *Celosia* was harvested fresh at six weeks after planting (WAP). Growth and yield parameters data collected were as follows: plant height, stem girth, number of leaves and yield components such as fresh and dry shoot weight.

Results and Discussion

The effects of fertilizer treatments on growth parameters at first and second planting are shown on Table 1.Un-ammended compost, organomineral and NPK fertilizers had significant effect on *Celosia.* At 6 WAP Sunshine Grade A, Aleshinloye Grade A and NPK were significantly ($p< 0.05$) better than Sunshine Grade B, Aleshinloye Grade Band control. The highest plant height of 44.7 cm was obtained from plant fertilized with Sunshine Grade A. Also, the residual effect of fertilizer treatments at 6 WAP shows that un-amended compost and organomineral fertilizers were significantly ($p< 0.05$) better than control and NPK. The highest plant height of 17.4 cm was obtained from Celosia plant fertilized with Aleshinloye Grade A.

Table 1. **Effects of un-amended compost, organomineral and inorganic fertilizer on the growth of Celosia *argentea*at first and second cropping**

Treatment	Plant Height (cm)	No of leaves	Stem girth (mm)
First Cropping			
Control	20.0c	9.0d	2.0c
Sunshine Grade A	44.7a	17.2a	4.4a
Sunshine Grade B	33.0b	13.3c	3.3b
Aleshinloye Grade A	42.0a	16.3ab	4.6a
Aleshinloye Grade B	35.0b	13.0c	3.2b
NPK 15-15-15	44.3a	15.0b	4.5a
Second Cropping			
Control	7.5c	7.6c	1.2c
Sunshine Grade A	14.7ab	12.5a	2.7a
Sunshine Grade B	14.7ab	11.3a	2.1b
Aleshinloye Grade A	17.4a	12.8a	2.8a
Aleshinloye Grade B	13.2ab	10.5ab	2.0b
NPK 15-15-15	10.4b	9.0b	2.1b

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level.

At 6 weeks after planting (6 WAP), Celosia number of leaves in Sunshine Grade A and Aleshinloye Grade Awere significantly ($p< 0.05$) higher than number of leaves from Sunshine Grade B, Aleshinloye Grade B, NPK and control. During second planting at 6 WAP,Celosianumber of leaves in un-ammended compost and organomineral fertilizers were significantly ($p< 0.05$) higher than number of leaves from NPK and control.The response of stem girth of Celosia to application of different types fertilizers during the first and second planting were shown in Table 1.At 6 WAP stem girth of CelosiawithSunshine Grade A, Aleshinloye Grade A and NPK were significantly ($p< 0.05$) higher than stem girth of Sunshine Grade

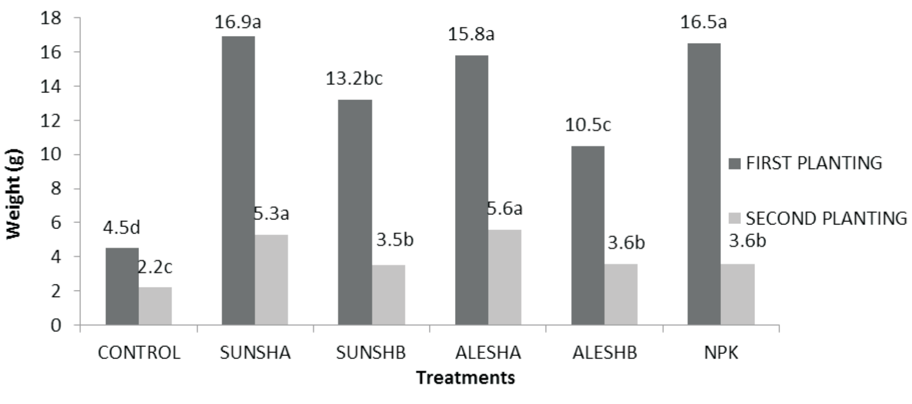

Figure 1: **Effects of un-amended compost, organomineral and NPK on fresh shoot weight of *celosia argentea* during first and second planting**

B, Aleshinloye Grade B and control. However, Aleshinloye Grade Aproduced the highest stem girth of 4.60 mm. The result of residual effect on Celosiastem girth at 6 WAP shows that Aleshinloye Grade Aand Sunshine Grade A were significantly ($p< 0.05$) higher than other treatments including the control.Figure1 shows that Aleshinloye Grade A, Sunshine Grade A and NPK has the highest fresh shoot yield and it is significantly ($p< 0.05$) higher than others. However, Sunshine Grade B and Aleshinloye Grade B came second and significantly better than control. For the second cropping, Aleshinloye Grade A and Sunshine Grade Ahas the highest fresh shoot yield, followed by NPK, Aleshinloye Grade B and Sunshine Grade B.

Figure 2 shows that Aleshinloye Grade A, Sunshine Grade A and NPK has the highest dry shoot yield for the first planting and it is significantly ($p< 0.05$) better than others. However, Sunshine Grade B, Aleshinloye Grade B and NPK came second and significantly different from control. During the second planting,there was no significant difference ($p< 0.05$) between the dry shoot values between Aleshinloye Grade A and Sunshine Grade A.

Application of Aleshinloye Grade A and Sunshine Grade A proved most effective in ensuring good performance in terms of growth, fresh shoot and dry shoot yieldof *Celosia argentea* at first and second cropping. In agreement with these results, Akinyele *et al*., (2012) reported that organomineral fertilizer significantly improved growth and yield of *Celosia argentea* compared to NPK. Similarly, Olowoake, (2014) reported that growth and shoot weight of *Amaranthus cruentus* at first and second cropping was markedly influenced by the application of organomineral, Aleshinloye Grade A and Sunshine Grade A. This might be as a result of higher N, P, and K present in organomineral fertilizer than un-amended compost (Akinyele *et al*., 2012). The low residual effect of *Celosia argentea* to NPK fertilizer as compared to Organomineral fertilizers corroborates the response patterns reported by Ogunlade *et al.,* (2011) on *Solanum macrocarpon* and Olowoake and Ojo (2014) on *Amaranthus caudatus.*

Conclusion

Generally, from the study there was an increase in the performance of *Celosia argentea* on the parameters measured. This implies that *celosia* responds well to organomineral and un-amended compost and NPK fertilizers. However, the application of Aleshinloye Grade A and Sunshine Grade A influences its growth than NPK fertilizer. This indicated that organomineral fertilizer is good for the farmers to use as soil amendments for production of *Celosia argentea*.

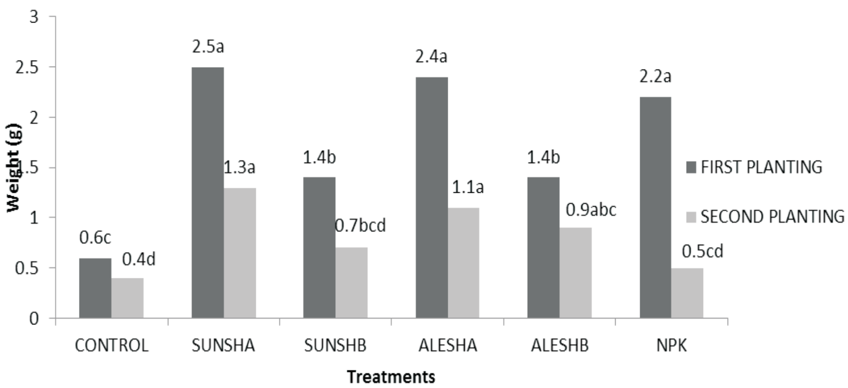

Figure 2: **Effects of un-amended compost, organomineral and NPK on dry shoot weight of *celosia argentea* during first and second planting**

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Influence of Organic Fertilizer Rates and Growth Media on the Growth and Nutrient Uptake of Oil Palm Seedlings

ATANDA, T. T. AND OLANIYI, J.O.
Crop Production and Soil Science
Department, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
Corresponding Author: atandatoyin85@gmail.com

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Abstract

Experiment was carried out at the Teaching and Research Farm, LAUTECH, Ogbomoso, to determine the influence of organic fertilizer rates and growth media on the growth and nutrient uptake of oil palm seedlings. Oil palm seedlings were subjected to three growth media (soil, soil + poultry manure and soil + saw dust) and five Aleshinloye grade A fertilizer rates (0, 50, 100, 150 and 200 kg Nha^{-1}). The 3 x 5 factorial experiments were laid out in a completely randomized design (CRD) with three replicates. The growth parameters (plant height and no of leaves) and the nutrient uptake were assessed.Results obtained showed that the growth parameters increased as the plant aged. Growth media significantly ($P \leq 0.05$) improved the growth parameters and nutrient uptake of oil palm seedlings. The oil palm seedlings planted in soil + poultry manure recorded the highest growth parameters and nutrient uptake irrespective of the fertilizer rate. The applied fertilizer rate significantly improved the growth parameters and nutrient uptake of oil palm seedlings with the highest value obtained from the organic fertilizer rate of 150 kg Nha^{-1} regardless of the growth media. The combined application of soil + poultry manure at 150 kg Nha^{-1} organic fertilizer rate gave the best performance of oil palm seedlings.In conclusion, the use of soil + poultry manure and 150 kg Nha^{-1} of Aleshinloye grade A fertilizer rate could be recommended for the early growth and nutrient uptake of oil palm seedlings.

Introduction

Oil palm (*Elaeis guineensis)* is a tropical crop which belong to the family palmae and the family contains about 25 genera with over 2600 species and it is the most important of the sub family cocideae (Opeke, 1987). Oil palm is a typical crop of the rainy tropical lowlands. The recent studies showed that the oil palm spread from Senegal to Angola. The main oil palm belt of West Africa run through southern Sierra-Leone, Liberia, Ivory Coast, Ghana, Togo, Benin, Nigeria, Cameroon and into the equatorial region of Zaire and Angola (Purseglove, 1975).

Oil palm is one of the main sources of vegetable oil that is rich in carotene, a natural compound that gives the palm oil orange-red colour. It has two distinct oil types which are palm oil and seed oil called the kernel oil. Its carotenoids contains vitamin A which aids vision, effective antioxidant that help strengthens the body immune system and reduce the risk of cancer, heart disease and cataract (Mpoc, 2007). Palm oil is rich in vitamin E, a powerful anti-oxidant which is capable of reducing the harmful types of molecules (free radicals) in the body. This delay body's ageing process.The micronutrient keeps the body cells healthy and functioning properly (Mpoc, 2008). The sap is a source of delicious drink which can intoxicate if left to ferment (palm wine) (Opeke, 1987).

The loss of nutrient through surface erosion and runoff has resulted in the use of fertilizer in supplementing poor indigenous soil nutrient supply in oil palm cultivation. For good yield to be sustained fertilizer inputs are necessary and typically constitute 40 – 50% of total field upkeep cost. The nutrient requirement of oil palm is large and varies widely. Young nursery palms contain about 1.4%N (Goh *et al., 1999a; Mohammed et al.,* 2008). Nitrogen application to young palms increases leaf area, improve leaf production and net assimilation rate thus resulting in increased biomass production (Corley and Mok, 1972; Breure, 1982). Hence an adequate supply of N is very important during the first five years after planting (Goh and Harder, 2005). The regulation of nutrient regime in organic farming is achieved through balanced crop relation and application of organic fertilizers such as compost, green manure and animal wastes (Brady and Weil, 1999;Meludu, 2005; Odiete *et al.,* 2005; Karanatsides and Berova, 2009).

Plant growing medium is not only a growing place but also a source of nutrient for plant growth. Media composition used influences the quality of seedlings (Wilson *et al.,* 2001). Generally, media for fruit crop seedlings are composed of soil, organic matter and sand. The soil is usually used as a basic medium because it is the cheapest and easy to get, supplementing of the sand is aimed at making media more porous while the organic matter is to enrich the seedling with adequate nutrients. There is a better relationship between the manure and rooting rather than conventional soil mix, and less predispose the seedling to soil borne pest and disease (Akanbi *et al.,* 2002).

Despite the several studies on growth media conducted on various tree crops by different researchers in Nigeria, little is known about the effect of growth media and organic fertilizer rates on the growth of oil palm. Therefore, there is need for research on the effect of growth media and organic fertilizer rates on the performance of oil palm seedlings.

The objectives of this study were to determine adequate Aleshinloye organic fertilizer rate required for optimum growth and nutrient uptake of oil palm seedlings, as well as the best growth media for raising oil palm seedlings.

Materials and Methods

The pot experiment was carried out at the Teaching and Research Farm of LAUTECH, Ogbomoso, Nigeria, to determine the effect of growth media and organic fertilizer rates on the performance of oil palm seedlings. The treatments were three types of growth media (Soil, soil + poultry manure and soil + sawdust) and Aleshinloye grade A organic fertilizer applied at five rates (0, 50, 100, 150 and 200 kg Nha^{-1}). Sprouted nuts of oil palm obtained from the National Institute for Oil Palm Research (NIFOR), Benin City, Nigeria, were used as test crop.

The experimental site was cleared; topsoil was collected from the cashew plantation, poultry manure as well as sawdust were collected and used to fill the pots. A total number of 180 pots were used and arranged into three replicates with each replicate containing 60 pots. A replicate contained 20 pots each of 5 kg of topsoil, 5 kg topsoil + poultry manure in ratio 2:1 and 5 kg topsoil + sawdust in 2:1 ratio. The 3 x 5 factorial experiments were laid out in a complete randomized design (CRD) with three replicates.

One sprouted nut of oil palm was planted per pot at the depth of 0.05 m, spaced at 0.5m within and 1m between. Five organic fertilizer rates (0, 50, 100, 150 and 200 kg ha^{-1}) were applied at one month after planting to their respective growth media. Data were collected on the growth parameters while the nutrient uptake was also assessed. Data collected were subjected to analysis of variance and means compared by Lsd at 0.05% probability level.

Results and Discussion

The mean height of oil palm seedling was significantly ($P \leq 0.05$) improved by the growth media (Table 1). The oil palm seedlings planted in the pot containing soil+ poultry manure as propagation medium recorded the highest plant height (4.77 cm) while the seedlings planted in soil + sawdust gave the least value (3.63 cm) irrespective of the fertilizer rate. The highest plant height was recorded at the optimum rate of 150 kg ha^{-1} irrespective of the growth media. The interactive effects of combined application of growth media and fertilizer rates significantly ($P \leq 0.05$) improved the height of oil palm seedlings at all sampling periods. The oil palm seedlings raised in a combined treatment of soil + poultry manure at 150 kg Nha^{-1} rate recorded the best plant height.

The mean number of leaves of oil palm seedlings is shown in table 1. The number of leaves of oil palm seedling was significantly ($P \leq 0.05$) improved by the growth media 8 to10 weeks after planting. The highest number was obtained from the plant treated with soil + poultry manure (4.40) while the plant treated with soil + saw-dust recorded the least value (3.67), irrespective of the fertilizer rate. The number of leaves of oil palm seedlings increased with increase in fertilizer rate from 0 up till 200 kg Nha^{-1} but there was no significant difference between the value obtained at 150 kg Nha^{-1} and 200 kg Nha^{-1}, irrespective of the growth media. The interactive effects of combined application of growth media and fertilizer rates significantly ($P \leq 0.05$) influenced the number of leaves of oil palm seedlings at every sampling occasion. The combined treatment combination of soil mixed with poultry manure at 150 kg Nha^{-1} rate recorded the highest number of leaves of oil palm seedlings.

The N, P, K, Ca and Mg uptake of oil palm seedlings (Table 2) showed the different concentrations as affected by the applied organic fertilizer rates and growth media. Nitrogen (N) content of oil palm seedling was significantly ($P \leq 0.05$) improved by the applied organic fertilizer rates and growth media. The plants propagated with soil only gave the highest N uptake (0.44 g) while those planted in soil + sawdust gave the least (0.22 g) value, regardless of the fertilizer rate.

The highest N uptake was obtained from plant treated with soil + poultry manure at 150 kg Nha^{-1} fertilizer rate. The phosphorus content of oil palm seedling was significantly ($P \leq 0.05$) improved by the applied organic fertilizer rate and growth media. The highest mean P uptake (0.26 g) was obtained from the pot containing soil + poultry manure as propagation medium while the oil palm seedling treated with soil + sawdust gave the least value (0.05 g) irrespective of the fertilizer rate. The potassium content of oil palm seedling was significantly ($P \leq 0.05$) improved by the applied organic fertilizer and growth media. The highest K uptake (1.98 g) was obtained from oil palm seedlings propagated in soil mixed with poultry manure while the plant propagated in soil mixed with sawdust recorded the least value (1.22g), irrespective of the fertilizer rate. The calcium content of oil palm seedling was significantly ($P \leq 0.05$) improved by the applied organic fertilizer rate and growth media. The oil palm seedlings propagated in the pot containing soil alone gave the highest mean Ca uptake value (2.60 g) while plants propagated in soil mixed with poultry manure recorded the least (1.58 g) value irrespective of the fertilizer rate. The magnesium content of oil palm seedling significantly ($P \leq 0.05$) improved by the applied organic fertilizer rate and growth media. The oil palm seedlings planted in the pot containing soil + poultry manure recorded the highest Mg value (2.62 g) while plant propagated in soil + sawdust gave the least value (1.92 g) irrespective of the fertilizer rate.

The mean dry weight of oil palm seedling was significantly ($P \leq 0.05$) influenced by the growth media. The oil palm seedling raised in soil + poultry manure recorded the highest value (3.37 g) while the oil palm seedling raised in soil + saw dust recorded the least value (2.88 g), irrespective of the fertilizer rate. The applied fertilizer rate and interactive effect of growth media and organic fertilizer had significant ($P \leq 0.05$) influence on the dry weight of oil palm seedlings. The optimum fertilizer rate of 150 kg ha^{-1} recorded the highest value.

In conclusion, the growth parameters assessed under this study and the nutrient uptake were significantly ($P \leq 0.05$) influenced by the various treatments. The use of soil + poultry manure as growth medium and at organic fertilizer application at 150 kg Nha^{-1} recorded the best growth parameters and nutrient uptake. Therefore, the sole application of soil + poultry manure, organic fertilizer rate of 150 kg Nha^{-1} and their combinations can be used in order to improve the production of oil palm seedlings.

Table 1. **The mean growth parameters of oil palm seedling as affected by the growth media and organic fertilizer rates**

Growth media	Fertilizer rate (kg/ha)	No of leaves 12WAP	Plant height 12WAP	Plant dry weight 12WAP
Soil	0	3.83	4.25	2.52
	50	4.11	4.28	2.83
	100	4.22	4.55	2.88
	150	4.25	4.61	3.80
	200	4.22	3.36	3.15
	Mean	**4.13**	**4.21**	**3.04**
PM	0	3.75	4.17	1.88
+	50	4.33	4.29	3.49
Soil	100	4.50	5.19	4.42
	150	4.64	5.21	4.52
	200	4.78	5.0	2.52
	Mean	**4.40**	**4.77**	**3.37**
SD	0	3.25	3.08	1.92
+	50	3.17	3.14	2.33
Soil	100	3.72	3.83	3.39
	150	3.64	4.22	4.76
	200	4.55	3.88	2.04
	Mean	**3.67**	**3.63**	**2.88**
LSD(0.05)				
GM		0.54	0.86	0.35
FR		0.70	NS	0.45
GM*FR		0.37	0.86	0.16

Key: GM=growth media, FR=fertilizer rate, PM=poultry manure, SD=sawdust

Table 2: **The nutrient uptake (g/plant) of oil palm seedlings as affected by growth media and organic fertilizer rates**

Growth media	**Fertilizer rate (kg/ha)**	**NUTRIENT UPTAKE (g/plant)**				
		N	**P**	**K**	**Ca**	**Mg**
Soil	0	0.19	0.03	1.36	1.83	1.95
	50	0.20	0.03	1.13	2.24	1.66
	100	0.30	0.15	1.82	3.46	2.58
	150	0.40	0.14	1.50	2.69	1.81
	200	1.15	0.17	1.64	2.77	2.25
	Mean	**0.44**	**0.10**	**1.49**	**2.60**	**2.05**
PM	0	0.31	0.11	1.82	2.16	2.51
+	50	0.40	0.22	2.48	3.01	3.27
Soil	100	0.21	0.15	1.11	1.82	1.45
	150	0.68	0.54	2.94	0.68	3.84
	200	0.25	0.30	1.54	0.25	2.04
	Mean	**0.37**	**0.26**	**1.98**	**1.58**	**2.62**
SD	0	0.14	0.03	1.18	2.27	2.03
+	50	0.14	0.02	0.93	1.35	1.47
Soil	100	0.13	0.04	0.83	0.25	1.25
	150	0.48	0.10	2.19	3.71	3.33
	200	0.22	0.08	0.96	1.67	1.53
	Mean	**0.22**	**0.05**	**1.22**	**2.05**	**1.92**
LSD (0.05)						
GM		0.12	0.17	0.18	0.16	0.18
FR		0.16	0.22	0.23	0.20	0.24
GM*FR		0.02	0.04	0.04	0.03	0.05

Key: GM=growth media, FR=fertilizer rate, PM=poultry manure, SD=sawdust

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Influence of Cassava Peels and Poultry Manure Based Compost on Soil Properties, Growth and Yield of Waterleaf (*Talinum triangulare* Jacq) in an *Ultisol* of Southeastern Nigeria

O. B. IREN[1], J. F. AKPAN[1], V. F. EDIENE[1], I. G. UDUAK[2] AND E. E ASANGA[3]
[1]Department of Soil Science, University of Calabar, Calabar, Cross River State, Nigeria
[2]Department of Soil Science, Akwa Ibom State University, Akwa Ibom State, Nigeria
[3]Department of Soil Science, University of Uyo, Uyo, Akwa Ibom State, Nigeria
Corresponding Author: myirenlady@gmail.com

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Abstract

Effects of cassava peels and poultry manure-based compost and their sole applications on soil properties, growth and yield of waterleaf were investigated at the University of Calabar Teaching and Research Farm in 2013 and 2014 cropping seasons. The experiment was laid out in a randomized complete block design (RCBD) with three replications. There were seven treatments consisting of mixture of cassava peels and poultry manure (compost), sole application of composted cassava peels and poultry manure each applied at two rates (4 and 8 t/ha) and control (without amendment). The results obtained showed that soil pH, total nitrogen (N), available phosphorus (P), exchangeable potassium (K), magnesium (Mg) and calcium (Ca) were significantly increased with levels of application of treatments compared to control with plots fertilized with compost at 8 t/ha having a higher significant influence on most of the soil chemical properties. There were significant differences ($P<0.05$) among treatments in plant height, leaf area, number of leaves, number of branches, stem girth and fresh yield of waterleaf. Generally, application of compost irrespective of the rate of application, enhanced waterleaf growth and yield better compared to other treatments. Compost applied at 8 t/ha had the best mean fresh yield of 17.86, 22.92 and22.34 t/ha at 4, 7 and 10 weeks after planting (WAP) which out yielded the control by 66.41, 77.53 and 77.44 %, respectively. This study has demonstrated that the use of cassava peels in the preparation of compost for crop production would be more economical and will also be a useful development in sustainable food production as well as in promoting environmental safety.

Introduction

Waterleaf *(Talinum triangulare* Jacq*)* is a dicotyledonous plant belonging to the family Talinaceae. Waterleaf is extensively grown in Southern Nigeria, particularly in Cross River and Akwa Ibom States and is used in soups and other delicacies in combination with other vegetables such as african joint*(Gnetum Africana),(Lasienthera bulchozianum)* and fluted pumpkin *(Telfaria occidentalis)*.Waterleaf grows best under humid conditions with a mean temperature of about 30 °C. Growth is most profuse when water content of the soil is close to field capacity (Schippers, 2000).

Poor and reckless use of inorganic fertilizer changes physical, chemical and biological properties of the soils as well as reduces the fertility status of the soils.

Most often cassava peels are commonly found in farm locations and processing sites as heaps that are generally perceived as hazard to the environment. These materials, however, could be utilized more effectively and sustainably through recycling. Poultry manure contains nutrient elements that can support crop production and enhance the physical and chemical properties of the soil (Iren *et al.,* 2011a and b; John *et al*., 2011).

This study, therefore, evaluates the effects of cassava peels and poultry manure-based compost on soil properties, growth and yield of waterleaf.

Materials and Methods

Experimental Site: The experiment was conducted at the Teaching and Research Farm of the University of Calabar, Calabar, southeast Nigeria. Calabar lies between latitude 5° 32' and 4°27' N and longitude 7° 15' and 9° 28' E in Nigeria.

Land preparation, Experimental Design and Treatments: The experimental site was manually cleared, tilled and plots measuring 3 m x 1.5m marked out. The experiment was laid out in a randomized complete block design with three replications.

Compost was prepared using dry cassava peels and well –cured poultry manure in the ratio of 1:1 (dry weight basis). Cassava peels alone were also composted. The materials were allowed to decompose for a period of 12 weeks. There were seven treatments consisting of mixture of cassava peels and poultry manure (compost), composted cassava peels and poultry manure each applied at two rates (4 and 8 t/ha).There was also a control (without amendment).

Field studies: Prior to land preparation, one composite soil sample was collected from 0 – 15 cm depth using soil auger for physico-chemical analysis. The treatments were evenly distributed and incorporated into the soil one week before planting(WBP) as recommended by Iren *et al.* (2011c).Waterleaf was planted manually at a spacing of 5cm x 5cm using stem cuttings of 10 cm length with leaves still attached. Weeding was done manually by hand pulling within the plots and using hoe to weed around the plots.

Twenty plants were randomly selected, tagged and used in growth measurements. Growth parameters measured were plant height, number of leaves per plant, number of branches per plant, leaf area and stem girth. These parameters were assessed after 4 weeks of planting (WAP) and subsequently at three weeks intervals. Weights of freshly harvested waterleaf were taken from an area of 50 cm x 50 cm within each experimental plotat 4, 7and 10 WAP. At the end of the experiment, composite soil samples were taken per plot for chemical analysis.

Laboratory studies: The composite soil samples collected before and after experiment were air-dried and sieved through a 2mm mesh. The following analyses were carried out on the samples using standard procedures as described in Udo *et al*. (2009): Particle size distribution, soil pH, organic carbon content, organic matter, total nitrogen (N), available phosphorus (P), exchangeable bases and exchangeable acidity.

Data Analysis: Data were analyzed statistically and means were compared using Fisher's Least Significant Difference (FLSD) at 0.05 probability level (Wahua, 1999).

Results and Discussion

Soil properties before experiment and nutrient contents of the amendments used

The physicochemical analysis of the soils used for the experiment in 2013 and 2014 cropping seasons revealed that the soils were extremely acid (pH < 4.5) and sandy loam in texture (Table 1). The soils were low in organic carbon, total nitrogen, exchangeable cations and effective cation exchange capacity (ECEC) but high in available phosphorus. The low levels of nutrients obtained in the experimental soils indicate low fertility status which necessitates the need for additional nutrient supply to the soil to increase crop productivity. The nutrient contents of the amendments used are as presented in Table 1.

Changes in soil chemical properties after experiment

Changes in soil chemical properties after experiment are presented in Table 2. The amendments used significantly ($P < 0.05$) improved the pH, organic carbon, total nitrogen, available P, exchangeable K, Mg, Ca and base saturation of the soil compared to the control (without amendment). The improvement in most of the soil chemical properties by the compost treatment is in line with the findings of Eneje and Nwosu (2012) who observed highest improvement in exchangeable Ca and ECEC with the admixture of cow dung and cassava peels.

Influence of cassava peels and poultry manure -based compost on waterleaf growth and yield

At 4 and 7 WAP, there were significant increases in plant height by all the amendments compared with the control except the plants treated with 4 t/ha of cassava peels, but at 10 WAP all the amendments significantly increased waterleaf height relative to control (Table 3). There were significant increases in leaf area of waterleaf amongst treatments with the highest leaf area obtained from plants treated with 8 t/ha compost (Table 3). Number of leaves per waterleaf plant was significantly increased by all the treatments across all growth stages relative to control (Table 4), with the highest value (28.57) obtained from plants treated with 8 t/ha compost. The highest number of branches (9.70) was obtained from plants treated with 4 t/ha of compost at 10 WAP (Table 4), while the biggest stem girth (2.27 cm) was obtained from plants treated with 8 t/ha compost at 10 WAP, though not significantly different from other treatments except control (Table 5). The responses of waterleaf growth to fertilizer application in an *Ultisol* of Southeastern Nigeria have also been reported by Ndaeyo *et al*. (2013).

Fresh yield of waterleaf was significantly ($P < 0.05$) increased by all treatments at all growth stages compared with control (Table 5). The best mean fresh yields of 17.86, 22.92 and 22.34 t/ha obtained at 4, 7 and 10 WAP, respectively by 8 t/ha compost treated soil out yielded the control by 66.41, 77.53 and 77.44 %, respectively. Significant growth and yield increases with the use of compost have been reported by John *et al*. (2011 and 2013). The consistent increases in growth and yield of waterleaf by plants treated with compost, poultry manure and cassava peels over the control in this study is an indication that the amendments are able to supply the required nutrients for good growth and yield of waterleaf. This is in line with the findings of Iren *et al*. (2014) that application of organic manure increased crop growth and yield.

The use of cassava peels in combination with poultry manure gave better improvement in soil chemical properties, growth and yield of waterleaf and is therefore recommended for sustainable production of waterleaf as well as in promoting health and environmental safety.

Table 1. **Properties of the soil before treatment application**

Parameter	Value		Parameter	Poultry manure	Cassava peels	Compost
	2013	**2014**				
Sand (g/kg)	830	911	pH (H_2O)	7.4	5.4	7.8
Silt (g/kg)	113	56	Org. carbon (%)	8.52	12.57	7.48
Clay (g/kg)	57	33	Total N (%)	1.89	1.47	2.10
Textural class	SL	SL	C/N Ratio	4.51	8.55	3.56
pH (H_2O)	4.2	4.4	Total P (%)	1.47	0.79	2.13
Org. carbon (g/kg)	7.98	7.82	Total K (%)	0.37	0.11	0.65
Total nitrogen (g/kg)	0.54	0.62	Total Ca (%)	2.24	1.89	2.68
Av. P (mg/kg)	20.00	25.70	Total Mg (%)	0.87	0.81	1.08
Exch. K (cmol/kg)	0.09	0.10	Total Na (%)	0.016	0.012	0.019
Exch. Ca (cmol/kg)	2.00	1.84				
Exch. Mg (cmol/kg)	1.40	1.44				
Exch. Na (cmol/kg)	0.06	0.06				
Exch.acidity (cmol/kg)	2.43	2.20				
ECEC (cmol/kg)	5.98	5.64				
BS (%)	59.36	60.99				

SL =Sandy loam, BS =Base saturation, Compost = cassava peels and poultry manure

Table 2. **Influence of cassava peels with poultry manure based compost on soil properties**

Treatments	Soil pH (H_2O)	Org. C (g/kg)	Total N(g/kg)	Av. P (mg/kg)	Exchangeable cations (cmol/kg)				E. A. (cmol/kg)	ECEC (cmol/kg)	BS (%)
					K	Na	Mg	Ca			
2013											
4 t/ha poultry manure	4.5	13.1	0.70	36.02	0.08	0.05	0.60	1.03	1.70	3.46	50.87
8 t/ha poultry manure	4.8	18.3	0.80	36.12	0.10	0.06	0.61	1.20	1.80	3.77	52.25
4 t/ha cassava peels	4.1	13.8	0.50	20.66	0.07	0.05	0.80	1.42	2.20	4.54	51.54
8 t/ha cassava peels	4.2	19.6	0.70	28.13	0.11	0.06	1.10	1.40	1.80	4.47	59.73
4 t/ha compost	4.9	19.2	0.90	40.11	0.13	0.06	1.33	2.26	1.40	5.18	72.97
8 t/ha compost	5.3	18.9	1.10	43.00	0.15	0.08	1.60	2.60	1.20	5.63	78.69
LSD (0.05)	**0.2**	**3.2**	**0.02**	**6.19**	**0.01**	**NS**	**0.10**	**0.45**	**0.87**	**NS**	**7.33**
2014											
Control	4.1	10.7	0.50	20.46	0.06	0.04	0.60	1.00	2.26	3.96	42.93
4 t/ha poultry manure	4.4	17.2	0.90	30.60	0.08	0.06	0.60	1.50	1.80	4.04	55.45
8 t/ha poultry manure	5.2	19.2	1.00	35.30	0.13	0.05	1.60	1.70	1.80	5.28	65.91
4 t/ha cassava peels	4.0	15.1	0.50	22.20	0.13	0.04	1.55	1.10	1.80	4.62	61.04
8 t/ha cassava peels	4.1	19.7	0.70	25.00	0.15	0.05	1.60	1.23	2.00	5.03	60.24
4 t/ha compost	5.3	15.2	1.10	34.10	0.17	0.07	1.66	2.64	1.70	6.24	72.76
8 t/ha compost	5.6	21.8	1.12	36.80	0.18	0.07	1.70	2.72	1.40	6.07	76.94
LSD (0.05)	**0.4**	**4.1**	**0.06**	**5.81**	**0.02**	**NS**	**0.11**	**0.32**	**NS**	**NS**	**6.46**

Compost = cassava peels with poultry manure

Table 3. **The mean plant height and leaf area of waterleaf as influenced by cassava peels and poultry manure based compost**

Treatment	Plant height(cm)			Leaf area (cm^2)		
	4WAP	7WAP	10WAP	4WAP	7WAP	10WAP
Control	10.30	10.70	8.23	5.36	5.01	4.07
4 t/ha Poultry manure	13.10	13.30	11.27	8.86	9.11	6.39
8 t/ha Poultry manure	14.80	16.00	11.87	9.20	10.27	7.50
4 t/ha Cassava peels	10.33	11.70	10.90	6.20	7.14	5.89
8 t/ha Cassava peels	12.60	15.84	12.33	7.08	8.30	6.66
4 t/ha Compost	15.93	16.33	15.33	10.62	10.88	7.72
8 t/ha Compost	17.53	18.87	16.03	11.69	14.55	12.43
LSD (0.05)	**1.13**	**1.45**	**0.6**	**0.52**	**1.12**	**1.10**

Table 4. **The mean number of leaves and branches per plant of waterleaf as influenced by cassava peels and poultry manure based compost**

Treatment	Number of leaves			Number of branches per plant		
	4WAP	7WAP	10WAP	4WAP	7WAP	10WAP
Control	9.23	8.80	9.70	3.57	4.83	4.16
4 t/ha Poultry manure	14.37	24.60	22.67	5.87	6.90	7.30
8 t/ha Poultry manure	16.50	27.15	24.57	6.20	7.60	8.17
4 t/ha Cassava peels	10.83	12.70	12.33	4.30	4.80	5.86
8 t/ha Cassava peels	11.23	14.90	13.90	4.20	5.30	6.10
4 t/ha Compost	16.53	25.97	22.83	6.83	8.87	9.70
8 t/ha Compost	16.50	28.57	24.57	6.08	7.90	8.23
LSD (0.05)	**1.21**	**1.33**	**1.97**	**0.98**	**1.2**	**1.6**

Table 5. **The mean stem girth and fresh yield of waterleaf as influenced by cassava peels and poultry manure based compost**

Treatment	Stem girth (cm)			Fresh yield (t/ha)		
	4WAP	7WAP	10WAP	4WAP	7WAP	10WAP
Control	1.11	1.10	1.18	8.00	7.15	7.04
4 t/ha Poultry manure	1.57	1.82	1.76	16.60	17.20	13.55
8 t/ha Poultry manure	1.69	2.10	2.18	16.68	17.48	14.84
4 t/ha Cassava peels	1.45	1.58	1.58	8.80	10.49	11.40
8 t/ha Cassava peels	1.57	2.07	1.61	15.20	16.68	13.40
4 t/ha Compost	1.56	1.87	1.73	17.40	18.03	15.88
8 t/ha Compost	1.75	2.17	2.27	17.86	22.92	22.34
LSD (0.05)	**0.24**	**0.18**	**0.81**	**2.03**	**3.19**	**5.34**

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The Role of Composted Poultry Manure in Reducing Bioavailability of Heavy Metals in Tissues of *Celosia argentea* L. Grown on Dumpsite and Garden Soils

O. A. OGUNTADE, T. O. ADEBARI, O. A. ODUSANYA AND O. B. ODUNTAN
Department of Crop Production, College of Agricultural Sciences, Olabisi Onabanjo University, P.M.B. 2002, Ago-Iwoye, Ogun State, Nigeria
Corresponding Author: deletade@yahoo.com

Keywords: Bioaccumulation, composted manure, heavy metals, leafy vegetable, plant part.

Abstract

This study elucidates the effects of composted poultry manure on heavy metals bioaccumulation in tissues of celosia grown on dumpsite and garden soils in a pot culture. Manure rates of 0, 10, 20 and 30 t ha^{-1} were applied on 5 kg soils replicated three times in a Completely Randomized Design. Celosia seeds were sown in potted soils, irrigated with 200 ml of water every day and seedlings thinned to one plant per pot at two weeks after planting (WAP). At 6 WAP plants were harvested, separated into its edible (shoot) and non-edible (root) parts. Metal content of celosia tissues was analysed and uptake determined on dry weight basis. Concentrations of metals in the soils and manure were also determined. Results indicated no significant difference in heavy metal bioaccumulation in celosia tissues with manure rates. Manure rate of 30 t ha^{-1} reduced iron and zinc levels in celosia shoot proportionately.

Introduction

Population pressure and eventual competition for arable land has led to cultivation of crops including vegetables on dumpsite soils. Generally, dumpsite soils are believed to be rich in plant nutrients but soils around dumpsites have been regarded as most polluted part of ecosystem (Magaji, 2012). Crop plants such as leafy vegetables grown in polluted soils and environment could absorb high concentration of heavy metals in its tissues (Suruchi and Pankaj, 2011). However, at both local and international levels, regulatory bodies have set the maximum allowable limits within which metals in food items must be maintained due to increased awareness of health risks associated with the toxic metals in food chain (Radwan and Salama, 2006, Suruchi and Pankaj Khanna, 2011). The potential health risk of high concentration of heavy metals in food crops grown on contaminated soil depends on their bioavailability (Iwona, 2011). Apart from the beneficial role of manure in enhancing crop growth, it has also been helpful in metals immobilization in contaminated soils (Chiu *et al*., 2006).In spite of these information, little is documented on the effects of mature composted poultry manure in reducing bioaccumulation of heavy metals in edible and non-edible parts of *Celosia argentea* L. grown on garden and dumpsite soils in the study area.

Materials and Method

Soil sampling and experimentation

Soil sample (dumpsite soil) was collectedfrom age-old dumpsite in Ayetoro, Ogun state while control soil sample (garden soil) was collected from Teaching and Research farm of the College of Agricultural Sciences, Olabisi Onabanjo University, Ayetoro. The soil samples were air-dried and sieved with 2 mm mesh. Five kilogram each of the soil in 5 L capacity plastic bucket was used for the 24 potted experiment. Poultry manure collected from the livestock section of Teaching and Research farm College of Agricultural Sciences was composted by heap method for 8 weeks. The air dried and 2 mm mesh sieved composted poultry manure was thoroughly mixed with each 5 kg soil at the rates of 0, 10, 20, 30 t ha^{-1} and left for two weeks prior to seed sowing. The experiment was replicated three times and arranged in a Completely Randomized Design. Sub-samples of soils and the composted manure were analyzed for its chemical properties including heavy metals (Iron, Zinc, Lead and Cadmium) following standard procedures (Udo *et al*., 2009). Celosia seeds were sown in each potted soil and irrigated with 200 ml of water every day for six weeks. At 2 WAP celosia seedlings were thinned to one plant per pot. Plants were harvested at 6 WAP and separated into its edible (shoot) and non edible (root) parts for laboratory analysis. Heavy metal concentration of the tissues was determined on dry weight basis using Atomic Absorption Spectrophotometer (AAS) Buck 210 VGP model.

Results and Discussion

The pH of the composted manure was slightly alkaline (7.20) with 5.88 % organic carbon. The phosphorus (P), calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K) contents were high with 1730.0, 41824.0, 9145.0, 3927.0 and 3354.0 mg kg^{-1}, respectively. The concentration of heavy metals especially iron (Fe), zinc (Zn) and lead (Pb) which were 9558.20, 946.30 and 51.23 mg kg^{-1}, respectively were also high (Epstein, 1965) while the cadmium (0.97 mg kg^{-1}) was low in the manure. The high content of the metals in the manure could be due to their presence in high concentrations in the poultry diet. The physicochemical properties of the two soils used are presented in Table 1. The pH of the soils ranged from slightly acidic in garden (6.60) soil to slightly alkaline in dumpsite (7.60) soil. Total organic carbon, total nitrogen, available P, exchangeable Ca, Mg, K, Na and Effective Cation Exchange Capacity (ECEC) were higher in dumpsite than in garden soil. Except for Fe, the concentrations of Zn and Pb in the dumpsite soil were also higher than in garden soil.

Out of the four heavy metals assessed only Fe and Zn bio-accumulated at detectable levels in the celosia tissues (Table 2). In garden soil bioaccumulation of Fe in celosia shoot decreased with increased manure rate. But Zn content in celosia shoot initially increased with manure rate up to 20 t ha^{-1} and decreased at 30 t ha^{-1}. However, in celosia grown on dumpsite soil bioaccumulation of Fe in edible shoot increased initially with manure rate of 10 t ha^{-1} over control and then decreased steadily with increased manure rates. Meanwhile, shoot bioaccumulation of Zn in the celosia decreased with increased manure rate although with no significant difference. The high contents of these metals in root tissue and the subsequent translocation to shoot could be due to their elevated concentrations in the soils or in the manure applied. The decreased heavy metal bio-availability at higher manure rate could be attributed to the roles of organic compounds in the manure which act as a chelating agent (Cooper *et al*., 2011). It could also be due to influence of humic substance which immobilized the toxic metals in the soil (Tlustoš *et al*., 2006). At the different manure rates applied to garden soil Fe in celosia shoots were higher than permissible limit. Meanwhile, in dumpsite soil, shoot bioaccumulation of Zn was higher than 0.30 mg kg^{-1} allowable limit in vegetable by FAO/WHO/FEPA at all manure rates except at 30 t ha^{-1}.

Table 1. **Physicochemical properties of garden and dumpsite soils used.**

Properties	Garden soil	Dumpsite soil
pH (in water 1:1)	6.60	7.60
Total organic C (%)	1.55	1.87
Total N (%)	0.12	0.16
Available P (mg kg^{-1})	7.43	52.48
Calcium (cmol (+) kg^{-1})	13.08	51.75
Magnesium (cmol (+) kg^{-1})	3.44	5.29
Potassium (cmol (+) kg^{-1})	0.78	1.38
Sodium (cmol (+) kg^{-1})	1.45	2.54
Al+H (mg kg^{-1})	0.07	0.05
ECEC (cmol (+) kg^{-1})	18.82	61.01
Iron (mg kg^{-1})	5.05	2.15
Zinc (mg kg^{-1})	15.60	54.8
Cadmium (mg kg^{-1})	BDL	BDL
Lead (mg kg^{-1})	0.19	0.26
Sand (%)	85.40	77.50
Silt (%)	7.40	8.30
Clay (%)	7.20	14.20
Textural classes	Loamy sand	Loamy sand

BDL= Below Detection Limit of 0.002 mg kg^{-1}

Table 2. **Mean heavy metal uptake by shoot and root tissues of Celosia at 6WAP**

		Iron mg $plant^{-1}$		Zinc		Lead		Cadmium	
Soil type	Manure rate	shoot	root	shoot	root	shoot	root	Shoot	root
	0	1.19	0.159	0.186	0.023	BDL	BDL	BDL	BDL
Garden	10	1.06	0.162	0.198	0.029	BDL	BDL	BDL	BDL
	20	0.73	0.137	0.222	0.019	BDL	BDL	BDL	BDL
	30	0.54	0.201	0.160	0.009	BDL	BDL	BDL	BDL
	LSD	1.60	0.26	0.27	0.04				
	0	0.19	0.018	0.43	0.16	BDL	BDL	BDL	BDL
Dumpsite	10	0.27	0.024	0.40	0.11	BDL	BDL	BDL	BDL
	20	0.25	0.046	0.38	0.09	BDL	BDL	BDL	BDL
	30	0.14	0.023	0.23	0.04	BDL	BDL	BDL	BDL
	LSD	0.17	0.03	0.12	0.13				
FAO/WHO/FEPA Limit		0.30		0.30		0.10		0.10	

BDL Below Detection Limit (Pb= 0.005mg kg^{-1}, Cd =0.002mg kg^{-1})

Conclusion and Recommendation

It is evident from this study that vegetables grown by farmers on dumpsite soil in the study area are potential accumulators of heavy metals particularly Zn. Unfortunately the garden soil used also had elevated concentration of Fe which was translocated to edible shoot of celosia. Hence, the role of manure is germane in lowering bioavailability of these metals in tissues of leafy vegetable grown in such soils to prevent metal biomagnifications in food chain. Meanwhile, assessment of trace metals in the organic amendment may be necessary before its use. It is therefore suggested that farmers should avoid using dumpsites for cultivation of vegetables as consumption of such crops could transfer toxic metals into human body. Composted poultry manure at 30 t ha^{-1}could reduce bioavailability of the trace metals in leafy vegetable.

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Potentials of Two Brewery Waste-Based Composts on Soil Fertility for Amaranth (*Amaranthus Caudatus)* and Jackbean (*Canavalia Ensiformis)* Intercrop

ADEOLUWA O. O., E.Y. THOMAS, A. BELLO AND B. JOSHUA
Department of Agronomy, University of Ibadan, Ibadan, Nigeria.
Corresponding Author: adeoluwaoo@yahoo.com

Keywords: Amaranth, Ibadan brewery waste based compost, Jackbean, soil fertility.

Abstract

The need for an increased production of vegetables to meet the human dietary needs necessitate a research in the use of different organic resources, for improving the soil fertility as well as improved yield and quality of amaranth. Thus, this report investigated the potential of two brewery waste based composts on soil fertility for amaranth (Amaranthuscaudatus) and Jackbean (Canavalia ensiformis) intercrop. Six treatments; Compost IBBW1 (Ibadan brewery waste-based compost Grade A), Compost IBBW2 (Ibadan brewery waste-based compost Grade B), Compost IBBW1+ Jackbean (JB), Compost IBBW2+ Jackbean (JB), Jackbean and control (no fertilizer) were used. The compost was applied at the rate of 100 kgN/ha. The experiment was laid in a randomized complete block design (RCBD) of with four replications. The results revealed that the treatments had a significant effect on the total yield (fresh weight and dry weight in t/ha) of amaranths as well as some post soil chemical properties. Compost IBBW2 produced a significantly highest total fresh and dry weights of 31.3 and 2.64 t/ha respectively, that were better than control of 16.5 and 2.03 t/ha, but not different from those from IBBW1. The control was significantly better than fertilizer treatment combination with Jackbean. Based on the results from this experiment, both grades of the brewery waste-based compost increased the yield and improved the soil fertility, however IBBW2 compost performed better. Thus, the IBBW2 compost is recommended for amaranth-jackbean intercrop.

Introduction

Poor soil fertility has emerged as one of the greatest constraints to increasing agricultural productivity that is currently threatening food security (Mugwe *et al.,* 2009). Application of compost is one of the steps usually taken in addressing soil fertility management in organic crop production. However, different composts could behave differently under different soil and crop systems. This could be due to the composition of the composts in term of nutrient status, age and processing (Pietro *et al*., 2013).

Adoption of improved and sustainable farming system in order to guarantee improvements in crop productivity is alternative to soil fertility improvement (Landers, 2007). Among these farming systems is the use of integrated soil fertility management practices (ISFM) which has intercropping with legumes as one of its main components (Mucheru-Muna *et al.,* 2010). This farming system is popular among farmers due to the ability of legumes to reduce the risk against total crop failure, conserve soil and improve soil fertility. Furthermore, intercrop can give higher yields than sole crop yields, greater yield stability, and more efficient use of nutrients. Despite these beneficial effects, intercropping of legumes with cereals and vegetables could accelerate soil nutrient depletion, particularly for phosphorous. This is could be due to soil nutrient mining through the harvested crops (Mucheru-Muna *et al.,* 2010). However, augmenting soils with organic fertilizers like composts, in an organic crop production system could change the scenario.

Amaranth is a fast growing and highly nutritional leaf vegetables in the tropics. However, one of the major limitations to the cultivation of amaranths is that it requires high amount of nitrogen, which is one of the limiting nutrients in the tropical soil. Thus, this report investigated the potentials of two brewery waste based composts on soil fertility, for Amaranthus (*Amaranthuscaudatus)* and Jackbean (*Canavalia ensiformis) intercrop.*

Materials and Methods

The research work was carried at the Organic Vegetable Garden, Teaching and Research Farm of the University of Ibadan, Nigeria (7^0 24' N and 30^0 54' E), between May and June, 2014. The experiment was laid in a randomized complete block design (RCBD) of six treatments, with four replications. The dimension of each bed was 1.8m × 1.2 m. Fertilizer treatments used were; control (no fertilizer), Compost IBBW1 (brewery waste-based compost Grade A), Compost IBBW2 (brewery waste-based compost Grade B), Compost IBBW1+ Jackbean (JB), Compost IBBW2+ Jackbean (JB) and jackbean. The compost treatment was applied at the rate of 100kgN/ha. Jackbean seed and the compost were obtained from organic section of the Teaching and Research Farm, University Ibadan, while the Amaranth (*Amanranthus caudatus*) seed was obtained from a commercial outlet.

Jackbean was sown with a spacing of 40 x 40 cm apart, with a seeds per hole and amaranth was introduced in between the rows, two weeks after sowing the Jackbean, using the drilling method. Soil samples were collected at 0-15 cm before and after the experiment, to determine the pre and post planting nutrient status of the soil. The amaranth plants were then thinned to a population of 1.8 million plants/ ha equivalent and the plants were harvested fresh at four weeks after sowing (WAS), to determine the fresh shoot weight and whole plant weight. Plant samples were later oven dried at 70^0C to a constant weight, to determine the dry weights. All the parameters measured were subjected to analysis of variance (ANOVA) and means were separated using Least Significance Difference (LSD) at $p<0.05$.

Results

Chemical properties of soil before and after treatment application are shown in Table 1. The initial soil was slightly alkaline (7.3). The total nitrogen of the soil with the value of 0.6 g/kg was below the lower limit of the critical range for N (1.5 – 2.0g/kg). The organic carbon content of the soil (17.4 g/kg) was below the critical range of 20 – 30g/k, however, the available phosphorus of 25mg/kg was high. The exchangeable potassium (0.2cmol/kg) was medium. This revealed that the soil was suitable for experimental trials and application of compost should show some measurable responses as results . The post-harvest soil revealed soil pH remained the same for IBBW2 (7.0) treated soils, while those with IBBW1 decreased to 7.2. However, the Control (with no fertilizer additive), became slightly acidic (6.6). The organic matter content of the soil decreased in Control (1.44 g/kg), this was below the critical range of organic carbon (20-30g/kg). However, there was an increase in the organic matter content of the soils treated with compost IBBW1 (27.5 g/kg) and IBBW2 (35.3 g/kg), which was above the critical range of organic matter of the tropical soils. The post planting nitrogen content of all the soils was low; compared to the initial pre-planting level of 0.64g/kg, although, there was a little increase in the nitrogen content of the soil compared to control. Available phosphorus increased in all the treatments and calcium levelalso increased in all treatments, except control. The soils treated with IBBW2 showed an increased in potassium level(0.6cmol/kg).

Effects of Fertilizer Treatments on Fresh and Dry Weight yield of Amaranth (t/ha)

Effects of fertilizer treatments on fresh and dry yield of amaranth are shown in Table 2. The IBBW2 compost produced a significantly higher fresh whole weight (31.3 t/ha) at 4 weeks after sowing, which was not significantly ($p \leq 0.05$)different from those of IBBW1 (28.2 t/ha), but both better than yield of 16.5 t/ha from the control treatment. Control treatment was however significantly better than the IBBW1+Jackbean (9.7 t/ha), IBBW2+Jackbean (9.9 t/ha) and Jackbean alone (11.3 t/ha). Although, there was no significant difference in the dry weightsof plants treated with IBBW1 (2.21 t/ha), IBBW2 (2.64 t/ha) and control (2.03 t/ha), but they were significantly better than IBBW1+Jackbean (1.21 t/ha), IBBW2+Jackbean (1.34 t/ha) and Jackbean alone (1.64 t/ha).

Table 1. **Comparative chemical properties of pre and post planting soils**

Treatments	pH	OC	N	Av. P	Ca	K	Na	Mn	Fe	Cu
	◄	g/kg	►	mg/kg	◄ cmol/kg	►	◄	mg/kg	►	
Pre- planting soil analysis										
Initial	7.3	17	0.6	25	3.7	0.2	0.6	687	77	11
Post soil analysis										
Control	6.6	1.4	0.11	41	3.1	0.3	0.8	668	69	5
IBBW1 Compost	7.2	27.5	0.14	52	5.0	0.2	0.6	675	101	6
IBBW2 Compost	7.0	35.3	0.16	43	4.4	0.6	0.5	624	78	11
Mean	6.9	21.4	0.1	45	4.2	0.4	0.6	655	83	10
Standard deviation	0.3	14.7	0.2	11	0.8	0.2	0.1	27	14	3

Table 2. **Comparative effects of organic amendments on the yields of amaranths (t/ha)after 4 weeks of sowing**

Treatments	Fresh shoot weight	Fresh whole weight	Dry shoot weight	Dry whole weight
CONTROL	10	16.5	1.5	2.03
IBBW1+JACKBEAN	7.4	9.7	0.31	1.21
IBBW2+JACKBEAN	7.5	9.9	0.64	1.34
IBBW1	18.4	28.2	1.21	2.21
IBBW2	23.1	31.3	1.44	2.64
JACKBEAN	7.3	11.3	1.34	1.64
LSD (≤0.05)	12.2	8.7	1.2	1.8

LSD: Least Significant Difference

Discussion

Ibadan brewery waste-based grade B compost (IBBW2) had significant influence on the fresh and dry yields of amaranth and it performed better compared to other treatments. The best fresh mean yield of 31.4 t/ha obtained from this study is greater than the fresh yield of 30 t/ha reported by Grubben and Vanslotten (1978), but lower compared to the fresh yield of 34 t/ha reported by AdeOluwa *et al.* (2009).

The influence of the treatment on amaranths dry weight took the same trend and the variation observed could be due to N content in the fertilizer materials applied and the season of planting. The low yield obtained from the intercrop and treatment combinations with jackbean could be due to the shading effects of jackbean on the amaranths which in turn inhibited the photosynthesis activities of amaranth. This is consonance with the findings of Chuang *et al.* (2014) who reported that shading resulted in decrease in the uptake and transportation of CO_2 during photosynthesis; this could have reduced the growth and yield of the amaranth plants. Post-harvest soil with IBBW2 treatment had better nutrient status, compared to the control in terms of nitrogen, phosphorus, potassium and organic matter content. This is in accordance with findings of AdeOluwa and Cofie (2011), which revealed that organic fertilizer (human Urine), improved soil exchangeable cations and pH. Hepperly *et al*. (2009),reported that compost treatments supported both high yields and increased soil carbon and nitrogen contents. This revealed that the IBBW composts used without combination with jackbean could improve soil fertility and yields of amaranths.

Conclusion

Although, legumes have potential to improve soil fertility, this study revealed that the intercrop of Jackbean and amaranths augmented with compost did not work well. The results of this experiment revealed that both brewery waste-based compost grade A and grade B (IBBW1 and IBBW2)gave good yields that were significantly better than control of no fertilizer additive. However, Compost IBBW2 gave better yield compared to Compost IBBW1. The post-harvest soil analysis showed that IBBW2 is a good option to improve soil fertility and for soil fertility management due to the residual nutrient status of the soil post planting in amaranth-jackbean intercrop.

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Plantain (Musa AAB. cv Agbagba) Setts Growth in Response to Growing Media and Organic Fertilizers in South Western Nigeria

JOSEPH-ADEKUNLE, T.T. AND W.A. BABALOLA
Department of Horticulture, Federal University of Agriculture, Abeokuta, Ogun State
Corresponding Author: oyinlolo@gmail.com

Keywords: Bits, growth media, organic, plantain corms, plantlets, setts

Abstract

The increasing demand for plantain fruit in the recent times had led to tremendous increase in demand for vigorous plantain plantlets or suckers for the establishment new plantations, expansion of the existing and or rehabilitate the moribund ones. A study was conducted between November 2012 and April 2013 at the organic skill demonstration plot, Federal University of Agriculture Abeokuta (7° 15 'N, 3° 25 'E) to examine the effects growing media and organic fertilizers on the setts of Plantain cv Agbagba as a rapid local and adaptive alternate means of suckers multiplication. Treatments consisted of three growing media and two organic fertilizers at two rates and were laid out in a CRD with four replicates. The growth media were top soil (TS), sawdust (SD) and a mixture of TS and SD (TSSD). The organic fertilizers were fortified Gateway organic fertilizer (GOMF) and Cured poultry manure (CPM) applied at 10 t/ha and no fertilizer as control (C).Setts from plantain corms of freshly harvested stands were pared, cut into bits of 300g, dusted with wood ash and air dried for a week prior to planting. Data were collected from 5 weeks after planting (WAP) on number of leaves, plant height, stem diameter, leaf area, canopy diameter, root length and number of root. The result indicated a superior performance of setts planted in TSSD with CPM (26.7cm, 4.0, 62.4 cm, 24.7 cm) for plant height, number of leaves, canopy and stem circumference compared to plantlets in TS only with or without organic fertilizer with lowest values (0.7 cm. 2.3, 62.2cm, 9.0 cm) respectively.

Introduction

Plantain of family Musaeae is an important staple food for more than 50 million people ranking third among starchy staples after cassava and yam in Nigeria and other tropical regions where banana plays an important role in family diet (Venkatachalam *et al*., 2007). The fruit remains starchy at maturity and needs some minimal processing before consumption (Robinson, 1996). Nigeria is one of the leading producers of plantain globally with estimated annual production of 2.103 million tons from harvested from 389,000 ha (FAO, 2006).

There is currently under supply due to increasing demand for the fruits by processors who are involved in small and medium scale industries a (SME) producing value-added product (easy and convenient foods and snacks) in the urban centres. Plantain can occupy a strategic position in rapid food production because it is a perennial ratoon crop with a short gestation period(Akinyemi *et al.,*2010). All stages of the fruit are used as a source of food in one form or the other. The immature fruits are processed into powder and consumed as 'plantain fufu' The mature fruits (ripe or unripe) are consumed boiled, roasted, steamed, baked, pounded or sliced and fried into chips. Industrially plantain fruits serve as composite in the making of baby food such as (Babena and Soyamusa), bread, biscuit and others (Ogazi, 1996). Despite the huge potential of this crop, the far below supply with demand has hampered its status as a foreign exchange earner and under supply at home due to the shortage or inadequate supply of vigorous suckers for increasing large scale production. The study was therefore carried out to examine response of plantlets from setts from corms to growth media and organic amendments. The objectives of the study were to assess the effects of growing media on growth of setts and determine the influence of organic fertilizers on growth of the plantlets.

Materials and Methods

Perforated plastic buckets were filled with 12 kg of topsoil (TS), sawdust (SD) and mixture of topsoil and sawdust (TSSD). Gateway Organo-mineral fertilizer (GOMF) and Cured Poultry manure (CPM) were added at 2kg/pot (10t/ha) as described by Baiyeri & Tenkouano (2007), watered and allowed to stand for 14 days. Corms from recently harvested plantain stands were pared and cut into 300g setts, dusted with wood ash and air dried for 7days and planted in the growth media. The treatments were replicated four times and laid out in a CRD. Weeding of individual pot was done by rouging and watering was done once in a week with 1 litre of water per pot. Data collection on growth parameters started 5 weeks after planting (WAP) and continued at weekly intervals till 21 weeks after planting. Plant height (cm) was taken using measuring rule, number of leaves by count, stem circumference was determined by multiplying the value of the diameter measured using digital vernier calipers by formula πD (i.e 3.14 multiplied by the obtained diameter (D) value), leaf breadth and leaf length, canopy diameter using measuring rule. Leaf area was calculated using the formula ($Y = 0.65X - 0.22$ ($r = 0.97$) Aiyelaagbe, 1991. Y = Leaf area (m^2/plant), X = leaf length (m/plant). Number of roots and chord root length (cm) were assessed at 21 WAP. Data collected were subjected to analysis of variance (ANOVA) and significant treatment means separated with DMRT at 5 % probability level.

Results and Discussion

At 5WAP setts planted TSSD and SD with addition of CPM produced tallest plantlets and were not significantly different from those planted in TSSD with addition of GOMF. Setts planted in TS and SD only were not different from TSSD mixture. Application of GOMF in TS or SD produced the shortest plantlets. SD amended with CPM had comparable valueto the taller plantlets in TS, TSSD amended or not. Similar trend was observed up to 11 WAP for TSSD mixture with CPM application and TSSD mixture amended with GOMF. Between 13 and 19 WAP the treatments had significant differences on the plantlets. Setts planted in SD treated with CPM produced tallest plantlets, followed by plantlets in TSSD mixture with GOMF and CPM application. At 21 WAPTSSD mixture treated with GOMF produced the tallest plantain plantlets. Other treatments recorded lower values; TS with GOMF produced the shortest plantlets throughout (Table 1).

The media and applied organic fertilizers had significant effects on number of leaves. Highest number of leaves was recorded on TSSD mixture amended with GOMF at 15 WAP although it was not significantly different from values obtained between 9 and 15 WAP for SD amended with GOMF. This was followed by SD andTSSD amended with CPM between 7 and 15 WAP which produced significantly higher number of leaves per plant than other treatments while other treatments had significantly lower values(Table 2).

Table 1: **Effects of growing media and organic fertilizers on plantain plantlets**

Treatment	5	7	9	11	13	15	17	19	21
TS	3.1bc	9.7abc	11.9ab	13.4ab	15.5abc	16.8abc	16.8abc	18.1abc	22.8abc
SD	2.4bc	6.4abc	8.2abc	8.8abc	9.5bcd	10.0bcd	10.9bcd	12.0bcd	15.5bc
TSSD	1.6bc	3.7bc	5.1bc	6.0bc	6.5cd	7.5cd	7.5cd	8.8cd	13.3cd
TS +CPM	2.8bc	8.0abc	9.9abc	10.8abc	12.7abc	13.9abc	13.9abc	14.9abc	17.7abc
SD+CPM	7.7abc	13.6ab	15.8ab	16.9ab	21.0ab	25.0a	25.3a	26.6a	30.0a
TSSD+CPM	11.9a	16.2a	17.9a	18.7a	21.2ab	22.2ab	22.2ab	23.2ab	26.7abc
TS+ GOMF	0.7c	0.7c	0.7c	0.7c	0.7c	0.7c	0.7c	0.7c	0.7c
SD +GOMF	0.7c	7.0abc	10.5abc	11.5ab	18.0ab	22.0ab	22.0ab	23.3ab	29.0ab
TSSD+GOMF	9.4a	14.9a	16.8a	18.0a	21.6a	24.6a	25.1a	26.3a	31.0a

Table 2. **Effects of Growth media and fertilizer on number of leaves**

Treatment	Canopy (cm/plant)	Leaf area (cm^2)	Stem Circumf. (cm)	Leaf area (cm^2)	Number of roots	Chord root length (cm)
TS	46.3a	12.6ab	45.8b	12.6ab	9.9ab	58.0bcd
SD	46.8a	12.1ab	46.5b	12.1ab	12.0ab	118.0a
TSSD	38.0a	12.1ab	39.6b	12.1ab	10.8ab	101.0a
TS +CPM	34.2a	9.2ab	39.3b	9.2ab	6.4bc	20.8de
SD+CPM	57.3a	13.9ab	77.6a	13.9ab	15.5a	97.2abc
TSSD+CPM	62.4a	13.1ab	62.2ab	13.1ab	17.4a	52.6cd
TS+ GOMF	-	0.2c	2.2c	0.2c	0.7c	0.7e
SD +GOMF	53.3a	12.1ab	59.7ab	12.1ab	14.3ab	77.5abc
TSSD+GOMF	62.8a	16.0a	59.7ab	16.0a	16.8a	81.0abc

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Gender Involvement in Ecological Organic Crop Farming in Ogun State, Nigeria

OYEWOLE, MOJISOLA FAUZIYAH
Department of Agricultural Extension and Rural Development,
University of Ibadan, Nigeria.
Corresponding Author: oyemojidola2@yahoo.com

Keywords: Gender, Involvement, Ecological, Organic.

Abstract

This study investigates the gender involvement in ecological organic crop farming agriculture in Ogun state Nigeria. Two local government areas were purposively selected in Ogun state and systematic sampling technique was used to select ten percent of the one thousand two hundred (120) ecological organic agriculture registered farmers to give a total sample size of 120 respondents. Structured interview schedule was used to collect data and were analyzed using descriptive and inferential statistics. Sixty two percent of the male farmers and 38% of the female farmers were between the age 35 and 45 years. Majority (96% females and 95% males) were married, 84% of the female and 72% of the male farmers had no education, while 56% male were involved in land clearing activities while 51% of the female farmers were involved in processing activities. The male farmers (70%) had high knowledge while the female farmers (30%) had low knowledge in ecological organic agriculture. The male farmers (65%) had higher level of involvement while the level of involvement of female farmers (45%) was low. This study concludes that the low level of knowledge by the female farmers in ecological organic crop agriculture brings about their low level of involvement. It can be recommended that awareness on ecological organic agriculture needs to be created to sensitize the people, particularly female organic farmers on health, environmental, and ecological benefits of organic agriculture.

Introduction

Organic agriculture has many positive environmental effects, chiefly enhancing biodiversity and reducing the energy use for agricultural production. (Ziensemer, 2007). It has emerged as a viable alternative to the dominant conventional farming. It eliminates the use of synthetic pesticides, growth hormones, antibiotics and gene manipulation in the crop production system which poses a challenge to the crop and pest management specialists to device new tactics for crop production (Codex Alimentarius Commission, 2001). Organic agriculture combines traditional innovation and science to benefit the share environment and promote fair relationship and good quality of life for all gender (IFOAM, 2007).

According to Obasi (2004), gender refers to the many socially constructed characteristics, qualities, and roles which different societies ascribe to females and males. Gender also refers to social differences between men and women which vary widely among societies and cultures (Nwankwoala and Daniel, 2011). Different roles and responsibilities of men and women in organic agriculture are closely linked to environmental change through their economic and household activities.

Organic agriculture supports gender equality because it makes the women contribution more visible, offer economic opportunities such as low start up and production cost. It also support health of organic agricultural workers due to prohibition of synthetic chemicals and thus their ability to participate in income generating activities is not compromised. Among several benefits of organic agriculture emphasis on gender equity is one important aspect which makes it unique as it is believe to empower women (Subrahmanyeswari and Chander, 2010). Organic agriculture may have positive effects on the income of women, who make up a large sharing of small holding farms, particularly in sub- Saharan Africa and Asia (ESCAP, 2003).

The attempt to increase food production in the country has brought about the expansion of farmlands as well as increase in the use of agro chemicals by the farmers but its long term effect does not support sustainable agriculture. In an effort to ensure high production of agricultural produce at sustainable level, the second national conference on organic agriculture was held in Nigeria, under the regulation of International Federation of Organic Agriculture Movement (IFOAM) where male and female participants were charged with responsibilities of making agriculture works in Nigeria (IFOAM, 2007). This study therefore aimed to assess the level of gender involvement in ecological organic crop farming.

Materials and Methods

The study was carried out in Ogun state, Nigeria. Ogun state is located in southwestern part of Nigeria. It covers an area approximately 16,762 square kilometers. It lies between latitude 6.2^0N and 7.8^0N. It borders with Lagos state and the Atlantic Ocean to the south, Ondo state to the east, and in the north is Oyo and Osun states. It also shares an international border with Republic of Benin to the west It has the population 3, 751, 40 (NPC, 2006). Agriculture is one of the major occupations of the people. Purposive sampling technique was used to select two local government areas namely Abeokuta north and Yewa south local government areas given the fact that the dwellers in these areas are involved in organic crop farming agriculture. Simple random sampling was used to select 5% male farmers and 5% female farmers of the one thousand two hundred (1200) registered organic farmers in the study area, to give a sample size of 60 male farmers and 60 female farmers to give a total sample size of 120 respondents. The data was obtained through the use of interview schedule and were analyzed using descriptive and inferential statistics

Results and Discussion

The result on table 1 shows that 62% of the male farmers and 38% of the female farmers were between the age35-45 years. This implies that the respondents were in their active age. Majority (96% females and 95% males) were married, 84% of the female and 72% of the male farmers had no education, 85% of the female farmers and 70% male farmers had small farm size, while 65% of the male farmers and 70% of the female farmers had farming experience between 5-10 years. Cassava crop is the most cultivated crops (43%) by male farmers while the female farmers cultivate vegetable crops (48%) most.

Table 3 shows that Male farmers (56%) were involved in land clearing activities while 51% of female farmers were involved in processing activities. This implies that clearing of land activities is tedious for the female farmers. The result from table 4 shows that both male (65%) had high level of knowledge while the female respondents had low level of knowledge. This implies that only the male respondents were knowledgeable than their female respondents. Table 5 shows that the male farmers (65%) were more involved in ecological organic crop farming than their female farmers (45%) that were involved in ecological organic crop farming.

The result of analysis on table 6 reveals that there is a significant relationship between knowledge and their level of involvement in ecological organic crop farming. This implies that knowledge had great impact on their level involvement in ecological organic crop farming. This is according to the findings of Oyesola and Obabire (2011) that that having good knowledge of organic farming could influence high level of involvement of farmers in organic farming.

Table 1. **Distribution of respondents on their socio-economic characteristics (n= 120)**

Socio-economic characteristics	**Male**		**Female**	
	F	**%**	**F**	**%**
Age				
35- 45	37	62	23	38
46- 56	12	20	19	32
57- 67	6	10	10	17
>68	5	8	8	13
Total	**60**	**100**	**60**	**100**
Marital status				
Married	57	95	58	98
Single	1	1	1	1
Widow	2	4	1	1
Total	**60**	**100**	**60**	**100**
Education				
None	43	72	51	84
Primary	12	20	6	10
Secondary	3	5	2	4
Tertiary	2	3	1	2
Total	**60**	**100**	**60**	**100**
Farm size				
Small	42	70	51	85
Medium	13	22	7	12
Large	5	8	2	3
Total	**60**	**100**	**60**	**100**
Farming experience				
5 -10 years	39	65	38	63
11- 20years	13	21	12	20
< 30years	8	14	10	17
Total	**60**	**100**	**60**	**100**
Types of crops cultivated				
Cassava	25	43	8	14
Maize	18	32	13	23
Yam	7	12	6	11
Vegetables	5	8	27	48
Fruits	2	2	2	2
Plantain	1	1	1	1
Melon	2	2	3	3
Others				
Total	**60**	**100**	**60**	**100**

Table 2. **Distribution of respondents on involvement of crop production activities by gender**

Activities	Male		Female	
	F	%	F	%
Land clearing	33	56	3	5
Land preparation	12	21	4	7
Planting	3	5	6	10
Weeding	2	3	3	5
Harvesting	7	12	5	8
Processing	1	1	31	51
Marketing	2	2	8	14
Total	**60**	**100**	60	**100**

Table 3. **Distribution of respondents on their level of knowledge on ecological crop organic agriculture**

Scores	Male		Female		Minimum score	Maximum score	Mean
	F	%	F	%			
Low (< 9.4)		30		77	3	22	9.4
High (> 9.4)		70		23			
Total		**100**		**100**			

Table 4. **Distribution of respondents by level of Involvement in ecological crop organic agriculture**

Scores	Male		Female		Minimum	Maximum	Mean
	F	%	F	%			
Low (< 15.2)		35		45	3	22	15.2
High (> 15.2)		65		55			
Total		100		100			

Table 5. **Relationship between knowledge and gender involvement in ecological crop organic agriculture**

Variable	r- value	p- value	Remark	Decision
Knowledge	0.472	0.000	Significant	Reject

Conclusion

It can therefore be concluded that the level of knowledge of female farmers in ecological organic crop farming is low and this brings about their low level of involvement in ecological organic crop farming. This study recommends that extension agents should create awareness on the health, environmental and ecological benefits of organic agriculture over conventional farming.

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Awareness of Ecological Organic Agriculture in Nigeria Case Study of Edo State, Nigeria

ADEWOYIN O.B
Federal University of Oye Ekiti, Department of Crop Science and Horticulture, Oye Ekiti.
Corresponding Author: yinkadewoyin@gmail.com

Keywords: Ecological Organic agriculture, crop farmers, awareness, Nigeria.

Abstract

Ecological Organic Agriculture is a production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is relies on a minimal use off-farm inputs and management practices, to restore, maintain or enhance ecological harmony. The primary reason for organic agriculture is the need to optimise the health and productivity of interdependent communities of soil, plant, animal and people. Survey was conducted on the awareness of organic agriculture in Edo State, Nigeria to examine the level of awareness of ecological organic agriculture among crop farmers by the use of structured questionnaires. Three hundred(300) respondents were randomly selected from five(5) local governments and (3) three communities. Data were analysed using frequency distribution and percentages. The results revealed that most of the farmers were married and between ages 21 and 30 years with majority having household size of 3 to 5 dependants and post primary school education. Farming activities were carried out manually without financial assistance from government. Most respondents (77%) were informed about ecological organic agriculture through internet and friends; most of the farmers (24%) do not apply synthetic fertilizer. The research also revealed that ecological organic agriculture produce has high level of market attraction and brings good financial returns. The evaluation of respondents' perception of organic agriculture revealed strong agreement in the beneficial effect of ecological organic agriculture on the health of man and its environment. Based on the research, it is therefore recommended that there is need for government intervention on the adoption of ecological organic agriculture through NGO's, private organization and international organization for proper growth and development and to ensure environmental sustainability with a global partnership for development.

Introduction

Organic farming originated from England from the theories developed by Albert Howard in his Agricultural Testament in 1940. By the end of 1970s, organic farming came to the forefront in response to the emerging awareness of environmental conservation issues (Ojeniyi, 2000). It is an ecological production management system that promotes and enhances biodiversity and soil biological activity. It is based on minimal use of off-farm inputs and on management practices to restore, maintain or enhance ecological harmony (Abdullahi and Kutama, 2012).Organic farming took off, when production method continued to develop along with consumer's interest in almost all parts of the world. At the same time the public were gradually recognizing organic farming, as research topics and adopting its legislation. Until 2004, there was no known organic agriculture network in Nigeria. In the same year, an interdisciplinary team under the aegis of Organic Agricultural Projects in Tertiary Institution of Nigeria (OAPTIN) began a process of converging national conference that held in 2005 at the University of Agriculture, Abeokuta where stakeholders in organic agriculture adopted the project name and discussed the way forward. To further strengthen the impact of various organic groups, the Nigerian Organic Agricultural Network (NOAN) was formed which was supported by the International Federation of Organic Agriculture Movement (IFOAM). OAPTIN has successfully trained 23 agriculture graduates under the Work, Learn and Earn Project (WLEP), 4 senior agricultural development programme staff, 9 university teachers and practicing farmers in advanced courses on organic agriculture in collaboration with foreign partners. Organic agriculture movement is in its infancy in Nigeria, compared to other countries in Africa like Kenya, Uganda and Ghana where organic development started in the last 10-15 years. Organic farming could increase more farming jobs by more than 20%(Kutama *et al*, 2013). It can therefore be stated that in Nigeria, organic farming increases access to food on several levels. First, increased quantity of food produced per farm, leads to household food security. Second, the production and selling of food surpluses at local markets means farmers can benefit from higher incomes, which increases their purchasing power. Third, fresh organic produce becomes available to more people in the community. Finally, organic farming enables new and different groups in a community to get involved in agricultural production and trade where previously they were excluded for financial or cultural reason. Objective of the study is to determine the awareness of ecological organic agriculture among crop farmers in Edo State, Nigeria.

Methodology

Edo State, Nigeria lies between longitude 6^0 4'E and 6^0 43' E and latitude 50^0 44' N and 7^0 34'N. Edo State has a tropical climate characterised by two distinct seasons: wet and dry seasons. The temperature ranges between 25^0C to 28^0C. The main crop grown in Edo State are rubber, oil palm, cocoa, yam, cassava, maize, rice plantain, sugar cane, cashew, groundnut, soya beans, tomatoes, cotton, and tobacco, fruit crops (pineapples, coconut, oranges, avocados) and vegetables. Purposive sampling technique was used to select five (5) local governments out of the eighteen (18) local government. These are Oredo, Ikpoba-Okha, Orhiomwon, Egor, Ovia South local government areas. Purposive sampling techniques were also used to select twenty respondents from three (3) communities each from the five (5) local governments making a total of three hundred (300) crop farmers for the study. Questionnaires was used to collect primary data from the respondents which were later subjected to statistical analysis using percentages.

Results and Discussion

Majority of the respondents were within the age range of 21-30 years. This implied that most of the respondents are within the most active age to adopt new innovation which can improve the upcoming generation and will enhance sustainability. Most of the respondents had a household size of 3-5 persons. Most of the respondents were married. This implied that respondents were responsible individuals. The results indicated that majority farm manually and are well educated and this will drive them to want to get better in their farm work. The respondents had constraints such as low income, non-availability of labourers and land unavailability. The respondents do not make use of inorganic fertilizer in their farm. The respondents are aware of organic agriculture. The respondents were informed of organic agriculture through Seminars while other through internet and colleagues. Majority of the respondents are into organic vegetable farming. The correlation result on awareness of organic agriculture and socio-economic relationships showed that the relationship between sex and awareness of organic agriculture has a significant *p-value of* 0.015. Also, the correlation between marital status and awareness of organic has a significant *p-value* of 0.006. Finally, educational qualification and the awareness of organic agriculture showed a significant level of 0.002.

Table 1. **Socio economic characteristics (N=282)**

Age	**Frequency**	**Percent (%)**
Below 20yrs	36	12.8
Between 21-30yrs	103	36.5
31-40yrs	8	29.8
41-50	40	14.2
Above 50yrs	19	6.7
Total	**282**	**100**
Household Size	**Frequency**	**Percent (%)**
Less than 3persons	90	31.9
3-5persons	103	36.5
Above 5persons	89	31.6
Total	**282**	**100**
Marital Status	**Frequency**	**Percent (%)**
Single	114	40.4
Married	148	52.5
Divorced	4	1.4
Separated	5	1.8
Widowed	11	3.9
Total	**282**	**100**
Educational qualification	**Frequency**	**Percent (%)**
No formal Education	8	2.9
Primary Education	15	5.3
Secondary Education	44	5.6
Post Secondary Education	180	63.8
Others	35	12.4
Total	**282**	**100**

Table 2. **Distribution of Respondents Based on Method of Farm Operation (N=282)**

Method of farm operation	Frequency	Percent %
Manual	200	70.9
Semi mechanized	82	29
Total	**282**	**100**
Inorganic fertilizer used	**Frequency**	**Percentage (%)**
None	214	75.9
NPK	67	23.8
Phosphate	1	0.3
Total	**282**	**100**
Areas of Specialization	**Frequency**	**Percent (%)**
Vegetable farming	60	21.3
Arable crop farming	85	30.1
Livestock production	56	19.9
Cash crop production	37	13.1
Others	44	15.6
Total	**282**	**100**

Table 3. **Distribution of Respondents Based on the Awareness of Organic Agriculture (N=282)**

Awareness of organic agriculture	Frequency	Percentage
Yes	216	76.6
No	66	23.4
Total	**282**	**100**
Source of Awareness of organic agriculture	**Frequency**	**Percentage**
Through a friend	47	16.7
Through seminar	117	41.5
Through Mass Media	45	16
Through others (Internet, Colleague)	73	25.9
Total	**282**	**100**
Challenges of using organic Agriculture	**Frequency**	**Percent (%)**
No Financial	217	77
No Land availability	34	12.1
Non-availability of labourers	13	4.6
Soil quality is affected	18	6.4
Total	**282**	**100**

Table 4. **Perception of Respondent about Organic Agriculture (N=282)**

Statement	(4) Strongly Disagree	(3) Disagree	(2) Neutral	(1) Strongly Agree	MEAN
(1) organic product are farm product without chemical	23 (8.2)	32 (11.3)	87(30.9)	140(49.6)	1.78
(2) organic food contain more nutrients	13 (4.6)	13 (4.6)	110(39.0)	146(51.8)	1.24
(3) organic farm is good for the environment	7 (2.5)	26 (9.2)	105(37.2)	144 (51.1)	1.77
(4) market demand for organic food	14 (5.0)	18 (6.4)	110(39.0)	140 (49.6)	1.67

Table 5. **Correlation Result of Awareness of Organic Agriculture and Socio – economic Characteristics (N=282)**

Relationship	**R-value**	**P-value**	**Significance**	**Decision**
Sex Vs Awareness of Agriculture	0.148	0.015	S	Accept H_0
Marital Status Vs Awareness	0.167	0.006	S	Accept H_0
Educational qualification Vs Awareness	0.197	0.002	S	Accept H_0
H/size Vs Awareness	0.043	0.488	NS	Reject H_0

Significant @ 0.05 levels

Conclusion

The research showed that over 76 percent of the respondents were aware of ecological organic agriculture. Most farmers who are aware of organic fertilizer had financial constraints. In order to improve the awareness of ecological organic agriculture in Nigeria, there is need to include ecological organic agriculture education in our secondary school curriculum. Its inclusion in the universities should be boosted by research and government funding. On the level of rural farmers, extension services should be enhanced and equipped to inform farmers on ecological organic agriculture. Capacity building and training by government, research institutions, national and international organization for farmers should be encouraged. The recent endorsement of support for ecological organic agriculture by African Union and subsequent developing framework and strategies for organic farming should be implemented on states and local government levels and also backed up with favourable policies. In line with this, government should provide or encourage the production of organic inputs such as bio-fertilizer and bio-pesticides at subsidised rates and create certification agency that would promote certification of farms and marketing of organic foods internally and externally. There should be organised standard sales outlets for organic products to bring producers closer to potential buyers and consumers should be well informed on the health values of organic through advertisement and other means. Regulations and quality control measures should be developed and strictly followed to conform to international standards to attract foreign trade.

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Promotion of Ecological Organic Agriculture (EOA) Principles and Practices through Dissemination of Organic Research Outputs: Case Study Southwest Nigeria

YEKINNI, O. T., L. A. ADESIYAN AND P. OLANREWAJU
Department of Agricultural Extension and Rural Development,
University of Ibadan, Ibadan, Nigeria
Corresponding Author: taofeeqyekinni@gmail.com

Keywords: *Research, Dissemination, Ecological Organic Agriculture, Promotion*

Abstract

Research is one of the most important tools for the furtherance of development and promotion of organic food and farming. This study was conceived to assess how the research dissemination efforts promoted Ecological Organic Agriculture (EOA). The study investigated the research outputs on ecological organic agriculture and its dissemination to farmers in Southwest Nigeria. Multistage sampling procedure was used to select 86 research scientists from universities and research institutes in Ogun, Oyo and Ekiti states. Data were obtained and analysed using frequency counts, percentage and Pearsons Product Moment Correlations (PPMC). Results revealed that 52.2% of the respondents were between age 36 and 45years, 79.1% were male,55.9% held masters degree and majority (56.0%) had between 1 and 10 years of work experience. Most of the research findings were published ($\bar{x}$=6.0) in journals and disseminated ($\bar{x}$=452.36) to farmers through seminar/workshop. Significant correlation existed between organic research published and dissemination to farmers ($r=0.21$; $p \leq 0.05$). Substantial research activities were carried out to enhance the promotion of EOA in the study area and the major channel of dissemination of findings to the end users (farmers) is seminar/workshops.

Introduction

Scientific research should be the main driving forces behind the endeavours to find solutions to the key problems facing society; to develop innovations, to ensure growth, productivity and competitiveness of agricultural enterprises. Agricultural research and technological development are and will continue to be prerequisites for increasing agricultural productivity and generating income for farmers and the rural work force as opined by Adeoye (2005). However, the broader benefits of organic farming and agro-ecology (in terms of enhancing food security, environmental sustainability, social inclusion and reducing exposure to toxic pesticides) often go unrecognised or are simply ignored due to lack of enough research evidences, technology development and dissemination of available technology (IFOAM, 2006).

Organisation for Economic Co-operation and Development (2001) reported that *technology adoption* is affected by the development, dissemination and application of research information at the farm level about existing and new biological, chemical and mechanical techniques, all of which are encompassed in farm capital and other inputs. It is also affected by education, training, advice and information which form the basis of farmers' knowledge and experiences. Oladele (2011) observed that adequate agricultural information about new innovations, which tends to help inform farmer's decision-making regarding land, labour, livestock, capital and management. Recent increase in agricultural research outputs from Nigeria research institutes has led to a large pool of new agricultural technologies, which are yet to be utilised by farmers (Oladele, 2006). Aina and Mooko (2007) pointed out that most of these technologies do not reach the farmer's field because the medium for dissemination are not effective in West Africa and Nigeria in particular.

Recent study on selected Nigerian research institutes revealed that, the scientists have high knowledge on EOA and favourable perception to promoting organic agriculture as measure to climate change effects and increase farmers' income through sustainable practices (Olanrewaju, 2011). This finding shows the potentials of scientists to develop technologies that could be disseminated to farmers who are willing to be involved in organic agriculture production. Despite this increase in research activities on EOA, especially in Nigerian research institutes and universities, it is pertinent to find out the extent to which the research outputs have been disseminated to farmers.

The objective of the study is to ascertain the dissemination research findings on organic agriculture to farmers in Southwest Nigeria. The specific objectives are to:

1. Describe personal characteristics of the respondent in the study area,
2. Ascertain number of published research outputs on EOA,
3. Determine the numbers of farmers reached with the published research outcomes.

The study hypothesised that there is no significant correlation between organic research findings publications and dissemination of findings to farmers.

Materials and Methods

Area of Study

The study was carried out in south-western Nigeria comprising of Lagos, Ogun, Oyo, Osun, Ondo and Ekiti states. The respondents of the study were selected using multistage sampling procedure. Fifty percent of the states (Oyo, Ogun and Ondo) were selected using random sampling technique, which gave rise to a sample size of 100 respondents. Questionnaire and In-depth Interview were used as the research instrument for the study to elicit information on scientists' personal characteristic, area of research, innovation developed, dissemination strategies, and constraints to disseminations vis-à-vis the level of utilization among farmers. Data collected were analysed using descriptive statistics such as frequencies, percentages and mean, while inferential statistics such as PPMC to test for relationship between the variables in the stated hypotheses of the study.

Personal characteristics of the researchers

The result shows that 52.5% of the researchers are between the ages of 36 and 45 years. This implies that middle aged researchers were more in the study area. This suggests reasonable years of experience and vigour by the young persons in their activities. Harnessing these potentials of future looking young scientists for ecological organic agriculture research would enhance sustainability of the ecosystem.

Result also shows that majority (79.1%) of the respondents were male. This shows that males are involved in research more than females in the study area. The result shows that majority (55.9%) of the respondents had Masters degrees, 39.5% had Ph.D., 2.3% had M.Phil. while 2.4% had below masters degree. This implies that most of the research personnel had substantial resource endowment. This is an indication of a viable potential for possible meaningful innovation development for promoting ecological organic agriculture in the study area, provided such becomes research focus. This finding is in line with that of Olanrewaju (2011) who found that human resources endowment is in abundance in Nigeria research institutes as well as tertiary institutions.

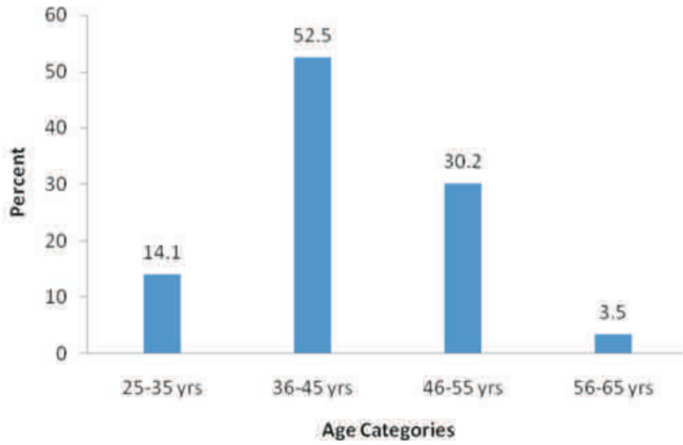

Figure 1: **Distribution of respondents by age**

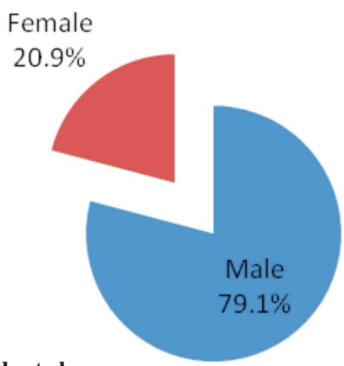

Figure 2: **Distribution of respondents by sex**

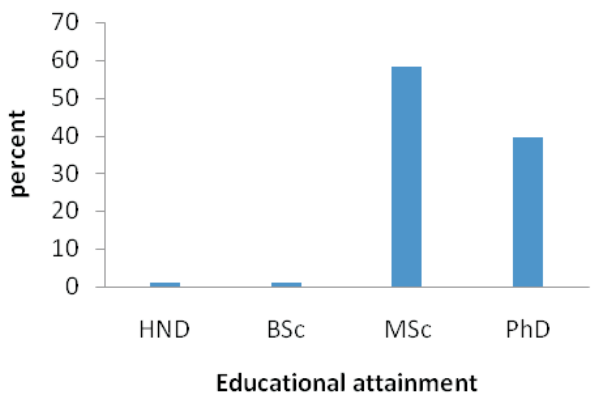

Figure 3: **Distribution of respondents by educational attainments**

Years of experience: The distribution of the respondents' year of experience is such that majority (56.0%) of the respondents had between 1 and 10 years of experience in research, 33.7% of them had between 11 and 20 years of experience, 5.9% had between 21 and 30 years of experience, with a mean of 11.2±8.2 years, this implies that the researchers that substantial years of experience, which is expected to be an advantage for the research and promotion of EOA in the study area.

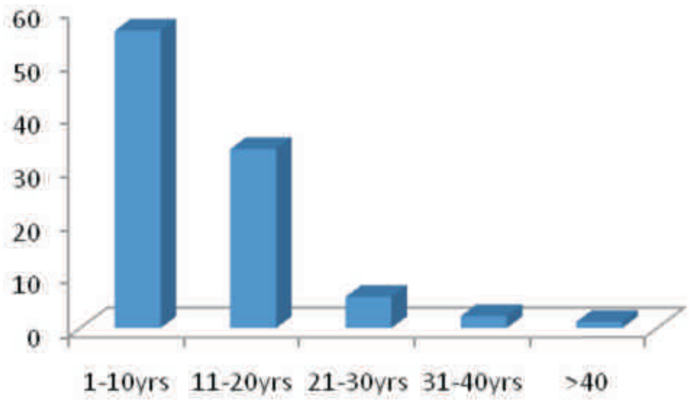

Figure 4: **Distribution of respondents by years of experience**

Publications on Organic Agriculture

Table 1 shows that most of the respondents published their organic agriculture researches findings in journals ($\bar{x}$ =6.0), followed by proceedings ($\bar{x}$ =1.9) and technical reports (0.9). This implies that most results or findings of the researches on organic agriculture are yet to be published, which may have negative implication on the promotion of organic agriculture. Farmers' access to the technologies developed from the research findings would therefore be limited and may be a waste of effort if not disseminated to them through other channels of disseminating research findings.

Table 1. **Distribution of respondents' publications on organic agriculture**

SN	Publications	Mean	Standard deviation
1	Journal	6.0465	13.69492 1
2.	Proceedings	1.9651	3.12277 2
3.	Technical Reports	0.9186	2.09882 3

Source: Field Survey, 2014

Number of Farmers Reached through Dissemination Strategies

Results on Table 2 shows that seminar/workshop strategy was used to reach an average of 452.36 farmers; radio was used to reach 363.35, television 215.12, handbill 141.90, demonstration 80.10 and extension agent 60.19 farmers. Others are video, with which 12.74 were reached, training 6.10 and one on one strategy 0.63. This implies that most of the research findings on EOA are presented to farmers at seminars/workshops. This should be taken to higher levels involving extension agents, field demonstration and training of trainers among farmers.

Table 2. **Distribution number of farmers reached by strategies**

SN	**Strategies**	**Mean**	**Rank**
1.	Seminar/workshop	452.36	1
2.	Radio	363.35	2
3.	Television	215.12	3
4.	Handbill	141.90	4
5.	Demonstration	80.10	5
6.	Extension Agent	60.19	6
7.	Video show	12.74	7
8.	Interview Session	2.81	8
9.	Training	6.978	9
10.	One by one	0.63	10

Source: Field survey, 2014, *multiple responses*

The study also established that significant relationship existed between organic research publication and dissemination of findings to farmers. This implies that the more the researchers published their findings on organic practices, the more they would disseminate the findings among the farmers. This implied that the researchers are committed to disseminating their research findings, which is a good development that would encourage the promotion of the EOA initiative in the study area.

Table 3. **Pearson product of Moment Correlation (PPMC) analysis on relationship between organic research findings publication and dissemination of findings to farmers**

Variables	r-values	p-values	Decision
Publications	0.206	0.057	Significant

Correlation is significant at 0.05 levels
Source: Field Survey, 2014

In conclusion, human potentials, research outputs to enhance promotion of EOA is high in the study area and major channel of dissemination of findings to farmers is seminar/workshops. Thus, for effective dissemination of research findings on organic agriculture practices, other media of dissemination such as demonstration, training and radio should be given more attention for rapid promotion of organic agriculture principles and practices in Nigeria.

Acknowledgement

We like to acknowledge the Swiss Development Corporation that made fund available through Biovision African Trust for the execution of the research under the University of Ibadan organic agriculture research team.

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Assessment of Awareness and Knowledge of Ecological Organic Agriculture in Southwest Nigeria

YEKINNI, O. T.
Department of Agricultural Extension and Rural Development,
University of Ibadan, Ibadan, Nigeria
Corresponding Author: taofeeqyekinni@gmail.com

Keywords: Awareness, knowledge and involvement in EOA activities.

Abstract

Organic agriculture is a production management system that promotes and enhances agro-ecosystem health; including biodiversity, biological cycles, and soil biological activity. Organic farming is labour and knowledge-intensive whereas conventional farming is capital-intensive, requiring more energy and manufactured inputs. Therefore, information about organic farming has to be made available to encourage practitioners in this sector of agriculture. The study was carried out in south-western Nigeria consists of Lagos, Ogun, Oyo, Osun, Ondo and Ekiti states. Multistage sampling procedure was used to select 320 respondents for the study. Questionnaire was used as the research instrument for the study to elicit data from the respondents. Data collected were analysed using descriptive statistics such as frequencies, percentages and mean, while inferential statistics such as Pearsons Product Moment Correlations (PPMC) to test for relationship between the variables in the stated hypotheses of the study. Result showed that 53.1% of the respondents are within the category of high level of awareness of EOA in the study area, 53.1% of them were in the category of high level involvement in organic agriculture practices, 53.1% had a high level of knowledge of organic agriculture while 60.6% of the respondents had unfavourable perceptions towards the EOA activities. The study established that opinions of the practitioners significantly (r=0.136) influenced their involvement in the EOA activities. Favourable opinion about ecological organic agriculture activities led to significant involvement in the activities.

Introduction

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health; including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. It is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

The issue of organic agriculture is thus knowledge oriented, which has its own principles and procedure, about which most people are oblivious. The definition and appropriate conceptualisation of Ecological Organic Agriculture (EOA) is very important in order to facilitate dissemination of appropriate information to new entrants into the practices. The organic food and farming sector is very dynamic, it is showing rapid growth and constant development, both of which need to be supported by new technologies. Research needs depend upon the evolution of the sector and in particular upon factors like diversification of production, new marketing possibilities and also changes in and/or updating of relevant legislations (European Commission, 2012). According to Halberg (2006), organic farming is labour and knowledge-intensive whereas conventional farming is capital-intensive, requiring more energy and manufactured inputs. Therefore, information about organic farming has to be made available to encourage practitioners in this sector of agriculture. Generally, basic information on organic agriculture is lacking in Nigeria while information about organic production techniques are also lacking among farmers.

In order to promote and engender ecological organic agriculture practices in Nigeria, detailed and comprehensive information of the current state of knowledge and information need about ecological organic agriculture practices will be necessary. Given the foregoing, the study proposed to assess the level of awareness and knowledge of farmers about ecological organic agriculture in south-west Nigeria. Specifically, the study is to:

– ascertain farmers' level of awareness of ecological organic agriculture
– find out the extent of involvement in EOA activities in the area
– determine the farmers' knowledge on ecological organic agriculture
– find out the opinions of farmers about ecological organic agriculture

The study hypothesised that there is no significant relationship between the knowledge of farmers about EOA activities and their perceptions of organic agriculture in the study area.

Materials and Methods

The study area is south-western Nigeria consists of Lagos, Ogun, Oyo, Osun, Ondo and Ekiti states. Organic agriculture farmers constitute the population for the study. Multistage sampling procedure was used to select the respondents for the study. Fifty percent of the states (Oyo, Ogun and Osun) were selected using random sampling technique. In each of selected states 20% of the organic agriculture groups were selected. Thereafter, 10% of the members of each of the selected groups were selected; this gave rise to a sample size of 320 respondents.

Questionnaire was used as the research instrument for the study; it was however administered as interview schedule to illiterate respondents. Data collected were analysed using descriptive statistics such as frequencies, percentages and mean, while inferential statistics such as PPMC to test for relationship between the variables in the stated hypotheses of the study.

Results

Awareness of EOA

The result of the study about awareness of EOA revealed that 53.1% of the respondents are within the category of high level of awareness of EOA in the study area. The implication of this finding is that awareness of the farmers in the region will lead to involvement in ecological organic agriculture production with the attendant benefits; ecological benefits, health, environmental, as well as the potentials at increasing the level of income of the farmers in the study area.

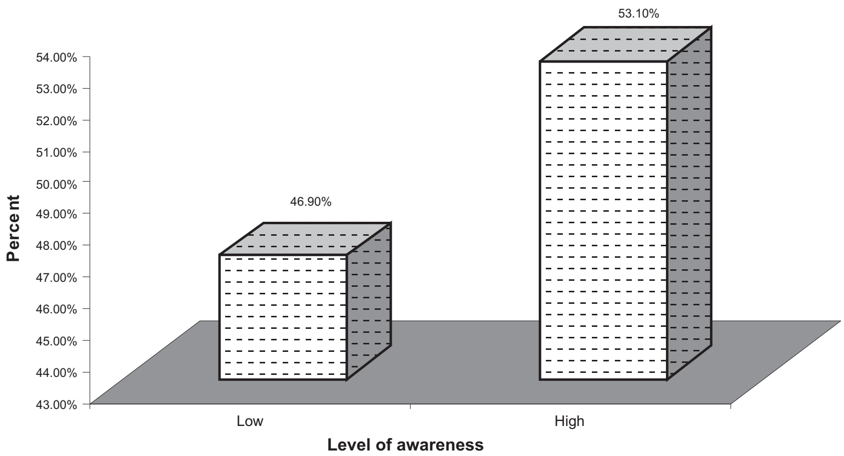

Figure 1. **Distribution of respondents by level of awareness of EOA**

Involvement in EOA

The study assessed the involvement of farmers in ecological organic agriculture activities; this is as regards extent of use of the various EOA innovations. Results on Figure 2 showed that more than half 53.1% of the respondents were in the category of high level involvement in organic agriculture practices, while 46.9% are in the low level category. This finding is encouraging despite the generally unfavourable opinions about the activities. This level of achievement can only be explained by the promotion activities, which has raised awareness substantially among the farmers.

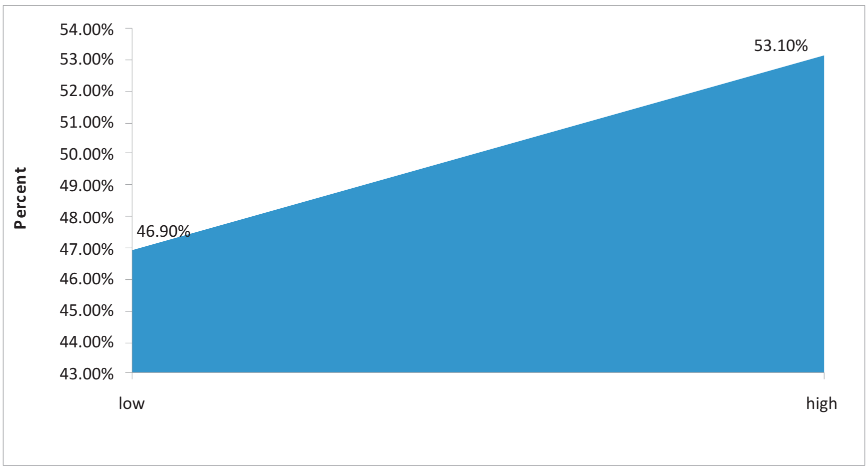

Figure 2 : **Distribution of respondents by level of involvement in EOA**

Level of knowledge of EOA

The results of the survey reveals that majority (53.1%) of the respondents had a high level of knowledge of organic agriculture. This result is not surprising, as it agrees with the earlier findings where majority of respondents were aware of organic agriculture practices, as well as more than half in high level in terms of use of EOA innovations.

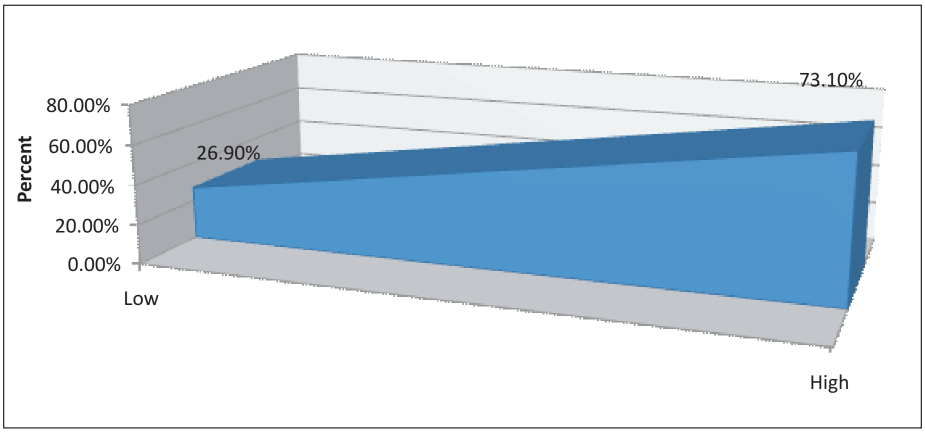

Figure 2. **Distribution of respondents by level of knowledge on EOA**

Farmers' opinion about EOA

The study gauged the opinions of farmers about EOA practices; results from the survey revealed that 60.6% of the respondents had unfavourable perceptions towards it, while only 39.4% had favourable opinion towards the concept. This finding is not strange given the fact that the essence of the concept is yet to be appreciated generally, even among the elites in the society. The public opinion about it is not expected to be different from the opinion of the farmers about it, given the fact that public appreciation of the concept will definitely influence their opinions about it. This will influence their perceptions of ecological organic agriculture as well their adoption of its practices.

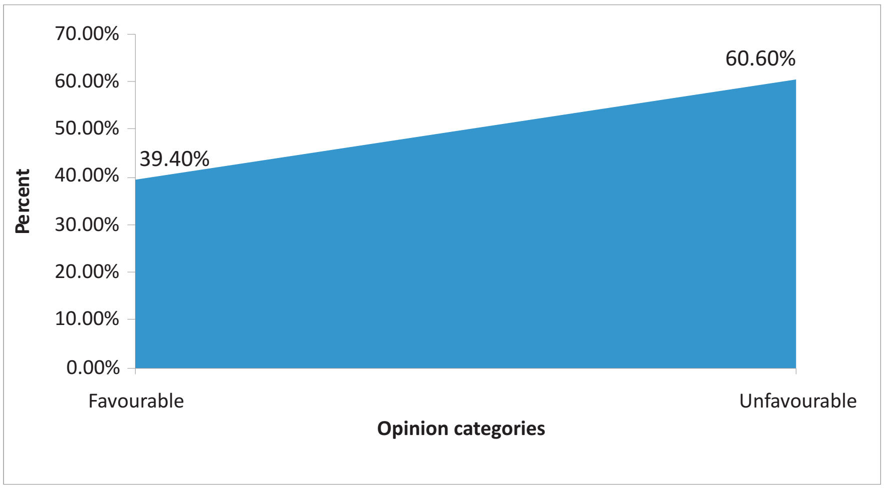

Figure 3. **Distribution of respondents by opinions on EOA**

Relationship between perceptions and of EOA

The study sought to establish relationship between opinions about EOA practices and extent of involvement in the activities. This is with the aim of ascertaining the extent to which the opinions of the practitioners influenced their involvements in the EOA practices. The result of the PPMC analysis in

Table 1 shows that opinions of the practitioners significantly (r=0.136) influenced their involvement in the EOA activities. This means that those who had favourable opinion about EOA are substantially involved in the activities. Though the relationship is statistically significantly, low (13.6%) strength of relationship implied that there are practitioners who still had unfavourable opinion about the concept, which as explained earlier, stemmed from the general opinion about ecological organic agriculture among the people generally in the society.

The picture depicted by significant relationship between opinions and involvement in EOA practices fulfilled the *a priori* expectation that it is those who have favourable opinion about an issue that would be involved in it. The finding was equally supported by other studies that established significant relationship between attitude and adoption of organic agriculture innovations (Rezvanfar*et al*, 2011 and Malek-Saeidi *et al*, 2012).

Table 1. **PPMC for test of relationship between opinions and involvement in EOA practices**

Variables	r-value	p-value
Involvement in EOA activities vs. Perceptions on EOA	0.136*	0.015

* Correlation is significant at the 0.05 level (2-tailed).

Conclusions

Favourable opinion about ecological organic agriculture activities led to significant involvement in the activities. There must be conscious efforts at promoting opinions about organic agriculture to the larger society in order to ensure its acceptance by the people and profitability by the practitioners.

Acknowledgements

The study acknowledged the funding by Swedish Society for Nature Conservation -SSNC) through the Biovision Africa Trust and the Nigerian Organic Agriculture Network (NOAN). The contribution and efforts of the project country coordinator, Dr O. O. AdeOluwa, his genuine concerns and effective monitoring are duly acknowledged.

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The Potential of Ecological Farming in Delivering Social and Economic Development to Small Holder Farming Families: The Rwenzori Experience

THADDEO TIBASIIMA, AAGE DISSING, INGE LIS DISSING, JANE NALUNGA,
ELLINOR ISGREN AND LONGINO MASEREKA
SATNET P.O BOX 884 Fortportal, Njara Hill Road, Uganda.
Corresponding Authors: tadsima2000@yahoo.com, fasanvej11@gmail.com,
jnalunga@nogamu.org.ug, ellinor.isgen@lucsus.lu.se,
longinom70@gmail.com

Keywords: Farmer family learning, Traditional, Ecological, Social responsibility, Cohesion.

Abstract

The benefits of ecological/organic farming alternatives are innumerable compared to the requirements for attaining such a valuable production system. The ecological farming alternatives have been easily adopted through the use of participatory community based agricultural farmer extension approaches such as the Farmer Family Learning Groups (FFLGs) in the Rwenzori region. During the five years of the FFLGs in the Rwenzori region, adoption of ecological/organic farming alternatives has fostered the Culture of sharing agro-inputs, Social capital building, Learning and innovation collaborations, Guaranteed trust, Appreciation for indigenous knowledge, Cost cutting along the value chain, Cost effective Seed management systems, Ecological resilience to economic losses, Labor efficiency, Increased production, productivity and associated income rises. Thus, ecological farming alternatives present a strong solution to most constraints that trap majority of the farmers in a vicious cycle of poverty. This paper presents a case for the upscaling and out scaling of ecological/organic farming alternatives.

Introduction

Sustainable Agriculture Trainers' Network (SATNET) in collaboration with National Organic Agriculture Movement of Uganda (NOGAMU) and Organic Denmark (OD) has since 2009 seen the establishment of over 130 ecological FFLGs in the Rwenzori region. An FFLG is a group of 15-30 small holder farmers who come together to improve their livelihoods through ecological farming alternatives. The practical learning is done in rotation such that every farmer's farm is uniquely studied to cater for the variations from one farm to another. In every FFLG, learning is guided by a Community Process Facilitator (CPF). A CPF is someone knowledgeable and experienced in ecological farming and has innovative skills to lead the group into achieving its agreed goals. A typical FFLG therefore is characterized by learning with and from each other the ecological/good traditional farming methods, working on each member's farm as a group, savings and credit schemes, joint marketing of produce and taking communal social responsibility (*Mette et al., 2012*).

The Rwenzori region of Uganda is a mountainous area, highly populated, endowed with relatively naturally fertile alluvial soils that are inherently capable of giving life to a diversity of crops and animals. According to the 2008 baseline survey for the FFLG project, majority of farmers in the Rwenzori use practices that fall between traditional and ecological farming methods by default. This is partly due to

the poor agricultural extension system, low income and the possibility to produce crops and animals without use of external synthetic inputs. Small holder farmers in the Rwenzori region are faced with several challenges such as; vulnerability to emerging pests and diseases, diminishing soil fertility, climate change, reducing available land for agriculture due to population growth, limited technology to handle laborious farm activities and high post harvest losses due to limited value addition.
The general aims and objectives of the FFLG project on which this paper is based are to:-

- Institute an action learning system for transitioning into ecological farming alternatives by farming families of Rwenzori.
- Create a massive advocating voice for ecological small holder farmer friendly policies.
- Organize small holder farmers into joint producer and marketing initiatives to access good markets.

Materials and Methods

Through the project period, the project team comprising the SATNET staff, NOGAMU staff and organic Denmark volunteers conducted monthly mentoring and coaching follow up meetings to the FFLGs. While meeting with FFLGs; individual farmer interviews, focus group discussions, key informants and field observations were carried out. Workshops for community process facilitators' learning and most significant change evaluation processes including external project evaluation were conducted resulting into various project documents. This paper is based on the comprehensive review of the above project documents and verified through field observations and focus group discussions with FFLGs in 2015.

Discussion of findings

Compared to the forms of conventional agriculture in which much effort has been invested in this part of the country, the FFLGs in the Rwenzori region clearly demonstrate the social and economic benefits of agricultural development approaches based on ecological/organic alternatives and strengthening of farmer collaboration. While environmental dimensions form an important motivation behind these efforts, the social and economic benefits explained below are equally important in justifying the FFLG approach and must be made more visible not least given their potential role in convincing other stakeholders of the merits of these efforts as elaborated below:-

Social aspects

Promoting/sustaining the culture of sharing agro-inputs

Ecological/organic farming systems adopted by FFLGs have enabled farmers to share agro-inputs such as compost and seed. Since the price of synthetic fertilizer, pesticides and herbicides is unaffordable especially among the small holder farmers; sharing among conventional farmers is therefore made impossible. The sharing of the locally made agro-inputs in the FFLGs has promoted social cohesion that extends to ensuring that the entire farmer group is utilizing the shared resource appropriately while gaining from the same through increased productivity.

Social capital building

All ecological FFLGs have contributed to the development of their community through making sacrifices such as investing a percentage of their profits in the education of less privileged children, supporting elderly women by cultivating their land, clearing a village access road and maintaining a village water source (Mette et al 2012). Such self-help initiatives have increased the appreciation of the group by the community hence encouraging collaboration and the spirit of self-help initiatives. Socially, this has become a building block for the community social movements to act together to solve their own problems.

Learning and innovation collaborations

Following that organic agriculture is knowledge-intensive; there is need for effective learning and innovation in FFLGs for farmers to convert from traditional farming methods to sustainable ecological methods. Farmers in the FFLGs learn from each others' farm and provide the site specific practical solutions to each farm through the Agro-Ecosystem Analysis of each specific farm under study. Such interaction and encouragement has strengthened farmer groups and stimulates innovation to overcome farming related and general life challenges (Mette et al 2012).

Guaranteed trust

Trust building through the Participatory Guarantee System (PGS) among ecological farmers has enabled joint marketing of produce. PGS being a trust and confidence based approach to product promotion, has built both the social and economic strength of the FFLGs and members through collaborative action and increased incomes associated with going together to the market. According to an external evaluation of the FFLGs in 2013, although over 50% of FFLGs had no PGS, the steps that had been taken enabled over 70% of FFLGs to associate around a similar enterprise for marketing. Consequently the FFLGs have been enabled to generally fetch prices 30% higher than the individual large scale holding conventional farmers marketing their products solely.

Appreciation for indigenous knowledge

Ecological farming builds on the existing indigenous/traditional farming methods hence building the confidence among the farmers to use and own the innovations. In the FFLGs, knowledge has been generated to adapt to climate change effects for example through developing appropriate intercropping patterns, soil and water conservation methods, pest and disease management and splitting planting periods. These indigenous based innovations have been strongly owned and built confidence and cohesion among the small holder farmer families.

Economic aspects

Cost cutting

In all FFLGs, avoidance of costs of synthetic and safety gear that is required in the use of synthetic agricultural inputs has enabled FFLGs to maximize profits(Investing in agriculture innovations 2013). Due to limited investment capital by small holder farmers, there is great need to avoid unnecessary expenditures on external inputs. Small holder farmers in the FFLGs have been able to share labor intensive work e.g. on digging trenches for water and soil Conservation, preparing their own compost and are using natural enemies in the control of pests. Given the life and environmental friendliness of nature based agro-inputs, by their use, the farmer certainly overcomes the unbearable costs associated with the purchase and precaution that must be taken while using synthetic inputs.

Cost effective Seed management systems

Seed security in FFLGs rely on the use of own saved and shared seed. This has enabled avoidance of costly seed yet made possible timely planting that has translated into strengthened socialization among the farmers. As such, FFLGs have overcome the climate change hazards that are more pronounced among conventional farmers who rely on purchased seed that is often delayed and adulterated.

Ecological resilience to economic losses

Ecological farming methods build resilience of farms through diversification that cushions climate change disruptions. The diversified farming in FFLGs comes with various ecological benefits such as soil fertility improvement, reducing input costs through for example serving crop residue to feed livestock during drought; trees providing shade to livestock during hot sun and in case of failure of one enterprise; the farmer is able to reap from another enterprise.

Increased production, productivity and associated income rises

An evaluation conducted five years after initiation of the FFLGs indicates that over 3255 farming families registered increased produce and productivity on their farms by over 40% for each enterprise resulting into average 25% income increase per household. This according to the evaluation report is associated with the enhanced soil fertility, use of better farming methods and cultivation of more than one crop on a unit of land and other factors of production. The double benefit of increased production and productivity reciprocating into food and income security is attributed to none other than the adoption of ecological farming alternatives in the FFLGs.

Labor efficiency

As a result of increased collaboration among farmers in the FFLGs, farmers work together and produce more work than when working individually. This reduces the cost of labor and enables timely farm operations hence overcoming the loss associated with short rain seasons. According to farmer level and FFLG level records, most FFLGs reported having ably opened up an acre of land in one day by 15 persons as opposed to the 25 days that are required for the same work when done by one individual. This saves a farmer 10 days of work.

Conclusion

Based on the experience in the Rwenzori region, we uphold that there is need for more emphasis to explore and confide in ecological farming alternatives at both small and large scale farmer levels.

The Farmer Family Learning Groups in the Rwenzori region is a reliable proof of the potential of ecological/organic farming alternatives in enabling attainment of sustainable social and economic development particularly among small holder farmers who form the majority of animal and crop producers world over. Therefore, adoption of the ecological/organic farming alternatives facilitated by practical farmer learning approaches is a reliable strategy for addressing the social and economic constraints that hinder majority of small holder farmers from realizing their full potential.

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Ecological Organic Agriculture Value Chain: Building Capacities on Identified Knowledge Gaps in Southwest Nigeria

AJAYI, A. J.
Department of Crop Production Technology,
Federal College of Agriculture, Akure, Ondo State
Corresponding Author: ajayiaj@yahoo.com

Keywords: Ecological Organic Agriculture, Value chain, Capacity building

Abstract

The lack of knowledge about ecological organic agriculture (EOA) makes many to perceive the shift to organic agriculture practice as risky. Farmers and other actors in the agricultural value chain production need adequate training and practical skills in EOA to enhance their capacity towards ensuring the availability of ecological organic products. Short course training was organized for actors in EOA value chain and the objective of the training focused on enhancing the capacity of actors in EOA value chain to translate the acquired knowledge into production and availability of organic products. A day short course training was organized for selected actors in the EOA value chain at the Federal College of Agriculture, Akure on September 25, 2014. The training was designed to equipped participants with requisite knowledge in EOA value chain. Thirty-two participants were trained in various aspect of organic agriculture such as basic principles in EOA, benefits and opportunity, technical tips on production in organic agriculture, EOA value chain framework and marketing. The training was delivered through lectures, discussion and participation by trainees, interaction and critical analysis of feedbacks and question. Feedback from participants revealed that new knowledge was impacted on the participants towards ensuring availability of organic produce.

Introduction

The ever increasing world population and the need to feed the entire populace resulted in pressure on land resources due to increasing land area under cultivation and intensification of production per unit land area. Massive use of external inputs that increases the cost of production became the order of the day in last few decades due to neglect in management of land resources required to sustain productivity (Ajayi and Bifarin, 2014). However, no respite has come to us in the food production sector with the practice of high input and high energy based production technology. Instead, myriads of challenges such as environmental problem, loss of biodiversity and health problems resulting from consumption of unwholesome products are associated.

In addressing the challenges associated with the conventional agriculture, sustainable farming system that draw on agro-ecology, the science of applying ecological concepts and sustainable management of agro-ecosystem must be adopted. The practice of ecological organic agriculture (EOA) satisfies these conditions of sustainability. EOA ensures sustainable production without jeopardizing the environment with the use of eco-friendly agricultural practices.

In Organic Agriculture eco-functional intensification is achieved by higher inputs of knowledge, observation skills and agro-ecological methods to intensify the beneficial effects of eco-system functions including, biodiversity and soil fertility, minimizing losses from material cycles and utilizing the self regulating mechanisms of biological systems to achieve stable farming systems (IFOAM, 2009). However, the knowledge component of the inputs required for organic agriculture as mentioned by International Federation of Organic Agriculture Movement (IFOAM) has been found inadequate. This knowledge GAP can only be filled through adequate training.

Most of the major players in the food production sectors are either trained or exposed to production system under conventional agriculture. Even our tertiary institutions curriculum for training specialist in agriculture is designed towards the conventional agriculture. Hence, manpower that plays major role in production system is not exposed to basic knowledge in organic agriculture. If this is the situation, there should be no expectation of understanding of the concept among the farmers that are supposed to be trained by these agriculture experts. Even in situations where knowledge of organic agriculture is claimed in Africa, it is often premised on equating organic agriculture with the use of organic fertilizers or claim of organic agriculture by default. This shows the extent of lack of knowledge among the actors in production system. FAO (1998) had reported that much organic knowledge would become common knowledge if the management were to be practiced by many and over several generations, so that the need for a certain kind of information will decrease over time.

In as much as awareness about the consumption of healthy food as proffered by organic concept is important, there is need for availability these wholesome agricultural produce for consumer to access. However, there are lots of knowledge or skill gap, misunderstanding and misinformation about the concept and practices of ecological organic agriculture. Aiyelaagbe *et al.* (2011) had also reported perceived skill gap in organic agriculture.

The lack of knowledge about ecological organic agriculture makes many to perceive the shift to organic agriculture as risky (FAO, 1998). Farmers and other actors in the agricultural value chain production need adequate training and practical skills in EOA to enhance their capacity towards ensuring the availability of ecological organic products. It is therefore imperative that specific and targeted steps be taken to ensure that these actors are trained in order to fill the knowledge gap.

In order to solve the problem of the identified knowledge gap, intervention program targeted at addressing the lack of EOA knowledge among actors through short course or training was put in place by Association of Organic Practitioner of Nigeria (NOAN), through a funding provided by Swiss Development Corporation (SDC) through Biovison African Trust (BvAT) and the course implemented by Federal College of Agriculture, Akure. The objective of the training is to enhance the capacity of actors in EOA value chain to translate the acquired knowledge into production and availability of organic products. The capacity building through short course training for targeted actors in EOA value chains is set out to fill the knowledge gap that exist among the actors of EOA value chain.

Materials and Methods

Training Location

The short course training was carried out in Akure, Ondo State located in the rainforest zone, South-west of Nigeria. Akure is surrounded by mainly agrarian communities in different local government area of the state. Akure was selected as the preferred location for the training based on the knowledge about the spread of NOAN'S activities in Oyo/Osun state region. Several training had been conducted on EOA by NOAN in this zone (training for trainers and farmers). However, various vocational training conducted by the Federal College of Agriculture, Akure in the last two years had revealed lack of knowledge about

EOA among actors in the agriculture value chain in this area. Over 100 individuals were exposed to rudimentary training on EOA through this platform of the college. The choice of this location will help the spread the awareness and adoption of EOA practices. The training was then targeted at actors in the agriculture value chain that has been part of any form of training of EOA implemented on the platform of the Federal College of Agriculture, Akure in order to build on their basic knowledge and to fill the existing knowledge gap.

Selection of Target Audience and Resource Persons

The first step taken to achieve the objective was to determine the composition of the participants and to select the appropriate audience is to train through a one day training program that will build on their previous basic knowledge in organic agriculture through lectures, discussion, and field visit.

Forty (40) targeted actors were selected and invited for the training from the pool of the various groups of vocational trainee on the college platform. This comprised mainly farmers, youths, and women within the catchment area of Ondo State who had previously been exposed to some form of training in one area of organic agriculture or the others that had no such opportunity.

Planned Output

The planned output was to support short course trainings for targeted actors in EOA value chain to build capacities on identified gaps.

Implementation

The short course training was conducted on Thursday, September 25, 2014 at the main auditorium of Federal College of Agriculture, Akure, Ondo State, Nigeria.

Training Session

To achieve the objective of the course, training was designed and implemented through lectures, discussion, questions and answers after each session, critical analysis of feedback and question, interaction and field visit to organic farm at the college.

The subject areas of discussion during the training include:

- Review of basic principles of Ecological Organic Agriculture (EOA), benefits and opportunities
- Technical guide for production in organic agriculture:
- Value chain in organic agriculture

o Sustainable ecological organic agriculture value chain
o Principles of value addition in organic agriculture

- Marketing strategy and development for organic agriculture
- Discussion forum:

o How to ensure production for the market and the sustainability

Attendance and Participation in the Programme

There were thirty two (32) registered participants for the short course training and two representations from the Ecological Organic Agriculture Initiative in Nigeria namely; Mr. Gbadamosi Oyewole who is the project manager for EOA and Dr. Taofeeq Yekinni, the Pillar Implementing Partner for Pillar 1, University of Ibadan Organic Agriculture Research Team.

Evaluation of the Short Course Training
At the end of the training programme, course evaluation was carried out by the research to determine the effectiveness of the training.

Results and Discussion

Short course trainings for targeted actors in EOA value chain to build capacities on identified knowledge gaps was carried out in Akure, Nigeria. The activity is a training intervention programme to build capacity of actors in EOA value chain under pillar 1 activities and was implemented by Federal College of Agriculture, Akure.

Activity: The activity is to train actors in EOA value chain.

Performance/objective verifiable index (OVI): The OVI for this activity is the *number of actors trained*.

Number of actors trained: Thirty two (32)
The actors trained comprise of male and female, youth and adults. In the course of the short course training, thirty two (32) actors were trained through series of lectures, discussion and interaction designed to equip them with adequate knowledge about the basics of ecological organic agriculture, the value chain and marketing strategies in order to ensure eventual translation of knowledge into production and availability of organic produce. The focus of each presentation is as follow:

- Training objectives: this session intimate the participants about the assignment to be accomplished by the training, the objective and the importance of the training. The expected impact of the training and what it should translate into.
- Lecture titled basics of ecological organic agriculture focused on principles of organic agriculture, the features and benefits.
- The lecture on technical tips for organic crop production focused impacting knowledge of good agronomic practices to participants. Also this session addressed the issue of pest control and different strategies required.
- The session on development of sustainable ecological organic value chain framework focused on description and constraints of EOA value chain, the interrelationship of different components. The understanding of this concept will stimulate the interest of all the actors in the agricultural business clusters to develop a formidable framework on ecological organic. New opportunities in the EOA value chain were also identified.
- The lecture on marketing of organic produce explained what an organic produce, the challenges of local market development and strategies of marketing organic.
  Observations in the course of the training revealed that participants were eager to learn and have developed interest in the organic agriculture. During the course of the training, several questions were asked by the participants and the questions were adequately attended to.

Conclusions

The need to adequately train farmers and other actors in the EOA value chain production cannot be overemphasized. Adequate training and practical skills will enhance their capacity towards ensuring the availability of ecological organic products.

Thirty-two participants were trained during a one day short course training program to build their capacity in EOA. The participants were exposed various aspect of EAO including the basic principles in EOA, value addition and marketing.

Feedback from the participants revealed that the training exposed the participants to existing knowledge gap in EOA and the participants were enthusiastic in taking steps and networking towards achieving the set objective of making ecological organic agriculture produce available.

It is suggested that further training be implemented to enhance the capacity of EOA actors through continuous learning using opportunity like field visit. Also, the group actors trained under this short course need to be followed up in order to sustain their motivation.

Acknowledgement

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Influence of Moringa Leaf Extract and Coconut Water as Priming Agent to Improve the Emergence and Early Seedling Growth in Cucumber

OLUWAGBENGA DUNSIN, CHRISTOPHER ABOYEJI, AND GIDEON NAYAN
Department of Crop & Soil Sciences, Landmark University, Omu-Aran, Kwara-State. Nigeria
Corresponding Author: dunsin.oluwagbenga@lmu.edu.ng

Keywords: Cucumber, Moringa leaf extract, Coconut water, Seed priming.

Abstract

Rapid and uniform field emergences are two essential prerequisites to increased yield, quality, and ultimately profits in annual crops production. Priming with plant growth regulators have been widely reported to improve seedling vigor and emergence. This study was conducted to evaluate the possibility of improvement in emergence and early seedling growth in cucumber by treating the seeds of cucumber for 18 hours in aerated solution of FMLE, SMLE and FCW. Priming with plant growth regulator improved the emergence rate and uniformity and early seedling growth. However, seed treatment with FMLE was more effective in reducing the mean emergence time, and improving the final emergence % and emergence energy and number of roots. However, maximum seedling fresh and dry weights, root length were recorded from seed treatment with fresh coconut water. Seed treatment with moringa leaf extract and/or coconut water can be successfully employed to improve the germination and seedling growth in cucumbers.

Abbreviations: FMLE=Fresh moringa leaf extract; SMLE=Stored moringa leaf extract; FCW=Fresh coconut water; MET=Mean emergence time; FEP=Final emergence percentage; EE=Emergence energy.

Introduction

Rapid and uniform field emergences are two essential prerequisites to increased yield, quality, and ultimately profits in annual crops production. Uniformity and percentage of seedling emergence of direct-seed crops have a major impact on the final yield and quality (Wurr and Fellow, 1983). Rate and uniformity of emergence are inherent to seed quality and environmental conditions during seedling emergence. Slow emergence result in smaller plants (Parera and Cantiliffe, 1994) and seedlings.

Seed priming is commonly used to reduce the time between seed sowing and seedling emergence (Parera and Cantliffe, 1994). Evenari (1980) reported that ancient Geek farmers soaked the seed of cucumber in water or milk and honey before sowing to increase germination rate and emergence. Nelson & Govers, (1986) reported delayed and reduced seedling emergence is major setback to achieve uniform and vigorous crop stand in early spring planted cucumber (*Cucumis sativus* L.) Moreover, erratic and non-uniform seedling emergence due to poor seed germination causes non-uniform plant development, thereby extending cucurbit fruit maturation for early markets.

Application of plant growth regulators or nutrients during pre-soaking, priming and other presowingtreatments in many crops have improved seed performance that results in overall plant growth and productivity particularly under adverse conditions, such as temperature extremes or salinity (Afzal *et al.,* 2008).Among different natural sources used extract of plant growth regulators are, *Moringa oleifera* L. is gaining a lot of attraction (Foidl *et al.,* 2001) and Coconut water.

Moringa belongs to family Moringaceae. There are about 13 species of moringa of which *M. oleifera* is most widely grown. The leaves of moringa are rich in zeatin, it can be used as natural source of cytokinin (Fuglie, 1999). Inaddition, moringa leaf is also rich in ascorbates, carotenoids, phenols, potassium and calcium, which have plant growth promoting capabilities and often applied as exogenous plant growth enhancers (Foidl *et al.,* 2001). Antioxidants such asascorbic acid and glutathione, which are found at high concentrations in moringa chloroplasts and other cellular compartments, are crucial for plant defense against oxidative stress (Noctor and Foyer, 1998).

The coconut (*Cocos nucifera* L.) is an important fruit tree in the tropical regions and the fruit can be made into a variety of foods and beverages. The edible part of the coconut fruit (coconut meat and coconut water) is the endosperm tissue. Coconut water (coconut liquid endosperm), with its many applications, is one of the world's most versatile natural product which is consumed worldwide as it is nutritious and beneficial for health. (Jean *et al* 2009). Some of the most significant and useful components in coconut water are cytokinins, (e.g., kinetin and *trans*-zeatin) which are a class of phytohormones (Kende and Zeevaart, 1997.), indole-3-acetic acid (IAA), the primary auxin in plants (Wu and BU, 2009), and other components like sugars, sugar alcohols, lipids, amino acids, nitrogenous compounds, organic acids and enzymes (Santoso et al,1996.), and they play different functional roles in plant and human systems due to their distinct chemical properties.

In view of all these reports, it is hypothesized that priming with leaf extract from moringa and coconut water, having a number of plant growth promoters, mineral nutrients and vitamins in a naturally balanced composition, may promote the plant growth and vigor. Therefore, the aim of this study is to evaluating the influence of pre-sowing Moringa leaf extract and Coconut water seed treatments on germination and early seedling growth of cucumbers.

Materials and Methods

Seed Materials: Seed of cucumber, cv. Nabil, were obtained from Premier Seed Nigeria limited. Zaria Kaduna State. Fresh moringa leaves were collected from a mature moringa tree and juice was extracted by a locally fabricated juice extraction machine following the method of Foidl *etal.* (2001). While fresh coconut was harvested form the mature tree and the water was extracted. Seeds were primed with respective aerated solutions of FMLE, FCW, and SMLE for 18 h. Non-primed seeds were considered as controls. Continuous aeration was provided using small aquarium pump. After each soaking treatment, seeds were dried on filter sheets for 48 hours at room temperature.

Evaluation of vigor: Control and primed seeds were sown in 20×20 cm plastic trays (25 in each) containing moistacid/water washed sand, replicated three times in a growth chamber using a completely randomized design. Numbers of emerged seedlings were recorded daily according to the seedling evaluation of the Association of Official Seed Analysts (1990) until a constant count was achieved. Mean emergence time (MET) was calculated according to the equation of Ellis and Roberts (1981).Energy of emergence (EE) was recorded on the fourth day after sowing. The percentage of emerging seeds 4 d after sowing is relative to the total number of seeds tested (Farooq *et al.,*2006). On the fifteenth day after emergence, seedlings were tested for vigor after being carefully removed from the sand. Number of roots, shoot and root length of five randomly selected seedlings were recorded per replicate and averaged. Seedling fresh weight was determined immediately after harvest; dry weight was taken after drying at 70°C for 7days.Graphical representation of data was made using Microsoft Excel program (Microsoft Corporation, Los Angeles, CA, USA). Standard error was computed using Microsoft Excel programme for comparison of treatments and parallels were drawn between emergence and seedling growth.

Results

All the priming treatments were effective in reducing the mean emergence time (MET), while enhancing final emergence percentage (FEP) percentage and emergence energy (EE) as compared to that of unprimed seeds which had low seed vigor and poor seed performance; (Fig. 1&2). It was noted in this study that seed priming resulted in improved seedling growth as indicated by increased root and shoot length, seedling fresh and dry weight (Fig. 3a & b; 4a & b;).

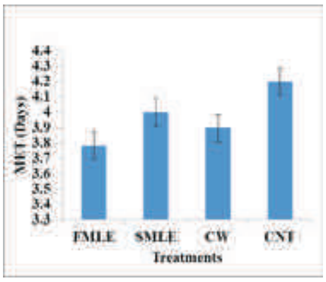
Seed priming can enhance the germination and early seedling growth in cucumber. Priming of cucumber seed with plant growth regulator decreased the emergence time and increased seedling emergence and seedling fresh and dry weight. Seed Priming not only resulted in earlier and more uniform emergence and emergence percentage, energy of emergence was also improved.

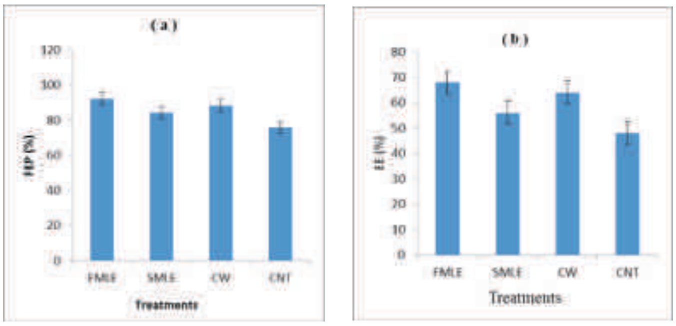
Discussion

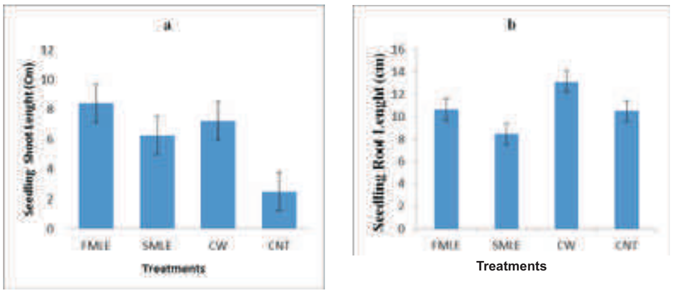
The present study shows that hormonal priming with plant growth regulators can be employed to improve early emergence and seedling growth in cucumber. Emergence rate, root shoot lengths, seedling biomass are all important contributors of seed vigor. Higher emergence rate is the main foundation, which ensures an improvement of overall seedling performance. The results of present study indicated that seed priming with FMLE resulted in earlier emergence, reduced MET and improved the final emergence and emergence energy as compared to FCW and SMLE (Fig. 1& 2). Increase in germination percentage after treatment might be the consequence of higher nutrients and vitamins of FMLE and/or high content of zeatin a natural cytokining found in the leaf of moringa. Seedling vigor was also improved by treating cucumber seeds with plant growth regulator, it was noted that seed priming with fresh coconut water has the highest seedling fresh and dry weights (Fig. 4a & 4b) which might be due to increased cell division within the apical meristem of seedling roots (Fig. 3b) from the phytohormones found in the coconut water (Kende & Zeevaart, 1997), while FMLE improved the seedling shoot length.

Hence, seed priming with Plant growth regulator (FMLE and FCW) can be successfully employed to improve the germination and seedling growth in cucumbers.

In conclusion, fresh moringa leaf extract and coconut water is effective for improving germination and early seedling growth and needs further investigation for its role in cucumber flowing and yield under various temperature.







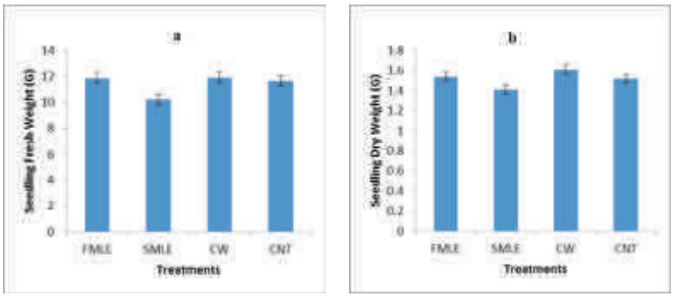


Figure 1: **Influence of seed priming on (a) seedling fresh weight and (b) seedling dry weight ± s.e. in cumber**

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Level of Compliance to Organic Agricultural Practice in the Practical Year Training Programme of University of Ibadan, Nigeria

TIJANI, S. A AND OWOLABI, G.
Department of Agricultural Extension and Rural Development, University of Ibadan, Ibadan, Nigeria.
Corresponding author: tsarafat@yahoo.com

Keywords: Compliance, organic agriculture, practical year training programme, students.

Abstract

The study assessed compliance to organic agricultural practice in the practical year training programme (PYTP) of the University of Ibadan, Nigeria. A total of 122 PYTP students were sampled. Data were collected through well-structured questionnaire and analysed with frequency counts, percentages and means. Study revealed that 73.1% have high level of knowledge on organic agriculture. Quest to meet up with required planted crops (amaranths, celosia and chocorus) yield, weed control and pest and diseases were the top constraints to compliance. Less than half (47.8%) of respondents had a high level of compliance. However, high knowledge of organic agricultural practices did not translate to high level of compliance to standard practice. Students must be made to adhere strictly to principles being taught by the instructor and other means of grading rather than yield should be employed.

Introduction

Organic agriculture is a production system that sustains the health of soils, ecosystems, biodiversity and people. It relies on ecological processes and nutrient cycles adapted to local conditions, rather than the use of external inputs. Organic agriculture combines traditional knowledge, innovation and modern science to benefit the shared environment and promote fair relationships and a good quality of life for all involved (IFOAM, 2004; AdeOluwa, 2010). The aim of organic agriculture is to create integrated humane, environmentally and economically viable agricultural systems that rely on local or on-farm renewable resources; management of ecological and biological processes (United Nations Conference on Trade and Development UNCTAD, 2008).

Organic agriculture helps in the improvement of the natural environment, farmers and household incomes. Organic farms are more profitable than conventional agriculture (Twarog 2006; Gibbon and Bolwig, 2007).

Edozien (2002) believed that Nigeria future lies in the participation of youths in agriculture. This led to establishment of practical year training programme (PYTP) in all tertiary institutions offering agriculture. The programme exposes 400 level students of the Faculty of Agriculture and Forestry to the practical aspect of agriculture. During this period each student is allowed to have her own plot and cultivate her crop to the harvesting level. The students are divided into two groups in which one of the group practices organic agriculture and the other practices conventional farming. However, organic agriculture practice is governed by some principles. Unfortunately, students in a mission to acquire good grades in their practical do everything possible to improve their yield despite the fact that the training is not profit oriented in monetary term. This attitude of students may negate the principles of organic agriculture. Also, if agricultural students that are meant to be information carrier of organic agriculture donot comply with all the principles then what is expected from rural farmers? The implication is that overtime, agricultural resources will be endangered. A dearth of knowledge on the extent to which students of organic agriculture know and comply with the standard of organic agricultural practice necessitated this study.

Materials and Methods

The study area was university of Ibadan. University of Ibadan was founded in 1948 and located in the ancient city of Ibadan the capital of Oyo state. It has over 12,000 students and ten faculties including Agriculture and Forestry aside the College of Medicine (Alabi and Ibiyemi, 2000). All PYTP students in 2012/2013 set were the target population. Sixty-seven (67) respondents purposefully sampled practised organic agriculture while the rest fifty- five (55) randomly sampled did not practice organic agriculture and data was obtained with the use of structured questionnaire. The level of compliance was measured by asking respondents to react to a list of expected/standard practices of organic agriculture through Yes or No. Scores of 1 was assigned to yes and 0 to no. A score of compliance was generated by summing all the scores obtained from the items indicated. The mean score was calculated and used as the benchmark for categorizing respondents into low and high compliance.

Results and Discussion

Respondents' Level of Knowledge on Organic Agriculture

The result shows that majority of respondents knew that precautionary measures are taken to avoid the contamination of organic sites (0.97), use of cover crops, green manure and crop rotation are important cultural practices (0.94), manure to be used on organic farm should be from organic source only (0.88) health, ecology and fairness are the major principles in organic agriculture (0.89). However, 0.54knew that conventional chemically untreated seeds, seedlings and planting material may be used in organic production, primary ecosystems such as primary forests and wetlands shall not be cleared or drained for the purpose of establishing organic production (0.52), Meanwhile, respondents are still undergoing training. Table 1 shows that majority (73.1%) have high level of knowledge while 26.8% have low level knowledge. Hence, PYTP on organic agriculture can be adjudged fair in terms of passing the right knowledge across to students.

Table 1. **Respondent's level of knowledge on organic agriculture**

Level of knowledge	Score	Frequency	%	Minimum	Maximum	Standard deviation	Mean score
Low	5 – 17	18	26.8	5	22	3.98	17.1
High	17.1-22	49	73.1				

Constraints to compliance with organic agriculture practices by the respondents

Table 2 reveals that meeting up with required planted crops (Amaranthus, Celosia and Chocorus) yield, weed control, pests and diseases and untimely information in that order were the major constraints to compliance while competition with fellow students for mark ranked lowest. The prominence given to quest to meet required yield arises because of the limited resources supply by the management.

Table 2. **Constraints to compliance to organic agricultural practice**

Constraints	Mean	Rank
Quest to meet up with required yield	0.90	1
Pests and diseases	0.75	3
Competition with fellow students for mark	0.48	7
Weed control	0.82	2
Untimely information	0.70	4
Marketing	0.67	5
Acceptability of organic food in the market	0.64	6

Compliance of respondents to organic agriculture

Table 3 indicates that respondents paid attention to some standards more than the others. More respondents paid attention to non-application of fertilizer (80.6%) but for use of manure; only few paid attention (26.9%). This might be due to inability to find organic animal farm around to supply such to them.

Table 3.**Level of compliance of respondents to organic agricultural practices**

Compliance statements	Yes	No
Fertilizer was applied on my farm	19.4	80.6
All seeds planted are from organic source	58.2	41.8
Manure used on my farm are strictly from organic sources	73.1	26.9
Herbicides and pesticides were used on my farm	19.4	80.6
Land has been used for conventional agriculture in the last two years	38.8	61.2
I used chemically untreated seeds for my production	62.7	37.3
I borrow farm tools from my colleagues who practiced non organic farming	13.4	86.6
I washed thoroughly the borrowed farm tools before using on my plot	4.5	9.0
At the selling point, inorganic produce were not mixed with organic produce	74.6	25.4
My organic produce were sold separately from produce of conventional farming	71.6	28.4
I wet my plants with hygienic water	74.6	25.4

Categorization of respondents based on compliance to organic practices

Result on Table 4 shows the minimum score of respondents to be 2 and the maximum score to be 8 while the mean score is 5.13.Therefore, respondents with scores below the mean score were considered to have low compliance while those with scores of mean and above were considered to have high compliance. Results show that 47.8% of the respondents have high level of compliance to the standards of organic agriculture while 52.2% of the respondents have low level of compliance with organic agriculture practice. This implies that less than half of the respondents had high level of compliance to organic agricultural practice.

Table 4. **Level of compliance to organic agriculture**

Compliance to organic practice	Score	F	%	Minimum	Maximum	Standard deviation	Mean
Low	2 -5.0	35	52.2	2	8	1.86	5.13
High	5.13 - 8	32	47.8				

Categorisation of respondents' knowledge difference shows high level of knowledge among those that practice organic agriculture than those who did not with 73.1% and 43.6% respectively. This implies that practice improves knowledge and for those who did not practice, going in to organic agriculture may be difficult.

Conclusion

The findings shown that majority who practiced organic agriculture though have high level of knowledge but they have low compliance. Also, the respondents who practiced organic agriculture have a higher level of knowledge than their counterpart and therefore it can be deduced that practice enhances knowledge. Organic agricultural practice should be made an integral part of practical year training programme for all the students so as to bridge the gap in knowledge and practice. Instructors should pay more attention to students in order to adhere strictly to principles being taught during practice. Compliance to the organic agriculture principles should be used in grading organic agriculture students rather than expected yield which has become a major constraint to them and may lead to going through shortcut in order to meet up.

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Organic Livestock Production Sustainable Increase of Meat Production on Natural Grasslands in Namibia

Gerold Rahmann[1], Christian Hülsebusch[2], Judith Isele[3] and Anita Idel[4]
[1]Thuenen-Institute of Organic Farming, Trenthorst, Germany, gerold.rahmann@ti.bund.de
[2]DITSL, German Institute of Tropical and Subtropical Agriculture, Witzenhausen, Germany
[3]Springbockvley farm and Polytech of Namibia, Windhoek, Namibia
[4]Mediator and Consultant "Biodiversity and Animal Health", Feldatal, Germany

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Abstract

Improvement in grazing systems are necessary to increase the productivity and sustainability of grassland utilisation in semi-arid Africa. Changes in stock density and stocking rate as described in the concept of "Holistic Management" can be an option of improvement. This management concept has not been tested scientifically yet, despite farmers report good success. Since 1993, "Holistic Management" carried out on the farm was Springbockvley in Namibia. From 2014, the grazing system has been changed to prove the concept. Approximately 800 head of cattle and 3,000 head of sheep are used in different herd densities have been introduced on a 9,500 ha farm. The vegetation and the stock productivity were assessed for the first experimental year. The designed methodology seems to be applicable for a scientific assessment of some "Holistic Management" tools. The preliminary results are, that the best way to assess the biomass is cut and assessing. But this is labor intensive. The use of a Platemeter® is recommended. It was observable that the biomass does change due to the experimental stock densities and rates. The stocking rate varied between 17 (1995) and 43 kg liveweight (2012) per hectare. The livestock had no adaptation problem (body performance, weight gain) with double stock density. The meat production (liveweight) per hectare between 5.3 (1995) and 15.2 kg (2013).

Introduction

Given the prominent role of herbivore livestock in grasslands, livestock must be addressed explicitly as a source of products such as meat, milk, hide, wool, fuel, manure and social security (Fresco and Steinfeld, 1998; Steinfeld *et al*., 2006) and as a major factor of ecological impact on the soils, the water and the vegetation of the pastures, which supply > 90% of livestock feed in the grassland-based livestock systems (Seré and Steinfeld, 1996).

Food production in the Southern African semi-arid countries like Namibia hinges to a large extent on effective management and utilization of the bulk of land, which consists of natural grassland, savannah systems, and rangeland-based farming systems with pockets of crop production (Bakker *et al*., 2006). Thus, the whole food system is essentially rangeland based and requires constant efforts to balance rangeland productivity with maintaining the natural resource base, including water saving technologies and strategies for combating or reversing the loss of land to desertification (Mills *et al.,* 2005).

Due to the agro-ecological and socio-economic conditions combined with the land use history and past and current management practices, the grassland based food system in Namibia (as well as other semi-arid savanna areas of Africa) today faces the following problems, leading to a) loss of livelihoods, b) reduced ecosystem services and c) reduced development potential for remote, marginal areas.

Given the above problem setting, the main challenges for food systems based on grazing systems in semi-arid Africa (Scherr *et al.,* 2010) lies in the sustainable improvement of natural grassland utilization starting out with the improvement of livestock management (production performance, health condition) and the integration of livestock and crop production (feed-manure chain). The utilization of the vast grasslands must maintain or even increase resource use efficiency (water, energy, nutrients, labour and land). The results will increase sustainable food production and profitability of rangeland use (food and income security). This is only possible if the results are understood, accepted, adapted, and applicable for farmers, stakeholders, and food policy decision makers.

Namibia is a semi-arid country with large savannah areas. The climate in Namibia is semi-arid (250-500 mm rainfall/year), with mono-modal distribution (rainy season Nov–Mar), and with high seasonal, annual, and spatial variability. The agro-ecological conditions can be taken as an example for similar areas throughout Africa.

Today, in Namibia livestock is kept in fenced pastures on farms, herded on communal farmland and non-farmland areas such as roadsides, forests, nature reserves, or kept as free roaming livestock close to the settlements (Zimmermann, 2009). Resettlement programmes tried to lease farmland out to individuals, but fencing and maintenance of water infrastructure is expensive for the individual farmer.

Goal of the Research

The vast grassland systems in countries like Namibia need to be developed to become a more productive and well integrated part of the overall food system, and there is increasing evidence that there are new paradigms of improved livestock management and crop-livestock integration that can sustainably integrate crop and livestock operations and increase production (MAWF, 2010).

Farmer's experiences with different innovative rangeland and grazing management approaches such as Holistic Management (HM) will be taken as starting point to assess and develop novel and accepted grassland food systems for Africa. In the 1970s, the Holistic Management Approach (HM) was developed by Savory and Butterfield (1999) for a sustainable use of the vast semi-arid grasslands of Africa. The main principles of the HM approach are close to what in science is termed the "ecosystem services approach" (Fynn, 2008).

So far, this approach lacks a thorough peer reviewed scientific evaluation. The "Springbockvley project" was launched in 2013 and by analyzing some minor aspects of the total approach wants to start a scientific assessment of HM to combat the future challenges in meat production on African savannah farming systems.

Research Questions:

– Which methodology is suitable to measure biomass production and grazing days?
– How does the changing of stock densities (LU/ha) influence biomass production?
– How does the changing of stocking rates (LU/ha/a) influence biomass production?

Material and Methodology

For the HM experiments, a 9,500 ha Organic cattle and sheep farm "Springbockvley" was used (Figure 1). The farm is located in the southern central part of Namibia, 180 km southeast of the capital Windhoek, on the Western edge of the typical Kalahari dune landscape but in almost completely flat countryside. With an average yearly rainfall of 260 mm Springbockvley is situated in an area of average production capacity which provides appropriate fodder for cattle and sheep alike. The farm has been managed according to the Holistic Management decision making framework since 1990 and is certified 'Namibian Organic' since 2013 (Isele 2014). In an inter-annual average, on the farm are about 800 Nguni cattle and 3,000 Damara sheep.

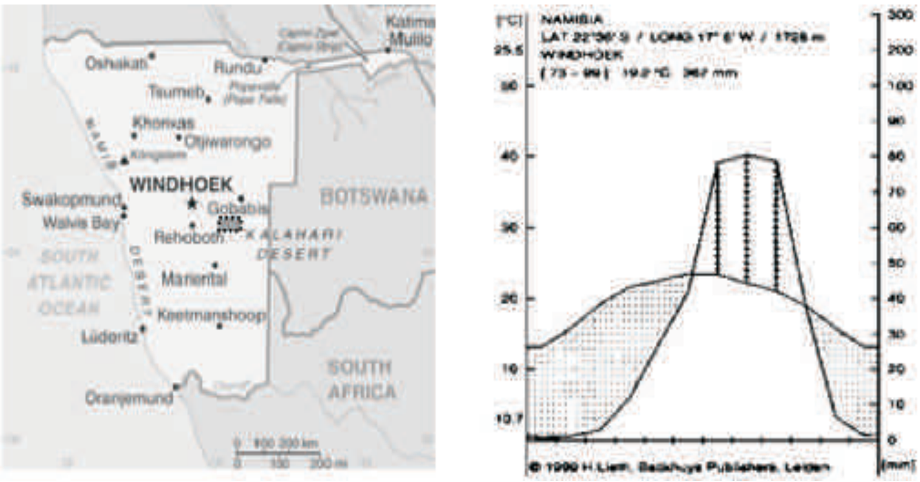

Figure 1: **Location of the Springbockvley farm and climate conditions in the region**

The Nguni cattle are an indigenous and robust breed and have an average live weight LW of 400 kg (thus, one cow is less than one Livestock Unit LU which is 450kg). The cows deliver every year a calf, which is suckling 6 to 8 months. Then calves are weaned and kept as fattening cattle in a separate "oxen herd". Between weaning and slaughtering at 3 years of age they gain about 300 kg and by then have an average live weight of 450 kg (1 LU). Taking into account different ages, sex and performance, the average live weight of the total cattle herd is considered to be 300 kg per total head of cattle including calves. The fat tailed Damara sheep are also a hardy indigenous breed. The ewes have an average live weight of 45 kg (10 ewes are one LU) and deliver about 1 lamb per year (natural lambing peak is May to August). The

Figure 2. **Nguni cattle and Damara sheep on Springbockvley**

average live weight of the total sheep flock is considered to be 35 kg per ewe including lambs. The average annual total live weight of all livestock depends on the available fodder, and since 2005 varied between 235 to 415 tons, which is about 25-44 kg LW per hectare (see Figure 2).

Different stocking densities and stocking rates have been taken as starting point to assess and develop sustainable stock densities and stocking rates on grassland in Namibia. In 2013, Springbockvley has changed the grazing management system (4 herds rotated in 4 farm sections) into a full farm rotation with 3 herds: cows, oxen and sheep (see figure 3). The three herds are in following structure (with inter- and intra-annual changes, recent figures March 2015) and sum up to a total live weight of 414,250 kg (920.6 LU) and a resulting stocking rate on the farm of 43.6 kg per hectare:

- **Cows herd:** consisting of 505 cattle: 134 cows with small calves, 123 pregnant cows that have recently weaned their calves, 40 pregnant heifers, 70 heifers ready to be bred, 15 bulls with an average live weight of 3,000 kg and a total liveweight of 151,500 kg (336.7 LU).
- **Ox herd:** consisting of 308 cattle: 194 oxen from weaning to slaughter age, 52 weaning heifers and 54 culled cows with 8 calves with an average live weight of 3000 kg and a total liveweight of 92,400 kg (205.3 LU).
- **Sheep flock:** consisting of 3,950 sheep and 107 cattle: 1,950ewes with lambs, 50 rams with an average live weight of 35 kg and a total liveweight of 138,250 kg (307.2 LU) plus 107 young bulls from weaning to slaughtering age with and average live weight of 300 kg and a total live weight of 32,100 kg (71.3 LU). Thus the total Sheep flock and bulls her has an average live weight of 170,350 kg (378.5 LU).

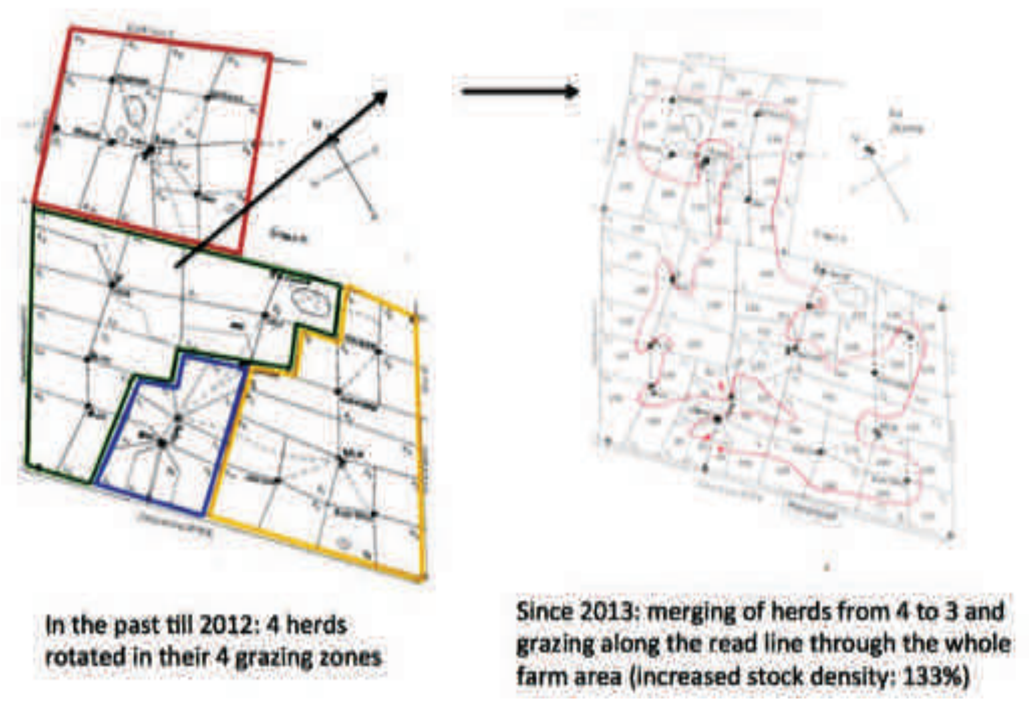

Figure 3: **Grazing management system with the three herds of cows, oxen and sheep on Springbockvley**

The changes of herd composition and grazing management have not increased the overall stocking rate, but the stocking density (about 133% compared to the conditions before 2013). The expected impact was further increase of biomass production, consequently an increase in carrying capacity and thus ultimately more meat production per ha, or, alternatively higher stability in the case of droughts (more fodder available for dry periods).

All three herds have followed the „red grazing line“ on the farm and provide average resting periods between 80 and 100 days for every grazed plot during the non-growing season and average recovery periods between 100 and 140 days during the growing season. That means, that every herd/flock has grazed every paddock approximately 1 to 1,3 times a year. Grazing plans are drawn up according to Holistic Management Planned Grazing(Savory and Butterfield 1996) after an annual estimation of animal consumable biomass (grazing days per ha) for every paddock using different methodologies. For the project two stocking and thus grazing treatment variations have been integrated:

- **HighSD:** Increased stocking density (The paddock will be subdivided with a mobile electric fence into a number of parcels equivalent to the planned days for the respective camp to be grazed in the current selection. Every day a new parcel will be opened for the herd to graze.)
- **DoubleSR:** Increased stocking rate (The paddock will be grazed for twice the duration of planned days for the camp to be grazed.)
- **Control:** These experimental grazing variations will be compared with the current system of stock density and stocking rate.

For these experiments, four replications have been selected on the farm. The goal of the research is to prove if these changes can be measured scientifically. The experiment will be done for 3 years, from May 2014 to May 2017.

Table 1. **Experimental plots for different stocking rates and densities**

	DoubleSR	HighSD	Control
Replication 1: "H" (House)	"H9" (95 ha)	"H2" (90 ha)	"H1" (80 ha)
Replication 2: "S" (Sand)	"S7" (130 ha)	"S11" (150 ha)	"S10" (145 ha)
Replication 3: "A" (Achab)	"A3" (145 ha)	"A6" (160 ha)	"A5" (160 ha)
Replication 4: "P" (Pan)	"P9" (150 ha)	"P4" (160 ha)	"P3" (150 ha)

The variation of the herd management has been done while the routine grazing modus, following the „red grazing line“. There was no fixing of the date, when the herds entered the paddock. The herds have entered each paddock in compliance with the grazing plan designed as per description above. The fodder availability expressed in grazing days per ha have been assessed in May of each year. The selected paddocks have been managed according to the grazing plan, and this has been assessed. The line“ has been modified so that the herds/flocks will always graze two normal paddocks (managed according to the current grazing regime) before they entered a treatment paddock (increased stocking density or double stocking rate). This is an adaptation period for the animals before entering treatment. The second of the normal paddocks between two treatments serves as control (Table 1 and map above).

From May 2014 until February 2015, the different herds have utilized the control and treatment plots in following time and densities (Table 2).

Table 2. **Grazing management from May 2014 until February 2015**

* Cow herd: breeding female cattle (cows, heifers and calves) with an average LW of 300 kg,
** Sheep herd = on breeding unit of ewes, rams and lambs (average LW of 35 kg) and breeding bulls (300 kg LW).
*** Oxen herd = fattening cattle (oxen, finished cows, fattening heifers) with an average LW of 300 kg.

Livestock Assessment

– Cattle: All cattle are weighed once every year during the compulsory vaccination routine (Anthrax, Brucella). The livestock is weighed always while they are close to the weigh scale (water point Mahali, 500 m east of farm house).
– Sheep: A randomly selected group of sheep will be weighed: clustered by age and function (lambs <6 months; lambs 6-12 months; adult sheep > 1 year). The average number per group should be 50 animals. The result is assumed to be the average weight of all the other sheep in that respective same cluster.
– All cattle and sheep will be estimated in liveweight as soon as they enter the experimental paddocks to have the most accurate liveweight of the herds.
– The wild game will be assessed for the experimental paddocks (in estimated kg liveweight).
– All routinely gathered weight data of livestock (liveweight, carcass weight, birth weights) will be included in the data base to improve the data as much as possible.
– Births weights of calves and lambs will be recorded randomly (50 calves and 200 lambs per season).
– All livestock records will be included in the study: losses, sales and purchases, livestock diseases, treatments, calvings, etc.

Vegetation Assessment

The main proof of the herd management will be on the assessment of the vegetation (Glatzle 1990). Because it is not clear, which methodology of biomass measurements can be used, a tool test (methodology assessment) has been included in the study. Seven different methodologies have been chosen for comparison:

- ***Platemeter test:*** Transect walk with a platemeter on all treatment and control paddocks. Done every May from corner to the opposite (diagonal) corner (between 1 and 2 km), every second step one measurement. The inter-annual comparison of the „average biomass height" will be the indication of growth and biomass.
- ***Vegetation cut test:*** on 200 m randomly chosen transect, not closer than 100 m from the paddock fences or other unusual parts of the paddock. Every 20 m a 1 sqm vegetation cut (10 samples per plot) will be done and can be assessed (biodiversity, biomass, feeding value). This will be done every May.
- ***Vegetation estimation test:*** on a 50x50 m (2,500 sqm) permanently defined and marked Estimation-parcel (minimum 100 m apart from the paddock fence and special parts of the paddock) the methodologies of
    - Klapp (Biodiversity and biomass estimation combined with special values: feeding value, grazing tolerance etc) and
    - Braun Blanquet (Biodiversity and coverage of vegetation, bare land and dead material). These methodologies will be done according to international standards of grassland estimations. The assessment will be done every May and just before and after each grazing event of the treatment and control paddocks.
- ***Transect test:*** on a 200 m quadrant line (the borders of the parcels in test 3) qualitative biomass assessment (occurrence and abundance of plant species) will be assessed.
  How and when to be done: Every meter along the 200 m line the a) alive plant, b) dead plant, c) litter and d) bare soil will be assessed (where the line touches on ground every m). This will be done in May each year.
- ***Picture test:*** every year, a transect line picture will be done. Comparison over the years. How and when to be done: Every May and before and after the grazing a picture is taken always from the main marking pole in the direction of the two adjacent marking poles (50 m distance).
- ***Quadrant test:*** in the corner of the parcel from test 3, a visual estimation will be done on how big one grazing day would be (estimation of the lateral length of the square that feeds one LU for one day). To be done every May and before and after each grazing event.
- ***STAC method test:*** the two diagonals of the parcel from test 3 will be measured according to the STAC method. Every second footfall the average bulk biomass will be estimated in grazing days per hectare. The average of all values will be taken as estimated grazing days per hectare for the area. To be done every May and before and after each grazing event.

The comparison of these seven very different vegetation tests is assumed to allow answers about the best, cheapest and most useable measure (also for farmers) to assess the vegetation coverage, biomass and grazing days estimations in heterogeneous semi-arid savannah-type grasslands. Although test 6 and 7 are rather subjective estimation methods they have been included in the tool test in order to reflect the necessity to provide reliable means to assess biomass in day to day farming life of practitioners.

Results

The meat production on Springbockvley was assessed by farm records from 1994 till 2012, the last year before converting towards organic farming and the novel grazing management system. The rainfall was uncertain and between 61 mm (1995) and 680 mm per year (2011), surprisingly with a slight increasing trend. The stocking rate and the meat production do follow the annual rainfall performance (Figure 4). The stocking rate varied between 17 (1995) and 43 kg liveweight (2012) per hectare, the meat production (liveweight) per hectare between 5.3 (1995) and 15.2 kg (2013).

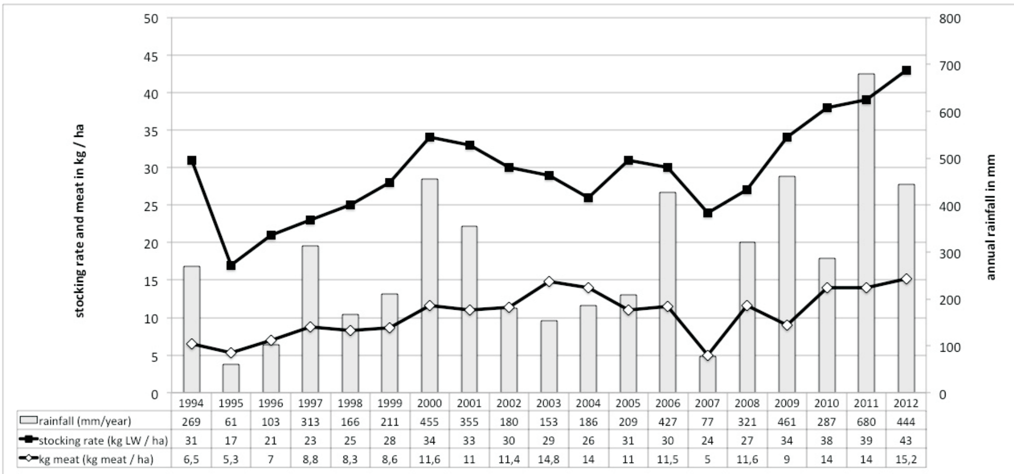

Figure 4: **Development of annual stocking rate, annual rainfall and meat production (kg/ha LW) 1994 - 2012**

The average number of different plant species on the different experimental grazing was assessed on 2,500 sqm plots before and after the three herds of cow herd, oxen and sheep have used the plots (Table 3). The total average number of species found in sampling plots before grazing events is higher than after grazing events. This applies to all grazing treatments, double stocking rate, high density and normal grazing respectively.

Table 3: **Average number of different plant species found in sampling plots before (pre-assessment) and after (post-assessment) grazing treatments**

	Cows		Oxen		Sheep		Average	
	Before	After	Before	After	Before	After	Before	After
DoubleSR	9.3	8.7	10.0	8.3	10.7	9.7	9.9	8.9
HighSD	12.0	12.7	13.0	10.0	10.7	9.0	11.8	10.6
Control	12.7	11.7	10.7	9.0	10.3	11.3	11.2	10.9

DoubleSR: double stocking rate; HighSD – high stocking density; Control: normal grazing; measured with method "Brown Blanquet" after grazing with the herd of cows, oxen and sheep respectively. Average across four replications.

Table 4. **Potential grazing days per hectare (GD/ha) estimated by means of the Quadrant method (see above, tool test 6) in sampling plots before and after grazing treatments**

	Cows		Oxen		Sheep	
	before	after	before	after	before	after
DoubleSR						
A	20.7	18.9	44.4	25.0	n.a.	n.a.
H	25.0	29.2	6.9	5.7	25.0	13.7
P	11.1	n.a.	14.8	10.4	30.9	13.7
S	100.0	39.1	n.a.	n.a.	59.2	27.7
HighSD						
A	14.8	14.8	34.6	17.4	n.a.	n.a.
H	44.4	20.7	n.a.	n.a.	14.8	16.0
P	n.a.	n.a.	18.9	17.4	30.9	25.0
S	51.0	30.9	n.a.	n.a.	20.7	20.7
Control						
A	34.6	30.9	39,1	39,1	n.a.	n.a.
H	11.1	16.0	13,7	n.a.	16.0	18.9
P	n.a.	n.a.	27,7	18,9	34.6	44.4
S	69.4	34.6	n.a.	n.a.	34.6	30.9

DoubleSR = double stocking rate; HighSD = high density; Control = normal grazing; across four replications "A", "H", "P" and "S".

Conclusion

The grazing systems in the semi-arid savannah area of Namibia are not well managed. Changes in stock density and stocking rate as described in the concept of "Holistic Management" could be an option of improvement. This management tools have not been tested scientifically yet, despite farmers reported good success. Different herd densities have been introduced on a 9,500 ha farm in Namibia in 2014 to prove the promises of the Holistic Management. The vegetation and the stock productivity have been assessed. The methodology seems to be applicable for a scientific assessment of Holistic Management.

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Analysis of Rural Household Use of Organic Farming-Practices- Amongst Livestock Farmers in South-South Nigeria

ATOMA C.N.[1], MATTHEWS-NJOKU, E.C.[2], NNADI F.N.[2]
[1]Department of Agricultural Extension and Management, Delta State Polytechnic, Ozoro, Nigeria
[2]Department of Agricultural Extension, Federal University of Technology, Owerri, Nigeria
Corresponding Author: nwacharity1211@gmail.com

Keywords: Livestock farmers, Organic Farming Practices.

Abstract

The paper focused on the use of organic farming practices amongst livestock farmers in South-South Nigeria.-Multistage sampling technique was used and three states (Bayelsa, Akwa Ibom and Delta States) were randomly selected from the six states that make up South-south Nigeria. Data for the study was obtained with a structured questionnaire administered to a sample size of one hundred and sixty two (162) livestock farmers. Twenty two (22) organic livestock farming practices were identified and respondents indicated their- use level on a four point likert type scale of High = 4, moderate = 3, low = 2, not at all = 1. A decision rule of mean score of 2.50 was established. Descriptive statistics, ANOVA and Scheffe model was used to analyze data. Findings revealed that use level was low in organic farming practices for livestock. Use of organic farming practices was high only in fresh drinking water and adequate feeding. There -was a significant difference among the three states in their level of use as revealed by the analysis of variance . The scheffe model indicated where actually the differences lied, Use level was significantly different between respondents in Bayelsa State (Mean=36.2692) and Akwa Ibom State (mean=46.1538). Also between Delta State (Mean=35.2979) and Akwa Ibom State (Mean=46.1538). However, there was no significant difference in use between Bayelsa State (mean =36.2692) and Delta State (mean =35.2979). Adequate campaign and training programs on awareness, use and benefit of organic farming practices for the farmers were recommended.

Introduction

Organic farming is an agricultural technique of naturally producing quality crops, vegetables, or animals without harming the environment, people, animal as well as other micro organisms. Studies have shown that organically grown foods are more nutritious, safe and of high quality. It offers improved food security and an array of other economic, environmental, health and social advantages (UNCTAD 2008).They are more important in ensuring human health compared to foods grown under conventional methods (Barec 2006; Worthington 2001).

According to Willer and Kilcher (2011), organic farming is practiced in 160 countries and 37.2 million hectares of agricultural land managed organically. Global sales oforganic food and drink reached US$ 54,9 billion in 2009. Animal products however, constitute a small share of the organic market compared to fruits, cereals and herbs (Willer and Keller 2011).

Organic livestock farming is the production of livestock with the use of organic and biodegradable inputs from the ecosystem for their upkeep, feeding, health, housing and breeding. Synthetic inputs such as drugs, feed additives and genetically modified inputs are avoided. According to Vaarst et al,. (2006) some key considerations in organic animal husbandry that producers and other stakeholders need to take into account are:

Origin of livestock :All livestock that are sold, labelled or advertised as organic must be raised under continuous organic management.
Livestock feed: The total rations of livestock that are produced under organic management must consist of agricultural products that have been organically produced and handled organically. These include pasture, forage and crops.
Living conditions: An organic livestock producer must create and maintain living conditions that promote the health and accommodate the natural behaviour of the animal. These living conditions must include access to the outdoors, shade, shelter, fresh air, direct sunlight suitable for the particular species and access to pastures for ruminants.
Waste management: Organic livestock producers are mandated to manage manure so that it does not contribute to the contamination of crops, soil or water and optimizes the recycling of nutrients.
Health care: Organic livestock production requires producers to establish preventive health care practices. Producers cannot provide preventive antibiotics but are encouraged to treat animals with appropriate protocols, including antibiotics and other conventional medicines when needed, but these treated animals cannot be sold or labelled as organic.
Record keeping: Organic livestock operations need to maintain records for a number of reasons. Certainly, records are important for the financial management of any organic livestock production.

Therefore, this study was undertaken to study the level of awareness of organic farming practices amongst livestock farmers in South-south Nigeria.

Methodology

Livestock farming was selected from the three prominent agricultural enterprises of fishery, livestock and crop. Multistage sampling technique was used. Firstly, three states- Delta, Bayelsa and Akwa-Ibom were selected from the six states that make up South-south Nigeria. Data for the study was obtained with a structured questionnaire administered to a sample size of one hundred and sixty two livestock farmers. The instrument elicited information on level of use of organic livestock farming practices identified with responses on a four point rating scale of very regularly = 4, regularly =3, rarely =2 never =1. A decision rule of mean score of 2.50 was established. Descriptive statistics, ANOVA and sheffe model was used to analyse data.

Results and Discussion

Level of Use of Organic Farming Practices Amongst Livestock Farmers

Table 1 shows that level of use was low generally in several Organic Farming Practices for livestock. Entries in the table indicated that farmers have high level of use offresh drinking water and adequate feeding. There was low level use of other practices since their mean score was below 2.50. The result showed that organic livestock production practices in South south Nigeria is 11.11% which is very low compared to countries like India with 75% (Prabir and Mahesh 2012). Though Indian farmers according to him cannot be regarded as practicing organic livestock farming. Even though 75% organic practices were used, some of the important principles of organic livestock production were not practiced. For example feed source was not organic and no evidence of record keeping. In South south, feeding is not organic with mean score of (2. 17) and record keeping (2.07) . Apart from fresh drinking water and adequate feeding all other practices were low with average below 2.50.

Analysis of variance in difference of organic farming practices in the three states

The analysis of variance table shows that there were significant differences in the level of livestock organic production practices among the three states since. A post hoc multiple comparison test using scheffe model was carried out to test where the difference lie. From the scheffe model (Table 3), it was observed that level of use was significantly different between respondents in Bayelsa state (Mean=36.2979) and Delta state (mean =35.2692). Also between Bayelsa State (Mean=36.2979) and Akwa Ibom State (Mean=46.1538). However, there was no significant difference in use between Bayelsa State (mean =36.2979) and Delta State (mean =35.2692).

Table 1. **Level of use of organic farming practices amongst livestock farmers**

Organic Farming Practices for livestock	Very regularly	Regularly	Rarely	Never	mean	Remark
Land holding	10(10.1)	25(25.3)	9(9.1)	55(55.6)	1.89	N.U
Farm diversification	10(10.1)	20(20.2)	9(9.1)	60(60.1)	1.80	N.U
Free movement of animals	0(0)	34(34.3)	16(16.2)	49(49.5)	1.85	N.U
Provision of fresh air and natural day light						
Protection against adverse weather condition	0(0)	28(28.3)	1(1.0)	70(70.7)	1.57	N.U
Resting areas	0(0)	20(20.2)	5(5.1)	74(74.1)	1.45	N.U
Clean and dry beddings	1(1.0)	39(39.4)	1(1.0)	58(58.6)	1.82	N.U
Enough space for exercise	11(11.1)	20(20.2)	15(15.2)	53(53.5)	1.89	N.U
Fresh drinking water	26(26.3)	48(48.5)	1(1.1)	24(24.2)	2.76	USE
Expression of natural behavior	3(3.1)	57(57.6)	3(3.0)	3636.4)	2.27	N.U
Local breed is used	11(11.1)	37(37.4)	1(1.0)	50(50.5)	2.09	N.U
Natural reproduction technique	10(10.1)	46(46.5)	1(1.0)	42(42.4)	2.24	N.U
Produce without genetic engineering , ionizing radiation or sewage sludge	4(4.0)	32(32.3)	4(4.0)	59(59.6)	1.81	N.U
Adequate feeding	18(18.2)	54(54.5)	1(1.0)	26(26.3)	2.64	USE
Animal feeding is 100% organic	15(15.2)	34(34.3)	3(3.0)	47(47.5)	2.17	N.U
Prompt treatment of sick animals	2(2.0)	57(57.6)	1(1.0)	39(39.4)	2.22	N.U
Manage animals without antibiotics	1(1.0)	17(17.0)	3(3.0)	78(78.8)	1.90	N.U
Traditional/natural treatment of sick animals	1(1.0)	27(27.3)	8(8.1)	63(63.6)	1.65	N.U
Vaccinate only during disease outbreak	1(1.0)	11(11.1)	11(11.1)	76(76.8)	1.36	N.U
Manage without added growth hormones	0(0.0)	29(29.3)	2(2.0)	68(68.7)	1.61	N.U
Accurate record keeping	1(1.0)	50(50.5)	3(3.1)	45(45.5)	2.07	N.U

Source- field survey 2015
Mean< 2.50 suggest not being practiced
Mean> 2.50 suggest being practiced
N.U means None Use

Table 2. **Analysis of variance in difference of organic farming practices in the three states**

ANOVA USE	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2021.084	2	1010.542	12.811	.000
Within Groups	7572.330	96	78.878		
Total	9593.414	98			

*Significant at 0.05 level

Table 3. **Scheffe model**

States	N	Mean level of use
Delta	26	35.2692
Bayelsa	47	36.2979
AkwaIbom	26	46.1538

Mean scores with different letters are significantly different at 0.05 le

Conclusion and Recommendations

Organic Livestock Production Practices of farmers in South-South Nigeria is very low. To enhance the practice of organic livestock production in the study area. There should be:

i. The creation of awareness on the benefit of organic farming and the dangers associated with conventional livestock production.
ii. Development of domestic market where the distinction between organic and conventional produce can be created. For example foods can be tagged organic or conventional. Consumers often pay for quality products (Prabir and Mahesh 2002).
iii. Training on organic production practices to be emphasised in Extension activities.

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Influence of Withdrawal period of Tetracin® on Physico-Chemical Properties and organoleptic attributes of Broiler Meat

AKINWUMI[1], A.O., ODUNSI[1], A.A., OMOJOLA[2], A. B AND ADEMOLA[1], S.G.
[1]Department of Animal Nutrition and Biotechnology, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
[2]Meat Science Laboratory, Department Animal Science, University of Ibadan, Ibadan, Nigeria.
Corresponding Author: aoakinwumi@lautech.edu.ng

Keywords: Withdrawal periods, Tetracin®, Physico-chemical properties, Organoleptic properties.

Abstract

Failure to observe withdrawal period of antibiotics drug is a major cause of residue in meat. This study evaluated the impact of withdrawal period of Tetracin® (a feed grade antibiotic) on quality and sensory attributes of broiler meat. One hundred and fifty (2 weeks old) broiler chick were randomly assigned to graded level of veterinary Tetracin® and were fed conventional broiler starters and finishers. The withdrawal period was observed for 15 days, 7 days and 0 day prior to slaughter at sixth week of the experiment. Thereafter the physico-chemical and organoleptic properties were analyzed and compared. Significant (P<0.05) differences were observed in cooking loss, drip loss, chilling loss, and water holding capacity (WHC) of the meat. Reduced losses (P<0.05) were recorded for all the physical properties at 15 days withdrawal period. Highest Crude Protein(21.32%) and EE (7.03%) were recorded at day 0 but progressively decline as the withdrawal days increased, although the values were not significantly (P>0.05) difference. The taste panelists did not found any (P<0.05) difference in colour, flavour and general acceptability but reported significance (P<0.05) in juiciness and tenderness. Observing withdrawal period for 15 days on the use of Tetracin® improved the physical properties of meat and has no adverse effect on the chemical composition and the general acceptability of broiler chicken.

Introduction

Drug and pesticide residue concerns are among the reasons adduced for Africa's denial into European and American livestock markets (Aliu, 2004). According to the author, residues of drug in threaten human health by being acutely or cumulatively allergenic, organotoxic, mutagenic, teratogenic or carcinogenic. Despite the ban on antibiotics in Europe, the drug is still being used in many developed countries like the United States of America and Africa especially including Nigeria. Antibiotics control many infections that are promoted by livestock production in present day farming conditions, making meat cheaper and more plentiful. The constant usage however promotes the development of microbes resistant to these drugs which is a threat to human (Steinfield, 2003).

Among other factors, failure to observe the withdrawal periods of a drug has been reported to be the major cause of antibiotic residues in food producing animals (Van Dresser and Wilcke, 1989). Booths (1988) defined withdrawal period as the interval required for the residue toxicology concern to reach safe concentrations in the tissue of the animal or the interval from the time an animal is removed from medication until the permitted time of slaughter. The purpose of withdrawal periods is to ensure that residues are at acceptable levels, taking into account the method of administration, the rate of absorption, metabolism and excretion of the drug. Adherence to withdrawal time maybe considered burdensome, inconvenient and expensive (Sundlorf, 1989; Akinwumi *et al.,* 2013). Also improper maintenance of treatment records, or failure to identify treated animals adequately, and attempting to salvage terminally ill animals for slaughter purposes that recently have been treated with antibacterial drugs can lead to abbreviated withdrawal periods. Akinwumi *et al.,* (2013) stated that most farmers (91%) in Nigeria claimed to be aware of the withdrawal period but their frequencies of observing (54%) it showed that some farmers are not always conscious of it and this could be counter-productive to the consuming public.

Apart from the reports on effect of antibiotics on resistance and existence of the residue, not much is known about the potential influence on meat quality of veterinary drugs. Overall quality traits of meat comprise hygienic aspects in relation to safety and toxicology (presence of undesirable microorganisms or residues such as antibiotics, hormones or chemical contaminants), nutritional value and technological and sensory attributes (Cavani *et al.,* 2009). As reported by Aliu (2004) the palatability, aroma and quality of meat could also be affected by drug residues. However, Hughes and Heritage (2004) reported direct beneficial effects on the product quality, such as decreased fat and increased protein in the meat, and indirect benefits such as a reduction in the amount of feed needed, and therefore a reduction in the amount of waste.

The study determined the effect of withdrawal period of antibiotic (Tetracin®)on physico-chemical properties and organoleptic properties of broiler meat.

Material and Methods

A 6- week experiment was conducted with 150, 2 week old broilers chicks that were randomly assigned to graded levels of veterinary antibiotic Tetracin®. Tetracin® (feed grade antibiotics) drug was bought at a reliable veterinary store and administered through Conventional broiler starter (CP – 23%, ME 3000kcal/kg) and broiler finisher (CP – 20%, ME 2900kcal/kg) diets at different inclusion levels.The withdrawal period (the feed grade antibiotic was stopped for selected birds) was observed for 15 days, 7 days and 0 day prior to slaughtering. Fifteen days was the actual label withdrawal period for Tetracin®. Five birds for each group were slaughtered by severing the jungular veins and carotid arteries, oesophagus and trachea, without severing the spinal cord.

Following slaughtering, Physico-chemical parameters of the meat from these birds were analyzed and compared. WHC of the samples were determined by the filter press method as modified by Tsai and Ockerman (1981). Cooking loss and thermal loss were calculated as the difference in percentage terms between pre - and post-cooking weight and length respectively (Honickel, 1998). Warner Brazter shear force (WBSF) determination was performed on the boiled meat samples using the modified Warner Brazter Shear Force procedure (Bouton and Harris, 1978). Proximate analysis was use to determine the chemical attributes of the broiler meat according to A.O.A.C (1999). The organoleptic properties was conducted using a 10 member trained panelists according to the procedures of AMSA (1995). The trained panelists evaluated the samples for colour, flavour, juiciness, tenderness and general acceptability. The assessment was based on a 9 point hedonic scale.

All data obtained were processed and subjected to analysis of variance (ANOVA) using statistical analysis software (SAS, 1999). Significantly different means were separated using Duncan's multiple Range (DMR) test.

Results

There were significant (P<0.05) differences observed in cooking loss, WHC, drip loss and chilling loss of the broiler chicken (Table 1). At 15 days withdrawal period, a lower (P<0.05) cooking loss (18.42%) was observed compared to values obtained for 0 day (24.45%) and 7 days (21.34%) withdrawal periods. The WHC for the meat samples expectedly showed similar trend with the cooking loss but in an inverse way. The highest (P<0.05) value was obtained in 15days withdrawal period with 81.60% and the least in 0day (74.82%). Both drip loss and chilling loss showed a progressive decrease with an increase in the days of withdrawal period and the least values were found in the 15 days withdrawal period. Shear force showed no significant differences (P>0.05) as the days of withdrawal period increased. The withdrawal periods of the antibiotics had no significant (P>0.05) effect on the chemical composition of the meat (Table 1). The CP, EE and ash numerically decreased as the withdrawal periods increased. When withdrawal periods are not observed (0 day), the highest CP and EE were recorded as 21.32% and 7.03% respectively. Significant (P<0.05) difference was also observed in the moisture content as the lowest was found in day0 of the withdrawal period.

The sensory evaluation of the panelist is as shown in Table 2. The withdrawal period had no effect (P>0.05) on the colour, flavor and general acceptability of the broiler meat. The tenderness and the

Table 1. **Effect of withdrawal periods of Tetracin®on physical and chemical properties of broiler chickens**

Withdrawal periods Parameters **(%)**	**0day**	**7days**	**15days**	**SEM**
Physical properties				
Thermal loss	12.34	11.89	10.57	2.43
Cooking loss	24.45^{a}	21.34^{b}	18.42^{c}	1.34
WHC	74.82^{c}	78.06^{b}	81.60^{a}	2.34
Drip loss	3.66^{a}	3.47^{b}	3.21^{c}	0.23
Chilling loss	5.79^{a}	4.34^{b}	3.42^{c}	0.54
Shear force	2.24	2.29	2.14	0.07
Chemical properties				
Crude protein	21.32	19.51	19.31	1.82
Ether Extract	7.03	5.96	6.00	0.34
Ash	1.13	1.19	1.08	0.04
Moisture content	70.15^{b}	72.37^{a}	73.23^{a}	0.42

$^{a,b,c:}$ Means along the same row with different superscripts differ significantly (P<0.05)

Table 2. **Effect of withdrawal periods of Tetracin®on organoleptic properties of broiler chickens**

Withdrawal periods **Parameters (%)**	**0day**	**7days**	**15days**	**SEM**
Colour	6.42	6.34	6.53	0.42
Flavour	5.37	5.52	5.68	0.25
Juiciness	6.62b	6.67b	7.16a	0.33
Tenderness	6.34a	5.83ab	5.00c	0.21
General Acceptability	7.42	7.32	7.51	0.53

$^{a,b,c:}$ Means along the same row with different superscripts differ significantly (P<0.05

juiciness of the meat samples were however significantly (P<0.05) influenced significantly (P<0.05) by the withdrawal periods. An increase (P<0.05) in value was observed in the values for juiciness while a decrease (P<0.05) was observed in the tenderness as the days of withdrawal increased.

Discussion

The ability of fresh meat to retain moisture is arguably one of the most important quality characteristics of raw products. Product weight losses due to purge loss entail the loss of a significant amount of nutrients (Melody *et al.,*2004). Lower WHC indicated losses in the nutritive value through exudates that are released and result in drier and tougher meat (Dabes, 2001; Akinwumi, 2006). It was however observed that the physical properties (especially cooking loss and the WHC) improved when withdrawal periods were observed at 15days.

This study corroborated the earlier findings of Hughes and Heritage (2004) that antibiotics in animal feeds result in a better meat quality with a reduced fat and increased protein contents. Higher values for protein was reported when withdrawal periods was not observed, it was also puzzling to observe a decline in the fat contents as the withdrawal periods of the antibiotic increased.

No influence was observed by the panelist on the withdrawal periods of the general acceptability of the broiler meat. It was rated as moderately liked. This means with or without observation of withdrawal period of antibiotic, consumer will still like the meat and will be willing to consume it. This was in agreement with Ristic (2003), who reported that production system did not affect overall sensory attributes. Omojola *et al.* (2012) also stated that meat acceptability was mostly based on attractive colour, desirable flavour in the first instance, and on the combined effects of tenderness, juiciness and texture of a particular meat as evaluated by an individual consumer. However, the juiciness increased while the tenderness reduced with the increase in days of withdrawal period, this could be attributed to the improved values in WHC and cooking loss. But all this was to no avail with the overall panelists rating of the meat. This result corroborated Aberle *et al.,*(2001) who reported that experience of eating meat did not cause separate impressions of tenderness, juiciness, and flavour, but rather an overall impression.

Conclusively, this study has revealed a better cooking loss and WHC with no adverse effect on proximate composition of meat when withdrawal period of antibiotic was observed. The overall acceptability of the meat showed that with or without observation of withdrawal period of antibiotic, consumer will be willing to consume it.

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Antifungal Activity of Essential Oils from Some Tropical Plants against *Penicillium Digitatum* Infected *Citrus Sinensis Fruit during Storage*

OJO, O. A. AND ADEBAYO T.A
Department of Crop and Environmental Protection,
Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
Corresponding Author: ojo.cep@hotmail.com

Keywords: Cybopogon flexuosus, Xylopia aethiopica, Ocimum gratissimum, Cybopogon citratus, Pycathus angonensis, Penicillium rot, Essential oil, Citrus.

Abstract

Increasing public concern over the level of pesticide residues in food, especially fresh produce, has built up adequate pressure for scientists to look for less hazardous and environmentally safer compounds for controlling post-harvest diseases. This study, therefore identify the essential oils with antifungal activity from some Nigerian plants and their potential application as antifungal compounds against Penicillium digitatum infected Citrus sinensis fruit in an in-vivo experiment. The Cybopogon flexuosus oil exhibited significantly ($P \leq 0.05$) highest antifungal activity of 100% mycelial inhibition at 1200 part per million (ppm). Similar trends were observed on the effect of essential oil of Cybopogon flexuosus on spore germination, germ tube elongation and weight of mycelial of P. digitatum. This was followed by that of Xylopia aethiopica which also gave significantly ($P \leq 0.05$) high degree of mycelial and spore germination inhibition. The essential oil of Pycathus angonensis did not show any inhibitory effect on mycelial growth of P. digitatum even at the highest concentration. While the essential oil of Ocimum gratissimum and Cybopogon citrutus respectively gave the significantly ($P \leq 0.05$) least degree of mycelial and spore germination inhibition. Spore germination and germ tube elongation of the pathogens in potato dextrose agar were significantly ($P \leq 0.05$) decreased with increase in the concentration of Cybopogon flexuosus oil. The same concentration of this oil reduced the percentage of decayed Citrus sinensis. This result showed that the essential oil of C.flexuosus gave the significantly ($P \leq 0.05$) least fruit rot of 21.91% at the 21 days after incubation (DAI) and concentration of 1200ppm. The result showed that the essential oil of C. flexuosus at the highest concentration of 1200ppm gave the significantly ($P \leq 0.05$) least fruit rot of 21.91% at the 21 DAI compared with the artificial inoculated fruit with no treatment that gave significantly ($P \leq 0.05$) complete fruit rot of 100%. In addition, when unwounded naturally infected Citrus sinensis fruits were treated with different concentrations of essential oil of C.flexuosus only 8.92% fruit rot was recorded at the concentration of 1200ppm and 21 DAI. The fruit rot in unwounded and naturally infected Citrus sinensis was significantly ($P \leq 0.05$) lower than the wounded and artificially inoculated Citrus sinensis fruits. The result showed that Citrus sinensis fruits were better protected against fruit rot, whether artificial or naturally inoculated over a period of 21 DAI using essential oil of Cybopogon flexuosus. Whereas, the significantly ($P \leq 0.05$) highest fruits rots of 70.14% was observed at 21 DAI when the fruits were not wounded and 100% fruit rot in the artificially inoculated fruit. The inhibitory effect of the essential oil of C.flexuosus significantly ($P \leq 0.05$) increased with increase in concentrations. Application of essential oils for postharvest disease control of fresh produce, as a novel emerging alternative to hazardous anti-fungal treatments will allow a safer and environmentally more acceptable management of postharvest diseases.

Introduction

Citrus sinensis originated in Asia, mainly South-east, where many species can be found growing in the wild and belongs to the family Rutacea. The world production of citrus is greater than that of any other fruit crops (Okwu and Emenike, 2007). Citrus is the world number one fruit crop in terms of production being 78.2 million metric tonnes in 1991; followed by grape, banana and apple which were 55.9, 47.8 and 39.6 million metric tonnes respectively (FAO, 1994; Mary *et al*., 2003). Citrus fruits and citrus juice have several beneficial health benefits and nutritive properties (Ezeibekwe and Unambi, 2006). They are rich in ascorbic and folic acid. Citrus flavonoids are widely distributed group of polyphenolic compounds with health related properties, which are based on their antioxidant activity (Dim, 2004). These properties have been found to include anti-carcinogenic, antiviral, anti-inflammatory activities, effects on capillary fragility and ability to inhibit human platelet aggregation. In addition, some citrus flavonoids and their derivatives in the field of food technology are well known for their ability to provide a sweet taste and as bitterness inhibitor (Dim, 2004).

Apart from being rich in ascorbic and folic acids, citrus fruits are good sources of dietary fiber. They are fat free, low in sodium content and without cholesterol (Ezeibekwe and unamb, 2009). Citrus fruits are also helpful to reduce the risk of pregnant women to have children with birth disease (Dim, 2004). Due to the hesperid in content as well as diosmine and other flavonoids, the citrus fruits reinforces the ability of the capillary vessels and improves venous blood flow (Timmer, 1994; Dim, 2004). They are useful in cases of swollen legs, edema, varicose veins, hemorrhoids, thrombosis and emboli (Ezeibekwe and Unamb, 2009). It is also recommended for people who suffer from higher blood pressure (Ezeibekwe and Unamb, 2009). In Nigeria the major citrus producing states are Benue, Taraba, Oyo, Imo, Ebonyi, Kwara, Kogi, Kaduna, Ogun, Ondo, Ekiti, Edo, Delta and Osun (Adisa and Fajola, 1983). Some of the important species within the genus are *Citrus sinensis* commonly called sweet orange. Many moulds and yeasts are involved in the spoilage of citrus fruits. Jay (2001) found *Hansenula sp* and *Saccharomyces cerevisiae*, to be responsible for spoilage of citrus fruit, such as sweet orange and tangerine. Akinsumire (2011) reported *Penicillium digitatum* as causing considerable loses in *Citrus sinensis* during marketing in the tropics. A number of bio-deteriorative moulds such as *Penicillium digitatum* have been found to be associated with citrus fruits especially sweet orange (AbdAlla *et. al*, 2013; Ojo, 2013). Dim (2004) found *Aspergillus sp.*, *Penicillium sp.,* and *Rhizopus sp.,* were found to be responsible for spoilage of oranges. Timmer and Menge (2000) reported these genera of yeasts as being involved in the spoilage of citrus fruits: *Candida, Cryptococcus, Hansenula, Rhodotorula, Kloekera, Pichia, Saccharomyces and Trichosporon.* Application of essential oil is a very attractive method for controlling postharvest diseases. Production of essential oils by plants is believed to be predominantly a defense mechanism against pathogens and indeed, essential oils have been shown to possess antimicrobial and antifungal properties (Ahmet *et al*., 2005, Abd-alla, *et al*., 2013, Kavoosi *et al*., 2014). Essential oils and their components are gaining increasing interest because of their relatively safe status, their wide acceptance by consumers and their exploitation for potential multi-purpose functional use (Jobling, 2000). Essential oils are made up of many different volatile compounds and the composition of the oil quite often varies between species (Mishra and Dubey, 1994). It is difficult to associate the antifungal activity to single compounds or class of compounds. It seems that the antifungal and antimicrobial effects are the result of many compounds acting synergistically (Kavoosi *et al*., 2014). Thus, there would be negligible chance of development of resistant races of fungi after application of essential oils to fruit and vegetables (Kavoosi *et al*., 2014). As a consequence essential oils are one of the most promising candidate groups of natural compounds for the development of safer antifungal agents. Therefore, the objective of this study was to investigate the inhibitory effects of essential oils extracted from five plant species against *Penicillium digitatum* and to evaluate the potential application of essential oils to control *Penicillium rot* of stored *Citrus sinensis* fruit.

Materials and Methods

Plant material: The fresh leaves of the following plants: *Cybopogon flexuosus, Ocimum gratissimum, Cybopogon citratus, Pycathus angonensis* and fruits of *Xylopia aethiopical* were collected from Ogbomoso and environs. These were identified at the Department of pure and Applied Biology, Ladoke Akintola University, Ogbomoso, Nigeria. Plant materials were freed from foreign materials and carefully rubbed between soft cloths to remove dust.

Extraction of essential oil: The essential oil extraction of the fresh plants was done through hydro-distillation at Department of Pure and Applied Chemistry, Ladoke Akintola University Ogbomoso Nigeria. The air-dried plants material weighing 200g was placed in round bottom flask containing 150 ml water and distilled. The distillate was saturated with NaCl and transferred to a separator funnel where it was extracted with diethyl ether. The organic phase was recovered and concentrated on a steam bath to yielding 2.8 g/100 g plants material. The essential oils were stored in bottles at 4°C in a refrigerator.

Isolation of fungi: Fungi were isolated from deteriorating *Citrus sinensis* fruits purchased from the market in Ogbomoso, Nigeria using Potato Dextrose Agar (PDA) containing 100 mg chloramphenicol per ml and identified with the aid of the appropriate taxonomic keys following the method of Ainsworth *et al.*, (1973). The isolates were maintained on PDA slants at 4°C till needed.

In vitro antifungal assay:
Effects of different concentrations of Essential oils on Mycelial Inhibition of *Penicillium digitartum:* PDA was autoclaved and cooled in a water bath to 40°C. The essential oils were mixed with sterile molten PDA to obtain final concentrations 0, 100, 300, 600, 900 and 1200 Part Per Million (PPM). The PDA was poured into 90 mm Petri plates (15 mL $plate^{-1}$) that were then inoculated with 6 mm plugs from 7-days-old cultures. Three replicates were used per treatment plates were incubated for 7 days at 28°C. Fungal growth was recorded after 7 days. Growth inhibition was calculated as the percentage of inhibition of radial growth relative to the control. Experiments were performed three times. Using the formular of Amadioha (1998):

$$Mp = \frac{M_1 - M_2}{M_1} \times 100$$

= Percentage inhibition of mycelial growth.
M_1 = Mycelial growth in the control petridish
M_2 = Mycelial in the petridish containing different concentration of each plant extract.

Effect of different concentrations of Essential oil of *Cybopogon flexuosus* on spore germination and germ tube length of *Penicillium digitatum*: The effect of *Cybopogon flexuosus* oil on spore germination and germ tube elongation of the pathogens were tested in Potato Dextrose Broth (PDB). *Cybopogon flexuosus oil* was added to a 10 ml glass tube containing 5 mL PDB to obtain final concentrations 0, 100, 300, 600, 900 and 1200 ppm. At the same time, aliquots (100μL) of spore suspensions (1×107 spores mL^{-1}) of *P. digitatum* were added to each tube. After 20 h of incubation at 28°C on a rotary shaker (200 rpm), at least 100 spores per replicate were observed microscopically to determine germination rate and germ tube length (Droby *et al.,* 1997). The percentage inhibition was calculated from the data obtained following the formular of Amadioha (1998) % inhibition:

$$= \frac{S_c - S_t}{S_c} \times 100$$

Where Sc = Spore germination in the control plates.
St = Spore germination in the treated plates.

Effects of Extract of different Plant at Various Concentration on Fresh and Dry Weight of Mycelial Growth of *Penicillium digitatum* Association with *Citrus sinensis*.
Concentrations of essential oil of different plant species obtained were evaluate on the fresh and dry weight of mycelial growth of various *Penicillium digitatum* associated with *Citrus sinensis* seed according to the method of Amadioha (1998). One ml of each of the concentration of different plant extracts was added to the Potato Dextrose Broth (PDB) in sterilized 200ml conical flask separately. Each flask was inoculated assay disc (5mm in diameter) cut from advancing margin of 7day old healthy growing mycelium of *Penicillium digitatum*. For the controls, sterile distilled water was added to the sterilized flask containing potato dextrose broth. Each flask was replicated five times and incubated at 26°C. For the assessment of mycelial weights of the *Penicillium digitatum*, four harvest were taken at intervals of 7-days each. The mycelial fragment for the pathogen was separated from the potato dextrose broth by filtration using two layers of sterile muslim cloth. The fresh weight of mycelial of the *Penicillium digitatum* was collected, on pre-weighed filter paper and recorded, and its dry weight was determined after 24hours oven drying at 60°C.

***In vivo* applicability of *Cybopogon flexuosus oil* in control of post-harvest Penicillum digitatum *Citrus sinensis*:**
Effects of *Cybopogon flexuosus* oil on decay development in artificially inoculated and wounded fruits: Fruits were selected for freedom of injuries and infections and were placed in 1.5 L plastic boxes. Fruits were dipped in the solution of 1% sodium hypochlorite for 2 min, rinsed with tap water and air-dried before wounding. *Citrus sinensis* were wounded with a sterile puncher to make one uniform 2 mm deep by 5-mm wide wound on their peel at the equatorial region. Aliquots of 20µL of 100, 300, 600, 900 and 1200 ppm *Cybopogon flexuosus oil* and sterile distilled water (control) was pipetted into each wound site. After 0.5 h, 10µL of conidial suspension of *P. digitatum* (5×10^4 spores mL^{-1}) was pipetted into each wound. Treated *Citrus sinensis* were stored at 20°C. The percentage of infected fruits was recorded at three days intervals for 21days after incubation. Each treatment was replicated three times with 20 fruits per replicate.

Effects of *Cybopogon flexuosus oil* on naturally infected development in unwounded fruit: The concentration of the *Cybopogon flexuosus* oils were prepared by dissolving the requisite amounts in 25 mL of 0.05% Tween-80 and then mixing with 475 mL of sterile distilled water. The control sets were prepared similarly using equal amounts of sterilized water in place of the essential oil. *Citrus sinensis* were dipped into the solutions for 1 min at room temperature and air dried. Fruits were dipped into sterile distilled water, which served as control and air dried. Treated *Citrus sinensis* were stored at 20°C for 21 days. The percentage of infected fruits was recorded at three days intervals for 21days after incubation. Each treatment was replicated three times with 20 fruits per replicate.

Data Analysis
Data obtained in percentages were arcsined transformed before statistical analysis. The data obtained were subjected to statistical analysis using analysis of variance (ANOVA). The means were separated using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

Results

The result on the effect of different concentrations of essential oil of some tropical plants on mycelial inhibition of *Penicillium digitatum* the causal agent of blue mold disease of *Citrus sinensis* is presented in Table 1. The result showed that the essential oil of all the tropical plants with the exception of *Pycathus angonensis* significantly ($P \leq 0.05$) inhibited the mycelial growth of their pathogen comparison to the control (Table 1).

The essential oil of *Cybopogon flexuosus* gave significantly ($P \leq 0.05$) highest mycelial inhibition *P. digitatum*, that is one hundred percent inhibition at concentration of 1200 part per million (ppm) concentration (Table 1). The essential of *Xylopia aethiopica* exhibited a significantly ($P \leq 0.05$) moderate to high antifungal activity against the tested pathogen, ranging from 70.50-82.71% at 900 and 1200 ppm respectively. In addition, significantly ($P \leq 0.05$) lowest mycelial growth inhibition of *P. digitatum* by *Ocimum gratissimum* and *Cybopogon citratus* oil with inhibition percentage from 10.11-35.51 and 24.4% respectively. While *Pycathus angonensis* essential did not inhibit growth of P. digitatum. The result on the inhibitory effect of different concentration of essential oil of some tropical plants on spore germination of *P. digitatum* is presented in Table 2. It is clearly revealed that essential oil of *Cybopogon flexuosus* strongly inhibited the spore germination and germ tube length *P. digitatum* respectively (Table 2).

Table1. **Inhibitory Effects of Different concentrations Essential oils of some Nigeria Plants on Penicillium digitatum**

Essential oils	***Mycilia* inhabitation (%) at different concentrations (part per million (ppm)**				
	100	**300**	**600**	**900**	**1200**
Cybopogon flexuosus	21.31^{a}	54.68^{a}	71.06^{a}	100.00^{a}	100.00^{a}
Xylopia aethiopica	17.80^{a}	49.11^{a}	60.73^{b}	71.20^{b}	83.70^{b}
Ocimum gratissimum	0.00^{b}	0.00^{b}	10.11^{c}	29.30^{c}	35.57^{c}
Cybopogon Citratus	0.00^{b}	0.00^{b}	12.23^{c}	21.01^{c}	30.01^{c}
Pycathus angonensis	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{c}	0.00^{c}
Control (water)	0.00^{b}	0.00^{b}	0.00^{c}	0.00^{c}	0.00^{c}

Data are average of five replicates from four separate experiment followed by a similar Data having the same Alphabets are not significantly different at 5% level of probability using Duncan Multiple Range Test (DMRT).

Table 2. **Effect of different concentrations of *Cybopogon flexuosus oil* on spore germination and germ tube elongation of *Penicilliun digitatum***

Treatments	**Spore germination (%)**	**Germ tube length (µm)**
Contro	100.00^{a}	-
100 ppm	60.91^{b}	99.03^{a}
300 ppm	34.38^{c}	85.91^{b}
600 ppm	15.61^{d}	56.01^{c}
900 ppm	08.13^{e}	32.76^{d}
1200 ppm	02.11^{f}	29.21^{d}

Transformed before subject to Analysis of variance. Values in the same column followed by a similar Alphabets are significantly at 5% level of probability using Duncan Multiple Range Test (DMRT).

Table 3. **Effect of Different Concentrations of *Cybopogon flexusosus* on Fresh Weight of *Penicillium digitatum* at Different Days of after Incubation**

Concentrations of Cybopogon Part Per Million (Ppm)	Infected *Citrus sinensiss* Fruit (%) after Days of Incubation (DAI)						
	3	6	9	12	15	18	21
Control	10.11a	17.20[a]	25.73[a]	50.01[a]	70.81[a]	85.13[a]	100.00[a]
100	08.53[b]	13.54[b]	20.90[b]	28.13[b]	35.18[b]	47.07[b]	50.08[b]
300	05.91[c]	10.76[c]	14.91[c]	22.50[c]	28.00[c]	39.11[c]	43.00[c]
600	04.71[d]	07.11[d]	10.00[d]	15.00[d]	20.00[d]	28.80[d]	35.71[d]
900	02.83[e]	05.38[e]	07.11[e]	10.79[e]	15.61[e]	21.17[e]	28.00[e]
1200	01.01[f]	03.00[f]	05.03[f]	08.00[f]	11.04[f]	16.46[f]	21.91[f]

Data are average of five replicates from four separate experiment. Values in the same column followed by a similar Alphabets are significantly at 5% level of probability using Duncan Multiple Range Test (DMRT).

Table 4. **Effect of Difference Concentrations of *Cybopogon flexuosus* on inhibition of *Penicillium digitatum* on Artificially Inoculated *Citrus sinensis***

Treatments Part Per Million (ppm)	Mean weight of *Penicilliumdigitatum* at Different Days of Incubation							
	Fresh weight (g)				Dry weight (g)			
	7	14	21	28	7	14	21	28
Control	70.23[a]	81.05[a]	93.25[a]	98.90[a]	48.00[a]	60.03[a]	71.00[a]	78.11[a]
100	62.09[b]	70.01[b]	77.11[b]	85.00[b]	30.71[b]	35.93[b]	41.08[b]	46.99[b]
300	50.11[c]	58.53[c]	63.07[c]	71.93[c]	21.15[c]	27.00[c]	34.05[c]	40.00[c]
600	38.30[d]	46.00[d]	54.11[d]	66.00[d]	12.30[d]	16.07[d]	22.00[d]	31.78[d]
900	23.00[e]	31.93[e]	36.01[e]	41.75[e]	07.03[e]	09.71[e]	14.79[e]	20.99[e]
1200	05.11[f]	07.28[f]	10.87[f]	12.91[f]	02.11[f]	03.05[f]	04.81[f]	09.98[f]

Data are average of five replicates from four separate experiment.
Data in percentages were arcsinne transformed before subject to statistical analysis.
Data in the same column followed by the same alphabet are significantly different at 5% level of probability using Duncan Multiple Range Test (DMRT).

Table 5. **Effect of Different concentrations of Essential oil of *Cybopogon Citratus* on Natural infected *Penicillium digitatum* in Unwounded *Citrus sinensis***

Treatment part per million (ppm)	Infected citrus sinesis fruit (%) at different Days after incubation DAI)					
	3	6	9	12	15	18
0	00.00[a]	15.30a	25.00[a]	34.13[a]	50.00[a]	70.14[a]
100	00.00[a]	10.00b	15.13[b]	25.45[b]	30.38b	41.30[b]
300	00.00[a]	06.51b	08.13c	13.30c	20.00c	28.38[c]
600	00.00[a]	03.31c	04.91d	08.00[d]	11.91[d]	20.15[d]
900	00.00[a]	0.00d	02.30[e]	04.10e	09.10e	14.30[e]
1200	00.00a	00.00d	00.00f	02.00f	06.00f	09.92[f]

Data in percentage were arcsined transformed before statistical analysis. Data having similar alphabets are not significantly different at 5% level of probability.

The inhibitory ability of *Cybopogon flexuosus* increases significantly (P ≤ 0.05) with increase in its concentration. The significantly (P ≤ 0.05) least spore germination inhibition of 2.11% was recorded in the control (Table 2). The result on the effect of different concentrations of essential oil of *Cybopogon flexuosus* on fresh and dry weight of *Penicillium digitatum* at different days after incubation was presented in Table 3.

The result showed that the mean fresh and dry weight of *P. digitatum* decreases significantly (P ≤ 0.05) with increase in concentration of essential oil of *Cybopogon flexuosus* and days after incubation respectively (Table 3). The result on the effect of different concentration of *Cybopogon flexuosus* on inhibition of *Penicillium digitatum* decay artificially inoculated *Citrus sinensis* is presented in Table 4. The result showed that the essential oil of *C. flexuosus* significantly (P ≤ 0.05) reduced fruit rot when the *Citrus sinensis* was artificially inoculated with P. digitatum (Table 4).

The result also showed that essential oil of *C. flexuosus* gave the significantly (P ≤ 0.05) least fruit rot of 21.91% at the 21 DAI compared with the artificially inoculated fruit with no treatment that gave significantly (P ≤ 0.05) complete fruits rot of 100% (Table 4). Also, when unwounded *Citrussinensis* fruits were treated with different concentration of essential oil of *C. flexuosus*, only 8.92% fruit rot was recorded at the concentration of 1200ppm at 12 DAI (Table 5).
The result showed that the *Citrussinensis* fruits were better protected against rot when artificially inoculated or unwounded over a period of 21 DAI. The significantly (P ≤ 0.05) highest fruit rot of 70.14% was observed at 21 DAI when the *C. sinensis* fruits were not wounded, and 100% fruit rot when it was artificially wounded

Discussion

In an attempt to reduce the use of synthetic pesticides, over the past two decades extensive investigations have been made into the possible exploitation of plant compounds as natural commercial products, that are safer for humans and the environment (Amadioha, 1998; Antunes and Cavaco, 2010; Gachango *et al*. 2012; Victoratos et. al. 2013; Kavoosi *et al*.,2014). The natural and bio-control fungicides might be a good alternative to the use of synthetic fungicides and in turns fulfil consumer requirement for more natural and healthy foods (Martinez-Romero et. al. 2008; Gato et. al, 2011; Gachango et. al, 2012). The essential oils are reported to have some fungicidal properties against certain post-harvest diseases of tropical fruits, and vegetables (Wilson et. al., 1997; Mee pagala et. al., 2002; Imelouane et. al., 2009; Abd- Alla and Wafaa, 2013; Kavoosi *et al*., 2014). It is clearly revealed in this study that *Cybopogon flexuosus* gave significantly highest mycelial and spore germination inhibition. In addition, it gave the significantly lowest percentage fruit rot. It also reveals that the inhibitory potential of this essential oil increases with increase in its concentration. This results could be corroborated with the result of Abd-Alla and Wafaa (2013) and Vitoratos *et al*., (2013) working on post-harvest pathogens. Enikuomehin (2005) and Okigbo *et al*., (2010) have also use *C. flexuosus* to control leaf spot and fungal tuber rot respectively. Dubey *et al.,* (1997) described that essential oil from some tropical plants had an antifungal activity against post-harvest fungal pathogens of some tropical fruits. In addition, they found that essential oils had an inhibitory effect on pectinase and cellulase, the two important enzymes produced by phytopathogenic fungi in disease development. Victoratos *et al*., (2013) reported that the anti-microbial activity of essential oil could be related to the presence of an aromatic nucleus and OH group that can affect hydrogen bonds of enzyme in micro-organisms. Feng and Zheng (2007) studied the effects of cassia oil on decay development in artificially and wounded tomatoes fruits, the result indicated that when wounded cherry tomatoes were treated with cassia oil, all concentrations with the exception of 100ppm significantly inhibited *A. alternaria* on tomatoes fruit stored at 20^0C for 5 days. In similar study, Abd-Alla and Wafaa, 2013 reported that essential oil of basel, orange lemon and mustered significantly inhibited mycelial growth of *Collectotrichum gloesporiodes* in mango fruit and reduced the percentage of fruit rot when compared with untreated fruits. Shelef (1983) described that within several components available in essential oils, the antimicrobial activity of phenolic compounds were higher than that of alcholic components. It is known that cell wall of pathogens is the main target of the phenolic compounds and these may disrupts the permeability barrier of cell membrane and thereby inhibit respiration. It has been postulated that the hydrophobia nature of essential oils and their components enables these compounds to penetrate the lipid of fungal cell membrane and mitochondria which thereby disrupts their structures (Cox *et al*., 2000; Abd-Alla *et al*., 2013). In addition, they stated that these components accumulated in the cell membrane of the pathogen causing energy depletion. Furthermore, in some studies Nychas (1995) and Maqbool *et al*., (2010) stated that essential oils affects proteins and also caused damage to the enzymatic activities of the fungal cell membrane.

Conclusion

The results of this present study showed that the essential oil of *Cybopogan flexuosus* significantly reduce the mycelial growth of spore germinating and mycelial weight of *Penicilliumdigitatum* the causal agent of Blue mold of *Citrus sinensis* fruit as well as reduce fruit rot. Therefore, essential of *C. flexuosus* can be used as a potential source of sustainable eco-friendly botanical fungicide in the storage of *C. sinensis* fruit. But it is important to state that further work needs to be carried out on the effects of this essential oil on post-harvest quality of *C. sinensis* during storage.

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The Role of Medicinal Plants in Traditionally Managed Cattle in Odeda Local Government Area, Ogun State, Nigeria

FASAE O.A., OLAWALE E.O AND SHOWALE, A.G.
Department of Animal Production and Health, Federal University of Agriculture,
P.M.B 2240, Abeokuta, Nigeria
Corresponding Author: animalexp@yahoo.co.uk

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Abstract

This study investigates into the role of indigenous medicinal plants used in traditionally managed cattle in five locations of Odeda local government area, Ogun state, humid zone of Nigeria. A structured questionnaire was used to collect personal data of cattle rearers, plant specimens and pertinent information on plant use. Results showed that cattle rearers were majorly men from the Fulani tribe with no formal education. A total of twenty (20) plants were identified and evaluated for the treatment of cattle parasites and diseases, with various parts namely leaves, stems, bark, seeds, fruits and twigs been used, the leaves been widely utilized. However, the mode of preparation and application of these plants parts require different methods. These traditional remedies are more preferred because they are locally available, cheaper, safer and effective compared to the orthodox veterinary medicines. Some of these plants provide multipurpose remedies, preventing or curing several kinds of ailments. It was therefore concluded that the study areas are a rich source of medicinal plants for disease management in the traditional cattle production system. However, there is need to scientifically ascertain the authenticity of the claimed use of these plants.

Introduction

The use of medicinal plants to treat various diseases in livestock has been part of human culture since ancient times and is relied upon in most developing countries as a major source of natural therapeutic remedies for the treatment of different diseases (Ody, 1993). Nowadays, natural products of plant sources have been the centre of focus as the main source of new, safer and more effective bioactive compounds with medicinal properties (Nitta *et al.,* 2002).

The use of indigenous medicinal plants in the management of livestock, also referred to as ethnoveterinary medicine has been reported to be widespread among herdsmen and found to be of great value in areas where allopathic or orthodox veterinary medicines are often beyond the reach of the poor livestock producers. Majority of these farmers rely on these traditional healthcare practices to keep their animals healthy as most of these herbal plants have been used for centuries in the management and prevention of a wide range of livestock diseases. The users believe that medicinal plants are more efficacious for treatment of cattle ailments than modern medicines, simply because they are readily availability, easy to prepare and/or administer, at minute and at free of cost to the farmer (Jabbar *et al.,* 2005).

Hence, this study was designed to generate information on the role of indigenous medicinal plants used in traditionally managed cattle in Odeda local government area, Ogun state, humid zone of Nigeria.

Materials and Methods

The study was carried out in five different locations namely Oojo, Alabata, Odeda, Isolu and Apakila in Odeda local government area of Ogun state, humid zone of Nigeria. These villages were selected because of the dominance of the nomadic cattle rearers in these areas.

Information was collected by interviewing the cattle rearers, using a structured questionnaire, which contain the personal data, various common pest and diseases incidence among their animals, plants or plant parts used in ethno-veterinary practices and the preparation and administration of these plants parts. Consent was obtained from all the participants prior to the administration of the questionnaire. A total of 60 respondents were selected and interviewed from various communities. The plants that were singly and most frequently used by the cattle rearers were sought for during the survey. Collected plant samples were identified and authenticated. Data obtained are presented tables. They were analyzed using simple descriptive statistics to generate frequencies and percentages with the aid of SPSS (2007).

Results and Discussion

The frequency distribution of the respondent is shown in Table 1. A total of 60 respondents were interviewed, with all the herd owners in the study area being men and from the Fulani tribe. The rearers were majorly between 40 and 49 years of age (38.3%) with 85% married. Majority of the respondents (71.7%) are illiterate with no formal educational background while 28.3% had a form of Arabic education. This is in line with the reports of UNESCO (2003) and Iro, (2004) that cattle rearers have no form of formal education. Despite the importance of education, many Fulani have not embraced it. This is partly due to the fact that cattle rearing are time consuming and does not give room for school enrollment.

Table 1. **Frequency distribution of respondent's personal data (n= 60)**

Personal data	Frequency	Percentage
Gender		
Male	60	100
Female	-	-
Age Group		
10 -19	3	5.0
20 – 29	11	18.3
30 – 39	13	21.7
40 – 49	23	38.3
50 and above	10	16.7
Ethnic group		
Fulani	60	100
Other	-	-
Marital status		
Single	9	15
Married	51	85
Educational attainment		
Arabic School	17	28.3
No formal Education	43	71.7

Table 2. **Medicinal plants used by cattle herdsmen in Odeda local government area, Ogun state.**

Scientific name	Common name	Local Name*	Part used	Diseases cured	Application
Hibiscus esculentus	Okra	Ila	Stem	Placenta ejection	Pound dry stem /add water. Drench the animal with liquid.
Ficus exasperate	Fig tree	Opoto	Leaves	Fever/Malnutrition	Mash leaves, mix with water, give the liquid extract to animal
Azadirachta indica	Neem	Dongoyaro	Bark/ leaves	Worms/ parasites Trypanosomiasis	Soak leaves or bark in water and give orally or drench the animal.
Parkia biglobosa	Locust bean	Iru	Seeds	Foot pain	Use grinded seeds to rub affected part till symptoms disappear.
Vernonia conferta	Bitter leaf	Ewuro	Leaves	Diarrhoea	Macerate in water and administer orally.
Spondias mombin	Hog plum	Iyeye	Leaves	Retained placenta/ mastitis	Dry the seeds and mix with water, then administer orally.
Dioscorea dametorum	Bitter yam	Esuru	Root	Blindness	Pound extract with water and drop into the eye
Solanum aculestrum	Love apple	Odu	Fruits	Streptothricosis	Roast fruits, slice into halves. Scrub the affected area for 1-3 days.
Mangifera indica	Mango	Mongora	Leaves/ Bark	Diarrhoea/ dysentery	Grind leaves/ bark, mix with water and give animal
Citrus aurantifolia	Lime	Osan-wewe	Leaves	Diarrhoea	Give the liquid extract to animal orally until symptoms disappear
Ficus platyphylla	Broad leaf fig	Epo-Obo	Bark	Bovine contagious pleuropneumonia	Dry/pound the bark into powder and add salt, administer orally with the liquid.
Newbouldia laevis	Boundary plant	Akoko	Leaves	Constipation	Leaves are squeezed and given to animals.
Nicotiana tabacum	Tobacco	Taba	Leaves	Cold	Mash leaves and give animal to lick.
Piliostigma thonningii	Monkey bread	Abefe	Twig	Muscular weakness	Tie the twig to the affected joints of animal for few days to recover.
Annona senegalensis	Wild custard apple	Abo	Leaves	Anti-biotics	Macerate in water and administer orally to the animal
Khaya ivorensis	African mahogany	Oganwo	Bark	Reduced fertility/ Diarrheoa	Dry and pound the bark, add salt with water and give animal to drink
Tephrosia vogelii	Fish bean	Orobeja	Leaves	Tick	Pound leaves, soak with wood ash in water, stir, filter and add animal urine. Bathe animal with solution.
Zea mays	Maize	Agbado	Grain	Diarrhoea	Roast and feed animal.
Phaseolus vulgaris	Common bean	Nyebbe	Leaves	Milk ejection	Pound and add water. Drench the animal with the liquid.
Phaseolus vulgaris	Common bean	Nyebbe	Leaves	Milk ejection	Pound and add water. Drench the animal with the liquid.
Acacia albida	Apple ring	Gawo	Leaves	Stuffy eye	Macerate in water and drench the animal.

**Local names are either in Hausa or Yoruba languages*

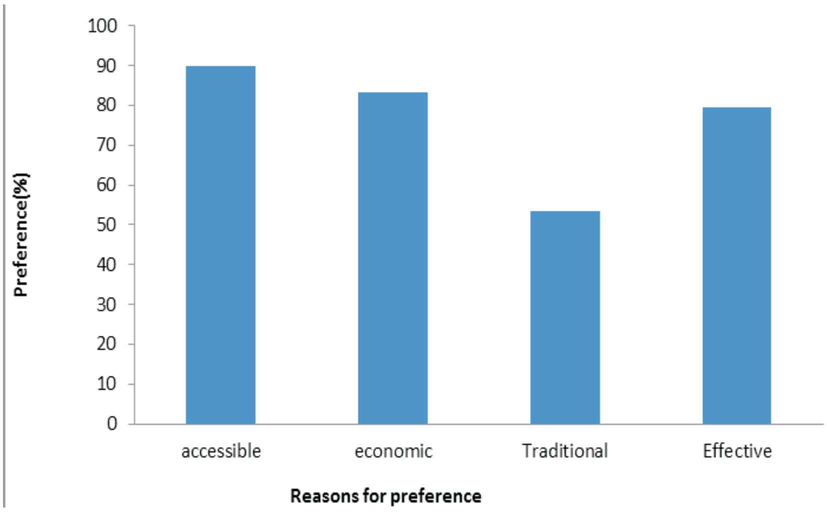

Figure 1: **Reasons for preference of the use of medicinal plants by cattle rearers**

In terms of the reasons associated with the preference for the use of medicinal plants among the cattle rearers, Figure 1 shows that majority of the respondents preferred these plants because of easy accessibility (89.5%), while 81.25% and 51.33% of the respondents prefer it because it is economical and traditional in nature, respectively. However, 77.5% of the respondents claimed its simplicity and effectiveness in healing without visible adverse effects.

Table 2 presents the list of plant species and other traditional methods used in the treatment and management of diseases of cattle in the study area. Twenty (20) plants were identified by respondents for the treatment of cattle diseases and parasites. It was evident that various plants were extensively used through different herbal preparations administered to the animals.

It was also observed that various plant parts namely the leaves, bark, roots, leaves, twigs, seeds and sometimes the fruits were used as remedies for a variety of disease conditions in the traditional cattle production system, with the leaves been widely used. This confirms reports that indicated preference for the use of plant leaves because it is more convenient to collect leaves than root parts, flowers and fruits (Giday et al., 2009).

Plant leaves have also been known to be actively involved in photosynthesis and the production of metabolites (Ghorbani, 2005). Thus, the numerous constituents found in leaves could explain their efficacy in the treatment of various ailments in both humans and animals. This therefore suggests that the basic active ingredients used for treating various ailments are accumulated in the different parts of plants being used, showing that most of these plants contain some physiologically active compounds, which are known to be potent medicines (Iwu, 1993). However, the mode of preparation and application of these plants parts require different methods.

Some of the medicinal plants recorded in this study have been found by earlier researches to contain antimicrobial activities. *Vernonia conferta*has been used for the treatment of gastrointestinal disorders (Iwu 1993). *Acacia albida*, *Piliostigma thonningii* and *Parkia biglobosa*have been reported to be used by Fulani herdsmen in the management of animal diarrhoea in Plateau State, Nigeria (Offiah *et al.,* 2012).

Moreover, some of these plants appeared to provide multipurpose remedies, preventing or curing several kinds of ailments. For example, *Spondias mombin* are used for treating retained placenta and mastitis.The potential of *Azadirachta indica*as trypanocidal and anthelmintic has being reported (Nok *et al.,* 1993, Jabbar, 2006). The root and twig of *Piliostigma thonningii* has also been used for the treatment of dysentery, fever, snake bites, hookworm and skin disease as well as laxative, antihelmintic and anti-inflammatory agents (Fakae *et al*., 2000; Igoli *et al.,* 2005).

Also, *Ficus platyphylla* extracts which was identified in this study for the treatment of Bovine contagious pleuropneumonia have also been found to be used for the treatment of various ailments such as dysentery, cough, diarrhoea, tuberculosis and pain relief (Sandabe and Kwari, 2000). The extracts of *Annona senegalensis* though used as an antibiotic in this study also possess trypanocidal properties (Ogbadoyi *et al.,* 2007). From the accumulated information obtained in this study, it could be concluded that the study areas are a rich source of medicinal plants which can be used in the management of diseases in traditional cattle production system. However, there is need to scientifically ascertain the authenticity of the claimed use of these plants. The use of these medicinal plants if adequately harnessed could be an option for cattle rearers involved in organic programs as well as those that cannot afford the use of allopathic drugs in the treatment and control of cattle diseases.

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Evaluation of *Moringa oleifera* Root Extract as a Biopesticide in Tomato (*Solanum lycopersicum L.)* Production

FAYINMINNU, O.O.[1]; OLAOSEBIKAN, F.T.[1] AND T.I. OLABIYI.[2]
[1]Department of Crop Protection and Environmental Biology, University of Ibadan, Nigeria
[2]Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, PMB. 4000, Ogbomoso, Nigeria.
Corresponding Author: olorijkb2008@gmail.com

Keywords: *Solanum lycopersicum*, Moringa oleifera, phytochemicals, *Helicoverpa armigera*, biopesticide, insect.

Abstract

Pot experiment was carried out at the open roof top garden of the Department of Crop Protection and Environmental Biology, University of Ibadan, Nigeria, to evaluate the biopesticidal potential of Moringa oleifera on Helicoverpa armigera insect pest of Solanum lycopersicum (Tomato). There were five treatments replicated four times and laid out in a completely randomised design (CRD). The treatments were 20g/L, 40g/L, 60g/L of root powder of M.oleifera prepared as extract in 1 litre of water respectively, Cypermethrin (0.125ml/L) and control (no insecticide). They were applied on tomato plants from five weeks after sowing (WAS) till final harvest. Data collected were on plant height, number of leaves, number of branches, number of fruits and fruit weight/yield of S. lycopersicumand analyzed using descriptive statistics and ANOVA at P = 0.05. Results revealed the presence of alkaloids, saponis, reducing sugar, triterpenoids and anthraquinone as the phytochemical compounds present in M. oleifera rootpowder. There were no significant differences (p>0.05) observed among the treatments in growth parameters but significant difference (p<0.05) was observed on yield (fruit weight) parameter of S. lycopersicum. The potency and efficacy of M. oleifera rootextracts at 60g/L and other treatments on Helicoverpa armigera insectpest compared favourably with synthetic cypermethrin (0.125ml/L) in recording highest growth parameters while the synthetic recorded the lowest values in all parameters in the study. This study revealed that Moringa oleifera root extract could suppress Helicoverpa armigera insectpest population and could be used as a natural pesticide in tomato production with additional economic benefit in enhancing organic farming for food sustainability.

Introduction

Pesticides are applied to agricultural fields to optimize crop yield and their global use is substantial. Indiscriminate applications of synthetic insecticides to vegetables have been reported to cause variable changes in brain on consumption (Ecobichon *et al*., 1994). These highly stable and persistent compounds can last for years and decades before breaking down in the environment and have wide range of being globally transported (Williams, 2000).Pesticides have been linked to causing the number of adverse effects on health problems, notably death, several diseases (cancer, allergies etc) and birth defects among human and animals (Maroni, 1990).

Tomato (*Solanum lycopersicum* L.) is the most important vegetable grown in Nigeria, ranking 6th behind root and tuber crops and cereal crops (FAO, 2011). Tomatoes contain calcium, iron, carotenes, riboflavin, vitamins and antioxidants furthermore; the lycopene it contains is active against prostate and breast cancer. The productivity of this vegetable crop in Nigeria is however challenged by an array of pests that make its cultivation difficult and also low in yield production. The insect pests' infesting tomato include tomato fruit borer*, Helicoverpa armigera* and white flies (Umeh *et al.,* 2002).Control of these pests has been mostly through the use of synthetic chemical insecticides. Farmworkers are highly vulnerable to health threats due to intensive exposure to a variety of pesticides, either from applying these chemicals or from harvesting pesticide-sprayed agricultural products.

However, fears concerning the effect on workers' health of these chemicals, have led to the development of more environmentally acceptable, cost effective control alternatives(Grzywacz and Leavett, 2012), low cash input, readily available and with a minimised environmental impact to manage pests (Fayinminnu *et al*., 2013). Research efforts have geared towards an ecofriendly approach; this is with plants/ biopesticidal products (Bekele *et al.,* 1997). Most of these plant products are known to have insecticidal properties (Mariani *et al*., 2008; Fayinminnu and Shiro, 2014).

Moringa oleifera Lam. is one of the most useful multi-purpose plants known to man. It has been found to be useful in the treatment of medical conditions like malaria, diabetes, hypertension, gastritis/ulcers, heart burn, asthma, impotence and stress (Kasolo *et al.,*2010). Balogun *et al*.(2004) found *M. oleifera* seed powder to compare most favourably with Fernazzan D (a chemical fungicidal material) in inhibiting the mycelial growth of *Aspergillus flavus* isolated from stored maize grains. It has also been found that when the toxic root bark of Moringa is removed, the flesh contains alkaloid spirochin which can cause nerve paralysis on organisms (Morton, 1991).

The objective of this study is therefore, to evaluate the efficacy of the biopesticide product of *Moringa oleifera* root extract for the pest management of *Helicoverpa armigera*in tomato production.

Materials and Methods

Sources of Planting Materials

The experiment was carried out between April and July 2015, at the open roof top garden of the department of Crop Protection and Environmental Biology (CPEB), University of Ibadan, Ibadan, Nigeria. Tomato seeds Roma VF (Improved variety) were purchased from Agrotropic Nigeria Limited, Ibadan while the *Moringa oleifera* roots were harvested from Okoro village, Eleyele, Ibadan, Nigeria.

Phytochemical Screening

This was performed on the milled to powder, extracted *M. oleifera* root and analysed for phytochemicals in the Organic laboratory of department of Chemistry, University of Ibadan, using the method of Ajaiyeoba *et al*., (2006).

Preparation of *Moringa oleifera* Root Powder Extract

Extraction procedure was carried out in Toxicology laboratory of CPEB according to the method of Ojiako *et al*. (2013) with a modification. Moringa roots harvested were chopped and air dried for four weeks at room temperature of 27°C ±2°Cin the Ecology laboratory of CPEB and milled into powder. Twenty (20), 40 and 60 grams of the root plant materials were dissolved in 1 liter of water respectively and soaked for 24 hours; the solution was filtered through muslin cloth to remove the debris. Filtrate obtained was passed through Whatman No.1 filter paper. The final filtrates of plant part were made to obtain 20g/L, 40g/L, and 60g/L (v/v) strength. The extracts were labeled and stored in refrigerator at 20°C for 24hours prior to use to prevent putrefaction and degradation of phytochemicals present in them. The extracts were used for the bioassay. Cypermethrin insectide was bought from Jubaili Agrotec, Ibadan, Nigeria.

Pot Experimental Work

This was carried out at the open roof top garden of the department of Crop Protection and Environmental Biology (CPEB), University of Ibadan, Ibadan, Nigeria. The top soil was obtained from the farm garden of CPEB and sterilized at 170°C. The soil of 5kg was allotted into each experimental pot of 23cmx16cm with five treatments replicated four times and laid out in a completely randomised design (CRD). Tomato (*Solanum lycopersicum)* seeds were sown on sterilized soil and raised in the nursery for three weeks at the CPEB screen house and were later transplanted to the experimental pots. Seedlings were allowed to stabilise for two weeks after transplanting (WAT) before treatments commenced. The three treatments of Moringa root extracts at 20g/L, 40g/L and 60g/L, Cypermethrin 0.125/L (recommended) and control (no insecticide) were applied as insecticides on tomato (*Solanum lycopersicum) plants* weekly till harvesting. A 2- litre hand-pumppressure sprayer was used for the application. Fresh mixtures were compounded each time they were needed.

Data Collection and Statistical analysis

At 2 weeks interval, tomato plants were assessed for growth parameters by measuring the plant height (using meter rule), number of leaves produced, number of branches, days to flowering and number of fruits and fruit weight/yield at harvest. All data obtained were subjected to analysis of variance (ANOVA), the means were compared by Duncan`s Multiple Range Test (DMRT) at P = 0.05 for significance.

Results and Discussion

The results as shown in Table 1 revealed the phytochemical compounds in *Moringa oleifera* root extracts such as alkaloids, saponins, reducing sugar, anthraquinone and triterpenoids.

At five (5) weeks after sowing (WAS) before treatment application, the tomato plants were observed to have insect-pest attack of *Helicoverpa armigera*. By 3 weeks after the treatments commenced (8WAS), the insect pest reduced especially within the plots treated with Moringa root extracts. The growth parameters on tomato plants: plant height, number of leaves and number of tomato plant branches (Figs.1 -3) showed no significant differences (p>0.05) among all the treatments from two weeks after treatment (WAT) to eight WAT. All the growth parameters followed the same trend whereby plots treated with 60g/L of Moringa root extract recorded highest values over other treatments, closely followed by 40g/L treated plots while the lowest values were observed in cypermethrin treated plots.

Table 1. **Phytochemicals Present in Root Powder of *Moringa oleifera***

Compounds	Powdered Root Water Extract
Alkaloids	+
Saponins	+
Steroid	-
Reducing Sugar	+
Flavonoids	-
Tannins	-
Anthraquinone	+
Coumarins	-
Triterpenoids	+

+ indicates presence - indicates absence

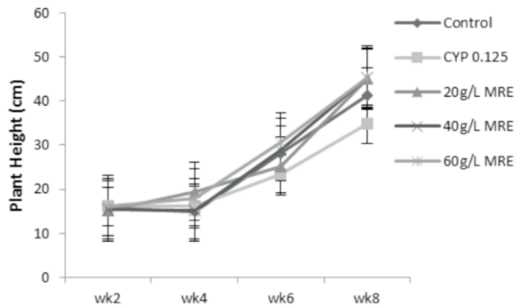

Fig. 1: Mean Effects of different treatments of Moringa root extracts and Cypermethrin on plant height of tomato

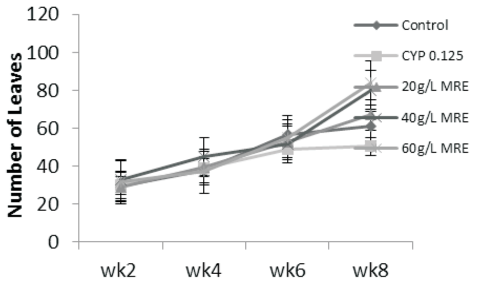

Fig.2:Mean Effects of different treatments of Moringa Root Extracts and Cypermethrin on the Number of Leaves of Tomato

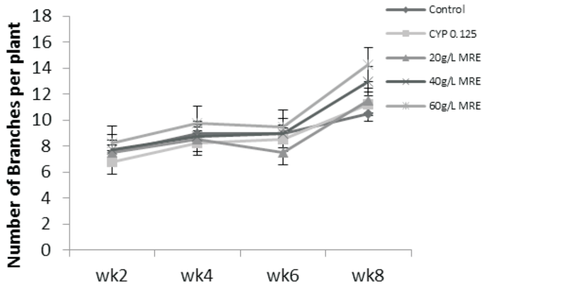

Fig. 3:Mean Effects of different treatments of Moringa Root Extracts and Cypermethri on the Number of Branches Produced by Tomato plant

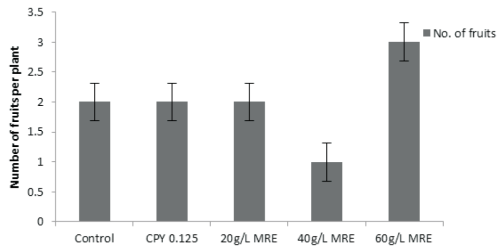

Fig. 4: Means Effects of different treatments of Moringa Root Extracts and Cypermethrin on Number of tomato fruits produced

CPY= Cypermethrin in litre, MRE=Moring Root Extract in litre

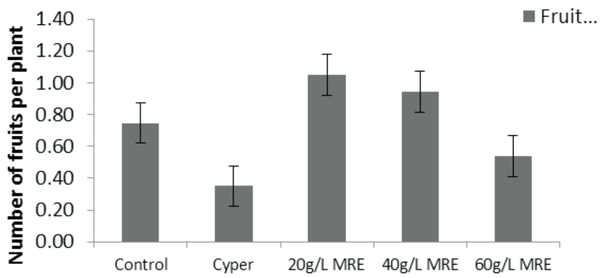

Fig. 5:Mean Effects of different treatments of Moringa Root Extracts and Cypermethrin on fruit weights (yield) Produced byTomato plant

CPY= Cypermethrin in litre, MRE=Moring Root Extract in litre

The yield parameters; number of fruits of tomato plant recorded no significant difference ($p>0.05$) among the treatments (Fig.4) while the fruit weight (yield) recorded significant differences ($p<0.05$) among the treatments (Fig.5). The 20g/L Moringa root extract treated plots recorded the significant highest number of tomato fruit weight (yield) over other treatments; closely followed by 40g/L Moringa root extract treatment while the cypermethrin treatment recorded the lowest yield. The entire Moringa root extracts at 20g/L, 40g/L and 60g/L compared favourably with the synthetic cypermethrin at 0.125/L (recommended) in growth and yield parameters.

This study revealed the potency and efficacy of different concentrations of Moringa root extracts on *Helicoverpa armigera*andwhite flies in having potent insecticidal potential(Ojiako *et al*., 2013). The excellent performance of the Moringa root extracts may be due to the presence of high concentrations of the phytochemicals; alkaloids, saponins, reducing sugar, triterponoids and anthraquinones which is in agreement with Morton, (1991).Also the fact that water exhibited stronger reactions thus being able to extract more phytochemicals means that there are more non-polar phytochemicals in the root in line with the work of Kasolo *et al.,* (2011). The secondary metabolites such as alkaloids, saponins (anti-feedant), (Isman, 2006; Fayinminnu and Shiro, 2014), triterponoids and anthraquinones (minor chemicals) are also toxic to insects. Moringa root,however,had been reported to contain alkaloid- spirachin (a nerve paralyzant) and the potent antibiotic and fungicide, pterygospermin (Panchall *et al.,*2012). According to Ojiako et al.(2013), it was found that Moringa plant (root and seeds) extracts were able to control the targeted storage and field insect pests of cowpea.

Conclusion

The use of biopesticide products should be well hard-earned to especially in developing countries because they could control the targeted pests and hence reduce the environmental pollution due to synthetic pesticides and increase biodiversities. *Moringa oleifera* is a household tree recently; therefore the products from it are readily available and cheap.The evidence is that the root extracts of *Moringa olifera* root as a natural insecticide against *Helicoverpa armigera*andwhite flies fits in sustainable agriculture with additional economic benefit. This biopesticide product is therefore recommended to farmers.

However, further studies needs to be carried out on pesticidal activities of *Moringa oleifera* as a bio-pesticide, to remove limitations potency variations, standardization of extraction methods and active ingredients and shelf life. This will enhance organic farming, Integrated Pest Management and increase global food production for sustainability.

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Assessment of Bio-Nematicides on the Growth and Yield of Cowpea Planted on Nematode Infested Soil

OLABIYI, T. I.[1], AKANDE, V. O.[1] ATUNGWU, J. J.[2], FAYINMINNU, O.O.[3] AND A. R. GBADAMOSI[1]
[1]Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, PMB. 4000, Ogbomoso, Nigeria.
[2]Department of Crop Protection, Federal University of Technology, Abeokuta, Nigeria.
[3]Department of Crop Protection and Environmental Biology, University of Ibadan, Nigeria
Corresponding Author: tiolabiyi@lautech..edu.ng

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Abstract

Nematodes remain global treats to the cultivation of cowpea. Use of synthetic nematicides have been the usual practice for the control of nematode pests of cowpea, but most times they are not available in market for the use of farmers and not eco-friendly. Their persistency in the soil is dangerous to soil health. All these side-effects of synthetic nematicides have prompted the scientists to search for environment friendly control measures. Application of bio-nematicides is one of the suggested measures because of their bio-degradable and non-persistency natures. The objective of this research was to assess the effects of plant-based bio-nematicides on the growth and yield of cowpea planted on nematode infested soil. The bio-nematicides were formulated from the combination of black soap and dried leaf ofChromolaena odorata, Hyptis suaveolens, Lantanacamara and Nicotiana tabacum.Single application of black soap and water served as control experiment 1 and 2 respectively. The six treatments was fitted into randomized complete block design and replicated four times. Nematodes identified in the soil includes: Meloidogyne, Pratylenchus, Helicotylenchus and Xiphinema species. The results showed that the root damage and soil population of nematodes were significantly (P≤0-05) reduced in the plots where plant-based bio-nematicides were applied when compared with the controls. The growth and yield of cowpea treated with the plant-based bio-nematicides were significantly (P≤0-05) more enhanced than those that were not treated. Research work is ongoing to characterise the plant-based bio-nematicides.

Introduction

Cowpea (*Vigna unguiculata* L. Walp) is one of the ancient crop known to man which, is now broadly adapted as highly variable crop, cultivated worldwide, primarily for seed which is a cheap source of protein for both urban and rural consumers (Singh, 2002; Chinma *et al*., 2008). Infections caused by plant parasitic nematodes are of great concern to growers of agricultural or garden crops because nematodes lives mainly in the soil, feed on the plant roots thereby causing significant reduction in the yield and quality of susceptible economic crops (Maggenti, 1981; Jonathan and Hedwig, 1991).

Cowpea is susceptible to a wide range of insect pests and pathogens that attack the crop at different stages of growth. Most cowpea varieties are susceptible to nematodes (Izuogu *et al*, 2014). It has been established that plant parasitic nematodes in conjunction with other pests and pathogens, are some of the factors that account for low yield in cowpea. Out of plant parasitic nematodes that cause severe infections on cowpea, root knot nematodes, caused the major serious infection (Sasser, 1979). Root knot nematodes are probably the major obstacle to the production of sufficient food, vegetables and fibre crops in many developing countries.

Control measures recommended for root knot nematodes are chemical, physical, cultural and host resistance. But chemical control is rated best because of its potential of killing nematodes instantly (Olabiyi, 2004). Nevertheless, the high costs as well as hazards associated with their applications are problems that cannot be ignored. Therefore, researchers are searching for environment friendly measures for nematode control. The objective of this research was to assess the effects of plant-based bio-nematicides on the growth and yield of cowpea planted on nematode infested soil.

Materials and Methods

Experimental location

The experiment was conducted at Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The temperature of the year ranges between 28^0C and 33^0C, with annual average rainfall of 1000 mm and relative humidity of about 74%.

Preparation of bio-nematicide

The fresh leaves of the plants with nematicidal properties (*Chromolaena odorata*, *Hyptis suaveolens,Lantana camara* and *Nicotiana tabacum*) were collected within theUniversity premises, air dried at ambient temperature (28 ± 2^oC) on the laboratory benches for 14 days. The leaves were grinded, using attrition mill, into powder. The powder was soaked for 48 hours at the rate of 2 kg plant-based bio-nematicide into 10 litres of water. The content was sieved with muslin cloth. The filtrate was mixed with black soap, which served as adjuvant, at a ratio of 1:10 (adjuvant: bio-nematicide).

Field preparation

The experimental field was ploughed twice and harrowed once. The experimental site was laid out into 4 blocks. Vegetable beds of 3 m by 2 m were manually constructed with 1 m spacing between beds.

Planting materials and field establishment

Seeds of cowpea (TVX-3236) were obtained from International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Three seeds were planted per hole with spacing of 50 cm by 25 cm and planting depth of approximately 5 cm and later thinned down to 2 healthy seedlings per stand at full crop establishment.

Inoculation

Cowpea was inoculated with 10 g per stand of chopped galled roots (root knot infested roots) of *Celosia argentea* at two weeks after planting.

Treatment application

The treatments were: *Chromoleana odorata* leaf + black soap, *Hyptis suaveolens* leaf + black soap, *Lantanacamara* leaf + black soap, dried *Nicotiana tabacum* leaf+ black soap, black soap (control 1) and water (control 2). The treatments were applied at the dilution rate of 3 litres of stock solution to 15 litres of water at4 and 6 weeks after planting as soil drench.

Cultural practices

Cultural practices like weeding was carried out as at when due. Spraying of the cowpea plants against insects was done using neem seed extract on 4th, 7th and 10th week after planting.

Data collection

Data were collected on plant height, number of leaves per plant, number of branches, number of pod per plant, number of seed per pod, weight of seed per pod, weight of seed per plant, root gall index, initial nematode population in the soil, final nematode population in the soil.

Data analysis

All data collected were subjected to analysis of variance (ANOVA) using SAS package and mean was separated using Duncan multiple range test at 5% level of probability ($P \leq 0.05$).

Results

Enhancement of growth on crops in soil treated with certain bio-pesticide could be attributed to the effective control measure of such bio-pesticide on the specified pathogen. Usually, it is required of an effective bio-nematicide to suppress the population of soil inhabiting plant parasitic nematodes, and also enhance the growth and yield of crop. This assertion was evident in Table 1 as it shows how bio-nematicides significantly enhanced the growth of cowpea planted in nematode infested soil.

Table 1. **Effect of bio-nematicides on the growth of cowpea planted on nematode infested soil**

Treatments	**Mean plant height**	**Mean number of leaves per plant**	**Mean number of branches per plant**
C. odorata leaf + black soap	62.7b	53.7c	3.3b
H. suaveolens leaf+ black soap	61.3b	78.2a	4.9a
*L.camara*leaf + black soap	70.7a	64.7b	4.0a
*N. tabacum*leaf + black soap	58.3c	59.4c	5.7a
Black soap (control 1)	46.2d	31.9d	2.8bc
Water (control 2)	38.0e	27.9d	2.4c

Figures followed with same letter along the same column are not significantly different ($P \leq 0.05$).

Table 2. **Effect of bio-nematicides on the yield of cowpea planted on nematode infested soil.**

Treatments	**Mean number of pod/plant**	**Mean number of seed/pod**	**Mean weight of seed/pod**	**Mean weight of seed/plant**
C. odorata leaf + black soap	36.0a	10.3a	1.2a	26.0b
H. suaveolens leaf+ black soap	29.0b	12.1a	1.5a	23.7b
L.camara leaf + black soap	20.3c	10.3a	1.8a	24.8b
N. tabacum leaf + black soap	32.0a	11.6a	1.7a	32.5a
Black soap (control 1)	8.0d	4.9b	0.6b	4.0c
Water (control 2)	7.8d	3.2b	0.4b	2.8d

Figures followed with same letter along the same column are not significantly different ($P \leq 0.05$).

Table 3. **Effect of bio-nematicides on the soil nematode population and root damage of cowpea planted on nematode infested soil**

Treatments	Initial nematode population	Mean Final nematode population	Mean Root gall index
C. odorata leaf + black soap	675a	412b	1.2a
H. suaveolens leaf+ black soap	680a	315a	1.0a
*L.camara*leaf + black soap	669a	430b	1.0a
*N. tabacum*leaf + black soap	670a	307a	1.0a
Black soap (control 1)	670a	698c	3.5b
Water (control 2)	672a	1210d	4.2c

Figures followed with same letters along the same column are not significantly different ($p<0.05$)

Table 2 shows the effect of bio-nematicides on the yield of cowpea planted on nematode infested soil. The cowpea plants that were treated with bio-nematicides have significantly higher yield when compared with the controls (single applications of black soap and water). The soil population of nematode were significantly ($P\leq0.05$) reduced in the soil treated with bio-nematicides (Table 3). While the population of nematodes were significantly reduced in the soil treated with bio-nematicides, they were significantly increased in soils that were not treated (single applications of black soap and water). The degree of root damage, a measure of root gall index, was significantly ($P\leq0.05$) reduced on cowpea plants that were treated with the bio-nematicides. Cowpea plants that were not treated with bio-nematicides have significantly ($P\leq0.05$) higher root damage (root gall index).

Discussion

The results from this research have shown that bio-nematicides improved the growth and yield of cowpea planted on nematode infested soil and this corroborate findings from other researchers. Olabiyi *et al* (2004) have reported the bio-nematicidal properties in some plants, including *H. suaveolens*. In 2006, Olabiyi *et al* (2006) also reported the bio-nematicidal properties in African marigold, rattle weed, nitta and basil. Akinyele *et al* (2009) also reported reduction of nematode population in plantain after the application of*Tithonia diversifolia* as bio-nematicide.

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Strengthening Collaboration Between Researchers and Practitioners within the Organic Sector in East Africa

ESTHER W. WAWERU, CHARITON D.B. NAMUWOZA, EUSTACE GACHANJA AND JORDAN GAMA
[1]International Center for Research in Organic Food System (ICROFS), Denmark,
www.icrofs.org E-mail: esther.waweru@icrofs.org
[2]National Organic Agricultural Movement of Uganda (Nogamu), Uganda,
www.nogamu.org.ug E-mail: cnamuwoza@nogamu.org.ug
[3]Kenya Organic Agricultural Network (KOAN), Kenya, www.koan.co.ke
E-mail: ekiarii@koan.co.ke
[4]Tanzania Organic Agricultural Movement (TOAM), Tanzania
E- mail: toam@kilimohai.org

Keywords: Participatory research, communication, partnership.

Abstract

There has been a longstanding debate on how to bridge the gap between research and practice and improve communication between researchers and practitioners. It has been argued by a number of scholars that there are clear divides between academics and practitioners and areas which remain unique to each. However, some experiences show that there are many coinciding areas that both institutions have observed. The objective of the paper is to illustrate the collaboration between the researchers and organic movements and the experiences of knowledge sharing between these actors. In conclusion the experiences from the project show that a collaborative relationship and partnership does serve multiple purposes as well as symbiotic for the partners.

Introduction

Collaboration between universities and non-governmental organisations can have many benefits. However, bridging the gap between the research environment and practice can sometimes be a challenge. The research and capacity building project 'Productivity and Growth in Organic Value Chains (ProGrOV) is a platform where researchers and organic farming movements in East Africa share knowledge and experience in order to develop the organic food farming sector.

ProGrOV focuses on improving productivity and growth in existing organic value chains in Uganda, Kenya and Tanzania through research that is informed by the needs of the sector and addresses development of agro-ecological methods, governance, management of organic value-chains, and capacity development in participatory and interdisciplinary approaches. Experience has shown that there are many coinciding areas in which to collaborate, such as problem identification, research needs, fieldwork facilitation, data collection trainings and dissemination. The result is participatory research.

Participatory research emerged in response to limitations of top-down research and development approaches. Researchers based their work on the transfer-technology model which they presumed would be adoptable by and beneficial to small farmers. It was discovered the key to success lies in creating better extension services provided by local non-governmental organisation (NGOs). These local organisations are highly motivated by solidarity; they have direct contact to the local population and enjoy a better knowledge of the local people's circumstances and needs. (Ponzio,*et al* 2013)

ProGrOV implements this ideology. The organic movements in Kenya, Uganda and Tanzania have been continuously involved in the steps towards strengthening the organic sector in this region. Together with major organic food chain operators, they have identified specific research and adaptation needs in primary production processing and chain management. These identified research areas were the basis of discussion with the partners in ProGrOV.

Before the project, the Universities from the three countries had little association with the organic movements of their countries even though one of the universities (Sokoine University of Agriculture Tanzania) had organic agriculture in their curriculum. However since the start of ProGrOV, their collaboration emerged to be one that was crucial for the success of the project as well as beneficial to both the academic institutes and the organic movements. Some of the gains realised through the project include:

– **Identification and prioritization of relevant research areas:** The project approach encouraged having all parties involved in the project formulation and the inception of the project ensured that research questions were relevant to problems faced in the field.
– **Stakeholders' engagement:** Collaboration links the university and the organic sector stakeholders, such as policy makers, exporters and farmers. Much of the research data was generated from or through stakeholder engagement and their involvement contributed to enriching research. This has further lead to more participation in policy dialogues by researchers who have influenced the policy development process that affects the organic sector in the region.
– **Dissemination and communication:** There are arrangements that synthesised research findings will be translated through national organic movements into popular language, thus easing dissemination.

Not an easy task

Our experiences from the past ProGrOV field work and research is that it is not an easy task to bridge the looming gap between researchers and farmers. There is still the issue of a "top-down" perspective which is mainly seen with researchers as they work and communicate with the farmers and other actors. Consequently, this approach limits capacity of information flow that is necessary for the researchers to conduct relevant studies. Expected recipients of results also find it difficult to adopt or adapt knowledge and /or practices "handed down" to them by "strangers". In such situations, the farmers' motivation sets back the research because they demand "other" incentives from the researchers during their fieldwork. The result is that fewer farmers participate in the research, more time is consumed in problem identification, "imaginary" problems are addressed, and students and organic movements find it hard to persuade participation. However the farmers who participate in research do feel short-changed as the final findings are more often not synthesized in a way that farmers could understand or use at their level.

Paving the way for more collaboration

The platform created by ProGrOV has opened up new avenues for the universities and organic movements to further work together in other projects and joint initiatives.

In Uganda both Makerere University (MAK) and National Organic Agriculture Movement of Uganda (NOGAMU) have joined forces with other organizations across Africa to implement the Ecological Organic Agriculture (EOA) initiative. EOA is an African led initiative by the African Union to mainstream ecological organic agriculture into the African Development Agenda. Both institutes are involved in 2 pillars i.e. the information, communication and networking pillar and the value chain and marketing pillar. The Ugandan partners have also established a National Platform for experience sharing and have a continuous dissemination strategy. This will not only target the value chain actors but the general public as well. Their key focus is to use local media in creating awareness as well as advocate for organic agriculture and its research.

The relationship between the Tanzanian partners has had new developments as Tanzanian team leader from Sokoine University of Agriculture is currently a board member in Tanzania Organic Agriculture Movement TOAM. This involvement has further lead to other joint activities and events i.e. 'Nane-Nane' a farmers' shows that is held annually by Sustainable Agriculture Tanzania (a member of Tanzania Organic Agriculture Movement TOAM). The exhibition is held at university grounds (for free) where they have demonstrations such as sack gardens and hill farming. Students from the university benefit from the exhibition as they visit them as part of their organic course. The Tanzanian organisations are in the process of developing an MOU for a long-term collaboration. Some of these future collaborations include;

- Adding a course on the organic certification in the university curriculum and having members of Tanzania Organic Agriculture Movement as guest lectures;
- Plan on opening a research centre, the Organic Centre of Excellence;
- Establish a demo farm on organic agriculture on a piece land that was offered to them by the former head of the Crop science department in the University.

In Kenya, the project partners feel that their relationship has been beneficial as the networking has made it easier to bring the four arms in the organic sector (the producers, the market, the consumers and the researchers) together to this platform. The two are currently developing a demonstration farm on the university grounds where organic farming practices will be taught. This will also be a place/market where the organic farmers can bring their produce together and it would be packed and sold to consumers. Kenya Organic Agriculture Network (KOAN) and University of Nairobi (UON) have recently established an Organic Consumer Alliance (OCA) which is an online platform for information and advocacy on organic consumption. The board, chaired by Professor Wahome (Kenya-ProGrOV manager), comprises of leading organic product processors, distributors and retailers.

Across the borders, the three organic movements and the University of Nairobi UON are also partners of 'Enhancing the Coordination of Organic Products access to Markets in East Africa' - ECOMEA, a regional project funded by Danida and whose objective is to enhance the coordination of markets in East Africa.

Conclusion

ProGrOV has shown that a collaborative relationship and partnership does serve multiple purposes, for example in formulation of relevant research questions, having interaction with different actors throughout the research process, supporting data collection and analysis, and providing outlets for sharing, feedback and dissemination. This initiative also demonstrates that such a partnership is symbiotic for the partners i.e. the organic movements have provided access to empirical experience and evidence, while the universities have brought theoretical framing and methodological expertise which are key in the development of organic agriculture sector in East Africa. Development organisations such as the NOAMs have a clear goal on advocacy but working with research institutes helps to make this message clear thus such collaboration is beneficial in bridging the gap between research and practice and aids in improving the communication between researchers and practioners.

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Opinion and Involvement of Fish Farmers in Organic Aquaculture in Osun State, Nigeria

MABEL O. IPINMOROTI
Department of Fisheries and Wildlife Management,
Osun State University, Osogbo, Nigeria
Corresponding Author: wumsco@yahoo.com

Keywords: Organic practice, fish farming, nutrition, culture systems.

Abstract

The increasing demand for healthy food as means of reducing the incidence of food related diseases necessitated the desire for better food production practices. Organic practice aims at maximizing productivity using natural, biological and ecological processes. Food production in most developing countries lays in the hands of small holders. This study reveals the opinion and the level of involvement of fish farmers in organic aquaculture in Osun state. Fish farmers were identified from three communities in each of the six Local Government Areas using multistage random and purposive selection techniques. Structured questionnaire was designed to identify Farmers' knowledge and involvements in organic aquaculture. Data were analysed using descriptive statistics of mean, frequencies and percentages, and inferential statistics of analysis of variance using SPSS 17 for Windows. A total sixty-six farmers were identified across the six selected LGA. Level of organic practice is low among farmers and a high level of lack of knowledge of organic practice was observed. There is the need to enlighten and train farmers on the benefits and practices of organic fish farming, if the desire for good quality food will be met.

Introduction

There has been an increase in global demand for fish to meet the growing population. This led to increase in pressure on the ecosystem, leading to overfishing and dwindling supply (ICTSD, 2009). Production from aquaculture seems the plausible option to bridge the gap between production and demand. Indeed there has been a steady growth in production from aquaculture (FAO, 2012). Production of fish from aquaculture in the conventional way is associated with the use of substances and processes that are suspected to have health implications and other negative impacts (Lasner and Hamm 2011).

Advances in health and nutrition have led to higher interest in the production of agricultural resources through natural otherwise known as organic means. Organic practice aims at maximizing productivity using natural, biological and ecological processes. Organic production processes are environment friendly (materials are biodegradable and harmless to the ecosystem), products are of better quality and are healthier for consumption (Ipinmoroti, 2010). Theoretically, organic farming means letting the animal being raised grow according to its nature and at stocking densities that closely mimics its natural habitat (Lembo, 2011). Organic aquaculture protects consumer health by reducing the overall exposure to toxic chemicals from pesticides that can accumulate in the ground, air, water and food supply. Organic aquaculture doesn't use toxic pesticides and helps prevent top soil erosion, improves soil fertility, protects ground water, and conserves energy. In simple words organic aquaculture can be called an approach for safer fisheries (Bai and Lee, 2011).

Sustainable methods of aquaculture otherwise known as ecological organic aquaculture is a response to negative impacts of overfishing of natural ecosystems and problems associated with conventional aquaculture. For organic aquaculture to thrive fish farmers who are the major stake holders in the supply chain must have basic knowledge and the right opinion about the system and the product. This study finds out the opinion and to what extent fish farmers in Osun State are involved in the practice of organic aquaculture.

Methodology

Multistage selection technique was used for the study.

Stage1: Was the random selection of six Local Government Areas in Osun State, Nigeria. They were: Odo Otin, Ikirun, Osogbo, Ede, Ejigbo and Iwo.

Stage 2: Random selection of three communities from each of the six LGAs.

Stage 3: Purposive selection of practising fish farmers were identified in each of the communities.

Structured questionnaire prepared to assess the knowledge, opinion and involvement of fish farmers in organic aquaculture were administered to those identified. A total of Sixty-six fish farmers were identified for the study. Farmers' knowledge were assessed through acceptable and non-acceptable organic aquaculture practices, benefits to man and environment while their involvements were assessed based on the frequency at which they practice some acceptable organic aquaculture activities. Data were analysed using descriptive statistics of mean, frequencies and percentages, and inferential statistics of analysis of variance using SPSS 15 for Windows.

Results and Discussion

Table 1 shows the distribution of respondents on the bases of religion, marital status and educational level. Sixty – six fish farmers that were identified responded to the structured questionnaire interview that was administered for the study. Forty-eight (72.7%) of them were male and eighteen (27.3%) were females. The dominance of men in fisheries and fish farming has been reported by other authors (Brummet, 2010; Ele *et al*, 2012 and Olaoye *et al*,2013). It is believed that the male dominance in fisheries and agriculture activities is linked with the traditional system of land acquisition in most communities in Africa .The population comprises 40.9% Christians, 57.3% Muslims and 1.5% Traditionalists. Most of the respondents (63.6%) are married; the populations of single, widowed and divorced were 12.1% respectively. The result shows average literacy level among the practitioners 30% had secondary education, 27.3% had tertiary education and 18.2% have secondary education while 24.2% had non and no formal education. The level of education is generally lower than those reported for their counterparts in Oyo State in similar study by Olaoye (2013).

Table 1. **Demographic information on respondents**

Item	Options	Frequency	Percentage
Gender	Male	48	72.7
	Female	18	27.3
	Total	**66**	**100.0**
Religion	Christianity	27	40.9
	Muslim	38	57.6
	Traditionalist	1	1.5
	Total	**66**	**100.0**
Marital status	Married	42	63.6
	Single	8	12.1
	Widowed	8	12.1
	Divorced	8	12.1
	Total	**66**	**99.9**
Level of education	No formal	9	13.6
	Non formal	7	10.6
	Primary	12	18.2
	Secondary	20	30.3
	Tertiary	18	27.3
	Total	**66**	**100.0**

Table 2. **Awareness of some facts about organic fish farming activities**

Organic fish farming Activities		**Frequency (%)**		**Score**
Practice	**Component**	**Yes**	**No**	
Use of organic manure	Compost	74	25.8	H
	Animal manure	96.9	3.1	H
	Plant residue	81.4	8.6	H
Natural resources for lime	Limestone	46.00	54.00	L
	Wood ash	37.88	62.12	L
Feed	Ingredient from organic produce	70.77	29.23	H
	Already prepared feed	73.85	26.15	H
Pest and Weed control	Biological(plant extract, herbivorous, insectivorous fish)	58.46	41.54	M
	Cultural(proper pond construction/preparation, stocking density etc)	81.8	18.2	H
	Mechanical(use of physical tools)	75.75	24.24	H
Conversion period	6 months for drainable facilities	89.39	10.61	H
	24 for non drainable facilities	45.46	54.54	L
Culture system	Polyculture system	77.27	22.73	H
Culture facilities	Use Earthen ponds	14.03	85.96	L
Breeding mates	Same species	76	24	H

Organic fish farming is practiced by 18.18% of the fish farmers, 7.58% practice both conventional and organic while 74.24% practice only conventional fish farming. A total of 25.76% adopt organic practice out of this 7.57% were female 18.19% were male. Organic practice is a new innovation, it is therefore expected that adoption will naturally be gradual. This also applies to the number of ponds under organic practices. The minimum, mean and maximum number of ponds own by individuals practicing organic fish farming is 1, 3 and 10 respectively. The number of ponds for conventional practice range between 1 and 50 with a mean of 7 (Table 2).

Fish farmers were well aware of the use of organic manure, compost (74%), animal manure (96.9%) and plant residue (81.4%); organic feed (70.77%) and feed ingredients (73.85%); biological pest and weed control (58.46%), cultural control (81.8%) conversion period of 6 months for drainable ponds (89.39%), acceptable culture system (77.27%) and breeding mates (76%). However, the farmers score low in the awareness of acceptable culture facility (14.03%), lime materials (37-46%) and 37-45.46% for conversion period of 24 months for non-drainable facilities (45.46%) (Table 2).

Table 3. **Fish farmers Opinion on Ecological Organic Aquaculture**

Opinion on organic fish farming	**Frequency (%)**		**Score**
	Agreed	***Disagree***	***Don't know***
Encourages natural fish behaviour	63.64	31.82	4.54
Practice increases water pollution	73.8*	12.1	15.1
Causes Ecosystem sustainability	72.73	22.73	4.54
Produces fish of better quality than conventional	18.5*	58.5	23.1
Fish produced are not pollutant/toxic free	43.9*	9.1	47.0
Fish have better taste than those from conventional practice	51.50	22.7	25.8
Practice does not ensure safe food and clean environment for practitioners	43.1*	32.3	24.6
Practice encourages native species	*7.5	74.3	18.2
Practice pollutes ground water	69.7*	22.73	7.6
Practice ensures proper waste disposal	22.7*	69.7	7.6
Product command good price than conventional	39.39	31.32	28.79

**wrong opinions about organic aquaculture.*

Fish farmers in the study area have some wrong opinions or are ignorant of organic aquaculture practices and products (Table 3). Many of the wrong opinions include the belief that products from organic aquaculture are not toxic free (43.9%); organic practice does not ensure safe environment (43.1%), it increase water ground pollution(69.7%). More respondents however believe that organic products have better taste (51.50%) and are better priced (39.39%) than conventionally produced ones. A high level of ignorance (47.0%) was revealed on whether or not products are toxic. Knowledge is the first stage in adoption process and it indicates the awareness of an innovation. It is the stage at which individuals come into contact with information about the innovation and learn about how it works (Roger, 2003). The prevalence of negative opinions about organic agriculture displayed by these farmers show that they do not have correct information on organic fish farming and its products, the low level of organic practice (18.18%) is therefore expected.

Table 4. **Organic aquaculture practices among fish farmers**

Practice	Always	Occasional	Never
Use of animal wastes as manure	78.6	21.4	
Use of crop/plant wastes as manure	33.34	45.5	21.2
Integrated fish farming (fish/animal and or plant)	54.31	22.9	22.79
Use of Compost manure	42.9	47.6	9.5
Feeding of good quality feed to encourage breeding	71.2	27.7	6.1
Use of plant extract to control pest and diseases	27.3	54.5	18.2
Use of biological/cultural weed and pest control	59.1	34.8	6.1

The use of animal wastes as manure is well accepted by the fish farmers (78.6%). It is not very clear why compost and the use of plant wastes seems not to be popular among the farmers (33.34%), for compost it is either because of poor understanding of its importance or the skill to produce it. Fish diseases are rare under good cultural and management practices hence the low level (27.3%) of usage of herbs in combating disease is understandable (Akogun et al, 1997).

Conclusion

There seems to be lack of adequate knowledge of the benefits associated with organic aquaculture practices in the study area. This was evident in the various negative opinion and ignorance paraded by the fish farmers. The need for better education of fish farmers is apt. This is because fish is reared in environment that harbours most pollutants produced on the surface of the earth which makes it at high risk. Protein from animal sources, especial fish, are better utilised in human than those of plants. It is therefore pertinent to take proactive measures that will lead to better understanding of organic aquaculture practices that would encourage the adoption of the innovation and production of healthy fish for human consumption by fish farmers especially in Osun State, Nigeria.

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Opportunities and Challenges for Reinforcing Organic Agriculture Research Capacity in East African Universities: Experience of Makerere University

FRED KABI[1], SYLVIA NALUBWAMA[1], SAMUEL KABI[1,2], NORMAN KWIKIRIZA[1],
STEPHEN ANECHO AND MUHAMMAD KIGGUNDU[1]
[1]Makerere University, School of Agricultural Sciences, P.O. Box 7062, Kampala, Uganda
[2]Gulu University, Faculty of Agriculture and the Environment P. O. Box 166, Gulu, Uganda
Corresponding Author: fred.kabi@gmail.com, fredkabi@caes.mak.ac.ug

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Abstract

There is a need for generation of new knowledge and skills to reinforce organic agriculture capacity to answer a variety of lingering questions about production, product quality, marketing, social economic implications on livelihoods and sustainable development through research. Generated knowledge is also needed to inform development and institutionalization of national policies on organic agriculture. Support to universities in collaboration with the private sector to popularize and commercialize organic agriculture through curriculum review and regional harmonization will help to produce a critical mass of competent graduates to promote organic agriculture. At Makerere University we believe great success in the subsector will only come from great support.

Introduction

Growth and development of organic agriculture in East Africa continues to be driven by the increasing demand from nutritionally and environmentally conscious consumers in developed countries. In Uganda, the organic subsector is mainly driven by the private sector and commercial export companies . Development of organic export market was earlier accelerated by support from the Swedish International Development Agency (SIDA) under the Export Promotion of Organic Products from Africa (EPOPA) in 1994. A study by concluded that farms engaged in certified organic export production are more profitable than those that are solely engaged in conventional production. However, much of the progress made in the subsector has been in the area of crop production with little or no integration with organic livestock production.

Despite the availability of market for organic products in the European Union and beyond, organic farming still faces a number of challenges. This is attributed to several factors including minimal demand for organic products locally and regionally, limited government infrastructural support, high costs of third party certification and low levels of knowledge and poor information dissemination (UNEP-UNCTAD, 2010). Limited research in organic agriculture in African universities has possibly contributed to the minimal demand for organic products locally and regionally. Besides, negative stereotyped attitude towards a career in the subsector is quite evident among many scholars. This has further exacerbated lack of appropriate technologies and limited capacity to attract research funding to organic agriculture. It is, therefore, postulated that if organic agriculture is to be mainstreamed into the

African development agenda, involvement of universities is crucial in reinforcing organic agriculture research capacities. Moreover, agricultural faculties have been slow to adopt and adapt to new realities of the need for mainstreaming organic agriculture into undergraduate and graduate curricula as a way of generating a critical mass of actors in the subsector. Other hindrances to organic agriculture in Uganda include in existence of an explicit organic agriculture policy . The objective of this article is to highlight the opportunities, challenges, research impact and experience of Makerere University (MAK) in collaboration with International Center for Research in Organic Food systems (ICROFS), University of Nairobi (UoN), Sokoine University of Agriculture (SUA), University of Copenhagen and the three national organic movements of East Africa (NOGAMU, TOAM and KOAN) to build organic agriculture research capacity.

Structural approach for Reinforcing Organic Agriculture Research Capacity in East African Universities

In an attempt for Africa to address its growing food security concerns and broadening employment opportunities, it is crucial to engage universities to upgrade the quality of trained human resource. Therefore, agricultural colleges and faculties are important targets to accelerate production of graduates with relevant knowledge and skills to function as positive catalysts along the knowledge chain of organic agriculture, food security and safety.

Young researchers scientifically trained in different discipline were therefore identified from Makerere University (MAK), UoN and SUA. Relevance for organic agriculture was introduced to all the fresh recruits by the local and Danish supervisors using tailor made and focused training building on students' own field of expertise.

Overall, 9 Ph.D. and 6 M.Sc. students were initially enrolled at MAK, UoN and SUA under the DANIDA funded Productivity and Growth in Organic Value Chain (ProGrOV) project. The students were expected to present several seminars and to produce M.Sc. and Ph.D. theses as well as scientific publications before graduation. The capacity of the students and their assigned local and international supervisors was strengthened to enable collaboration with private sector through a series of programmed rotational workshops in the region. Interdisciplinary research based on both within country and regional challenges was developed aimed at producing competent graduates. The research focused on whole supply chain of organic products, farm systems, product quality, marketing, social economic implications and impact on rural community development. A number of support structures were developed to facilitate learning and communication between students and their supervisor. All supervisors and regional students were structured to attend annual workshops. This was aimed at broadening the perspective of the students and their supervisors on their own research, including values and principles of organic farming as a way of understanding the wider context in which their research is embedded. The students were also encouraged to present their findings at international conferences and all the publications were exposed to international community readership via the literature platform on organic food and farming found at the organic E-prints: http://organic prints.org.

All Ph.D. students underwent SOAR training course in Denmark aimed at imparting scientific approaches to research in global organic food chains. Agro-ecology, environmental care and livelihood research were also introduced. The students were inducted into formulation of research questions on complex issues which are relevant in the current economic, agricultural and political situation in East Africa.

Impact of Reinforcing Organic Agriculture Research Capacity at Makerere University

The Agro-ecology and agricultural productivity component attracted two Ph.D. students. One student focused on integrating livestock into crop production system so as to encourage value addition and diversification of sources of income in the organic pineapple production chain. The second Ph.D researched on developing an integrated pest management package for organic pineapple farmers. The major challenge faced by candidates was to defend the new concept of organic agriculture research among professors on the college graduate board who were researchers in conventional agriculture. It took the students over one year to convince the different panels in order to get officially registered as graduate candidate. Fortunately, all the candidates stayed the course and the Ph.Ds are in their final year. Community needs assessment was carried out (Nalubwama et al., 2014)to identify challenges of integrating livestock into organic pineapple farming. This was aimed at developing strategies to enhance nutrient recycling for sustainable organic pineapple productivity. It was observed that in addition to growing pineapples, the farms also kept different livestock(Figure 1).

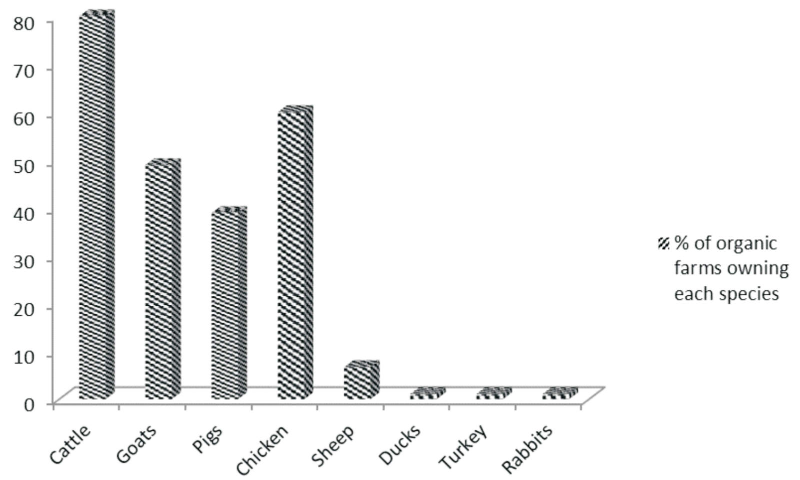

Figure 1. **Proportions (%) of organic pineapple farms owning each livestock species in both Kayunga and Luwero districts.**

A move towards having organic farms orientated towards organic livestock production will possibly enable farmers benefit from a fully integrated organic system with the benefit of accessing niche markets for the organic animal and their products. Research that improves farmer's knowledge on how to select for particular production traits from indigenous livestock based on organic farming principles under tropical conditions were suggested as strategies that might support integration of livestock into smallholder organic pineapple production.

The second PhD candidate observed that the occurrence of the pineapple mealybug (*Dysmicoccus* spp.) has been increasing at an alarming rate on pineapples farms in Uganda (Kabi *et a*l., 2015). The cause of the epidemic is unknown. The study therefore set out to establish if the prevailing cropping systems, production and management practices can provide an insight into the trend. Farmers used different soil fertility management practices depending on farm type (organic or conventional) (χ^2 = 99.351; df =3; P <0.001) (Table 1). Using a biological monitoring study, it was observed that mealybug populations were lower in the pineapple-banana intercrop as compared to the sole pineapple crop. Earthed-up seedbeds created a favourable environment for mealybug multiplication compared to growing the plant on flat beds. The popular practice of using coffee husks as soil amendments was found to promote population build up whereas fallowing reduced the infestation levels.

Table 1. **Proportion of organic and conventional farmers using different soil management practices and cropping systems**

Management Practices/systems	**Percentage of farmers**		**Pearson Chi-Square Value (χ^2)**
	Organic farmers	**Conventional farmers**	
Seedbed type			
Earthed-up	31.0	63.6	0.487^{ns}
Flat seedbed	69.0	36.4	
Soil fertility management Practices			
Coffee husks	31.0	36.4	99.361***
Foliar fertilizer	0	28.8	
Fallowing (<10yeas) +Foliar fertilizers	0	34.8	
Fallowing (=10years)+No amendment	69.0	0	
Cropping Systems			
Pineapple-banana intercrop	59.5	53.0	0.662^{ns}
Pineapple-beans-banana intercrop	7.1	7.6	
Pineapple sole crop	33.4	39.4	

*, ** and *** represent Chi-square values (χ^2) significant at P<0.05; 0.01 and 0.001, respectively

The M.Sc. candidate in this component evaluated the use and availability of feed resources and the coping strategies used by smallholder certified organic pineapple farms to overcome dry season feed shortages. Farmers reported high cost of concentrates and scarcity of feeds as their biggest challenges in dairy cattle production. As a coping strategy to feed shortages, majority (42.9%) of farmer scavenged for feed resources from both organic certified and nonorganic neighboring farms which is contrary to organic livestock farming standards. The practice of acquiring feed resources varied with cattle management systems, willingness and attitudes towards using non conventional feed resources (Figure 2 and Figure 3). It was, therefore, concluded that management of livestock feeding in the study area fell short of the requirements for organic livestock feeding standards. Research to develop strategies that can use alternative on-farm feed resources through ensiling organic pineapple wastes during the dry season was recommended and implemented together with the farmers as a long term strategy to address feed challenges for organic livestock farmers.

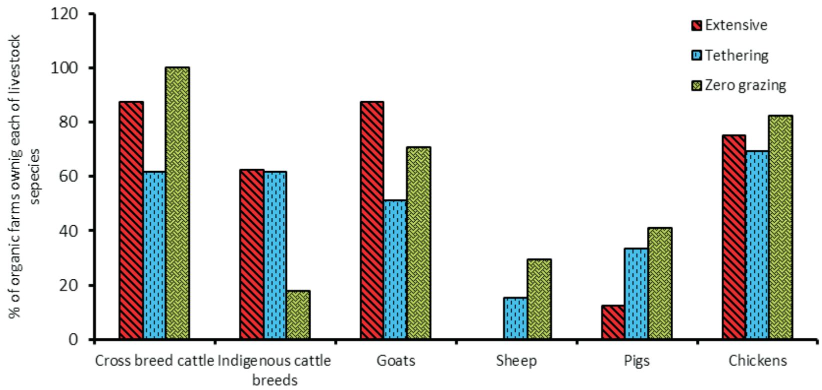

Figure 2. **Graph showing the percentage distribution of livestock species under the different cattle management systems.**

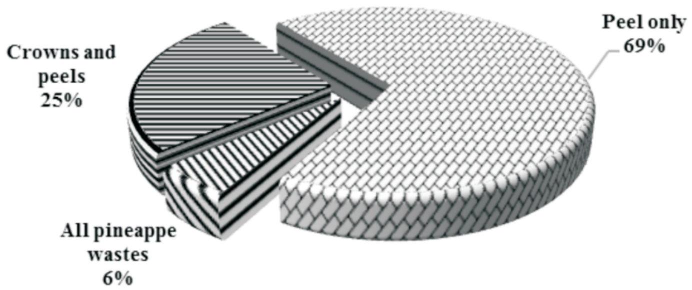

Figure 3. **Percentage of use of the different pineapple processing by-products by farmers in feeding their cattle**

The third Ph.D candidate in the Value chain and agribusiness development component analyzed governance of the global value chain exporting pineapple from Uganda. In this component the second M.Sc student explored two aspects: i) Consumer characteristics and determinants of their preferences for organic products in Kampala, Uganda. ii)Determinants of consumer willingness to pay for organic products in Kampala; Uganda. Although the M.Sc. completed and is working on the publications, he has not yet defended his thesis due to institutional bottlenecks of locating external examiners with competences in organic agriculture. The Ph.D candidate in this component is in his final year and has one manuscripts under review in the African Crop Science Journal. Results showed that 10 export companies linked farmer produce groups to importers in Europe, Japan and America. The organic pineapple value stream was reported to be shorter than the conventional stream. A small proportion (28%) of pineapples produced by farmers was exported through the organic pineapple value stream. Exporters seldom met the volume orders from importers possibly due to infrastructural limitations. More volumes could be exported if i) interest rates were lowered to encourage investment by exporters, ii) a range of organic pineapple products were produced through value addition, iii)there was better coordination among export companies, iv) there was more vigilance by the Government especially through enacting legislation that favor the organic sector.

Conclusion

Mainstreaming organic agriculture into the African development agenda will only be possible if universities in partnership with private sector are involved in creating a critical mass of practitioners to advance the subsector. This will only be possible if new knowledge and skills are generated through research to reinforce organic agriculture capacity to answer a variety of lingering questions on production, farm systems, product quality and marketing of organic products at local and regional levels. New knowledge through research is also needed to inform development and institutionalization of national policies on organic agriculture. It is our belief that great success in popularizing and commercialization of organic agriculture locally and regionally will only come from great support to universities through curriculum review and development to train competent graduate.

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Yield Response to Type of Mulch and Time of Mulch Application in Organic Production of Tomato (*Solanum lycopersicum* L.)

L. SHECHAMBO[1], K.P. SIBUGA[1], T.J. MSOGOYA[1] AND SIGSAARD, L.[2]
[1]Department of Crop Science and Production, Sokoine University of Agriculture, Morogoro, Tanzania.
Email: headcrop@suanet.ac.tz
[2]Zoology Group, Department of Agriculture and Ecology, University of Copenhagen, Denmark.
Corresponding Author: lilly_lish@yahoo.com, sibuga88@yahoo.co.uk,
tjmsogoya@yahoo.com, les@plen.ku.dk

Keywords: RCBD, Mulch, Tomato, Transplanting, *Solanum lycopersicum L.*

Abstract

Mulching in organic agriculture is important for a variety of roles it performs. Mexican weeping pine (Pinus patula Schelde. ex Schltdl and Cham) and wild lemon grass (Cymbopogon spp.) were used as mulch to evaluate the effect of type of mulch, time of applying mulch and influence of seasons on yield of organically produced tomato (Solanum lycopersicum L.) in Lushoto district, north-eastern Tanzania. The experiment followed a Randomized Complete Block Design (RCBD). The treatments were pine mulch applied 3 days after transplanting, pine mulch applied 3 weeks after transplanting, grass mulch applied 3 days after transplanting, grass mulch applied 3 weeks after transplanting, weeded and unweeded (control). Yield data were taken at harvesting. Data analysis was done by using Genstat Statistical Package. Results showed that the time of mulch application at an interval of three days and three weeks after transplanting did not have an influence on yield but yields of tomato were significantly higher in mulched than in unmulched treatments. Tomatoyields recorded in season 1 (wet and cold) were higher at both sites than yields recorded in season 2 (dry and warm).This study reveals that the type of mulch used and the time of application affect tomato yield positively.

Introduction

Tomato (*Solanum lycopersicum* L.) is a highly valued horticultural crop consumed as a source of Vitamins A and C necessary for supplementing the daily dietary requirements of the human body. Tomato is used in diverse ways around the world in its raw form and in a cooked form as an ingredient in many dishes. Tomato is cultivated by using conventional as well as organic methods however, the ecological, toxicological and environmental shortcomings concerning synthetic pesticide and fertilizer residues in food and the environment have raised some restrictions on the use of the conventional agricultural produce (Cohen and Yuval, 2000). The raised doubts and restrictions on conventional produce is the driving force behind the recent preferences in organic produce worldwide (Willer and Yussefi, 2006). Organic production not only reduces health risks to both producers and consumers but also maintains and improves soil qualities (Van Elsen, 2000). Soil-bound organisms also benefit because of increased bacteria populations due to incorporation of natural fertilizer such as manure, while experiencing reduced intake of pesticides (Hole *et al*., 2005). Crop management in organic production systems requires an integration of all possible cultural and preventive practices. Among the cultural practices allowed in organic production systems, mulching is highly emphasized for its role of suppressing weeds, conserving soil moisture, providing nutrients upon decomposition, conserving natural enemies of insect pests by providing them with a suitable habitat, moisture, protection and alternative prey (Cortesero *et al*., 2000).

Lushoto district, in the northeastern of Tanzania is one of the areas where organic production of many vegetables including tomato occurs. Farmers commonly use star grass, banana leaves, bean plants and pods and other crop residues as mulch. However, several challenges have been associated with the use of common organic types of mulch such as an increase in labour cost in terms of time and money as most of these mulches require frequent replenishment, a year-through inaccessibility as most of these mulch become available only after harvest following the rainy season and inadequate availability even during the season because most of these mulches are also used to feed domestic animals. Challenges associated with such commonly used mulches in Lushoto district, has diverged attention towards alternative organic mulches. Pine litter and wild lemon grass have been considered as the potential alternative organic mulch that can be used in organic production of tomato in Lushoto district. However, an investigation is necessary as much is still unknown regarding the use of pine and wild lemon grass as organic mulch in organic production of tomato in Lushoto district. This paper reports the outcome of studying the effect of type of mulch and time of applying mulch on yield of organically produced tomato.

Materials and methods

Description of study area and materials

The study was done n Lushoto district, Tanga region, Tanzania. The district is located in the West Usambara mountains lying between 38º 10' and 38º 36'E and 4º 24' and 5º 00'S.The altitude in Lushoto is between 800-2300 m above sea level. The rainfall received is in bimodal pattern with the short rains from October to December and the long rains from March to June. Annual rainfall ranges from 600 to 1200 mm while temperature ranges from 16 - 30º C. The soils are generally latosols (Shemdoe, 2011). The experimental sites were Lushoto (38° 17' 24" East and 4° 47' 55" South) with an altitude of about 1500m. a.s.l. located at Lushoto town-forest area and Ubiri (38° 21' 59" East and 4° 50' 29" South) with an altitude of about 1218m. a.s.l. located at Ubiri village along Mombo-Lushoto road.

Tomato variety 'Tanya' was grown for two seasons from April to December, 2013. The first season (season 1) began in April to August, 2013 while the second season (season 2) began in August to December, 2013 at Lushoto and Ubiri experimental sites, respectively. The two seasons experienced two very different weather conditions. Season 1 was wet and cold while the season 2 was dry and hot. In season 1 seeds were sown in late February 2013, transplanting of seedlings was done in April 2013 while in the second season seeds were sown in July and seedlings were transplanted to the field in late August, 2013. Organic compost used was ERTHFOOD$_{TM}$ (1.5-0.5-0.5) at the quantity of 500g per hole applied one day before tomato seedlings were transplanted. This was later supplemented with a seven day soaked solution of cow urine (20 litres), cow dung (50 kg) and water (200 litres) as top dressing organic manure applied at 0.5 litres per plant. The seeds of *Azadirachta indica* A. Juss. in dried, ground and sieved form (0.5 kg), sour milk (0.5 litres), ashes (0.5 kg), banana flower (1 piece) and kerosene (0.25 litres) all mixed in 15 litres of water, were used to prepare a local biopesticide. This mixture was applied against aphid outbreak in season 1 and against thrips outbreak in season 2. This biopesticide was also used against fungal and bacterial diseases. Crops were irrigated by tap water (at Lushoto) and by furrow water (at Ubiri). Organic mulch used was dried pine needles and dried wild lemon grass.

Pine mulch was collected under pine trees located in the pine forest near Lushoto experimental site while wild lemon grass was collected from the big rocks on top of the mountains at Kizara village near Ubiri village along the Mombo-Lushoto road. Pine mulch came in dry form and did not require chopping due to its needle-like shape while wild lemon grass came in fresh form hence required about three weeks to dry before it was chopped and used. The experiment followed a Randomized Complete Block Design (RCBD) with six treatments and three replications. The treatments were pine mulch applied 3 days after transplanting (PI), pine mulch applied after three weeks (PA), wild lemon grass mulch applied 3 days after transplanting (GI), wild lemon grass mulch applied after three weeks (GA), weeded and unweeded (Controls). The size of each plot was 9m^2.

Data on yield of organically produced tomato were collected based on the type of mulch applied and on time of mulch application. All data were subjected to Analysis of Variance (ANOVA) using GenStat Discovery Edition 4 package.

Results

Tomato yields in all mulched treatments were statistically similar (on each location and within seasons revealing that the type of mulch whether pine or wild lemon grass did not have an influence on yield (Table 1). The difference in yield is only significant when mulched treatments are compared to unmulched treatments. The time of applying mulch between treatments applied in 3 and 21 days after transplanting in all cases did not show a significant difference in yield. Yields between mulched and unmulched treatments in all cases show huge differences implying that mulch is very important than simply doing weeding. Tomato yields were significantly ($p<0.05$) influenced by seasons (Table 2). Yields in season 1 at Lushoto were significantly ($P<0.05$) higher than yields in season 2. Yields at Ubiri showed no significant ($p>0.05$) difference between season 1 and season 2.

Table 1. **Influence of types of mulch on tomato yield at Lushoto and Ubiri**

Treatments	Yield (t/ha) Lushoto Season 1 (Apr-Aug)	Lushoto Season 2 (Aug-Dec)	Ubiri Season 1 (Apr-Aug)	Ubiri Season 2 (Aug-Dec)
PI	18.20ab	14.98a	17.37a	14.63ab
PA	19.70ab	12.03ab	15.42a	16.10a
GI	22.90ab	12.05ab	16.75a	14.63ab
GA	21.40ab	12.23ab	15.08a	13.88ab
Weeded	14.70b	9.73b	10.15b	10.45b
Control	3.17c	2.10c	2.52c	2.34c
Mean	16.66	10.77	13.10	11.99
LSD	8.63	3.91	4.35	4.79
p-value	0.043	0.026	0.008	0.036

Mean values with the same letter(s) within the column are not significantly different at P=0.05 according to LSD. Season 1: April-August, 2013. Season 2:August-December, 2013.

Table 2. **Influence of seasons on tomato yield at Lushoto and Ubiri**

Seasons	Yield (t/ha) Lushoto	Ubiri
Season 1 (wet and cold)	17.63a	13.98
Season 2 (dry and hot)	11.42b	13.02
Mean	14.53	13.50
LSD	2.77	1.88
p-value	<0.001	0.304

Mean values with the same letter(s) within the column are not significantly different at P=0.05 according to LSD. Season 1: April-August, 2013. Season 2:August-December, 2013.

Discussion

Yield of organically grown tomato was two times higher in pine and grass mulched plots than yield of tomato in unmulched (control) plots in both season 1 and season 2 at Lushoto and at Ubiri sites. The results show clearly that using any of the two types of organic mulch was much better than having no mulch at all. Pine needles are known for the ability to last long and to possess high amounts of N (Singh, 1982) while grass mulch posses high amounts of P (Sinkeviciene *et al*., 2009). This might be the reason behind the similar quantities of yield recorded. Like any other organic mulch, grass mulch show effectiveness in regulating soil moisture and temperature in the beginning of the experiment before it decomposes to release nutrients to the soil.

The time of mulch application did not have any influence on yield in all mulched treatments. This may probably be due to the fact that in the first three weeks after transplanting the emerged weeds were not aggressive enough to cause yield reduction as the critical period of weed competition in tomato is around four to five weeks after transplanting (Monks, 1993).

The differences in tomato yield between season 1 and season 2 are clearly observed at Lushoto site. Season 1 which was characterized by long rains from late March to the end of May followed by cold temperatures form June to August. Tomato plants at Lushoto were able to withstand the weather, although some plants were affected by late blight, those which survived the weather ended up with very high yields harvested in August. The probable cause for this response may be due to slow growth and the ability to utilize soil water and nutrients both from the soil and from pine and grass mulch. In season 2, temperatures went high and it was dry. The yields were not very high probably because the soils had dried up and irrigation water was not enough to enable plants to draw nutrients from the soil as it was in season 1.

Conclusion and recommendations

Employing organic mulch in tomato production is quite useful for its contribution on yield, suppression of weeds, protecting soil fauna, protecting the soil against solar radiations thereby reducing evaporation and providing conducive environment for tomato growth. It is therefore recommended that, organic mulch should be used for tomato production in the two studied areas.

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Perception of Leafy Vegetable Farmers on Neem Extract for the Control of Insects in Akinyele Local Government Area of Oyo State, Nigeria

NKIRU T. MELUDU, OLOPADE TOLULOPE, OKANLAWON OLUWATOYIN AND OLANREWAJU PETER
Agricultural Extension and Rural Development, University of Ibadan, Ibadan, Nigeria.
Corresponding author: nkiru_m@yahoo.com, oklat4real@yahoo.com

Keywords: Neem extract, perception, leafy vegetables, insects.

Abstract

The environmental injustice inherent in conventional pests management practices are perpetrated mainly through widespread exposure to chemicals used in agricultural production. The overall ill effect of this chemical based product to the environment and human health are some of the challenges which called for search of efficient and effective alternatives that are capable of replacing chemical pesticides in agricultural production. Thus, this study investigated the perception of leafy vegetable farmers to use of neem extract for insect control in Akinyele Local Government Area of Oyo State. Random sampling was used to select 60% of registered leafy vegetable farmers form Akinyele Local Government Area of Oyo state to give a total of 93 respondents. Interview schedule was used to obtain information from the respondents. Descriptive and inferential statistics were used for the data generated from the field. The result showed that majority (59.9%) of the respondents were within the age range of 30-40 years with the mean age of 40.5. Majority (92.5%) of the respondents had formal education and majority (47.6%) of the respondents had mean household size of 5.High proportion (76.3%) of the respondents had between 5-10 years of farming experience and the mean farm size in the study area was 2 acres. Majority (58.1%) of the farmers used family labour while majority of the respondents had their average monthly income ranging from 21,000-30,000 naira. The result also revealed that the most utilized source of information about organic pesticide was the radio (77.4%). The respondents' level of knowledge on neem extract was high (84.9%), benefits derived from utilization of neem extract such as prevention of pest and diseases ranked highest (95.7%) and the constraint associated with the utilization of neem extract was also high (50.5%). Chi square test of relationship revealed that there was significant relationship between socio economic characteristics such as: Age (χ^2= 26.668, p= 0.009), level of education (χ^2 = 66.351, p = 0.007), income (χ^2 =27.443, r= 0.007), major occupation (χ^2= 28.592, r= 0.005), farm size (χ^2=71.001, p= 0.000) and the vegetable farmers' perception of neem extract. The study further revealed that respondents sources of information on neem extract (p= 0.001), benefits derived from application of neem extract (p= 0.029), and constraints associated with the utilization of neem extract (p= 0.000), had significant relationship with respondents' perception of neem extract. The respondents had favourable perception of neem extract for the control of insects. Therefore, to sustain farmers' interest in organic farming, the farmers should be motivated through training on application of neem extract and there should also be documentation of effectiveness and correct quantity of neem extract to use.

Introduction

Pesticides are substances or mixture of substances used for preventing and controlling pest (FAO, 2002).The term pesticide includes insecticides, herbicides, nematicides, rodenticides, and fungicides

(Gilden, Huffling, and Sattler, 2010). The council on scientific affairs, American Medical Association (1997) grouped pesticides based on chemical structure. The active ingredients are either inorganic or organic. Inorganic pesticides do not contain carbon and are usually derived from mineral ores which is extracted from the earth. Examples include copper sulphate, ferrous sulphate, copper and sulphur. Organic pesticides have carbon as the basis of their chemical structure. Inorganic pesticides have active ingredients that operate faster in preventing and controlling insects which in turn helps in increasing the yield of crops; Deedat, (1994). This has over time caused a lot of damage by harming beneficial organisms, affecting biodiversity, increasing insect resistance, depletion of essential nutrients like Nitrogen and phosphorus in the soil as well as causing severe health problems such as cancer in humans (FAO, 2007). However natural organic pesticide is safer for humans and non -target organism such as earthworm and fishes. Hence, there is a need to develop a safer, more environmentally friendly and efficient alternatives that have the potential to replace synthetic pesticides and are convenient to use (Tapondjou, 2005). In recent decades, research on the interactions between plants and insects has revealed the potential use of plant metabolites for the purpose of killing or repelling insects Pavela, (2004). With respect to this, Neem an example of such plants is the focus of this study.

Neem's unique feature in terms of its insecticidal properties; has over 100 compounds with pesticidal properties which are used for damaging over 500 types of insects such as ticks, whiteflies, thrips, leafminers, caterpillars, aphids, scales, beetles, true bugs, mealy bugs and nematodes (Thacker 2002, Copping 2001). Neem acts as a broad spectrum repellent and insect regulator which causes deformities in the insect offspring; as an insect growth regulator, it prevents insects from molting by inhibiting production of ecdysone an insect hormone (Weinzierl and Henn, 1991). Neem also discourages feeding by making plants unpalatable to insects Sarode, Deotale and Thakure, (1995) or suppresses the insects' appetite (anti fedant effects) and if the insects still attack it limits their ability to moult and lay eggs. The use of these plants for insecticidal purposes in storage pests control has been documented (Dike and Msheila, 1997). The active insecticidal compounds in neem include Azadirachtin, Nimbin, Salannin and Meliatriol (Vietmeyer, 1992) which are concentrated more in the seed and tree bark. Neem leaf extract have also been reported to be very effective in the control of insects of leafy vegetables in Nigeria; Aderolu, Omoloye and Ojo (2012); Okunlola and Akinrinola (2013). Therefore, an assessment of the perception of vegetable farmers on neem extract will help to determine how effective neem extract is in controlling insects of leafy vegetable crops.

Farmers all over Nigeria especially the resource poor ones have been using botanicals successfully for protecting their crops against insect pests, nematode, fungal and bacterial diseases either on the field or in the store (Anjorin, Salako and Ndana, 2004). Several scientists and farmers have reported the use of crude or formulated bioactive plant pesticide in Nigeria (Anjorin, Salako and Ndana, 2004). Salako (2002) stated that the use of *A. indica on the farm for the control of insects* has obvious advantages; it is relatively cheap and easily available, its complex mixture of active ingredients which function differently on various parts of the insects life cycle and physiology makes it difficult for pests to develop resistance to it. Schmutterer, (1990) opined that neem products are suitable for integrated pest management because of their low toxicity to non- target organisms, easy preparation and compatibility with other bio-products. Aderolu, Omoloye and Ojo (2012); Okunlola and Akinrinola (2013) reported that Neem extract is effective in controlling insects of leafy vegetables than other botanical pesticide. Despite the various importance of neem in controlling insects, its potential has not been fully utilized due to numerous social reasons that are yet unknown; hence it becomes imperative to carry out a research on the perception of vegetable farmers to neem extract for the control of insect.

Objectives of the study

The objectives of this study include:

- identify the socio economic characteristics of the farmers;
- determine the farmers sources of information on neem extract;
- ascertain the farmers' level of knowledge on neem extract;
- determine the farmers perception of neem extract;
- find out the benefits derived from utilization of neem extract and,
- identify the constraints associated with the utilization of neem extract during vegetable production.

Methodology

The study area is Akinyele Local Government area of Oyo State, Nigeria. A list of registered leafy vegetable farmers was obtained from leafy vegetable farmers association located in the study area. Multistage sampling technique was adopted in which three villages were purposively selected out of the twelve wards which are; Ajibode, Ojoo, and Elekuru and this is because of the high population of leafy vegetable farmers in the villages; simple random sampling was used to select 60% of the estimated number of vegetable farmers in the local government to give a total number of 93 vegetable farmers. The use of descriptive and inferential statistics was used to the analysis the data.

Results and Discussion

The result depicted in table 1 shows that majority (78.5%) of the respondents are married, above average (52.7%) had secondary education, about half (50.5%) of the respondents earn between 21-30 thousand naira per month and that majority (58.1%) of the population made use of family labour.

Table 1. **Distribution of respondents by socio- economic characteristics**

Variables	Frequency	Percentage	Mean value
Marital status			
Single	16	17.2	
Married	73	78.4	
Widowed	4	4.4	
Educational attainment			
Non- formal education	8	8.6	
Primary education	29	31.2	
Secondary education	49	52.7	
Tertiary education	7	7.5	
Income			
10000-20000	16	17.2	
21000-30000	47	50.5	
31000-40000	24	25.8	
> 40000	6	6.5	
Household Size			
>3	13	14.0	5
5-10	71	76.3	
11-15	9	9.7	
Sources of labour			
Family	54	58.1	
Hired labour	22	23.7	
Family and hired labour	13	13.9	
Communal labour	4	4.3	

Results further show majority (84.9%) of the respondents had a high level of knowledge on application of neem extract on the farm, majority (68.8%) of the respondents opined that neem extract to a lesser extent kills all insects present on the vegetable farm after infestation. However, majority (38.7%) of the respondents considered inadequate knowledge of the correct measurement of neem extract solution to apply on the farm as a serious constraint which shows that inadequate knowledge and information on measurement can affect the efficacy of neem extract. However, the perception of the respondents on neem extract was favourable (52.7%).

Table 2. **Distribution of respondents on perception of neem extract**

Perception of Neem	Score range	Frequency	Percentage (%)	Mean
Unfavourable	6- 36.5	44	47.3	36.6
Favourable	= 36.6	49	52.7	
Total		93	100	

Source: Field survey, 2014

The study further revealed that respondents' sources of information on neem extract (p= 0.001), benefits derived from application of neem extract (p= 0.029), and constraints associated with the utilization of neem extract (p= 0.000), had significant relationship with their perception of neem extract.

In conclusion the respondents had favourable perception of neem extract for the control of insects. The he farmers' perception was influenced by source of information on neem extract application, benefits derived from the utilization and constraint associated with the utilization of neem extract. Therefore, to sustain farmers' interest in organic farming, the farmers should be motivated through training on application of neem extract and there should also be documentation of effectiveness and correct quantity of neem extract to use.

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The Control of Damping Off Disease of Two Tropical Vegetables with some Botanicals

OJO, O.A AND OLANIRAN, O.A.
Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, Ogbomoso, Nigeria
Corresponding Author: ojo.cep@hotmail.com

Keywords: *Rhizotonia solani,* damping off disease, extract, *Ageratum conyzoides,* Tomato, Eggplant.

Abstract

Frequency of isolation and pathogenicity of fungi associated with damping-off disease infected tomato and eggplant seedling in Ogbomoso, Nigeria as well as controlling effects of aqueous extract of some botanicals on the causal organisms of damping-off disease of both crops and their seedling performance were investigated. The result showed that five fungal isolates were associated with damping off disease of tomato and eggplant seedlings. These fungal isolates were Fusarium oxysporum Fusarium solani, Sclerotium roffsii, Rhizoctonia solani and Macrophomina pheseolina. Rhizoctonia solani was significantly ($P \leq 0.05$) the most frequently isolated and with highest pathogenicity on both seedlings. In addition, all the extract of botanicals tested gave significantly ($P \leq 0.05$) higher inhibition of mycelial growth and sporulation Also, the results clearly showed that all the seed treated with extract of botanicals gave significantly ($P \leq 0.05$) higher seed germination and on all tested growth characters of both crops. However, Ageratum conyzoides gave the significantly ($P \leq 0.05$) highest seed germination percentage, better seedling performance and significantly ($P \leq 0.05$) lowest damping off disease incidence on both crops seedlings. Therefore, it is clearly revealed from this study that the extract of A. conyzoides showed some promise in its usage in the control of damping off disease of tomato and egg plant.

Introduction

Eggplant and tomato are very important vegetables in nearly every household in Nigeria. They are both cultivated in both southern and northern part of Nigeria during the dry and raining season (Adesegun *et.al,* 2012). Both are very good source of vitamin A and C in diets (Okereke and Wokocha, 2007). There are many factors responsible for the low yield of vegetable and *among diseases, Sclerotium rolfsii, Fusarium oxysporium* and *Rhizoctonia solani* causing damping-off has treated as the major constraints of vegetable cultivation in our country. The fungi *Fusarium oxysporum*, *Sclerotium rolfsii* and *Rhizoctonia solani* are soil inhabiting pathogens with wide host range and thereby, very difficult to control (Suleiman and Emua, 2009; Aslam et al. 2010; Monaim, 2011; Nweke and Ibiam,2012).There are several methods applicable for controlling damping-off disease. This include use of fungicides soil solarization, soil amendment and bio-agent. Organic soil amendment is an important option and eco-friendly approach for controlling damping-off causing soil borne pathogen by developing suppressive soil (Patil and Katan, 1997; Dey 2005; Islam *et. al.* 2007). In case of bio-control agents such as *Trichoderma spp.,* they have effective ability to reduce damping-off disease caused by pathogenic fungi [Harman and lumsden, 1990; Uddin *et. al*. 2011; Enyinkwu*et al.,* 2014). The concept of management of diseases employing eco-friendly materials gained momentum as mankind became more environment conscious. Use of botanicals instead of chemical fungicides is one of the recent approaches for plant disease control, as fungicides may cause health hazard and environmental pollution.

However, some research works have been found in controlling wide range of seed borne pathogens by different botanicals (Howlader,2003; Hossin *et al*.,2005; Chowdharry,2005 Islam *et. al.,*2006 and Adesegun *et al.*, 2012) and very few research have been performed to evaluate the efficacy of botanicals against soil borne pathogens in field level (Monaim *et al*., 2011). In view of the above circumstances, the present study was designed to evaluate the efficacy of different botanicals as a seed treating agent against damping-off pathogens of eggplant and tomato seedlings.

Materials and Methods

Collection of Crop seeds and plant materials

Local varieties of eggplant and tomato seeds were collected at the farmers shopping center in Ogbomoso, Nigeria. Also the plant materials were collected from the University Teaching and Research Farm, Ogbomoso and its environs (Table 1). The collected plant materials were identified at the Department of Pure and Applied Biology, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Table 1. **Scientific name and part of the tropical plant used in extract preparation.**

S/N	Scientific name	Plant part used
1	*Ageratum conyzoides*	Whole
2	*Ocimmum gratissimum*	Leaf
3	*Eucalyptus tereticornis*	Seed
4	*Chromolaena odorata*	Leaf
5	*Moringa oleifera*	Seed
6	*Zingiber officinale*	Rhizomes
7	*Citrus aurantifolia*	Peel
8	*Hoslundia opposite*	Leaf and fruit
9	*Piper guinensis*	Seed
10	*Afromamum melegueta*	Seed

Collection of Tomato and eggplant seedlings: Tomato and eggplant seedlings, showing the damping-off disease symptoms were collected from the fields of Agriculture Extension Zone, Ogbomoso, Nigeria. The diseased plants were collected in sterile polythene bags and brought to the laboratory of Pure and Applied Biology, Ladoke Akintola University of Technology, Ogbomoso, Nigeria, for isolation of the disease-causing fungi.

Isolation: isolation of fungi associated with damping off disease sample of tomato and eggplant seedling was carried out following the method of *Monain et al.*,(2011). In this method, Isolation was done from 100 small root pieces, cut from adjoining areas of diseased and healthy areas of the plants. Root pieces were washed under tap water for about 5 minutes to remove any dirt or soil particle. The root pieces were dipped in0.01% $HgCl_2$for about 2 minutes and then passed from two washes of sterile distilled water for 2-3 minutes each. The treated root pieces were dried completely and then transferred to Petri dishes containing sterilized potato-dextrose agar medium (PDA) with five pieces per plate. All the plates were kept at 25 ± 1^{O}C for 7 days.

The fresh growth of the fungi was subcultured on to PDA. The fungi isolated were identified by studying their typical mycelial growth produced on the potato dextrose agar medium and conidial morphology using standard diagnostic keys (Monaina *et al*., 2011; Adesegun *et al*., 2012).

Pathogenicity test: The pathogenicity test of most predominant damping-off fungi namely *Fusarium oxysporum*, *Fusarium solani*, *Sclerotium roltsii*, *Rhizoctonia solani*, *Macrophomin aphaseolina* was conducted by mixing the fresh inoculum of each fungus with 1kg of steam sterilized soil in plastic pots. Eighty tomato and eggplant seeds were sown per pot containing infested soil. The data were recorded on number of healthy and infected plant and disease incidence after 15 and 30 days of sowing from pots containing infested and un-infested soil.

Preparation of Plant Extracts

The plant extracts were prepared using the method of Ashrafuzzaman and Hossain, (1992).The collected leaves were weighed in an electric balance and then washed in the water. After washing, the big leaves were cut into small pieces. In order to obtain the extract for each plant, weighed plant parts were blended in an electric blender and distilled water was added. The pulverized mass was squeezed through 3 folds of fine cotton cloth. In order to obtain 1:2 (w/v) ratio 200 ml of distilled water was added to 100 g plant parts. The particulars of the botanicals used for the experiment are listed in previous Table 2. Seeds were treated by soaking them separately in different extracts. Different plant extracts were poured in different sterilized conical flask and then four hundred seeds per treatment were soaked in the solution for 30 minutes according to the method of *Monain et al., (2011).* Furthermore, the excess extract was drained off and treated seeds were kept in blotting paper to remove excess moisture from seed surface and was air dried before sowing. The seeds were sown in the pot at the rate of 100 seeds/pot. The following parameters were taken: seed germination, percent damping-off, seedling height, shoot length, root length, fresh shoot weight, fresh root weight, dry root weight, dry shoot weight and average biomass. Percent germination was observed at 8, 16 and 2 4Days After Sowing (DAS) while 6, 12 and 16 DAS for eggplant. Damping-off disease incidence was recorded at12, 24 and 36 DSA for tomato and 11, 22 and 33 DAS for eggplant. Seedling growth characters such as shoot length, root length, fresh shoot weight, fresh root weight, dry shoot weight, dry root weight and biomass were also recorded at 30 DAS for tomato and 36 DAS for egg-plant. The tomato and eggplant seedling height was taken at 12, 24 and 36 DAS respectively.

Data analysis

Data in percentage were arcsine transformed before statistical analysis. Data were analyzed using analysis of variance (ANOVA) while mean separation was carried out using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Results

The results on the pathogenicity test of fungal isolates from damping-off infected tomato and egg plant is presented in Table 2. The result showed that five pathogenic fungi were associated with damping off disease of tomato and eggplant seedling in Ogbomoso Agricultural Extension Zone, Nigeria. These were *Fusarium oxysporum, Fusarium solani, Sclerotium rolfsii*, *Rhizoctonia solani* and *Macrophomina* *phaseolina.* The results also showed that *R. solani* was significantly ($P \leq 0.05$) frequent in both tomato and egg-plant seedling (Table 2).However,*Rhizoctoniasolani* gave significantly ($P \leq 0.05$) highest pathogenicity of 95% and 97% respectively in both tomato and garden egg seedling (Table 3) while others were in the order of *F. oxysporum F. solani*, *Sclerotium rolfsii* and *M. phaseolina* (Table 1).

Table 2. **Pathogenicity Test of Fungal Isolates from Damping off Tomato and Egg plant**

Fungal Isolates	**Pathogenicity (%)**	
	Tomato	**Egg plant**
Fusarium oxysporum	78^{b}	65^{b}
Fusarium solani	75^{b}	63^{b}
Sclerotium rolfsii	75^{b}	60^{b}
Rhizoctonia solani	95^{a}	97^{a}
Macrophomina phaseolina	74^{b}	61^{b}

Data are average of five replicates from four separate experiments. Values in the same column followed by a similar alphabets are not significantly different using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Table 3. **Frequency of Pathogenic fungi on Tomato and Eggplant Damping-off diseased seedling**

	Frequently of isolation (%)	
Fungal Isolates	**Tomato**	**Egg plant**
Fusarium oxysporum	70.05	71.11
Fusarium solani	68.00^{b}	70.28^{b}
Sclerotium rolfsii	67.08^{b}	69.95^{b}
Rhizoctonia solani	95.7^{a}	97.09^{a}
Macrophomina phaseolina	68.11^{b}	71.00^{b}

Data are average of five replicates from four separate experiments. Values in the same column followed by a similar alphabets are not significantly different using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Table 4. **Antifungal effect of plant extracts on mycelial and spore germination inhibition of fungi associated with damping-off disease of eggplant seedling**

Treatments	**Mycelial growth inhibition (%)**	**Spore germination inhibition (%)**
ST_1	95.31^{a}	84.94^{a}
ST_2	80.00^{d}	69.78
ST_3	85.11^{c}	76.01
ST_4	62.39	50.98
ST_5	89.93^{b}	78.95
ST_6	92.60^{a}	83.01
ST_7	69.20^{f}	58.11
ST_8	75.11^{e}	66.34
ST_9	68.96^{f}	59.01
ST_{10}	50.31^{g}	45.29
ST_{11}	95.99^{a}	85.00^{a}
ST_{12}	0^{h}	0^{h}

ST_1 = *Ageratum conyzoides* leaf extract
ST_2 = *Ocimmum gratissimum* leaf extract
ST_3 = *Eucalyptus tereticornis* leaf extract
ST_4 = *Chromolaena odorata* leaf extract
ST_5 = *Moringa oleifera* leaf extract
ST_6 = *Zingiber officinale* rhizome extract
ST_7 = *Citrus aurantifolia* peel extract
ST_8 = *Heslundia opposite* leaf and fruit extract
ST_9 = *Piper guinensis* seed extract
ST_{10} = *Afromamum melegueta* seed extract
ST_{11} = control-*Benomyl* at recommended rate
ST_{12} = Control-*Rhizoctonia solani* alone.
Data in percentages were arcsined transformed before statistical analysis. Data are average of five replicates from four separate experiments. Values in the same column followed by similar alphabets are not significantly different using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Table 5. **Effect of different botanicals on seed germination and damping off disease incidence on tomato**

Treatment	Percentage germination (%) at Damping Incidence Different Day After Sowing(DAS)Different Day After Sowing(DAS)					
	8DAS	**16DAS**	**24DAS**	**12DAS**	**24DAS**	**36DAS**
T_1	68.73	89.07	96.82	0.00	02.11	03.06
T_2	52.15	74.10	81.09	07.98	08.11	10.29
T_3	59.10	76.55	84.98	06.11	07.49	08.35
T_4	46.93	67.06	74.11	11.20	12.25	14.06
T_5	55.19	78.01	85.07	05.00	06.35	07.99
T_6	60.11	80.00	88.09	03.72	05.90	06.86
T_7	46.19	67.12	75.04	10.01	11.98	13.85
T_8	52.00	71.90	78.00	08.13	09.08	11.74
T_9	47.50	68.01	75.95	09.91	11.53	13.01
T_{10}	42.61	64.00	71.00	11.95	13.08	15.28
T_{11}	70.04	90.67	97.91	0.00	01.00	02.00
T_{12}	35.07	47.11	54.34	20.51	31.89	45.66

ST_1 = *Ageratum conyzoides* leaf extract
ST_2 = *Ocimmum gratissimum* leaf extract
ST_3 = *Eucalyptus tereticornis* leaf extract
ST_4 = *Chromolaena odorata* leaf extract
ST_5 = *Moringa oleifera* leaf extract
ST_6 = *Zingiber officinale* rhizome extract
ST_7 = *Citrus aurantifolia* peel extract
ST_8 = *Heslundia opposite* leaf and fruit extract
ST_9 = *Piper guinensis* seed extract
ST_{10} = *Afromamum melegueta* seed extract
ST_{11} = control-*Benomyl* at recommended rate
ST_{12} = Control-*Rhizoctonia solani* alone.
Data in percentages were arcsined transformed before statistical analysis. Data are average of five replicates from four separate experiments. Values in the same column followed by similar alphabets are not significantly different using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Table 6. **Effect of seed treatment with plant extracts on seed germination and damping-off disease incidence of Eggplant**

Treatment	Germination (%) of seed at Different Days After sowing (DAS)			Damping off Disease incidence (%) at Different Days After sow ing (DAS)		
	6DAS	**12DAS**	**18DAS**	**11DAS**	**22DAS**	**33DAS**
T_1	70.11	82.84	97.64	0.00	01.33	02.95
T_2	50.00	58.66	66.35	05.04	07.90	10.56
T_3	54.91	65.04	74.99	03.61	06.43	09.00
T_4	33.48	39.00	45.10	08.55	13.00	14.56
T_5	60.25	70.38	81.57	02.15	05.38	07.00
T_6	65.03	77.00	90.32	01.03	03.06	04.06
T_7	37.01	43.49	50.38	07.50	11.01	12.53
T_8	42.05	50.33	59.73	06.71	09.91	11.78
T_9	36.98	43.01	50.07	07.92	11.30	12.90
T_{10}	27.55	34.00	40.03	09.75	14.71	16.00
T_{11}	71.50	84.01	98.08	0.00	01.01	02.63
T_{12}	20.11	26.00	34.59	35.83	47.00	50.00

ST_1 = *Ageratum conyzoides* leaf extract
ST_2 = *Ocimmum gratissimum* leaf extract
ST_3 = *Eucalyptus tereticornis* leaf extract
ST_4 = *Chromolaena odorata* leaf extract
ST_5 = *Moringa oleifera* leaf extract
ST_6 = *Zingiber officinale* rhizome extract
ST_7 = *Citrus aurantifolia* peel extract
ST_8 = *Heslundia opposite* leaf and fruit extract
ST_9 = *Piper guinensis* seed extract
ST_{10} = *Afromamum melegueta* seed extract
ST_{11} = control-*Benomyl* at recommended rate
ST_{12} = Control-*Rhizoctonia solani* alone.
Data in percentages were arcsined transformed before statistical analysis. Data are average of five replicates from four separate experiments. Values in the same column followed by similar alphabets are not significantly different using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Table 7. **Effect of seed treatment with plant extracts on seedling height of tomato and eggplant**

Treatment	Mean height (cm) of seedling at Different Days After Storage (DAS)					
	Tomato			Eggplant		
	12DAS	**24DAS**	**36DAS**	**12DAS**	**24DAS**	**36DAS**
T_1	26.30	35.81	47.03	10.84	17.78	25.91
T_2	13.00	22.99	31.90	04.00	08.06	12.04
T_3	16.79	27.01	38.16	05.11	10.64	14.80
T_4	07.00	18.03	26.19	02.00	03.71	06.20
T_5	20.00	31.08	40.30	06.01	12.00	16.80
T_6	23.11	34.00	43.90	08.79	15.01	21.00
T_7	08.72	19.24	29.03	02.47	05.00	08.01
T_8	10.05	21.11	30.00	03.02	06.14	09.73
T_9	08.70	19.20	30.11	02.42	04.86	07.21
T_{10}	5.08	13.99	24.02	01.35	02.89	04.53
T_{11}	26.74	36.02	47.53	11.07	18.50	26.29
T_{12}	03.07	09.11	18.95	02.55	07.89	17.03

ST_1 = *Ageratum conyzoides* leaf extract
ST_2 = *Ocimmum gratissimum* leaf extract
ST_3 = *Eucalyptus tereticornis* leaf extract
ST_4 = *Chromolaena odorata* leaf extract
ST_5 = *Moringa oleifera* leaf extract
ST_6 = *Zingiber officinale* rhizome extract
ST_7 = *Citrus aurantifolia* peel extract
ST_8 = *Heslundia opposite* leaf and fruit extract
ST_9 = *Piper guinensis* seed extract
ST_{10} = *Afromamum melegueta* seed extract
ST_{11} = control-*Benomyl* at recommended rate
ST_{12} = Control-*Rhizoctoniasolani* alone.
Data in the same column followed by the same similar Alphabets are not significantly using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Table 8. **Effect of seed treatment with plant extracts on growth of tomato**

Treatments	Shoot length (cm)	Root length (cm)	Fresh shoot weight (g)	Fresh root weight (g)	Dry shoot weight (g)	Dry root weight (g)	Biomass (g)
T_1	40.08	13.05	11.63	0.477	05.37	0.215	6.35
T_2	32.79	08.00	07.80	0.298	03.78	0.116	4.91
T_3	34.00	09.91	08.96	0.317	04.03	0.130	5.30
T_4	26.04	07.00	04.21	0.208	02.21	0.049	3.95
T_5	35.89	10.99	09.90	0.379	04.53	0.168	5.61
T_6	38.79	11.00	10.78	0.400	04.99	0.189	5.96
T_7	29.07	08.88	05.40	0.219	02.89	0.075	4.21
T_8	32.00	09.00	06.72	0.258	03.21	0.099	4.46
T_9	29.03	08.70	05.31	0.217	02.76	0.070	4.17
T_{10}	23.02	5.29	03.60	0.199	01.93	0.028	3.73
T_{11}	13.41	13.41	11.88	0.499	05.91	0.218	6.40
T_{12}	04.00	04.00	04.57	01.89	01.60	0.015	3.50

ST_1 = *Ageratum conyzoides* leaf extract
ST_2 = *Ocimmum gratissimum* leaf extract
ST_3 = *Eucalyptus tereticornis* leaf extract
ST_4 = *Chromolaena odorata* leaf extract
ST_5 = *Moringa oleifera* leaf extract
ST_6 = *Zingiber officinale* rhizome extract
ST_7 = *Citrus aurantifolia* peel extract
ST_8 = *Heslundia opposite* leaf and fruit extract
ST_9 = *Piper guinensis* seed extract
ST_{10} = *Afromamum melegueta* seed extract
ST_{11} = control-*Benomyl* at recommended rate
ST_{12} = Control-*Rhizoctonia solani* alone.
Data in the same column followed by the same similar Alphabets are not significantly using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Table 9. **Effect of seed treatment with plant extracts on growth parameters of eggplant seedlings**

Treatments	Shoot length (cm)	Root length (cm)	Fresh shoot weight (g)	Fresh root weight (g)	Dry shoot weight (g)	Dry root weight (g)	Biomass (g)
T_1	26.06	08.62	04.99	0.398	01.78	0.113	2.003
T_2	14.79	04.36	03.17	0.301	01.00	0.065	1.301
T_3	16.20	05.30	03.65	0.320	01.10	0.079	1.500
T_4	09.70	02.75	02.00	0.231	0.502	0.050	0.900
T_5	18.30	06.46	04.06	0.349	01.39	0.090	1.705
T_6	23.45	07.50	04.50	0.370	01.61	0.101	1.899
T_7	10.71	03.12	02.30	0.260	0.608	0.040	1.100
T_8	12.60	03.80	02.74	0.284	0.800	0.065	1.204
T_9	10.64	03.09	02.24	0.258	0.600	0.039	1.090
T_{10}	09.56	02.00	01.70	0.203	0.400	0.037	0.800
T_{11}	26.14	08.99	05.08	0.410	01.85	0.119	2.009
T_{12}	05.03	01.50	01.19	0.115	0.156	0.013	0.400

ST_1 = *Ageratum conyzoides* leaf extract
ST_2 = *Ocimmum gratissimum* leaf extract
ST_3 = *Eucalyptus tereticornis* leaf extract
ST_4 = *Chromolaena odorata* leaf extract
ST_5 = *Moringa oleifera* leaf extract
ST_6 = *Zingiber officinale* rhizome extract
ST_7 = *Citrus aurantifolia* peel extract
ST_8 = *Heslundia opposite* leaf and fruit extract
ST_9 = *Piper guinensis* seed extract
ST_{10} = *Afromamum melegueta* seed extract
ST_{11} = control-*Benomyl* at recommended rate
ST_{12} = Control-*Rhizoctoniasolani* alone.
Data in the same column followed by the same similar Alphabets are not significantly using Duncan Multiple Range Test (DMRT) at 5% level of probability.

The results on the antifungal effect of plant extracts on mycelial and sporulation inhibition of *R. solani* associated with damping off disease of tomato and garden egg seedling is presented in Table 4. The results showed that all the plant extract tested in this study against *Rhizoctonia solani* gave significantly ($P \leq 0.05$) higher mycelial and sporulation inhibition compared to that of the control (Table 4). But the extract of *Ageratum conyzoides* and *Zingiber officinale* gave significantly ($P \leq 0.05$) highest mycelial and sporulation inhibition (Table 4). This was followed by the extract of *Moringa oleifera* and *Eucalyptus tereticornis* respectively (Table 4). It was also observed that extracts of *A. conyzoides* and *Z. officinale* gave significantly ($P \leq 0.05$) highest mycelial and sporulation inhibition of *R. solani* which was not significantly different from that of the commonly used synthetic fungicide-benomyl (Table 4).

Results of seed treatment with plant extracts on seed germination, damping-off disease incidence of tomato and garden egg-plant are presented in Tables 5 - 7 respectively. It was observed that all the tomato and egg plant seeds treated with plant extracts gave significantly ($P \leq 0.05$) higher germination compared to the untreated seeds (Table 5 - 7).

The results further revealed that extract of *A. conyzoides* gave significantly ($P \leq 0.05$) highest seed germination of both crops among all the plant extracts tested in this study (Table 5 - 7). There was no significant ($P \leq 0.05$) difference between the performance of the commonly used synthetic fungicide-benomyl and *A. conyzoides* in terms of seedling germination and plant height (Table 5 - 7).

This was followed by the extract of *Z. officinale* (Table 5 and 6). Furthermore it was observed that the damping off disease incidence of tomato and egg-plant seedling in all the seeds treated with plant extracts gave significantly ($P \leq 0.05$) lower damping off disease incidence (Table 5 - 7). The extract of *A. conyzoides* performs significantly($P \leq 0.05$) better like benomyl, commonly use synthetic fungicides in the control of damping off disease of vegetable seedlings. It is important to note that the seed germination and damping off incidence of both crops increased significantly with increase in the days after sowing in all treatments including the control (Table 5 - 7).

The results on the effect of seed treatments with plant extracts on growth components of tomato and egg-plant seedlings is presented in Table 8 and 9 respectively, there it was observed that all the seeds treated with extract of different plants gave significantly ($P \leq 0.05$) higher growth parameters which includes short root length, fresh and dry weight of shoot as well as bio mass compared to that of the control inoculated with *R. solani* without any plant extract treatments (Table 8 and 9).

The extract of *A. conyzoides* gave significantly ($P \leq 0.05$) highest growth parameters for both plants compared to all other plants. Than that of the benomyl (Table 8 and 9). The significantly ($P \leq 0.05$) least growth parameters for both crops was recorded in the seed inoculated with *R. solani*, the causal agent of damping off disease of tomato and egg-plant seedling (Table 8 and 9).

Discussion

The results from this study conclusively revealed that five fungal isolates were identified to be associated with damping-off in Ogbomoso, Oyo state, Nigeria. This result could be corroborated by that of Islam *et al.,* (2007) and Monaim *et al.*, (2011) in which *P. aphanidermatum*, *R. solani, M. phaseolina, A. solani*and *S. rolfsii* were identified as the causal agents of damping-off disease of cucumber and lupine seedling. Similar fungi have been isolated from tomato seedlings by Gunasekaran *et al*., (1994). *Morsy, et, at.,* (2009) recorded damping off as major disease on tomato and pepper caused by *S. sclerotiorum, R.solani, S.rolfsii* and *Pythium* spp. MacNish *et al*., (1995) detected AG-10 isolate of *R. solani*on potato dextrose agar medium. *Hossain et, al.,*(2005) *and Uddin et, al.,*(2011) isolated *Alternaria tenuis, A. solani* and *R. solani* from tomato fruit and seed rots *Dey* (2005) found *R. solani*as more pathogenic on potato than tobacco. *Islam et al.,(*2006) conducted pathogenicity of *R. solani* and observed typical symptoms of the fungus on root and lower stem of mung bean. *Aslam et al.,(*2010) inoculated lentil plants with *R. solani* and noted typical symptoms within 7 days and obtained 100% infection on lentil grown in soil infested with the fungus. In addition, the findings in this present study in which all the tested plant extracts gave significantly ($P = 0.05$) higher seed germination and lower percent of damping-off disease incidence of tomato and egg-plant seedling were well supported by previous reports (Islam *et al*., 2006; Suleiman and Emua 2009; Aslam *et al*., 2010; Monaim *et al*., 2011; Malhhan *et.al*., 2012; Enyinkwu *et.al. 2014*). The extract of *Aconyzoides* gave significantly ($P = 0.05$) highest seed germination, lowest percent damping off disease incidence and better growth characters of both tomato and eggplant seedling. The performance of *A. conyzoides* was as excellent as that of the commonly, used synthetic fungicide-benomyl in the control of damping-off disease incidence of vegetables. This result indicates that this plant extract could serve as alternative to the usage of synthetic fungicide, which has been adjudged to be of high mamalian to toxicity, less biodegradable, expensive and could cause high level of environmental pollution (Aslam et al., 2010 and Monaim et al., 2011). Morsy et al., (2009) have evaluated some plant extract against *F. oxysprum* and *S. rolfsii*, the causal agents of damping-off disease of cucumber and found that more than 60% growth inhibition when fungus containing potato dextrose agar (PDA) plate. Similar result was obtained by Suleiman and Emua (2009) who evaluated some plant extracts against *P. aphanidermatum* (damping-off causal pathogen) and found that 55% growth inhibition when fungus was grown on PDA containing neem leaf extract While ginger rhizome extract reduced 70% infection of *P. aphanidermatum* on cowpea in an *in vivo* experiment. This results were found to be in consonance with the previous findings of Howlader (2003) who observed that seed treatment with Allamanda leaf extract effectively increased seed germination of crops and significantly decreased important nursery diseases.

Conclusively, pre-emergence and post-emergence damping-off is the most common and prevalent disease of vegetable seedlings which affects seed germination and seedling performance in the tropics. The findings of this study indicate that plant extracts have promising effects against damping off disease causal pathogens. The use of plant extract in the control of plant diseases could reduce over dependence on synthetic fungicides by providing effective alternative that is environment friendly, cheaper, available and with low mammaliam toxicity as were as affordable by the poor resource formers in developing nations. Among the different tested plant extracts, *A. conyzoides* showed promising effect in controlling damping off disease and increasing germination as well as growth characters of some vegetable seedlings.

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Effect of Difference Sources of Organic Manure and Mineral Nitrogen, Sole and in Combination, on the Growth, Vegetative and Seed Yield of Fluted Pumpkin (*Telfairia occcidentalis*)

[1]OKORO-ROBINSON M. O., [1]OGUNJINMI, S.O., [2]FAWOLE, T.O., [2]OMILABU,S.K AND [3]ARIBISALA, L.A.
[1]Crop Production Technology Department, Oyo State College of Agriculture and Technology, Igboora. Oyo State.
[2]Agricultural Technology Department, Oyo State College of Agriculture and Technology, Igboora. Oyo State.
[3]Soil Science Technology Department, Oyo State College of Agriculture and Technology, Igboora. Oyo State.
Corresponding Author : tolasayo@gmail.com

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Abstract

This study investigated the effect of different sources of organic manure and mineral nitrogen (N), as sole and in combination, for optimum growth and seed yield of Telfairia occidentalisin Igboora, Southwestern Nigeria. Field experiments were conducted in the cropping seasons of 2012. The treatments involved mineral N (45 kg. N ha^{-1}), 3 sources of organic manure (poultry manure PM, pig manure and cow dung) (5 t. ha^{-1}) and their combinations (50% N - 50% t ha^{-1} organic manure). The treatments were assigned into a randomized complete block design with three replications. The parameters assessed for vegetative and seeds yield were number of leaves, vine length, number of vines, shoot yield and number, lengthof pods, mean weight of pod, number of seed per pod per hectare respectively. Treatments showed significant ($p<0.05$) influence on all the traits considered.The combined effectsof mineral N and organic manure significantly influenced the growth, vegetative and seeds yield of T. occidentalis, with the maximum values recorded at 50-50% PM and mineral N (Urea) for the former. However, this observation in performance is in par with 100% PM which recorded optimum seed yield. It was concluded within the limit of this work thatgrowth and yield of T. occidentalis in the guinea savannah zone of Nigeria could be significantly improved by application of 5 t. ha^{-1} of organic manure.

Introduction

Telfairia occidentalis Hook F. (fluted pumpkin) is a member of Cucurbitaceous family. It occurs in the forest zone of West and central Africa, most frequently in Benin, Nigeria and Cameroon (Kayode and Kayode 2011). It is a popular leafy and seed vegetable that is available all over Nigeria. The vegetable is widely grown since time immemorial majorly in Eastern part, Anambra, Imo, Abia and Ebonyi states of Nigeria. The crop is now grown prominently in Southern western Nigeria (Schippers, 2002).The young leaves and shoots of the plant are the important ingredients for edikoinkon, the Nigerian soup. Its seed is 5.5cm and darkred, rich in protein and fat, could be eaten cooked or ground into powder in favour of another soup (Egusi soup). This fruit is big with an average weight of 13kg depending on soil nutrients and prevailing environmental conditions. As a pot herb the leaves are rich source of protein, carbohydrate, iron, saponin, tannis and plytic acid, therefore a good food and medicinal source. (Akanbi *et al* 2007).Consumption of fluted pumpkin produce taste, palatability, increases appetite and produces fair amount of fibre. The quality of fluted pumpkin in terms of nutrient availability increases mostly when cultivate in good fertile soil rich in nitrogen, phosphorus and potassium (Awodun 2007). In Nigeria, however, especially in the south-eastern part, there is widespread problem of soil degradation due to continuous cultivation on the soils which is as a result of pressure from the increasing population of the area where the available land remains static. Fertile arable land is declining in Nigeria, thereby necessitating the use of manure to supplement the soil nutrients especially Nitrogen (N) which is required for succulent green leaves of fluted pumpkin plants. It is very important to know of the best type of organic manure and the rate of application to use for the crop. However Notticlge *et al (*2005) asserted that the use of inorganic fertilizer has not been able to sustain high productivity due to increase in soil acidity, nutrient leaching and degradation of soil organic matter and physical condition. Organic fertilizer therefore offer great prospect. Soil productivity and fertility can be maintained by the use of fertilizers. The problem with the use of inorganic fertilizer on Nigeria soils is that, the fertilizer are not obtained at the right time in addition to huge cost of procurement. Improper chemical fertilizer application has ruined tropical soils through abuse (IFDC 2005).Production of *Telfairia* are predominantly done by poor resource based farmers (Spore, 2005) The study therefore aimed at investigating the effect of different organic manure source on growth and yield of fluted pumpkin (*Telfairia Occidentalis*).

Materials and Methods

The field experiment was conducted during rainy season of 2013 at the Expérimental Field of Oyo State College of Agriculture and Technology, Igboora Oyo State Nigeria. Site location has latitude 30^0 East and longitude 7^0 40N. The town has a rain forest belt with average rainfall of about 1,45mm and mean temperature range of 27^0C to 30^0C.The soil of the experimental site is sandy loam in texture and contained pH 6.2 and organic carbon 0.19%. The soil N (g/kg), P (mg/kg) and K (cMol/kg) were 0.36, 7.93 and 0.23, respectively.

The region has a hot humid tropical climate and receives 1,080 mm rainfall annually. Matured pods of fluted pumpkin were split and seeds extracted. The seeds were sown in a plastic container and seedlings was raised and transplanted 28 days after sowing (DAS). Land preparation involved a single ploughing and harrowing. The experimental area was11 m x 13 m (143 m^2) and was subdivided into three blocks of 3 m x 11 m with a working path of 2.0 m. Each block was further sub-divided into 18 plots of 1.0 m x 3.0 m with a working path of 1.0 m between each plot. Four–week old-greenhouse grown fluted pumpkin seedlings were transplanted in with aninter - and intra – row spacing of 1m each. This is equivalent to 3 and 10,000 plant /plot and hectare, respectively. The experiment was a randomized complete block design. Treatments were randomized and replicated three times. The organic manure treatments were applied 2 week before transplanting while the urea treatment was applied 2 weeks after transplanting (WAT). Stalking was done 4 WAT using bamboo at 1m height.

Data collection was at every fortnight starting from WAT till 12WAP. Parameters assessed were length of primary vines, number of secondary vines, number of leaves per plant and shoot dry matter.

Table 1. **Details of nutrient treatments**

Treatment symbol	Fertilizer nutrient source / quantity
T1 (Control) O kg N /ha	
T2100%(60kg) N/ha Urea	
T3	5ton/ha Pig Dung
T4	5ton/ha Cow Dung
T5	5ton/ha Poultry Manure
T6	50%KgN+50% Poultry Manure
T7	50%kgN+50%Cow Dung
T8	50%KgN+50% Pig Dung

Table 2. **Chemical composition of poultry manure, swine manure and cow dung**

Properties	Poultry manure	Swine Manure	Cow Dung
N (%)	6.24	0.22	1.14
P (%)	0.25	1.21	0.92
K (%)	0.82	1.31	1.16
Organic carbon (OC) (gkg^{-1})	7.65	5.92	5.09
Ca (cmol kg^{-1})	0.07	0.71	13.5
Mg (cmol kg^{-1})	25.49	1.2	0.35
Zn (mg kg^{-1})	33.32	1.8	0.001
Cu (mg kg^{-1})	31.38	2.4	0.001
Fe (mg kg^{-1})	0.44	0.52	0.23
Na (cmol kg^{-1})	0.52	1.46	0.09
Mn (mg kg^{-1})	0.45	ND	0.23

ND: Not detected

Table 3. **Effect of different fertilizer treatments on the growth parameters of *Telfairia occidentalis***

Fertilizer Components	Primary vine Length (cm)	Number of vines	Number of leaves	Stem girth (cm)	Shoot dry weight (g /plant)
T1	157.8f	4.9e	23.33e	3.27e	24.5e
T2	203.0b	10.3a	48.32a	5.77ab	92.9b
T3	183.7ab	8.2c	34.67c	5.34c	83.7c
T4	174.53c	7.1d	29.78d	5.20c	74.8d
T5	194.1b	8.9b	38.8b	5.80b	87.5bc
T6	226.3a	9.8ab	48.60a	6.80a	98.8a
T7	168.5d	9.2b	32.9cd	5.10b	79.5dc
T8	178.6c	8.6bc	29.6d	4.80d	69.5d

Table 4. **Effect of different fertilizer treatments on the pod and seed attributes of *Telfairia occidentalis***

Fertilizer Components	Number of pods /plant	Pod length (cm)	Mean pod weight (kg)	Number of seeds /pod
T1	0.5e	22.8f	25.2e	29.1e
T2	4.8a	79.9ab	79.0b	88.1a
T3	3.2c	65.4c	78.3b	82.1abc
T4	3.1c	62.7dc	56.7d	79.1bc
T5	4.5a	82.1a	92.1a	84.7ab
T6	4.0ab	70.4b	65.9c	79.1bc
T7	3.7b	68.5bc	62.1cd	56.4f
T8	3.0d	58.5e	64.6c	61.7d

Application of fertilizer and different sources of manure with organo-mineral had significant influence on seed yield of fluted pumpkin. Highest number of pods (4.8) was recorded for plot treated with 100% N (Urea) which was statistically at par with 4.5 mean number of pods recorded at plots treated with PM but significantly different from lowest (0.5) mean recorded from control plots. Pod length values recorded the highest mean value (82.1) at the plots treated with PM which is significantly ($p<0.05$) the same with 79.9 recorded for plots treated with 100% N (Urea)and significantly higher($p<0.05$) than any other treatments with control plots recorded the least mean value (22.8). As in other parameter, mean pod weight values recorded for plots treated with PM (92.1) showed significantly difference from the lowest mean value (25.2) recorded from the control plots. However, 100% N (Urea) plots treatment gave the highest (88.1) mean number of seed which was statistically par with 82.1mean number of seed recorded for PM which is statistically similar to 79.1mean number of seed recorded for 50-50% PM and N (Urea) but showed significant difference ($p<0.05$) from the lowest (29.1) mean value recorded from the control plots.

Discussion

Results of the study revealed better performance of fertilized plants compared to non fertilized ones is in line with observation of Fasina *etal.* (2002) It was reported that for optimum vegetative growth and seed yield of *Telfairia occidentalis*, adequate fertilizer usage is required for its enhancement of soil fertility. In this study, it was observed that combined organic and inorganic (organo-mineral) fertilizer gave optimum results in all the parameters considered under vegetative yield. This may be attributed to the fact that the combination enhanced adequate uptake of available nutrients. The inorganic fraction of the combination releases its nutrients early enough for plant use while the organic portion could stimulate microbial activities and prevent loss of nutrients. This was in line with the observation of Akanbi (2007) and Maharishan *et al*.,(2004). However, excellent performance recorded at plots treated with PM and pig manure could be substituted with that obtained at plots treated with 100% N (Urea) and 50-50% PM and N (Urea)because they are next in performance. Inability of poultry manure and pig dung to perform better in this study could be associated with age of the birds and pigs and mode of preparation of the manures. This also confirms the report of Ewulo (2006) who stated that the performance of pig manure depends on the age of the pig.

Developments of pods and seeds attributes were enhanced with fertilizer application. In all cases where fertilizers were applied, these parameters were better. Significant differences exist among the pods and seed yield as influence by manure source and combined application. This study showed that application of PM gave optimum results and this was in support of the Hussein (1997) reports who stated that poultry manure is superior to other sources of organic manure. Having PM performing better than 100% N (Urea) in term of fruits yield could be attributed to ability of organic manure to stimulate microbial activities and prevent loss of nutrients while inorganic canter pants were easily leased away. This was in line with the observation of Maharishan *et al*. (2004).

Conclusion

The highest growth and vegetative yield attributes were obtained at 50-50% PM and mineral N (Urea) which is as effective as 100% PM application that recorded optimum seed yield.

It was therefore concluded that poultry manure improves the performance of fluted pumpkin manure improved the performance of *Telfairia occidentalis*. This is in support of scientific world propagating for organic agricultural for healthy life.

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Responses of Orange Fleshed Sweet Potato to Organic and Inorganic Fertilizers Planted in Root Knot Nematode Infested Soil

OLABIYI, T.I.[1], ADE-OMOWAYE, B.I.O.[2], AKINWANDE, B.A.[2], ADEOLA, R.G.[3], ODEWALE, O.O.[1], AND ADELEKE, M.A.[1]

[1] Department of Crop and Environmental Protection, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria.

[2] Department of Food Science and Engineering, Faculty of Engineering Technology, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria.

[3] Department of Agricultural Extension and Rural Development, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria.

Corresponding Author: tiolabiyi@lautech.edu.ng

Keywords: Orange fleshed sweet potato, nematode, organic and inorganic fertizers.

Abstract

Root knot nematode is an economic disease of orange fleshed sweet potato and many other crops worldwide. Field experiment was carried out at Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Nigeria to examine the effect of organic and inorganic fertilizers on orange fleshed sweet potato (OFSP) planted on root knot nematode infested soil. This research work is aimed at assessing the effect of the application of Tithonia compost, Maize cob, NPK, Urea and the mixture of Tithonia compost and NPK as control measures of root knot nematode disease of OFSP. There were six treatments including control. OFSP that were inoculated but not treated served as the control. Each treatment was replicated four times, fitted into randomized complete block design. Results showed that there were significant differences between the growth and yield of OFSP that were treated with organic and inorganic fertilizers and those that were inoculated but not treated. The growth and yield of OFSP treated with organic and inorganic fertilizers were significantly ($P \leq 0.05$) better than untreated OFSP. The OFSP that were treated with organic andinorganic fertilizers have higher vine length, yield and tuber girth, and significantly ($P \leq 0.05$) reduced tuber damage, and final soil root knot nematode population. OFSP respond to organic fertilizers more than inorganic fertilizers.

Introduction

Sweet potato *(Ipomoea batatas*Lam), belongs to the family Convolvulaceae, originated in Central and South America. Sweet potato is grown in tropical, subtropical and warmer temperate areas of the world. In Tanzania, Malawi, Mozambique, Zambia and Angola, sweet potato is an important food crop. Uganda is the largest African producer and the third largest producer in the world, growing approximately 2.2 million metric tons annually. Nearly 90% of the total African output comes from eastern and southern Africa. It is an important tropical food crop with versatile utility. The tubers are used as a subsidiary food after boiling, baking and frying. Tubers are also form of an industrial raw material for the production of starch, alcohol and pectin. Besides energy provider, it is a good source of minerals and vitamins.

Orange flesh sweet potatoes are rich in ß-carotene (precursor for vitamin A) (Sreekanth, 2008). Vitamin A deficiency is the major nutritional problem in the poverty prone developing countries. Orange flesh sweet potato consumption helps to alleviate vitamin A deficiency, which causes night blindness (Anderson *et al.,* 2007). The high yielding orange flesh varieties are fertilizer responsive. Research evidences indicate that the application of inorganic fertilizers increases root yield, but hampers the quality of sweet potato(Nedunchezhiyan *et al*., 2003). Better sweet potato root quality was observed at optimum amount of nitrogen supply especially through organic sources (Nedunchezhiyan *et al*., 2003). Organic manuring of sweet potato improves soil health.

Incorporation of organic manures influences soil enzymatic activity either because of the composition of the added materials themselves or because they increase microbial activity of the soil (Goyal *et al*., 1993). Soil enzymatic activity is responsible for forming stable organic molecules that contribute to the permanence of the soil ecosystem and for nitrogen (urease) and phosphorus (phosphatase) cycles (Pascual *et al*., 2002). B-glucosidase is considered as sensitive biological indicator of carbon content (Badiane *et al*., 2001). Soil microbial population which is partly responsible for soil enzyme activities could be improved through inoculation of microbes into the rhizosphere. However, their abundance depends on the source of organic and inorganic nutrients (Pramanik *et al*., 2007). Orange fleshed sweet potato varieties are gaining great attention as a means of reducing common Sweet potato. It ranks as the world's seventh most important crop with an estimated annual production of 300 million metric tons grown on 19 million hectares of land (Amamgbo and Nwachukwu, 2008; Kwach *et al*., 2010; Laurie et al., 2013; Muthoni *et al*., 2011).

Root knot nematodes (*Meloidogyne* spp.) are the world's most damaging plant parasitic nematode genus. They are widely distributed in the tropics and subtropics and are common in temperate regions where summers are warm. Severe infestations cause total crop loss, while yield losses of 5-20% occur in some crops despite routine use of synthetic nematicides. There are more than 40 species of root-knot nematodes but worldwide: 95% of the damage is caused by just four species, *M. arenarta, M. hapla, M. incognita and M. jauanica*. These species attack more than 2,000 plant species, including most crop plants.

The use of fertilizer augments soil nutrients and also reduces the population of root knot nematodes. However, information is scanty on the comparative study of the impact of both organic and synthetic fertilizers and their impact on soil nematode population.

The objective of this research was to assess the growth and yield responses of orange fleshed sweet potato planted in root knot nematode and treated with sole and combined application of organic and inorganic fertilizers.

Materials and Methods

Location of Experiment Site

The experiment was carried out at the Teaching and Research Farm Ladoke Akintola University of Technology, Ogbomoso, Nigeria which, is on longitude 4 10E and latitude 80 10N. The research was carried out during 2014 cropping season.

Soil sample collection

Soil samples were collected within 0-15cm depth at planting and harvesting stages in order to determine soil inhabiting nematodes.

Nematode population

Soil samples(250ml) taken on the field were taken to the Laboratory, Crop and Environmental Protection, Ladoke Akintola University of Technology, Ogbomoso, Nigeria to assess the nematode population in the soil. The soil samples taken at planting (initial) and at final harvest were placed in a sieved lined with serviette paper, placed on a plastic tray, water was then added in between the tray and sieve. The set up was allowed to stand still for 24hours and then the sieve with soil content was lifted out of the tray while the water was decanted and assessed for nematode under the microscope.

Treatments and experimental design

There were 6 treatment and each treatment was replicated four times in a randomized complete block design. The treatments were: Tithonia compost, Tithonia + NPK, Urea, NPK and Maize cob. The plots which were inoculated with root knot nematode but not treated served as control. Each treatment was applied at the rate of 250 g per OFSP vine.

Bed Preparation

Experimental site was ploughed twice and harrowed once, after which ridges were constructed with1.0 m alley ways in between treatment plots and blocks.

Planting material

Mother's delight OFSP variety vines were planted and cultural practices (weeding) was done as at when due.

Data collection

Data were collected on vine length, number of leaf/plant, total weight of tubers, initial and final root knot nematode population

Statistical analysis

Data were subjected to analysis of variance (ANOVA) and the significant means were separated using Duncan's multiple range test at 5% probability level.

Results

The effects of organic and inorganic fertilizers on the vine length and number of leaf of the orange fleshed sweet potato planted on nematode infested soil were shown in Table 1. The vine length of OFSP were enhanced in the experimental plots that were treated with Tithonia compost, urea, NPK maize cob and combination of Tithonia compost and NPK. However, plots where Tithonia compost was applied have longer vine length (343.25 cm), this was followed by combination of Tithonia compost and NPK (331.75 cm), followed by NPK (314 cm) maize cob (311.75 cm) and followed by Urea (284.25 cm). OFSP that were treated with organic and inorganic fertilizers have significant ($P \leq 0.05$) longer vine length and higher number of leaf per plant than untreated OFSP (control).

Table 1. **Effect of some fertilizers on the growth of orange fleshed sweet potatoes planted on nematode infested soil**

Treatment	Vine length(cm)	Number of leaves
Tithonia compost	343.25a	295a
Tithonia+ NPK	331.75a	399a
Urea	284.25a	328a
NPK	314.00a	360a
Maize cob	311.25a	371a
Control	195.00b	129b

Means followed by different letters in the same column are statistically different ($P \leq 0.05$)

Table 2. **Effect of some fertilizers on the yield of orange fleshed sweet potatoes planted on nematode infested soil**

Treatment	Total weight of tubers(kg)
Tithonia compost	1.6a
Tithonia + NPK	1.6a
Urea	1.3a
NPK	1.1ab
Maize cob	1.1ab
Control	0.7b

Means followed by different letters in the same column are statistically different ($P \leq 0.05$)

Table 3. **Effect of some fertilizers on the nematode population of orange fleshed sweet potatoes planted on nematode infested soil**

Treatment	Mean Initial nematode population	Mean Final nematode population	Degree of tuber damage (gall index)
Tithonia compost	216.00a	122.0a	1.0a
Tithonia + Npk	217.25a	155.7c	1.1a
Urea	219.00a	137.5b	1.1a
NPK	215.75a	127.5a	1.0a
Maize cob	215.00a	140.2c	1.3a
Control	218.51a	1456.4d	2.5b

Means followed by different letters in the same column are statistically different ($P \leq 0.05$)

The effects of organic and inorganic fertilizers on the orange fleshed sweet potato tuber weight planted on nematode infested soil were presented on Table 2. OFSP that were treated with Tithonia compost (1.6g), combination of Tithonia and NPK (1.6g), Urea (1.6g) have significant ($P \leq 0.05$) more tuber weight than other treatments.

Effects of organic and inorganic fertilizers on the nematode population and degree of tuber damage of orange fleshed sweet potato planted on nematode infested soil were presented on Table 3. There was no significant difference between the nematode populations at OFSP planting stage (initial nematode population). At final harvest, the population of nematodes in the soil varied significantly ($P \leq 0.05$). However, OFSP that were treated with both organic and inorganic fertilizers have significantly ($P \leq 0.05$) lower nematode populations than untreated OFSP. The degree of tuber damage as a result of nematode attack were significantly ($P \leq 0.05$) reduced in the experimental plots treated with organic and inorganic fertilizers. OFSP that were not treated with organic and inorganic fertilizers have much tuber damage.

Plate1: **Nematode infections on Orange fleshed sweet potato tubers**

Discussion

The OFSP that were treated with organic and inorganic fertilizers have higher vine length, yield and tuber girth, and significantly ($P \leq 0.05$) reduced tuber damage, and final soil root knot nematode population. OFSP respond to organic fertilizers more than inorganic fertilizers. The results corroborate earlier findings of Akpaninyang *et al*. (2009) and also Ndukwe *et al*. (2009) who reported that plants grown with fertilizer have better growth and yield than untreated crops. Costa *et al*. (1991) observed that inorganic fertilizer increased the soil water holding capacity thereby enhancing sustained release of nutrients with resultant higher growth and yield. Earlier research work of Atayase *et al* (2013) revealed that application of urea and NPK to orange flesh sweet potato resulted to higher weight of tuber compared to untreated control.

Conclusion

Based on the result of this research, it was evident that orange fleshed sweet potato that were treated with organic and inorganic fertilizers have higher yield and better growth than the control experiments which were not treated with fertilizer, and also organic and inorganic fertilizers significantly reduced nematode population and tuber damage. OFSP respond to organic fertilizers more than inorganic fertilizers. Application of organic fertilizers is therefore recommended for optimum OFSP production.

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Integrated Management of Two Foliar Diseases of Sesame (*Sesamum Indicum* L.) in Maize/Sesame Intercrop

JIMOH MUIDEEN[1], OLOLADE ENIKUOMEHIN[2], VICTOR OLOWE[3], AND CLEMENT AFOLABI[2]
[1] College of Agricultural Sciences, Osun State University, Ejigbo Campus, Ejigbo, Nigeria, jimohm79@gmail.com
[2] Department of Plant Protection, Federal University of Agriculture, Abeokuta (FUNAAB), www.funaab.edu.ng, adeenikuomehin@yahoo.com, afolabiog@funaab.edu.ng
[3] Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR), FUNAAB, Nigeria, www.funaab.edu.ng, owebaba@yahoo.com

Keywords: *Alternaria* leaf blight, C*ercospora* leaf spot, disease lesion, seed yield.

Abstract

The quest for alternative method in managing diseases in crop production as against the use of prohibitive synthetic chemicals which are harmful to human health has been receiving serious attention by scientists in the last two decades. Two field trials were conducted during the early and late cropping seasons of 2010 to evaluate the effect of nine treatments (Tithonia diversifolia and Chromolaena odorata sprayed at 7.0, 7.5 and 8.0%, sesame sprayed with distilled water, sesame intercropped with maize and sole sesame) on the control of Cercospora leaf spot (CLS) and Alternaria leaf blight (ALB) diseases and agronomic performance of sesame in the transition zone. The experiment was laid out in a randomized complete block design and replicated three times. The treatments imposed significantly (P<0.05; F-test) affected all the measured parameters. Number of lesions of CLS and lesion size of ALB were significantly (P<0.05) reduced when 8.0% of T. diversifolia extract was sprayed on intercropped sesame relative to the sole sesame and sesame sprayed with distilled water. Similarly, application of 7.5 and 8.0% of T. diversifolia extract resulted in comparatively high values for number and weight of capsules per plant, seed weight per plant and grain yield of intercropped sesame. Intercropped sesame (unsprayed) was on par with the sprayed intercropped sesame for most of the parameters measured. Application of T. diversifolia at 7.5 and 8.0% is recommended for managing CLS and ALB diseases in intercropped sesame in the humid tropics.

Introduction

Sesame (*Sesamum indicum* L.) is a very versatile oilseed crop that supplies seeds for confectionery purposes, edible oil, paste (tahini), cake and flour. Although, it ranks sixth in the world among vegetable oils (Olowe *et al.,* 2009), it is often referred to as minor oilseed crop because it is usually cultivated by small holder framers in the developing countries despite its market worth of a billion dollars (UDAID, 2010). The adverse effects of foliar diseases on sesame constitute a major constraint among others to its production worldwide. Prominent among the foliar disease are *Cercospora* leaf spot (CLS) caused by *Cercospora sesami* Zim and *Alternaria* leaf blight (ALB) caused by *Alternaria sesamicola* Kaw. Extensive research work has been done using synthetic fungicides on sesame (Uwala, 1998; Shokalu *et al.,* 2002; Culbreath *et al.,* 2002). Similarly, efforts have been made using natural plant products to control phytopathogenous fungi on crops in the last decades (Enikuonemhin and Peter, 2002; Gata-Gonclaves *et al.,* 2003; Ogwulumba *et al.,* 2008; Ambang *et al.,* 2010). More recently, intercropping sesame with maize resulted in reduction of incidence and severity of CLS and ALB diseases of sesame (Enikuomehin *et al.,* 2011). However, intercropping alone did not provide total control of the foliar diseases on sesame. Therefore, this study was carried out to evaluate the efficacy of the application of two plant extracts (*Tithonia diversifolia* and *Chromolaena odorata*) at different rates on the control of CLS and ALB on sesame intercropped with maize, and also establish their effect on the agronomic performance of sesame.

Materials and methods

The two field experiments were conducted during the early (June- Sept.) and late (August – Nov.) cropping seasons of 2010 at the Teaching and Research Farm of Osun State University, College of Agriculture, Ejigbo, Nigeria (7° 15′ N; 3° 25′ E) at 370 m above sea level. The experiment was laid out in a randomized complete block design and replicated three times. The test variety was E-8, an early maturing sesame variety. The nine treatments imposed were: *Tithonia diversifolia* (7.0, 7.5 and 8.0%), *Chromolaena odorata* (7.0, 7.5 and 8.0%), Maize/sesame, distilled water and sole sesame. The plant extracts were prepared from fresh leaves of *T diversifolia* and *C odorata* as described by Enikuomehin (2005). The crude plant extracts were sprayed at two week interval on sesame plants growing on designated plots from three weeks after sowing (3WAS). The control plot (sole sesame) was left unsprayed. The recommended agronomic practices for sesame were observed (ploughing, harrowing, thinning, manual weeding at 3 and 6 WAS). Sesame seeds were sown on June 12 and August 17, 2010 for the early and late experiments, respectively at a spacing of 60 cm X 10 cm in a single alternate row 1:1 arrangement with maize. The maize variety used was TZSR-Y, a streak resistant variety.

Five sesame plants were randomly selected and tagged per plot for grain yield attribute analysis (number and weight of capsules per plant, weight of seeds per plant and grain yield) after harvest. Disease symptom observation was done weekly, while quantitative assessment (number of leaves and plants infected) was carried out at 12 WAS using two permanent quadrants (50 cm X 100 cm) per plot as described by Enikuomehin *et al.,* 2002. All data collected were subjected to analysis of variance and means separated using the least significant difference method (LSD) at 5% probability level.

Results

Application of the treatments significantly ($P<0.05$; F-test) affected all the parameters presented in Table 1. The control treatment recorded significantly ($P<0.05$) higher number of CLS lesions and lesion size of ALB than the sesame plants that received the remaining eight treatments. No significant difference in the number of CLS lesions was recorded when the two extracts were sprayed during the early and late cropping seasons. However, *T. diversifolia* spray at three concentrations in both seasons and *C. odorata* during the early season at 8.0% resulted in significantly ($P<0.05$) lower lesion size of ALB on intercropped sesame relative to the sesame plants sprayed with distilled water and the control. Application of *T. diversifolia* at 8.0% on intercropped sesame resulted in significantly ($P<0.05$) higher number and weight of capsules per plant and seed weight per plant than the sole sesame, intercropped sesame and sesame plants sprayed with distilled water in both seasons. Sesame plants sprayed with *T.* diversifolia at 7.5% also recorded comparable results for these with sesame plants that were sprayed with *T diversifolia* at 8.0%. Similarly, sesame plants sprayed with *T. diversifolia* (especially at 8.0%) produced grain yield that was significantly ($P<0.05$) higher than the grain yield of sole sesame and sesame sprayed with distilled water. Average grain yield of intercropped sesame sprayed with *T. diversifolia* was higher than the grain yield of those sprayed with *C. odorata.*

Table 1. **Effect of foliar spray with *Tithonia diversifolia* and *Chromolaena odorata* leaf extracts on number of lesions *Cercospora* leaf spot (CLS) and lesion size of *Alternaria* leaf blight (ALB) diseases, and some agronomic traits of sesame during early and late cropping seasons of 2010.**

Parameter Season	Leaf extract concentration (%)				Distilled		Sesame Sole		LSD	
Tithonia diversifolia		*Chromolaena odorata*			water	/maize	sesame		(5%)	
Intercop		7.0	7.5	8.0		7.0	7.5	8.0		
No. of lesions of CLS Early	19.0	12.9	9.2	26.1	25.5	23.1	30.9	16.5	41.7	11.70
Late	17.0	12.6	10.6	23.3	23.0	24.0	29.0	20.0	40.6	9.38
Lesion size of ALB Early	7.9	6.2	5.4	53.7	41.4	9.9	40.6	14.3	139.5	30.43
Late	12.8	7.8	4.5	13.7	27.2	15.1	84.1	12.7	169.8	38.73
Capsules/plant Early	31.0	49.0	55.3	29.7	25.6	32.0	21.6	31.0	36.3	17.63
Late	32.6	53.3	63.6	29.3	28.6	33.6	21.3	34.3	42.3	14.92
Capsule wt/plant (g) Early	9.30	14.7	16.6	7.12	6.16	9.0	6.5	9.4	10.9	4.82
Late	9.80	16.0	19.1	8.9	8.6	10.1	6.4	10.3	12.7	4.46
Seed wt/plant (g) Early	5.45	10.57	11.57	4.9	3.9	5.8	4.4	5.1	3.3	2.57
Late	4.59	7.61	10.25	4.4	4.5	5.0	4.9	6.2	3.0	2.18
Grain yield (kg/ha) Early	418.7	471.7	494.0	330.0	330.7	374.7	255.7	380.3	295.0	141.84
Late	326.3	450.3	564.0	263.3	319.7	476.0	281.3	388.0	374.3	177.57

Discussion

Use of plant extracts in the control of disease incidence and severity in sesame is a worthwhile attempt to grow healthy plants of sesame in the humid tropics where the use of synthetic agro-chemicals is prohibitive and dangerous to human health. On average, the integrated approach of spraying sesame plants intercropped with maize using extracts of *T. diversifolia* and *C. odorata* was quite effective in controlling CLS and ALB diseases on sesame. *T. diversifolia* sprayed at 7.5 and 8.0% was very effective in controlling the two diseases on intercropped sesame. These concentrations are similar to earlier plant extract rates recommended for cucumber (10%) and sesame (7.5%) by Tohamy *et al.* (2002) and Enikuomehin (2005). Intercropping treatment resulted in comparable values for all the parameters evaluated in this study. This trend corroborated earlier findings that intercropping is capable of reducing the proportion of susceptible host tissues and thereby impact on the production, amount and efficiency of the disease inoculums by limiting the spread and development of the disease within the cropping system (Ramert and Lennarston, 2002). Maize, being a taller plant and dominant crop in the system apparently created a physical barrier that limited the spread of the pathogen from one sesame plant to the other. Application of *T. diversifolia* extract integrated with inercropping resulted in comparable grain yield (326.3 – 564 $t.ha^{-1}$) of sesame to the world (0.47 $t.ha^{-1}$) and African (0.46 $t.ha^{-1}$) averages reported by FAO, 2004 and earlier findings on the test variety (E-8) when cultivated under limited moisture conditions (Olowe and Adeniregun, 2009). Therefore, application of plant extract of *T. diversifolia* at 7.5 or 8.0% concentration coupled with intercropping is hereby recommended for sesame production in the humid tropics.

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Effectiveness of Agroecological Intensification Techniques in Enhancing Soil Nutrient Status, Moisture Content, and Crop Productivity in Semi-Arid Lands of Kenya

ONWONGA R.N[1], LELEI J. J.[2] AND NAMOI N.L[1].
[1]Department of Land Resource Management and Agricultural Technology, University of Nairobi, Nairobi, Kenya.
[2]Department of Crops, Horticulture and Soils, Egerton University, Egerton, Kenya.
Corresponding Author: onwongarichard@gmail.com, namoinictor@gmail.com, joycendemo@gmail.com

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Abstract

The current study investigated effectiveness of selected agroecological intensification techniques on soil moisture, nutrient (N, P, and organic C) status, and crop yields in semi-arid Katangi division of Yatta sub-County, Kenya. The study was conducted for two seasons; long and short rains of 2010. The experimental set up was a split plot fitted into a randomized complete block design. The main plots were three cropping systems (CS); monocropping (cassava and sorghum), intercropping [sorghum/dolichos (Lablab purpureus), sorghum/pigeonpea (Cajanus cajan (L.) Millspaugh), cassava/dolichos, cassava/pigeon pea) and rotation (dolichos - sorghum, pigeon pea - sorghum, dolichos - cassava and pigeon pea-cassava). The split plots comprised organic fertilizers (OF); farm yard manure (FYM) and compost. Measured N, P and organic C levels, in the long rains, were significantly higher in crop rotation, followed by intercropping and monocropping systems with application of FYM. The crop yields were significantly higher in the short rains across all CS and OF with crop rotation and monocropping performing better than intercropping system. Crop diversification in both space and time with application of organic fertilizers could thus boost soil nutrient status, soil moisture and, cassava and Sorghum yields in the semi-arid Yatta Sub-county.

Introduction

Crop productivity in semi-arid lands (ASALs), of Kenya is on the decline owing to; inadequate soil moisture, insufficient and erratic rains and poor soil quality due to inappropriate management (Biamah, 2005; Itabari *et al*., 2004; Mwanga, 2004).This scenario behooves researchers to develop sustainable technologies to improve soil and crop productivity and subsequently ensure food and nutritional security in the ASALs. The technologies, to be effective, must be within farmers' resource constraints, resource levels and acceptable risk (Snapp *et al*., 2003). One such technology is agroecological intensification (AEI) of land use which is defined as improvement of agricultural performance through integration of ecological principles into farm and system management (CCRP, 2014). Use of organic fertilizers alongside reintroduction of abandoned/neglected traditional crops such as cassava and sorghum, and legumes; pigeon peas (*Cajanus cajan* L.) and dolichos (*Lablab purpureus*) with application of organic fertilizers borrows from and fits into the principles of AEI.

Against this backdrop, the current study assessed the effectiveness of AEI techniques as a pathway to enhancing soil fertility, moisture content, and crop productivity in semi-arid Lands of Kenya.

Materials and Methods

Site Description: The study was conducted in Katangi division of Yatta sub-County, Kenya. Yatta sub-County has a semi-arid climate with mean annual temperature varying from 17ºC to 24ºC and experiences bimodal rainfall with long rains (LRS) occurring from end of March to April/May (400 mm) and short rains (SRS) from end of October to December (500mm) (Jaetzold *et al*., 2007). The soils are predominantly Ferralsols (Kibunja *et al*.,2010). Majority of the farmers in the area are small-scale mixed farmers with low income investment for agricultural production (Jaetzold *et al*., 2007).

Experimental Design and treatments: The experimental set up was a split plot fitted into a randomized complete block design, with three replicates. The main plots (10 × 10m) were three cropping systems; monocropping (cassava and sorghum), intercropping (sorghum/dolichos, sorghum/pigeon pea, cassava/dolichos, cassava/pigeon pea) and crop rotation; (dolichos - sorghum, pigeonpea - sorghum, dolichos – cassava, pigeonpea-cassava). The split plots (5 × 10m) were organic fertilizers types; farm yard manure (FYM) and compost.

Agronomic practices: Land preparation was done using an oxen-plough. FYM and compost were applied (5 t/ha) in planting holes, dug using hand hoes, and thoroughly mixed with soil. One cassava cutting was planted per hill at a depth of between 10 and 15 cm. Three seeds of; Sorghum, dolichos and pigeon peawere planted per hill and later thinned to two plants per hill. Spacing used for sole crops was 1m × 1m for cassava, 0.75m × 0.25m for sorghum, 0.75 × 0.3m for dolichos and 0.75m × 0.50m for pigeon pea. All crops planted as intercrops (legumes) were sown in rows between cassavas and sorghum at same inter-plant spacing as in pure stands. When in rotation, legumes (dolichos or pigeon pea) were planted in LRS (season 1) and later followed by either sorghum or cassava in the SRS (season 2).

Sampling of soils and organic fertilizers: Soil samples (0-15 cm) for nutrient and moisturedetermination were collected at crop maturity from five randomly selected points of each plot and composited. Soil samples for, moisture determination were oven dried for 24 hours at 105°C. The air dried soil samples were ground to pass through a 2mm sieve and analyzed for total N, P and K, pH and organic C using laboratory standard procedures as compiled and described by Okalebo *et al*. (2002).

Measurement of grain and tuber yields: Grain yields of sorghum were determined at physiological maturity of crops from a net plot area of 3 by 2m, from center of each sub plot. Tuber harvesting was done (eleven months after planting) from a net plot area of 3 by 3m.

Statistical Analysis: Data collected was subjected to analysis of variance, using Genstat statistical software (Payne et al., 2006). LSD test was used to identify significant differences among treatment means ($P<0.05$).

Results and Discussion

Soil N and P as affected by cropping systems and organic fertilizers: Soil N content followed the order, crop rotation, intercropping and monocropping across organic fertilizer types and seasons (Fig. 1).

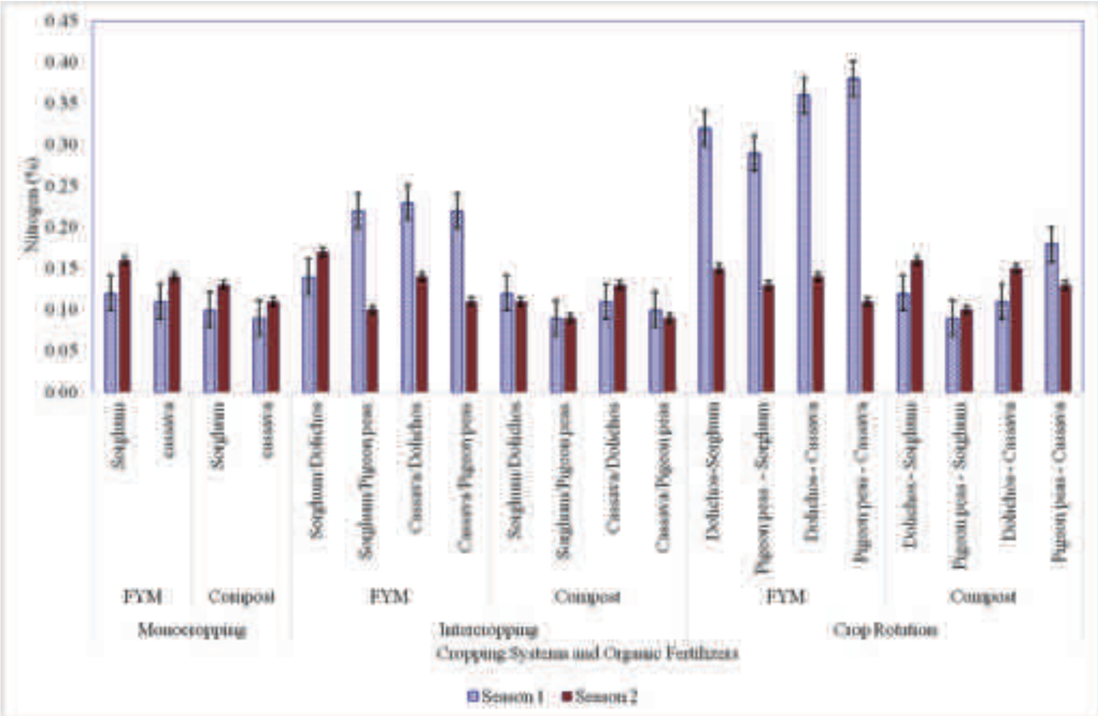

Figure 1: **Effects of cropping systems and organic fertilizers on total N for season I (LRS) and Season II (SRS)**

Soil N and P levels were higher in sorghum than cassava plots and higher with integration of dolichos than pigeon peas. The soil N and P levels, in the SRS, were particularly high in cropping system involving dolichos compared to pigeon peas (Figs.1 and 2).

Significantly higher levels of total N were obtained with application of FYM than compost in all cropping systems and seasons (Fig. 1). A distinct observation on P levels was made with FYM application in the dolichos-sorghum crop rotation in LRS and sorghum/dolichos intercrop in the SRS (Fig. 3). Significantly higher amounts of soil N and P were realized in LRS than in SRS (Fig. 1 and 2). In the SRS, elevated levels of soil available P were recorded in crop rotation system with application of compost whereas in LRS, the differences were not apparent.

Pronounced soil N levels in rotation than monocropping system may be attributed partly to symbiotic N fixation by dolichos and pigeon pea legumes. Non-leguminous cover crops, typically grasses or small grains, do not fix N_2 (Baldwin and Creamer, 2014) and this may partly explain low soil N levels in monocropping system. Higher soil N content in rotation system may also be explained in terms of the N cycling by legume roots (Pasternak, 2013).

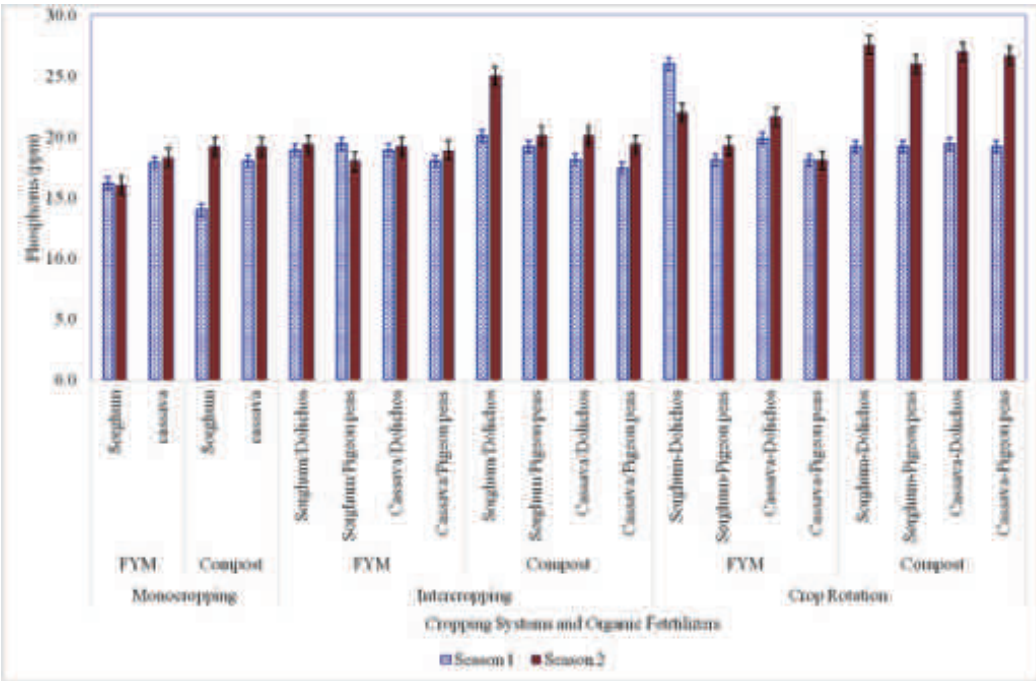

Figure 2: **Effects of cropping systems and organic fertilizers on phosphorus for season I (LRS) and Season II (SRS)**

The elevated soil available P levels in crop rotation system may be as a result of legumes' efficiency in solubilizing P from bound sources. Root induced chemical processes increase P acquisition in impoverished soils (Hinsinger, 2001; Lelei and Onwonga, 2014). Significantly higher levels of total N and P with dolichos integration may be explained in terms of a higher dolichos biomass produced, compared to pigeon pea and hence more nutrient release upon residue decomposition(Mmbaga and Friesen, 2003; Adjei-Nsiah 2012).

Lower N and P levels in intercropping than rotation system, and cassava plots is attributable to competition among component crops for N and P, and nutrient export through removal of aboveground biomass and harvested tubers, respectively. Pypers et al. (2011) reported that, cassava exports high amounts of nutrients, particularly N and K.

Significantly higher amounts of total N and P in soil in the SRS could be as a result of organic matter build up over time through crop residue incorporation from the prior season (LRS) and organic fertilizer application. When manure and compost are used to fertilize crops, soil organic matter will increase over time and subsequent rates of application can generally be reduced because of increased nutrient cycling (Rosen and Bierman, 2014).

Soil organic carbon as influenced by cropping systems and organic fertilizer type: The organic C content was high with application of FYM during the SRS across all cropping systems. In the LRS, however, soil organic C content was higher with application of compost in the intercropping and crop rotation system (Fig. 3).

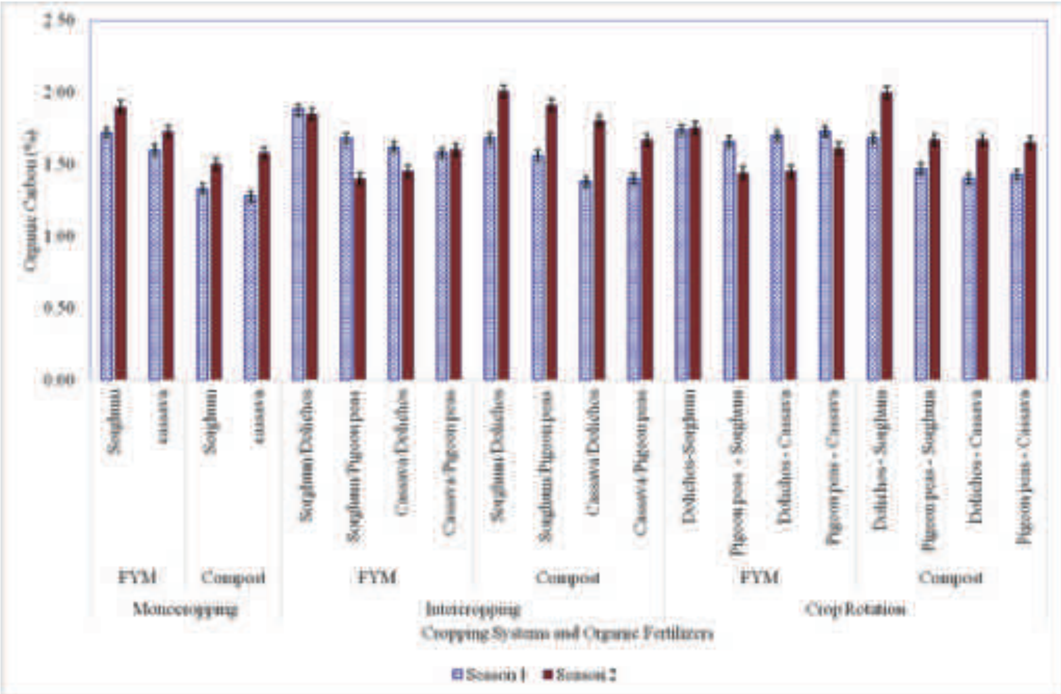

Figure 3: **Effects of cropping systems and organic fertilizers on organic C for season I (LRS) and Season II (SRS)**

The higher levels of organic C in SRS for both organic fertilizer types may have been due to direct addition of organic matter by FYM and compost, and residue incorporation following harvest of LRS crops. Higher levels of soil organic carbon in FYM treatment in the LRS may be due to its higher organic matter (OM) content whereas lower organic C in FYM treatment in the SRS may have resulted from its faster mineralization rate (Bwenya and Terokun, 2001).Conversely, the higher organic C in compost than FYM during the SRS may be due to its slower decomposition. It has been reported that use of composted manure contributes more to the organic matter content of the soil (Rosen and Bierman, 2014).

Soil moisture as affected by organic fertilizer types and cropping systems: For all cropping systems and organic fertilizers, soil moisture content was higher in cropping systems that involved dolichos,and higher in intercropping than rotation and monocropping (Figure 4).

Higher soil moisture content in intercropping than monocropping and rotation systems may be attributed to reduced evaporation due to better ground cover. Mmbaga and Friessen (2003) reported higher moisture retention in maize/legume intercrops compared to maize alone and bare land. The higher soil moisture contents in cropping systems containing dolichos can be attributed to reduced evaporation due its greater canopy cover. Dolichos cover crop forms an excellent ground cover and persists through the dry season (Steiner, 2002).

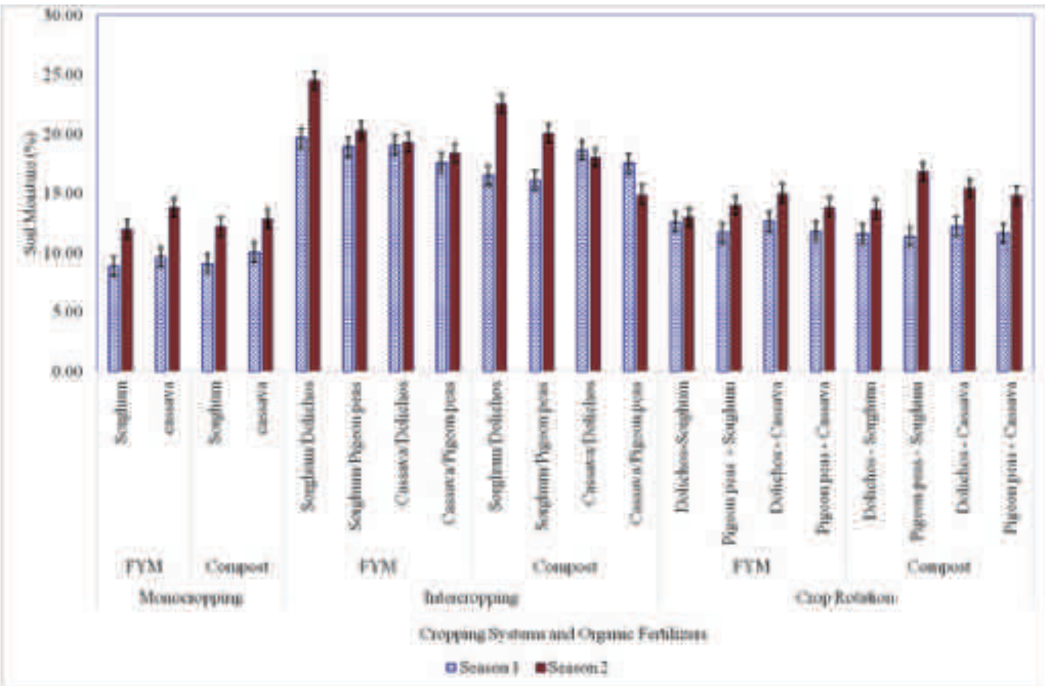

Figure 4. **Effects of cropping systems and organic fertilizers on soil moisture for season I (LRS) and Season II (SRS)**

The pronounced soil moisture content in LRS was due partly to water retention by organic matter resulting from application of organic fertilizers and incorporated residues from prior season. Plant residues, left on ground or cover crops contribute to soil organic matter (Sanginga 2003). Steiner (2002) reported that dolichos, through litter fall, improve soil structures, soil bulk density and soil moisture retention.

Sorghum and Cassava yields

Cropping systems involving dolichos, in both seasons registered higher sorghum yields compared with those involving pigeon pea (Fig. 5) across all organic fertilizers. The elevated sorghum yields were pronounced under crop rotation system than in intercropping system with application of FYM. The cassava tuber yields, measured in season two (SRS), were significantly higher in cassava-dolichos and cassava-pigeon peas rotation for both FYM and compost treatments (Fig. 5).

Increased yields with organic fertilizer application could partially be attributed to supply of nutrients, such as N and P upon mineralization, and improved moisture retention due to build up of soil organic matter. Inadequate soil moisture is most limiting constraint to land productivity in semi-arid lands of Kenya (Itabari *et al*., 2004). The higher yields obtained in rotation system was partly as a result of increased soil N content due to nitrogen fixation by dolichos and pigeon pea legumes. Vanlauwe and Giller (2006) reported that N is a key factor in the response of cereals following legumes compared with cereals following non-legumes in continuous monocultures.

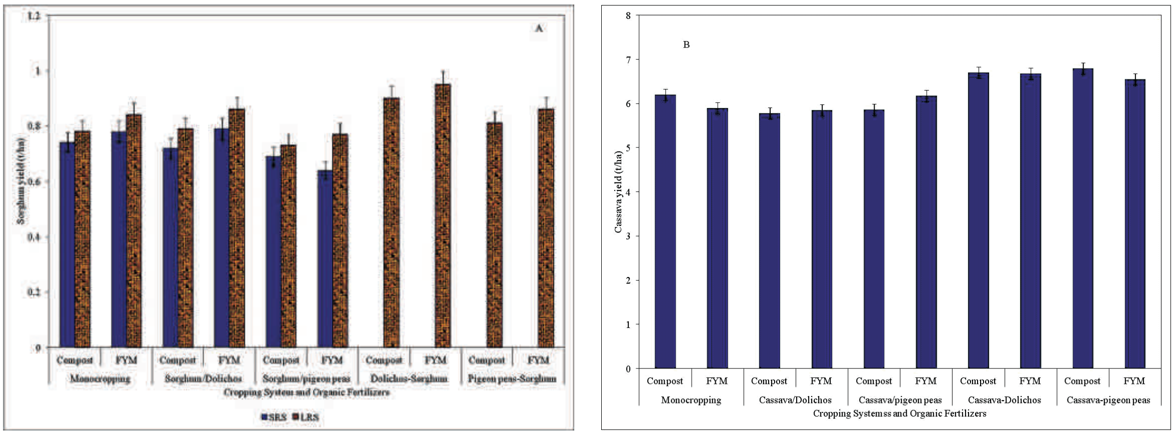

Figure 5: **Effect of cropping systems and organic fertilizers on Sorghum (A) and Cassava (B) yields for season I (Sorghum) and II (sorghum and Cassava)**

Dolichos has been reported to significantly improve soil nitrogen status and yield of cereals (Cheruiyot *et al*., 2003). The lower yields in intercropping system could have resulted from interspecific competition for nutrients, which occurs when two crops are grown together (Vandermeer 1992). Similarly, adverse effects of intercropping have been attributed to competition for root development, light, nutrients, and water during the co-growth phase (Herrmann *et al*., 2014).

Conclusion

The findings of the study confirm the hypothesis that selected agroecological intensification techniques could improve crop productivity in ASALs of Kenya. Pigeon pea, dolichos and sorghum grew to maturity and performed relatively well albeit and the low and unreliable rainfall experienced in the study area. Cassava performed well with integration of legumes and addition of organic fertilizers. Whereas cassava and sorghum performed better in rotation and monocrop systems. Intercropping system may still be beneficial and preferable to the farmers since two crops could be harvested from same unit area. Pigeon peas and dolichos could thus provide compatible and profitable options for intercropping with sorghum and cassava because of their higher grain yield contribution to overall yield. Soil moisture retention was higher when sorghum and cassava were intercropped and FYM applied. If sorghum is to be grown, then dolichos would be applicable as an intercrop while with cassava, pigeon pea would be the ideal legume. Crop diversification in both space and time with application of organic fertilizers would therefore boost soil nutrient status, soil moisture and crop productivity in the semi arid Yatta district and consequently enhanced food availability.

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Chlorophyll and Proteincontents of Fluted Pumpkin (Telfariaoccidentalis) Planted on Heavy Metal Contaminated Soil in Response to Different Organic Amendments

ADEJUMO, S.A.
Department of Crop Protection and Environmental Biology,
University of Ibadan, Ibadan, Nigeria.
Corresponding Author: nikade_05@yahoo.com

Keywords: Pollution, Human health, food chain, organics, contamination, vegetables.

Abstract

Contamination of agricultural lands by heavy metals poses serious threat on human health through food chain. The use of organic amendments to immobilize metal in contaminated medium and prevent crop contamination is preferred because of its cost-effectiveness and environment-friendliness. In this research, effects of different organic amendments (Mexican sunflower extract, Compost, Compost tea and poultry manure tea) were tested on the growth, chlorophyll contents lead uptake, protein and yield of Telfaria occidentalis (Fluted pumpkin) grown on lead polluted soil. These were applied at different rates and period (two week before and after planting of ugwu seeds). Results showed that T. occidentalis grown on organic amended soils performed better in all the parameters considered compared to control (contaminated soils only). Amendment with organic materials increased the vine length, number of leaves, fresh and dry weight. Application of the treatments two weeks before planting was better than after planting. In terms of chlorophyll contents those treated with organic materials had more chlorophyll than control. Organic treated soil also reduced Pb concentration in the crop compared to untreated contaminated control. Organic amendment therefore, enhanced crop growth on contaminated soil and reduced metal accumulation.

Introduction

The issue of land contamination by heavy metal which stemmed from increase in urbanization and industrialization is now posing a great challenge to agricultural production most especially in the developing countries. This has led to several hectares of land mostly in urban and peri-urban centres being contaminated by heavy metals thereby reducing the amount of cultivable land for crop production. Soil contamination apart from reducing the agricultural productivity also poses significant threat on human health through food chain (Eriyamremu *et al*. 2005). Toxic levels of lead (Pb) in cultivated crops have been widely reported (Sharma *et al.,* 2007). Heavy metals are said to enter into animals and human beings through ingestion of contaminated plants/crops (CDC, 1991).

Vegetables are important part of human diet all over the world. It constitutes a potential source of nutrients and food components which have significant health effects. *Telfaria occidentalis* (Fluted pumpkin)popularly known as Ugwu, is one of the popular vegetables widely consumed in the Eastern/Western parts of Nigeria for its medicinal and nutritive values. It has high concentration of iron

(Fe) which makes it a source of food supplements for people suffering from blood shortages. It is mostly cultivated by women in urban centres along with other vegetables. With the recent advocate on the promotion of urban and peri-urban agriculture coupled with the exhaustion and unavailability of cultivable arable lands in urban and peri-urban areas, contaminated lands are being converted to agricultural uses thereby posing a lot of risks to human health. Conventional methods to clean up metal contaminated soils are capital intensive, not applicable to large areas and some are not sustainable.

The available options are development of sustainable strategies to remediate these lands or immobilize the contaminants thereby preventing their uptake. In this study, different forms and types of organic amendments (dry compost, compost tea, green manure tea and poultry manure tea) applied at different rates on the growth, Pb uptake, chlorophyll content, Protein and yield of *Telfariaoccidentalis* were assessed. Assessment of the effects of organic amendments on the growth and biochemical properties of crops grown on contaminated soil will help in determining the efficiency of different forms of organic amendments on metal uptake by crop and provide understanding of their effects on crop yield. The major aim was to increase soil nutrient contents and pH with these materials so as to increase yield and decrease Pb uptake by Ugwu grown on contaminated soil.

Materials and Methods

Description of the experimental site and soil sampling procedure

The study was carried out using the soil collected from a lead-acid battery waste contaminated site at Kumapayi village in Egbeda Local Government Area, Oyo State, Nigeria. The site contains high amount of heavy metals(Pb: 138,000mg/kg, Cu: 482mg/kg, Zn: 1510mg/kg, Cr: 12.3mg/kg and Cd: 41.3mg/kg) (Adejumo*et al*., 2011) and covers about 24,985 m^2. Soil sampling was carried out at 0-15cm depth and specific quantity of soil was taken at five different locations for physico-chemical analysis and pot experiment. The soil was homogenized, air-dried and sieved.

Preparation of different organic products used for the experiment

Organic amendments used include; Mexican sunflower extract, Dried compost, Compost and poultry manure tea. Leachate production from fresh *Tithoniadiversifolia* was carried out by cutting the middle aged plants, weighed to know the fresh weight and then packed inside a 250 litres capacity plastic pot using partially aerated composting technique. The pot was perforated at the bottom and placed on a 50litres capacity bucket to collect the leachates. Dried compost was made from Mexican sunflower and Poultry manure in ratio 3:1 using PACT techmique (Adediran*e t al*.2001) and Poultry manure tea was prepared using partially aerated extraction method as described by Pant *et al*., (2012) with small modifications.

Experimental procedure

The five treatments (Mexican sunflower leachate; SL, Poultry manure tea; PM Compost tea; COT, Compost; COM and Control) were replicated 4 times using three application rates (0, 20t/ha, 30t/ha and 40t/ha). The treatments also included application period (one week before (BP) and after planting (AP) of Ugwu seeds). For the compost tea and sunflower leachates, the quantity applied was calculated based on the amount of leachates produced from the known quantity of dry compost and fresh *Tithoniadiversifolia* respectively. For compost application rate of 20t/ha, 30t/ha and 40t/ha, the quantity of tea or leachates applied was 15.15 (R1), 22.73 (R2), and 30.30mls (R3) per 5kgsoil for the soil receiving 20t/ha (R1), 30t/ha (R2) and 40t/ha (R3) respectively.

Data collection

Data were collected on yield parameters, Chlorophyll content using the method explained by Akparobi, (2009). Dry matter yield was determined at harvesting. The ash content was determined by ashing specific quantity of leaf sample in a muffle furnace at 500°C for 12hours. Nitrogen was determined using macrokjeldahl method and protein content was calculated by multiplying the values obtained for Nitrogen by 6.25 factor (Akanbi*et al*., 2007). Lead (Pb) content of the edible part (Leaf) was determined by Adejumo *et al.* (2011) and analysed for Pb content using Atomic Absorption Spectrophotometer (AAS).

Data analysis: Data collected were analysed using analysis of variance and the means were separated using DMRT at 5% probability level.

Results

Dry matter yield of Ugwuon contaminated soil amended with organic materials

Both fresh and dry weight of ugwu planted on contaminated soil responded positively to organic amendments. The fresh weight was enhanced mostly by the application of compost before planting at every rate. It was increased by 143% in plant treated with the highest rate of compost compared to control. This was followed by those of COLR1BP and SLR1AP. he lowest value was however recorded in those treated with poultry manure tea after planting (PMR2AP). Similarly, the shoot dry matter yield also followed the same trend. The root fresh weight was enhanced with compost tea treatment which gave the highest value followed by sunflower leachate, both applied after planting (Fig 1).

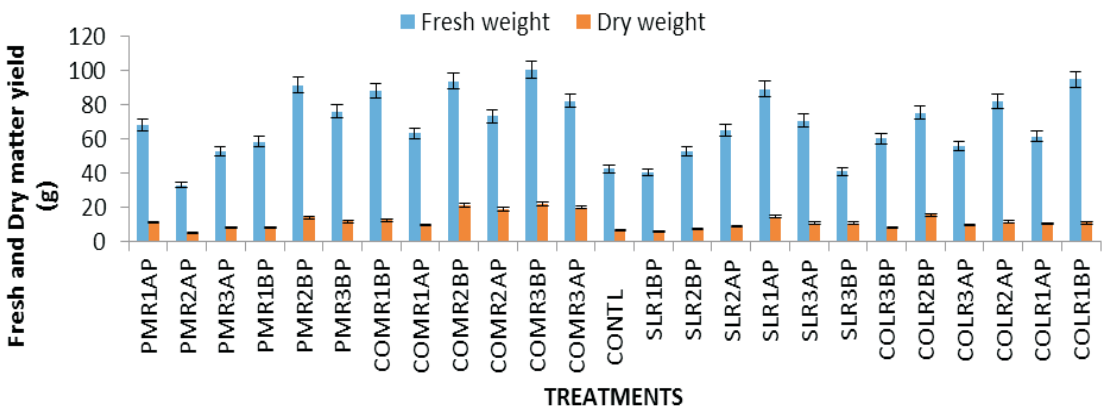

Figure 1: **Dry matter yield of Ugwuon contaminated soil amended with organic materials**

NB: Mexican sunflower leachate; SL, Poultry manure tea = PM, Compost tea = COL, Compost; COM and CONTL = Control on Pb soil, CONTN = Control on Normal soil) R1= 20t/ha, R2 = 30t/ha and R3 = 40t/ha; BP = Before Planting, AP=After Planting.

Heavy metal (Pb) uptake, Ash content, nitrogen and protein content of Ugwu* (Fluted pumpkin) *leaf from contaminated soil amended with organic amendments

The Pb concentration in the harvested ugwu leaf from Pb contaminated soil (825mg/g) was more than that of uncontaminated soil (5.34mg/g). Though, higher than the EU permissible level in edible plant part, application of organic amendments generally reduced the level of contamination by reducing the concentrations of Pb in the harvested leaf compared to control. Lower rate of compost tea applied at two weeks after planting reduced Pb concentration in the leaf more than other treatments (16.01mg/g). Except in COLRIBP treatment, the ash contents of the Ugwu leaves from all the organic amendment treatments increased more than that of control from contaminated and uncontaminated soils. Addition of organic amendments in any form at any rate and different timing enhanced nutrient accumulation by ugwu leaf. The lowest was however recorded in the control from contaminated soil. The same trend was observed in terms of nitrogen and protein contents of ugwu leaf in response to different organic amendments since protein content is a factor of nitrogen content. However, those leaves from lead contaminated soil had more of nitrogen and protein than those from normal soil irrespective of the treatments except in COLR1BP and COLR3AP(Table 1).

Table 1. **Pb uptake, Ash content, Nitrogen and Protein content of Ugwu on contaminated soil**

Treatments	Pb (mg/kg)	Ash content (g/g/DW)	Nitrogen (%)	Protein content (mg/g FW)
CONTL	825.00a	0.03i	4.67e	31.38e
CONTN	5.34v	0.18g	4.01m	26.95k
COM R1BP	417.00e	0.49ab	5.13b	34.47b
COM R1AP	373.00g	0.47b	5.30a	35.62a
COMR2BP	362.50i	0.37cd	4.86c	32.66c
COMR2 AP	61.30s	0.46b	4.65e	31.25e
COMR3BP	362.50i	0.37cd	4.86c	32.66c
COMR3 AP	61.30s	0.46b	4.65e	31.25e
PMR2BP	362.50i	0.37cd	4.86c	32.66c
PM R2 AP	61.30s	0.46b	4.65e	31.25e
PM R1 BP	641.00c	0.33e	4.85c	32.60c
PM R1 AP	205.50p	0.34cd	4.75d	31.92d
PM R3 BP	217.00o	0.23f	4.31j	28.96h
PM R3 AP	227.00m	0.33e	4.25k	28.56i
COLR1BP	32.20t	0.11h	3.41p	22.92m
COLRIAP	16.01u	0.30e	4.88c	32.80c
COL R2 BP	123.00r	0.20f	4.50g	30.24f
COL R2 AP	177.00q	0.30e	4.53fg	30.44f
COL R3 BP	318.50k	0.52a	4.21l	28.29i
COL R3 AP	330.50j	0.53a	3.48o	23.39l
SLR2 BP	233.50l	0.24f	4.55f	30.58f
SLR2 AP	432.50d	0.36cd	4.88c	32.79c
SL R1 BP	364.50h	0.21fg	4.39i	29.50g
SL R1 AP	223.00n	0.49ab	4.39i	29.50g
SL R3 BP	767.00b	0.38c	4.10m	27.56j
SLR3 AP	379.00.f	0.50a	4.40h	29.57g

Means followed by the same alphabet are not significantly different from each other at $P<0.05$ using DMRT.
NB: Mexican sunflower leachate; SL, Poultry manure tea = PM, Compost tea = COL, Compost; COM and CONTL = Control on Pb soil, CONTN = Control on Normal soil) R1= 20t/ha, R2 = 30t/ha and R3 = 40t/ha; BP = Before planting, AP= After planting.

Chlorophyll contents

Lead contamination reduced the chlorophyll content by 50% in the ugwu plant grown on un-amended contaminated soil compared to those grown on normal soil. The result of the effect of organic amendments on the chlorophyll content of Ugwu planted on lead polluted soil showed that organic amendment enhanced chlorophyll formation in Ugwu planted on contaminated soil compared with control. The responses however varied based on the form and rate of organic materials. Addition of higher rate of dry compost both before and after planting (i.e COMR3BP and COMR3AP), poultry manure tea after planting, sunflower leachate before and after planting (SLR3BPand SLR3AP) increased the chlorophyll content by 50-55% compared to control plant on Pb contaminated soil (Fig 2).

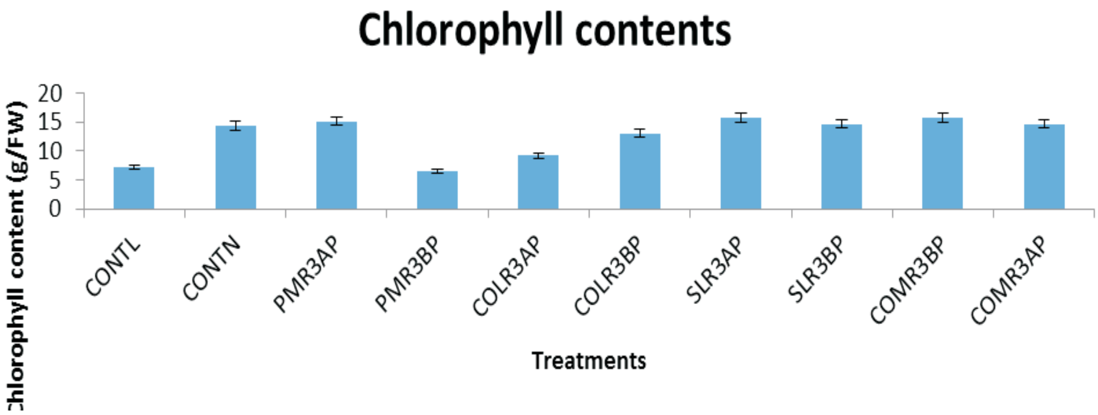

Figure 2: **Chlorophyll contents of Fluted pumpkin grown on organic amended contaminated soil**

Discussion

Organic amendments as previously reported (Chaney *et al*., 2000; Adediran *et al*., 2001; Adejumo 2010; Fleming *et al*., 2011) was able to increase crop growth on this contaminated soil and reduced the metal uptake by the crop. The use of dry compost performed better than the tea or the leachate because it has the ability to be retained more in the soil than its liquid counterparts which are proned to leaching. Increase in the growth and yield of treated ugwu confirmed the previous reports on the ameliorative effect of organic amendments on heavy metal stressed plant (Fleming *et al.*, 2011). Availability of nutrient as well as the ability of organic amendment to increase pH and soil redox potential is said to help in reducing metal solubility and uptake by plant. As observed in this study, the Pb concentration in the organic treated plants (though higher than that of the uncontaminated soil), were lower than control(Salati*et al*., 2010). The Chlorophyll concentrations of the leaves were significantly higher in Ugwu grown in organic amended contaminated soil. This confirmed the report that organic amendment increased the formation of organo-Fe complexes (Chen and Stevenson, 1986) which in turn enhances chlorophyll formation as Fe is very important in chlorophyll formation. Organic amendment has been reported to be a major source of iron-humate complex which has been reported to be more effective in increasing crop Fe-nutrition and has been used to correct Fe-deficiency in crop. With increase in chlorophyll content the photosynthetic ability of crop is also increased and this was revealed in the yield of Ugwu grown on amended soil as compared to control. Since ash content of the plant is a function of the nutrient composition of such plant, the control plant which probably had the lowest nutrient contents also contained the lowest quantity of ash. According to Hussain et al. (2012), stress factor such as heavy metal contamination in plant enhances the production of stress protective proteins in plants as was observed in this study, where protein and nitrogen contents contrary to what was expected, were higher in all the plant from contaminated soil more than that of control plant from normal soil.

Conclusion

Organic amendments increased the yield of ugwu on contaminated soil. Encouraging and promoting the use of organic amendment will help in preventing contamination of this vegetable with heavy metals.

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Nitrogen Contents of Composts Enriched with Organic Nitrogen Sources

FAWOLE, F.O.[1], AYODELE, O.J.[1] AND ADEOYE, G.O.[2]
[1]Department of Crop, Soil and Environmental Sciences, Ekiti State University, Ado-Ekiti
[2]Department of Agronomy, University of Ibadan, Ibadan
Corresponding Author: olufemi.ayodele@eksu.edu.ng

Keywords: Composts, agricultural wastes, enrichment, incubation, nitrogen content.

Abstract

Information is scanty on the potentials of agricultural wastes to enrich composts whose low nitrogen (N) content limits their use in organic farming. This study involved enriching composts - cow dung + sawdust (CDSD) and poultry droppings + sawdust (PDSD) with N at 10, 20, 30 and 50 kg/ha from bone, blood, hoof and horn meals; and neem leaf and tithonialeaf meals and their incubation in soil for 16 weeks. Total N contents monitored at four-week intervals of incubation showed enrichment in 74.0 and 83.0% of CDSD and PDSD compared to the respective controls and 50 kg N/ha gave the highest values. At 4 weeks, CDSD enriched with blood meal (CDSDBM) and bone meal (CDSDBN); and PDSD enriched with bone meal (PDSDBN) and tithonia leaf meal (PDSDTM) contained the highest N and would suitable for the cultivation of short-season leaf vegetables. CDSD enriched with neem leaf meal (CDSDNM) and PDSD enriched with blood meal (PDSDBM) which contained the highest total N at 16 weeks of incubation would be recommended for the cultivation of long-season vegetables.

Introduction

Soil fertility decline in Africa is very rapid, especially when continuously cultivated (Zingore *et al*., 2003) on account of low amounts of organic matter and available nutrients, yet it is on this fragile resources base that expectations for increased crop production are built. There is a growing concern over large-scale soil degradation from anthropogenic sources even as the farmers lack access to chemical fertilizers and so have difficulty in providing supplementary plant nutrients. The coping strategy of intensified land use accentuates nutrient 'mining' of soils such that the desired increases in crop productivity are unlikely unless adequate and balanced supply of nutrients is ensured.

Several studies have indicated the positive effects of organic wastes on soil productivity (Anikwe, 2000) compared to stagnant or declining crop yields from the continued use of chemical fertilizers due to increased soil acidity and nutrient imbalance. This necessitates the promotion of organic farming practices that encourage natural processes for nutrient supply (minerals, manures, symbiosis etc).Compost is manure produced from the controlled biological decomposition of organic materials which are sanitized through the generation of heat. Despite the age-long use and beneficial effects on plant growth, composts contain low amounts of nitrogen (N) which makes provision of additional N input inevitable. The search continues for materials which would improve the N content and so enhance the efficiency and quality of composts at low cost.

The potentials of agricultural wastes, as organic N sources, for raising the N levels of composts should be exploited. Wastes from the cattle industry (bones, hoofs, blood and horns)and the leaves of common plants such as neem (*Azadirachtaindica* L.) and Mexican sunflower (*Tithoniadiversifolia* (Hemsl) A. Gray) are organic N sources. The cattle abattoir wastes and leaves would be dried, ground into powder (meals) and used to supplement the N content of composts. Therefore, the objectives of this study were to: produce composts from conventional organic materials- cow dung, poultry droppings and saw dust; enrich the composts with blood, bone, hoof and horn meals, and neem leaf and tithonia leaf meals; and assess the N content of the enriched composts during periods of incubation.

Materials and Methods

Fresh poultry droppings from layers' battery cages, cow dung and cattle abattoir wastes (blood, horns, hoofs and bones) and sawdust were collected and analyzed for pH in water (at 1:2 ratio), total carbon, total N,P, Ca, Mg, K and Na.Cow dung and sawdust (CDSD), poultry droppings and sawdust (PDSD) were mixed at1:1 ratio (v/v) in heaps1.5m wide and 1m high, watered and turned fortnightly until composting was completed at 22 weeks. Blood, bone, hoof, horn, neem and tithonia leaf meals were mixed with the composts as follows:

CDSD	Cow dung + Sawdust	PDSD	Poultry dropping + Sawdust
CDSDBM	+ blood meal	PDSDBM	+ blood meal
CDSDBN	+ bone meal	PDSDBN	+ bone meal
CDSDHN	+ horn meal	PDSDHN	+ horn meal
CDSDHF	+ hoof meal	PDSDHF	+ hoof meal
CDSDNM	+ neem leaf meal	PDSDNM	+ neem leaf meal
CDSDTM	+ tithonia leaf meal	PDSDTM	+ tithonia leaf meal

The meals were added to supply 10, 20, 30 and 50 kg N/ha to give 50 treatments. The composts were applied at 30 MT/ha and thoroughly mixed with 2 kg of topsoil weighed into 2.5 litre bowls, moistened and covered with black polythene sheets. Each treatment had four replicates to accommodate the monitoring of soil total N in the samples at 4, 8, 12 and 16 weeks of incubation.

Results and Discussion

Table 1 shows that PD, CD and SD were alkaline; total N, K and Ca contents were highest in PD while CD contained the highest total P. BN, HN and TM were alkaline while BM, HF and NM were slightly acidic (pH=6.2-6.5). NM contained the highest N; HN and BN had the highest total P while HF and BM contained the highest Ca. The composts were alkaline and did not differ from those of the composting materials because the microbial breakdown of organic compounds in plant matter and animal wastes hardly reduced the Ca, Mg and K responsible for basic or alkaline reactions. CDSD contained higher total N, Ca, Mg, K and Na values whereas PDSD contained more total P. The N contents of the composts were similar to average contained in well-decomposed farmyard manure but lower than sheep, goat, cattle and poultry manures (Sreeniva, 2005) probably due to the dilution by sawdust (Adegbite and Olayinka, 2010). The N concentration in organic materials determines the net balance between mineralization and immobilization and materials with <24 g N/kg,such as sawdust used for composting, immobilization will exceed mineralization and the decomposing organic material will tie up N.

The N contents of composts enriched with organic N sources at various levels and incubated for 4, 8, 12 and 16 weeks are shown in Fig. 1 and 2. The patterns in N content were: (i) consistent increase from 4 to 16 weeks incubation in five (5) treatments (CDSDNM at 10, 20, 50 kg N/ha; PDSDHF at 10 kg N/ha and PDSDBM at 20 kg N/ha) (ii) increase from 4 weeks to the same value at 12 and 16 weeks in one (1) treatment (CDSDNM at 30 kg N/ha) (iii) decrease by average 20% from week 4 to week 8 followed by steady increase at 12 and 16 weeks of incubation in the remaining treatments. CDSDBM, CDSDBN and CDSDHF at 50 kg N/ha gave the highest N contents at week 4 while CDSDNM at 50kg N/ha contained the highest N at 8, 12 and 16 weeks incubation. PDSDBN, PDSDTM at 50 kg N/ha contained highest N at 4 and 8 weeks of incubation while PDSDBM at 50 kg N/ha gave highest values of N at 12 and 16 weeks of incubation.

The patterns in N contents over the periods of incubation would probably indicate the best time to use the composts. Enriched CDSD and PDSD had 46% of the treatments with the highest N contents at 4 weeks of incubation and a decrease till week 16; 26% showed increase at week 8 followed by a decrease till week 16 while equal proportion (16%) showed increase till week 12 followed by decrease at week 16 and increase from week 4 till highest N content at week 16. The enriched composts with highest N contents at 4 and 8 weeks of incubation would be suitable for the production of short-season crops such as leaf vegetables while those with highest values at 12 and 16 weeks of incubation will support the growth needed for optimum yield of long-duration leaf and fruit vegetables.

Table 1. **Some chemical properties of the compost materials, composts and the organic wastes used for N enrichment**

Parameters	Blood meal	Bone meal	Hoof meal	Horn meal	Tithonia meal	Neem meal	Cow dung	Poultry droppings	Saw dust	CDSD Compost	PDSD Compost
pH	6.2	10.5	6.2	8.2	8.2	6.5	8.0	8.4	8.4	8.4	8.2
Total N (g/kg)	78.8	2.0	58.1	44.2	82.0	98.7	53.9	79.2	1.5	64.0	42.2
Total C (g/kg)	325.6	7.8	405.4	182.6	339.1	407.8	222.9	327.2	334.3	258.0	158.0
Total P (g/kg)	3.2	241.4	8.9	256.3	26.8	11.7	268.2	86.4	2.2	10.0	23.0
Ca(g/kg)	12.2	10.9	12.1	10.0	9.7	9.2	9.5	13.1	10.4	13.0	11.5
Mg (g/kg)	6.1	5.8	6.6	6.0	6.2	5.9	6.0	6.7	6.4	6.8	6.2
K (g/kg)	4.4	4.1	5.0	4.1	5.1	4.1	4.4	5.2	4.8	6.1	5.4
Na (g/kg)	1.1	0.8	0.7	0.7	0.5	0.5	0.8	0.8	0.5	1.3	0.4

CDSD= Cow dung + Sawdust
PDSD= Poultry droppings + Sawdust

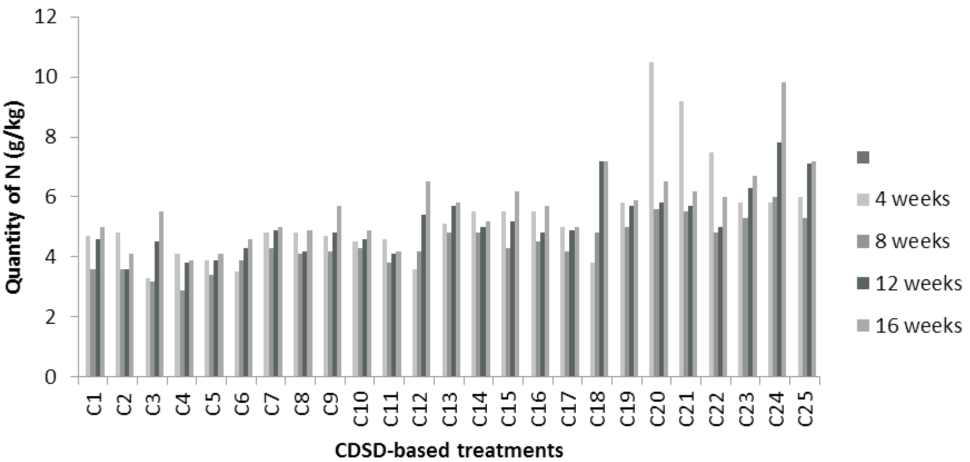

Figure 1: **Amounts of N in CDSD enriched with organic amendments at different rates and incubation periods**

Legend

C1	CDSD control				
C2	CDSDBM at 10 kg N/ha	C3	CDSDBN at 10 kg N/ha	C4	CDSDHN at 10 kg N/ha
C5	CDSDHF at 10 kg N/ha	C6	CDSDNM at 10 kg N/ha	C7	CDSDTM at 10 kg N/ha
C8	CDSDBM at 20 kg N/ha	C9	CDSDBN at 20 kg N/ha	C10	CDSDHN at 20 kg N/ha
C11	CDSDHF at 20 kg N/ha	C12	CDSDNM at 20 kg N/ha	C13	CDSDTM at 20 kg N/ha
C14	CDSDBM at 30 kg N/ha	C15	CDSDBN at 30 kg N/ha	C16	CDSDHN at 30 kg N/ha
C17	CDSDHF at 30 kg N/ha	C18	CDSDNM at 30 kg N/ha	C19	CDSDTM at 30 kg N/ha
C20	CDSDBM at 50 kg N/ha	C21	CDSDBN at 50 kg N/ha	C22	CDSDHN at 50 kg N/ha
C23	CDSDHF at 50 kg N/ha	C24	CDSDNM at 50 kg N/ha	C25	CDSDTM at 50 kg N/ha

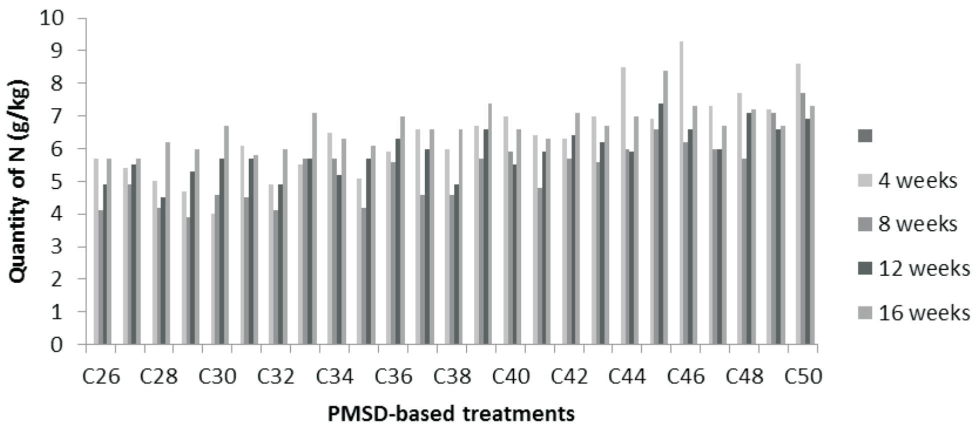

Figure 2: **Quantities of N released monthly during incubation for PMSD-based treatments at different N rates**

Legend

C26	PDSD				
C27	PDSDBM at 10 kg N/ha	C28	PDSDBN at 10 kg N/ha	C29	PDSD HM at 10 kg N/ha
C30	PDSDHF at 10 kg N/ha	C31	PDSDNM at 10 kg N/ha	C32	PDSDTM at 10 kg N/ha
C33	PDSDBM at 20 kg N/ha	C34	PDSDBN at 20 kg N/ha	C35	PDSDHM at 20 kg N/ha
C36	PDSDHF at 20 kg N/ha	C37	PDSDNM at 20 kg N/ha	C38	PDSDTM at 20 kg N/ha
C39	PDSDBM at 30 kg N/ha	C40	PDSDBN at 30 kg N/ha	C41	PDSDHM at 30 kg N/ha
C42	PDSDHF at 30 kg N/ha	C43	PDSDNM at 30 kg N/ha	C44	PDSDTM at 30 kg N/ha
C45	PDSDBM at 50 kg N/ha	C46	PDSDBN at 50 kg N/ha	C47	PDSDHM at 50 kg N/ha
C48	PDSDHF at 50 kg N/ha	C49	PDSDNM at 50 kg N/ha	C50	PDSDTM at 50 kg N/ha

Enriched CDSDNM continued to increase in N content which probably meant reduction in the fixation of available N and can be linked to the higher N content of the neem meal, lower C: N ratio of the CDSD than PMSD and so N would be released earlier and faster (Olayinka and Adebayo, 1984). Besides, neem products (seeds, seed oil and extracts) are used to retard nitrification of N fertilizers in soils and so resulted in substantial increase in N use efficiency in crops (Sharma and Prasad, 1996). PDSDBN and PDSDTM at 50 kg N/ha with highest N contents at 4 and 8 weeks incubation would be suitable for short-season vegetables while PDSDBM at 50 kg N/ha which had highest N at 12 and 16 weeks of incubation would be recommended for long-season tropical leaf and fruit vegetables.

The application of organic materials to enrich composts at 50 kg N/ha gave the highest N contents over the incubation period. However, the level of N should be increased in order to produce value-added composts that can be applied at substantially lower rates of few kg/ha compared to conventional manures and composts added at 10-30 MT/ha. The choice of 16 weeks incubation is based on the longest period most arable crops stay on the field and the high N contents will support the growth of the crops.

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Multi-Stakeholder Partnerships in Organic Value Chain Development: A Case of Ntungamo Innovation Platform in Western Uganda

KALIBWANI, R., KAMUGISHA, R., TWEBAZE, J., SABIITI, M., KUGONZA, I., TENYWA, M., AND NYAMWARO, S.O.
Bishop Stuart University, Department of Agriculture and Agribusiness, P.O. Box 9, Mbarara, Uganda.
Corresponding Author: rmkalibwani@yahoo.com, rmkalibwani@as.bsu.ac.ug

Keywords: Multi Stakeholder Partnerships, Organic Agriculture, Governance, Gross Margins, Innovation Platform.

Abstract

This study aims to demonstrate how multi-stakeholder partnerships in organic value chain development can foster social and economic development, using the case of Ntungamo Organic Pineapple Innovation Platform in Western Uganda. Specifically the study aims to identify the major stakeholders, processes and support services in the organic pineapple value chain, identify the opportunities that the value chain offers for upgrading farmers' knowledge and skills, identify the governance mechanisms that sustain the value chain operations, and compare gross margins between organic and conventional pineapple farmers in Ntungamo. The study utilises the approach of value chain analysis with three qualitative tools; value chain mapping, analysis of governance and institutional features, and identification of opportunities for demand-driven up grading of farmers' knowledge. Multi-stakeholder partnerships have provided technical support services and market access. They are also found to result into capacity building for organic farming, opportunities for product and process upgrading, and higher gross margins for organic farmers than their conventional counterparts.

Introduction

Organic agriculture has expanded rapidly in recent years and widely gained acceptance and popularity due mostly to environmental and health related concerns (Escobar and Hues, 2007). It can contribute to meaningful socio-economic and ecologically sustainable development, especially in the developing countries. This is due on one hand to the application of organic principles, which means efficient and cost effective management of local resources and on the other, to the excellent opportunities for producers in these countries to improve their income and living conditions (Klicher, 2007). However organic farming is a *know-how-intensive* farming method that requires competitive organic farmers to experiment with new techniques, and manage land, labour, capital and innovations quite differently from conventional farmers (Klicher, 2007). Organic farmers therefore need the support of service providers with various skills and resources to acquire the required knowledge for the development of organic value chains. Multi-stakeholder partnerships (MSPs) are believed to have enormous potential as development interventions in general (Brown 2007), and value chain development in particular. They are increasingly being recognized as important mechanisms to help address market failures, where neither the market nor government is able on its own to meet crucial social and environmental challenges. This study aims to demonstrate how MSPs in organic value chain development can foster social and economic development, using the case of Ntungamo Organic Pineapple Innovation Platform (NOPIP), in Western Uganda. Specifically the study aims to identify the major stakeholders, processes and support services in the organic pineapple value chain, identify the opportunities that the value chain offers for upgrading farmers' knowledge and skills, identify the governance mechanisms that sustain value chain operations, and compares gross margins between organic and conventional pineapple farmers in Ntungamo.

NOPIP was established in 2009 by the sub-Saharan Africa Challenge Program (SSA CP) that was funded by the Forum for Agricultural Research in Africa (FARA). The Innovation Platform (IP) was established to focus on the development of the organic pineapple value chain. NOPIP has since been comprised of development partners and farmers from seven sub-counties; Itojo, Rugarama, Kayonza, Ngoma, Nyabihoko, Ruhama, and Nyakyera that comprise the IP. It was then found necessary to identify partners that would support the farmers on various aspects of the value chain such as organic farming methods, access to appropriate planting material, post harvest handling processing among others.

Materials and Methods

The study utilises the approach of value chain analysis with three qualitative tools; value chain mapping of the stakeholders, processes, and support services, analysis of governance and institutional features, and identification of opportunities for demand-driven up grading of farmers' knowledge. Gross margins of the organic and conventional pineapple producers are computed from survey data that was collected after the Feb-July, 2014 season. A sample of 97 farmers was drawn purposively from two sub counties; Itojo one IP sub county, and Rubare a non-IP sub county for comparison. From Itojo, a total of 78 farmers were randomly selected, of which 28 were found to be certified organic farmers, and 50 were organic but still conventional farmers. A total of 19 farmers were randomly sampled from Rubare.

Results and Discussion

Value chain mapping of stakeholders, processes and support services

The key processes in the organic pineapple value chain include the supply of planting material (suckers), production, collection of pineapples at the solar dryer sites, solar drying, wholesale and retail marketing, and consumption. The suckers are shared by the farmers within the IP. The farmer groups within the IP are responsible for collecting their group pineapples and delivering them at a solar dryer for drying. The fresh pineapples that are not solar dried are either consumed at home or individually sold by the farmers in the local markets. The dried pineapple slices are packed and are expected to be sold to supermarkets in Kampala and exported. The potential exporters so far identified are Fruits of the Nile (FON) and Jakana Foods Ltd (JFL). In addition, there are support services that are provided along the value chain. These include research, training, extension and product promotion. Figure 1 shows a map of the key value chain actors / stakeholders, processes and support services in the OP value chain in NOPIP. The careful selection of the service providers has enabled the IP to access a range of technical services such as extension, soil and water conservation trainings, community banking, improved planting material among others. The presence of NDLG has also enabled the mobilization of farmers to join IP activities and ensured and political support.

Governance and institutional features of the value chain

The important coordination structures for this value chain include the groups in which the individual farmers are initially registered and the IP at the district level that registers member groups. The groups enable the coordination of the farmers and facilitate access to support services of extension, and training. This horizontal coordination also enables the identified market actors to interact with the farmers as a recognized entity, bulking of their produce, access to technical support, and enables them to overcome barriers to entry in global markets. The coordination is sustained by committees at the group and IP levels, as well as by regular meetings. Organic certification is offered by NOGAMU, a membership organization of farmer groups, associations, and buyers of organic products, which ensures access to a niche market of organic products in the region.

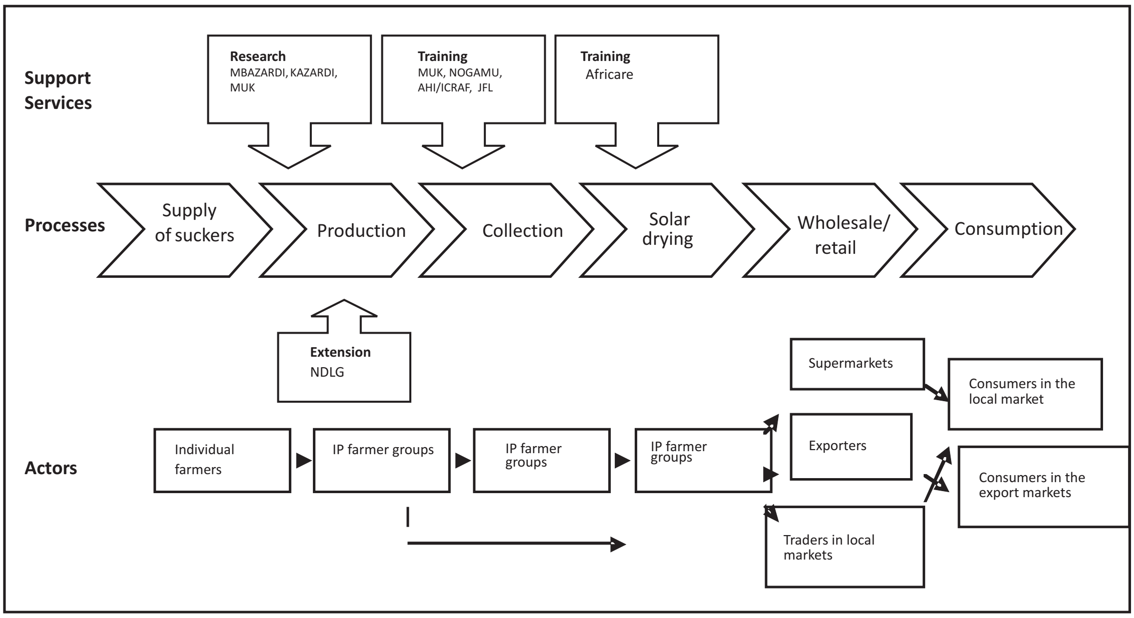

Figure 1: **Mapping of the stakeholders, processes and support services in the OP value chain**

The contracts, a form of vertical coordination, made between the private actors such as the exporters and the IP commit both parties to certain obligations that further sustain interaction of the value chain actors. Most of the rules that govern the functioning of the value chain are set by the exporting company, JFL. These include adherence to JFL standards, organic and fair for life requirements, agreed upon quantities of products and delivery schedules among others. NOGAMU has instituted an Internal Control System (ICS) to monitor the maintenance of its standards. The NOGAMU ICS consists of farmers that have been trained to monitor the requirements among fellow farmers' gardens. The major incentive for the farmers to abide by the specified rules and regulations are two premiums to be offered by JFL to the farmers upon delivery. The first is a 10% premium above the farm gate price, and the second is a premium by the fair trade regulations.

Opportunities for upgrading farmers' knowledge and skills

The OP value chain provides opportunities for this upgrading. Ordinarily the farmers in Ntungamo district grow pineapples without using fertilizers and pesticides. The *smooth cayenne* pineapple is well-favored by the warm climate. These factors make it easy for the farmers to shift from the conventional farming methods to organic farming since they would not need to purchase and apply chemicals in order to achieve the required product standards. From conventional farming methods the farmers have to adopt organic farming practices. There is both product and process upgrading, which contribute to improving product quality and chain efficiency. The value chain enables the farmers to achieve the standards required of the organic fresh and dried pineapple. This is done through the support services of the partners. It also enables functional upgrading of farmers' knowledge from simply production to processing. Dried pineapple in particular is produced by solar drying, where women IP members have been found to especially participate.

Comparison of Gross Margins

The total production costs per acre of crop land include the cost of manure, mulch and pesticides for the conventional farmers. Total production costs on average are highest with the certified organic farmers (Table 1).

Table 1. **Gross Margins across farmer category**

Variable	**Location**		
	Rubare (n=19) non-IP, conventional	**Itojo 1 (n=28) Certified Organic**	**Itojo 2 (n=50) IP conventional**
Mean Total household land	6.5	3.5	14.1
Mean Land under pineapples (n=94)	1.73	1.8	4.7
Proportion under pineapple (%)(n=94)	52.20	59.90	69.30
Total production cost per acre (shs) (n=83)	189,570.00	500,872.00	116,093.00
Labour (man days)			
Crop labour input (n=97)	80.63	975.2	91.7
Pineapple labour input (n=89)	56.4	66.1	50.2
Revenue (shs)			
Pineapple revenue per acre (shs) (n=72)	17073.00	368468.00	258553.00
Pineapple proportion of total inc.(%)(n=72)	2.57	25.42	34.01
Gross margins per pineapple acre (n=87)	63,239.00	894,077.00	513,465.00

Source: Survey data, 2014

The mean crop labor input in inevitably highest with the organic farmer category, nearly ten times more than the other two categories, reflecting the intensity of labor input in organic farming. However mean pineapple revenue per acre and gross margins per pineapple acre are also highest with the certified organic farmers. It is important to note that pineapples were valued at farm gate price and not considering the double premium that will be offered by the exporter under the terms of the contract. Pineapple revenue for the certified organic farmers under the terms of the contract is therefore likely to increase further. This opportunity is three-fold; through the sale of fresh organic pineapple to an export market and dried pineapple to local supermarkets, regional and export markets, and the sale of other organic products produced with the same resources on the certified organic farms, to the same markets.

Conclusion

Although organic farmers have the potential to produce more, better quality products and achieve higher incomes than conventional farmers, they need the support of stakeholders who provide various services as may be required to develop the organic value chain. MSPs provide technical support services, research for improved planting material, organic certification, and market linkages. The OP value chain presents opportunities for farmers to upgrade farming practices, product quality through drying the pineapple, and skills to package the products. The value chain further presents the opportunity to increase their gross margins above those of conventional farmers. This study recommends that efforts to support and promote such MSPs in organic value chain development will promote and sustain both the socio-economic and environmental benefits of organic farming in Uganda.

Acknowledgement

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Organic Governance Regimes: The Best Bet for Nigeria's Organic Sector

ADEBIYI JELILI ADEGBOYEGA
Department of Community Sustainability, Michigan State University, USA.
Corresponding Author: adebiyij@msu.edu

Keywords: Organic governance regime, third-party system, PGS, food production, smallholders.

Abstract

The paper explored the organic governance regime, which is the best bet for advancing the development of organic agriculture in Nigeria. The paper argued in favor of the participatory guarantee system (PGS). The core argument was that, compared to the internal control system (ICS) and the third-party system, the PGS is entirely focused on domestic organic markets. The paper also noted that Nigeria has largely underexploited domestic organic market potentials. It was therefore argued that the PGS offers a window for transforming untapped domestic organic market opportunities to foster the development of OA in the country. The paper also argued that by starting with the PGS, Nigeria's smallholders can master organic food production technical requirements, following which they can transition to the ICS and third-party system. Finally, the paper also appropriated the costs associated with the ICS and third-party system to make a case for the PGS as the best bet for Nigeria's infant organic sector.

Introduction

Organic agriculture (OA) is at its infancy in Nigeria. Yet, it is experiencing noticeable and promising growth. For example, from 3, 042 ha in 2006, the land in OA in Nigeria increased to 9, 521 ha in 2012 (FAOSTAT, 2014). Nigeria's farmers generally consider OA to be compatible with their farming practices. Nigeria also has untapped domestic market opportunities for organic products. These are indicative of the opportunities for the growth of OA in Nigeria. For this to happen, the constraints to the growth of OA in Nigeria, including, a lack of organic governance regimes (OGRs) must be addressed (Hagensen and Atungwu, 2010).

Worldwide, OGRs are part of organic food production systems. They can be created by governments/non-governmental stakeholders, including farmers. OGRs specify the rules governing and regulating organic food systems, including labelling, and marketing. OGRs may (1) enable or constrain the adoption of OA, (2) foster/restrict market access, especially, to international and domestic premium prices for organic products, (3) create conditions, which may favor or impede the entry and domination of the organic food systems by agribusinesses (Schmid, 2007; González and Nigh, 2005). Therefore, OGRs can shape the direction of growth and development of a country's OA by creating an exclusive institutional environment. Given this, this paper explores the OGRs, which offer the best bet for the development of OA in Nigeria, taking cognizance that smallholders dominate the country's agriculture.

Organic Governance Regimes: History and Rationale

OGRs are the rules/regulations that define how organic products should be produced, processed, conserved, packaged, certified, labelled and marketed. Government drawn OGRs are called regulations. The ones by farmers' associations, private-stakeholders, or semi-autonomous bodies, are called organic standards. Adherence to organic standards/regulations is confirmed through certification, a process, which usually, is executed by an independent third-party (Schmid, 2007; Dankers and Liu, 2003).

The origin of OGR is associated with the introduction of a private label called Demeter in 1928 in Berlin, Germany, by a co-operative inspired by and associated with Rudolf Steiner's biodynamic movement. Steiner is one of the pioneers of OA (Schmid, 2007; Rundgren, 2003). The Demeter was issued to farmers whose products were grown on biodynamically managed fields, whose seeds were obtained from fields, which did not use synthetic fertilizers for three years, and whose produce were produced according to basic food quality standards (Schmid, 2007).

The Demeter's norms and other biodynamic agriculture principles shaped the evolution of OA, a term which was first used in 1940 by Sir Northbourne, an Oxford agricultural scientist (Morgera et al., 2012). Comparable farming norms to Demeter's were established in the 1940s by two different organic-biological cooperatives in Switzerland (Schmid, 2007). The private norms specified 'codes' for organically grown foods. Then, the objective was "more to communicate what they (*farmers*, emphasis, mine) had learned than to codify what constitutes organic farming" (Dankers and Liu, 2003, p. 15). Rundgren (2003) also notes, "there was no pressure to define organic production systems strictly, because consumer interest was limited to the 'alternative' sector and links between producer and consumer often were close (p. 12). That explains why at the initial phase, voluntary 'OGRs' were farmer-driven, characterized 'loose codes,' and informal inspection of farmers' fields. Certification was based on farmers' peer-review (Rundgren, 2003).

In 1967, the Soil Association, UK, released her own organic standards to protect organic farmers and consumers from fraudulent organic claims. In the 1970s, similar farmers/consumers-driven private standards were also formulated in Australia, France and the United States Forthwith, inspection system became integral to OGR and certification systems to guarantee trust, and protect organic operators and customers' interest (Rundgren, 2003; Schmid, 2007).

As OA began to expand and command consumer attraction worldwide, private standards continue to proliferate and fragmentize. This created confusion within the organic community as products not certified according to a particular private standards may not be considered organic, even, within the same country. This necessitated the need for reference standards and a common definition of OA. Consequently, the IFOAM Basic Standards was developed in 1987 and later, the World Trade Organization's Codex Alimentarius for organic vegetable. Through the mid-1980s, inspection and compliance with organic standards was mainly done by farmers through a peer review process (Nelson et al., 2010). Yet, OA continued to be defined differently by private standards, nationally and internationally. Also, with the sector's growth beyond local communities, Global North consumers demanded for independent certifiers. Thus, some farmers-driven private standards' organizations transformed to specialized independent certifiers (Courville, 2006; González and Nigh, 2005).

The definitional crisis and explosion in organic trade also drew government's interest, especially in Europe, United States and Asia, who, from 1985, passed legislations regulating the sector and which established national definitions of OA. This was also an attempt to harmonize the sector by specifying a national definition of organic food production systems. Most of the national regulations drew on IFOAM Basic Standards. Also, to prevent conflict of interest, national regulations outlawed inspectors from advising farmers. The sector's growth, and advent of national regulation elicited commercial companies' interest in third-party organic certification (Rundgren, 2002). From 1990s, they started dominating and influencing organic standards/regulation setting. Thus, OGRs became a tool for facilitating market entry for organic products. Over time, OGRs became more prescriptive as lesser attention is paid to OA underlying principles. Also, inspection and certification became a procedure exclusively carried out by third-party, who are commercial actors and not farmers (González and Nigh, 2005). These changes were meant to accommodate global food market realities. They also reflect the influence of agribusinesses on the sector (Schmid, 2007). As later argued, the changes had obvious socio-economic implications for smallholders, whose interest, OA is supposed to protect.

Organic Certification and Inspection Systems

There are three forms of organic certification and inspection systems: first-party, second-party and third-party certification. In the first-party system, certification and inspection are done by farmers, often organized as producers' groups. It is modelled after the earliest forms of 'OGRs' in practice between 1928-1970s (González and Nigh, 2005). It is often promoted by pro-organic Civil Society Organizations (CSOs) and development agencies to help smallholders' access domestic organic markets, without necessarily attracting premium prices. Here, certification is informally done through peer-review by organic farmers, and may include other stakeholders, like consumers, and agronomists. It operates on a face-to-face social relationship, trust, and the exchange of knowledge between farmers and consumers (Nelson et al., 2010; Castro, 2014).

The first-party system is widely practiced through a documented quality assurance procedure called Participatory Guarantee System (PGS), which is in use in many developing countries, including Uganda, Tanzania, and Mexico. The PGS is locally focused as organic products so certified can only be traded locally. It is flexible as it requires less paperwork. It was developed to help foster an inclusive organic sector, which allows for smallholders' participation. Certification in the PGS can be based on either national regulation or private organic standards. To be successfully implemented, it requires local capacity building, technical support, transparency, shared vision and knowledge sharing. Also, the PGS requires educating farmers and consumers about OA underlying principles. The PGS offers a good stepping stone to the second and third-party system. Some of its downsides are that, it is not a basis for organic exports and may not attract premium prices (Katto-Andrighetto, 2013; IFOAM, 2013).

In the second-party system, a party other than farmers, audits and certifies that organic products complied with certain standards. The second-party may be a CSO or trading agents (commercial companies/private stakeholders) and are also responsible for setting or adopting standards/regulations to be used for certification (Setboonsarng, 2008). This certification system is often implemented through a documented quality assurance system called Internal Control System (ICS). The ICS is a group certification system as it requires organizing producers of the same organic product into a production group. This may be facilitated by pro-organic CSOs or trading agents, who also, will work with the producer groups to develop and sign an undertaken to adhere to an ICS, which informs their product certification. The ICS requires the production group to do internal audits of their members' production activities, and to develop and maintain up-to-date documentation of their farm operations to help guarantee compliance to set out organic standards/regulations. Random auditing of some farmers in the group, including their documentations will be conducted by an external auditor. Afterward, certification will be issued by a third-party, who may be a local or an international certifier. One certification fees will be paid, either by the farmers group or the second-party who holds the certification right. The advantages of this system are that: reduction in certification costs as one fees is paid by all the farmers in the group; ICS certified products can be marketed locally and international at premium prices. Its major limitations are that: farmers may not be to sell their products independently as they do not hold certification rights; farmers' often rely on trading agents to access markets for their products internationally; the entire group may be denied certification due to omission by one member (Preißel & Reckling 2010; Källander, 2008; Barrett et al., 2010).

Finally, the third-party system is conducted by a third-party, who is neither a farmer nor a trading agent. It is the only certification system that is recognized worldwide and upon which the term organically certified is conventionally associated with. A third-party certifier may be domestically or international located. However, majority of the third-party certifiers are located in developed countries. They often use standards adapted to their agroecological conditions and the interests of developed world consumers. Consequently, the costs and terms of certification are often too high for developing countries' smallholder farmers, thereby, constraining them from partaking in organic food markets. Also, the third-party system emphasizes compliance to allowable and prohibited inputs at the expense of OA socio-ecological principles. To prevent conflict of interest, it prohibits inspectors from guiding farmers on what they need to do right to be certified (Nelson et al, 2010; González and Nigh, 2005).

Organic Certification and Nigeria's Infant Organic Sector

This section explores the types of OGRs, which offer the best bet for Nigeria's infant organic sector. Presently, published studies suggest that the few organic farmers in Nigeria rely on international third-party certifiers and standards. Also, the adopters, and potential adopters of OA in Nigeria are farmers with about 0.1-10 ha. Majority of them have elementary and high school education and are living below poverty level (Oluwasusi, 2014; Faturoti et al., 2012). Given their poverty level, third-party certification may discourage majority of Nigerian smallholders from adopting and taking advantage of OA to improve their productivity, market access and livelihood conditions. Third-party certification costs are very expensive and beyond the reach of African smallholders, including Nigeria's (Rosinger, 2013; AdeOluwa, 2010). Also, third-party certified organic products are always sold to highly competitive markets in developed countries, where producers can earn premium prices, which may be good enough to cover their certification costs and make their farm operations profitable. With the mean farm size of the potential OA adopters in Nigeria, they may not able to meet and sustain the required production volume for export markets. This may not be the case if they sell through an association. Furthermore, the logistics and paper work associated with third-party certification present considerable barrier to the adoption of OA, especially in developing countries such as Nigeria with no locally-situated international certifier (Bolwig, 2012; AdeOluwa, 2010). Taken together, these factors suggest that promoting third-party certification system in Nigeria may potentially prevent the country's smallholders from adopting OA. This may hinder the inclusive development of the sector. The foregoing makes the ICS and PGS the potential best bet OGR options for Nigeria.

Previously, it was highlighted that the ICS and PGS are often promoted by pro-organic CSOs, and that they involve organizing farmers into production groups. In Nigeria, OA is currently promoted by CSOs, which mostly consists of agricultural scientists, and some farmers as members. These CSOs include the Organic Agriculture Project in Tertiary Institutions in Nigeria and the *Nigerian Organic Agricultural Network (NOAN)*.

Furthermore, most of the pro-organic CSOs are pioneered and hosted by some universities in the country. The CSOs partner farmers and other stakeholders to foster the adoption and development of OA (Aiyelaagbe 2009, cited in Aiyelaagbe et al., 2011; *Aiyelaagbe et al.,* 2009). This possibly positions the CSOs in a good stead to leverage their relationship with farmers to help organize the latter into production groups around certain organic products. Besides, the expertise of the CSOs can be explored to provide the technical and extensionist support necessary for Nigeria's smallholders to develop an ICS or PGS for their potential OA operations. Moreover, it is reported that the Nigerian farmers with the likelihood of adopting OA are members of farmers' cooperative society (Oluwasusi, 2014). This seems to present organizational social capital opportunity, which can be harnessed to organize smallholders with favorable disposition to OA into production groups.

Also, there are promising but untapped domestic market opportunities for organic foods in Nigeria, even without a third-party certification, especially in southwest Nigeria (Phillip and Dipeolu, 2010). Also, there is favorable disposition and some level of awareness about OA among Nigeria's smallholders (Solomon and Okolo, 2008; Adesope et al., 2008; Adebisi-Adelani et al., 2010; Adebayo and Oladele, 2014). With this, it seems reasonable that these category of farmers be organized around the PGS certification system as it is exclusively focused on domestic organic markets. Over time, the PGS may equip participating smallholders with the capacity to produce for the highly competitive export markets through the ICS or third-party certification system. Another reason the PGS may be the best bet for Nigerian organics is that its focus on domestic markets may help insulate Nigerian smallholders against a possible deep in organic export markets. However, Nigeria's smallholders, who are supported by agribusinesses/international agencies may be organized around the ICS or third-party system.

Given the analysis above, the PGS seems to be the best bet for the development of OA in Nigeria. It offers an opportunity to explore untapped domestic market opportunities for organic foods in Nigeria. Also, with the PGS, Nigerian smallholders have the opportunity to master OA production requirements, following which they can progress to the ICS and third-party system, which allow them to produce for export markets. The costs of the ICS and third-systems, and the competitiveness of producing for export markets also underscored why the PGS is considered the best bet for Nigeria's infant organic sector.

Conclusion

This paper found that the PGS offers the best bet for the development of OA in Nigeria. The underlying argument is that, compared to the ICS and third-party system, the PGS is exclusively focused on certifying for domestic organic markets. Also, noting the untapped domestic organic market potentials, it was argued that the PGS offers a window for translating domestic market opportunities for the development of OA in Nigeria. It was also reasoned that with the PGS, Nigerian smallholders have the opportunity to master organic food production technical requirements over time, following which they can progress to the ICS and third-party systems, which allow them to produce for highly competitive export markets. The costs of the ICS and third-systems, and the competitiveness of producing for export markets also underscored why the PGS was considered the best bet for Nigeria's infant organic sector.

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Effects of Climate Change on Irrigated Rice Production in Badagry Local Government Area of Lagos State, Nigeria

EZEKIEL, AYINDE ALANI
Department of Agricultural Economics, Ladoke Akintola University of Technology,
P.M.B. 4000, Ogbomoso, Oyo State, Nigeria
Corresponding Author: aaezekiel@lautech.edu.ng, ayinlani@yahoo.com

Keywords: Effects, Climate Change, Irrigation, Rice, Production, Nigeria.

Abstract

The study focused on the effects of climate on irrigated rice production in Badagry Local Government Area of Lagos State. It also examines the constraints the farmers faces in adapting to climate unpredictability. Purposive sampling was used to select a total of 120 farmers and were interviewed using a well structured questionnaire, descriptive statistical tools were used to describe the socio-economic characteristics and Regression model was used to determine the effect of climate change on irrigated rice. The empirical results of the regression analysis model revealed that vocational and adult education were significant at (P<0.05), farm size (P<0.05), income (P<0.1), level of awareness (P<0.01), primary education (P<0.01), level of adaptation (P<0.1), favourable education (P<0.01), sunlight intensity (P<0.1) all had significant impact on the effect of climate change on irrigated rice with intercept of -49225.13, results however suggest that with increasing access to extension services, credit facilities, improved electricity supply, access to adequate water supply, farmers can adopt various adaptation measures that can lead to improvement in practicing irrigated rice production.

Introduction

Rice is the seed of the monocot plant also known as mono-cotyledon (one seed) *Oryza sati*va (Asian rice) or *Oryza glaberrima* (African rice) and it is also a member of the grass family (Gramineae). Rice is a cereal grain, which is the most important staple food (a food that is eaten regularly and in such quantities as to constitute the dominant part of the diet and supplies a major proportion of energy and nutrient needs) for a large part of the population in Nigeria. It is the grain with the second highest production after Maize (Wikipedia, 2013). Rice is relatively easy to produce and is grown for both sale and consumption. In some areas, there is a tradition of growing but for others its cultivation is relatively recent. According to (Onwueme and Sinha, 1991). The traditional method of cultivating rice is flooding the field, while or after, setting the young seedlings. This simple method requires sound planning and servicing of the water damming and channelling, but reduces the growth of less robust weed and pest plants that have no submerged growth state, and deters vermin while flooding is not mandatory for the cultivation of rice. (Odjigo, 2010) said that, the production of irrigated rice in Nigeria is mostly in the rural areas, which is dominated by aged people and children. Young and able-bodied men that are capable of farming have migrated into the urban areas searching for greener pastures, thus leaving older men, who are not strong enough to work on the farm, making the farm work slow and less productive. The Nigerian government, both past and present recognized the importance of rice farming in Nigeria.

Statement of Problem

Rice production in Nigeria is faced with a lot of problem. The problem confronting rice cultivation and production in some part of Nigeria may be due to drought, flooding, salt stress, and extreme temperatures, insufficient rainfall, all of which are expected to worsen with climate change. Changes in rainfall patterns and increase in temperature will bring about unfavourable growing conditions into the cropping system there by modifying growing season which could subsequently reduce the crop productivity. Local rice has not kept up with the domestic consumption demand of the Nigerian's populace and consequently rice is still imported (Singh and jain, 1997). Therefore the following questions are fundamental to this study:

- What are the socio- economic characteristics of the respondent in the study area?
- How does climate change affect the production of rice farming in the study area?
- What is the effect of irrigation on rice production?
- What are the factors that determine rice productivity?

Objectives of Study are to:

- identify the socio- economic characteristics of rice farmers in the study area.
- examine the effect of climate change on the production of rice farming in the study area.
- evaluate the importance of irrigation on rice production in the study area.
- Analyze the factors that determine rice productivity among farmers in the study area.

Materials and Methods

The Study Area: This study was carried out in Badagry local government area, a coastal town in Lagos state, Nigeria. Badagry is traditionally known as 'Gbagi'. It is situated between metropolitan Lagos and the border with Benin at Seme. It was founded in the early 15th century on a lagoon off the gulf of guinea; The study area is located between a latitude of 6.4167/6°25`38`` N and a longitude of 2.8833/2°54`23`` E. It has a land size of 170sq meters (441km^2). Has an altitude of 118feet/35metres. As of the preliminary 2006 results, the municipality had a population of 241, 093. While using the 3.2% growth rate, the 2012 estimated population for the local government is 287, 382.

Source of Data: Both primary and secondary data were collected through which data was analyzed.

Analysis of Data: The data collected were analyzed through the use of descriptive analysis, and regression model.

Regression Analysis of the Determinant of the Effect of Climate Change on Irrigated Rice

The result of regression analysis shows the extent of the relationship between the independent variable (Farm size, income, level of awareness, level of adaptation, sunlight intensity, favourable climatic condition, disease prone environment, other education, and primary occupation) and the dependent variable Y.

The model used for the analysis is given below:

$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, x7, x_8, x_9)$

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + e$

Where Y = output of Rice

X_1 = Level of education, X_2 = Farm size, X_3 = income, X_4 = level of awareness, X_5 = primary, occupation, X_6 = level of adaptation, X_7 = favourable climatic conditions, X_8 = disease prone environment, X_9 = sunlight intensity. This was achieved using regression model as specified in the methodology. The result indicates that the F-value of 31.47 with $P < 0.01$. The R^2 is 0.8760 and the adjusted R^2 is 0.8482 which depicts that 84.82% of the dependent variable is been explained by the regressor, while the remaining 15.18% is due to factors outside those represented in the expression. Generally speaking the model has a good fit to the data. In the analysis, nine (9) of the nineteen (19) variable estimated were statistically significant at varying degree ranging between $P < 0.01$ and $P < 0.1$. The intercept is -49225.13 and this represent the autonomous coefficient for the irrigated rice farmers in the study area.

Socio-economic Characteristics of Respondents

Age of the Respondents: Table 1 shows that, 50.8% were between the ages of 31-40 years, 29.2% of the respondents were less than 30 years of age, 14.2% were between 41-50 years of age and 5.8% falls between the ranges of 51-60 years. This implies that majority of the sampled respondents' fell between the ages of 31-40 years. The mean age is 36 years, which implies that majority of the respondent are still in their active and productive age.

Sex of the Respondents: Table 2 revealed that majority of the respondents (70%) were male, while the remaining 30% were female. This implies that male were the majority involved in farming and the cultivation of irrigated rice and this might be due to the enormous physical activities involved in irrigated rice farming operations.

Marital Status of the Respondents: Table 3 revealed that, 71.7% of the irrigated rice farmers were married, and 28.3% were single. This implies that majority of the respondents involved with irrigated rice production were married and their respective spouse can assist in the farming operation thereby reducing cost of hiring labour.

Level of Education of the Respondents: Table 4 revealed that, 50.8% of the farmers had tertiary education, 45.9% had secondary education, and 3.3% of the farmers had primary education. This implies that majority of the respondents were educated, but with different qualifications. The average years is spent in school is 16 years.

Household Size of the Respondents: Table 5 shows that, 84.2% of the sample surveyed had household size that ranges between 1-5 and 15.8% had household that ranges between 6-10. This shows that majority of the respondents enjoy the luxury of family labour.

Income of the Respondents: Table 6 reveals that, 90% of the respondents earn less than or approximately 20 thousand naira. 5% of the respondents earn between 21-40 thousand naira, also 2.5 % earn between 61-80 thousand naira while 1.7% earn 81thousand and 0.8% of the respondents earn greater or equal to 41-60 thousand naira. This implies majority of the respondents are low class earners. The average income of the respondents is N19, 358.33.

Farm Size of the Respondents: Table 7 shows that, 65% have between 1-5 acres of land, 21.7% have land size of 10.1 – 15.1 acres, 7.5% have between 5.1 – 10.0 while the lowest percentage of 5.8 have no land at all meaning they work on other peoples farm. This might be as a result of various land policies and may affect rice production. The average farm size is 6acres.

Years of the Farming Experience of the Respondent: Table 8 shows that, 95.8% of the respondent had 11-20 years experience in the practice, 3.3% had less or equal to 10 years' experience, while 0.8% of them had an experience of 21 years and above in the practice. This implies that majority of them had been in the system for long with only 3.3% of the having an experience that ranges from 0-10 years. The average year of experience is 9 years.

Distribution of Respondents According to their Socio-Economic Characteristics

Table 1

Age	Frequency	Percentage
<30	35	29.2
31-40	61	50.8
41-50	17	14.2
51-60	7	5.8
Total	**120**	**100**

Table 2

Sex	Frequency	Percentage
Male	84	70
Female	36	30
Total	**120**	**100**

Table 3

Marital Status	Frequency	Percentage
Single	34	28.3
Married	86	71.7
Total	**120**	**100**

Table 4

Education	Frequency	Percentage
Primary	4	3.3
Secondary	55	45.9
Tertiary	61	50.8
Total	**120**	**100**

Table 5

Family Size	Frequency	Percentage
1 – 5	101	84.42
6 – 10	19	15.8
Total	**120**	**100**

Table 6

Income	Frequency	Percentage
= 20 000	108	90.0
21 000 – 40 000	6	5.0
41 000 – 60 000	1	0.8
61 000 – 80 000	3	2.5
= 81 000	2	1.7
Total	**120**	**100**

Table 7

Farm Size (Acres)	Frequency	Percentage
0	7	5.8
1.0 – 5.0	78	65.0
5.1 – 10.0	9	7.5
10.1 – 15.0	26	21.7
Total	**120**	**100**

Table 8

Farm Experience	Frequency	Percentage
= 10	4	3.3
11-20	115	95.8
= 21	1	0.8
Total	**120**	**100**

Table 9

Years of Irrigation	Frequency	Percentage
None	1	0.8
1	19	15.8
2	83	69.2
3	12	10
5	5	4.2
Total	**120**	**100**

Table 10

Source of Irrigation	Frequency	Percentage
Well	3	2.5
Borehole	107	89.2
Stream	1	0.8
River	9	7.5
Total	**120**	**100**

Table 11

Adequacy of Irrigation	Frequency	Percentage
No	10	8.3
Yes	110	91.7
Total	**120**	**100**

Source: Field Survey, 2013.

Conclusions and Recommendations

The general objective of this study is to analyze the effect of climate change on irrigated rice production in Badagry Local Government Area of Lagos State.
Based on the findings of the study in the study area, the following recommendations were made:

- There is need for the government to look into the electricity sectors because irrigation farming requires electricity/power supply to operate the system. The existing Dams should be monitored and put in use and also new dams should be created by both the federal and state government.
- Agricultural economist should work with other stakeholders such as Agronomist, Rural Sociologist, and Agricultural Extension Agencies to embark on massive campaign at helping the farmers to respond and cope effectively with global warming as most of the farmers foreseen the effect of climate change on irrigated rice production as due to environmental conditions.

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Tunisia's Organic Agriculture Success Story: Lessons for African Organics

ADEBIYI, JELILI ADEGBOYEGA
Department of Community Sustainability, Michigan State University, East Lansing, MI 48824, USA
Corresponding Author: adebiyij@msu.edu

Keywords: Success Story, institutionization, Tunisian OA Success story, stakeholders.

Abstract

This paper drew on some of the factors that stimulated the growth and development of Tunisia's organic sector as one of the best in Africa and worldwide, to offer recommendations for African organics. A major finding is that institution matter, as the formation of sector-wide coordinating institutions, with distinct and interconnected functions is central to Tunisia's organic agriculture success story. Also, the Tunisian experience demonstrates a need for wide-ranging involvement of public and private organic stakeholders in the institutionalization, agenda framing and their implementation for the development of an organic sector. Finally, the Tunisian OA success story exemplifies a need for financial dis/incentives for stimulating the growth of an organic sector.

Introduction

Africa is considered to have a high organic agriculture (OA) potentials that can be leveraged to mitigate some of its developmental challenges, including low food productivity, food insecurity, and rural poverty. One such potential is that the traditional farming systems in Africa are considered 'organic-by-default' because they involve little to no use of synthetic farm inputs (Parrott *et al.,* 2006; UNEP-UNCTAD, 2008). This may make transition to certified organic operation in Africa to be possibly faster, and potentially more productive. However, owing to some constraints, including dearth of organic support policies and institutions, and high costs of certification, African organics have remained largely underdeveloped (AdeOluwa, 2008; UNEP-UNCTAD, 2008).

Notwithstanding the underdeveloped state of African organics, Tunisia has been able to develop its organic sector such that it ranks as one of the most rated in the world. In terms of certified organic land area, with 196,918 ha, Tunisia ranks second in Africa, and 27th in the world. Also, Tunisia has the most organized and advanced OA institutions in Africa (Heinze, 2012; Paull, 2011). Given Tunisia's OA success story and that a high level of similarity exists in African agricultural clime, both in terms of challenges and farming systems, it seems reasonable for African organics to learn from the Tunisian experience. It is against this backdrop that this paper seeks to draw lessons from the Tunisia's OA experience, which other African countries can leverage to advance the development of their organic sectors. The discussion is limited to the institutionalization and organization of Tunisia's organic sector and the policy instruments used to foster its development.

Tunisian Organic Sector: Brief History and Sector Performance

OA started in Tunisia in the mid-1980s, when 5-6 farmers in Tozeur and Keili began to grow dates organically (Belkhiria and Ben Khedher, 2008; Carey, 2008). The government closely monitored the operations of the pioneer producers (Sameh Amara, cited in Lamboley, 2012). Convinced that OA can be harnessed to enhance farmers' revenue and livelihood conditions, in 1997, the Tunisian government started steering the development of the organic sector (Belkhiria and Ben Khedher, 2008). Since then and due to a number of state interventions, the number of organic farmers and the hectarage in OA in Tunisia have respectively grown by 251 and 594 manifolds (Figs. 1 & 2). Also, Tunisia's earnings from OA produce exports has been on the rise, undergoing about 575% increment between 2004-2012 (Fig. 3). Tunisia's export organic crops and products include olive oil, dates, almond, vegetables, dried fruits, aromatic and medicinal crops (Oxford Business Group, 2010; Turki and Bonezzi, 2011). Two of the major measures that contributed to the Tunisian OA success story are later explained.

Figure 1: **Total Number of Certified Organic Farmers**

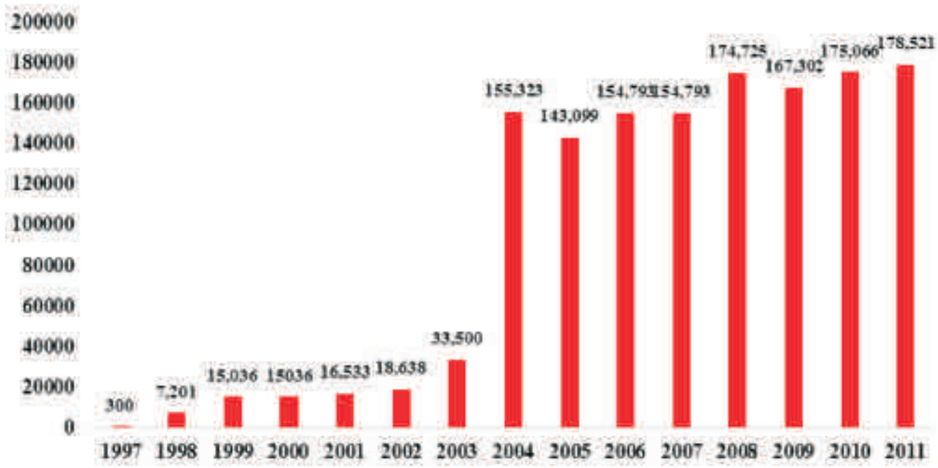

Figure 2: **Total Certified Organic Area (Ha)**

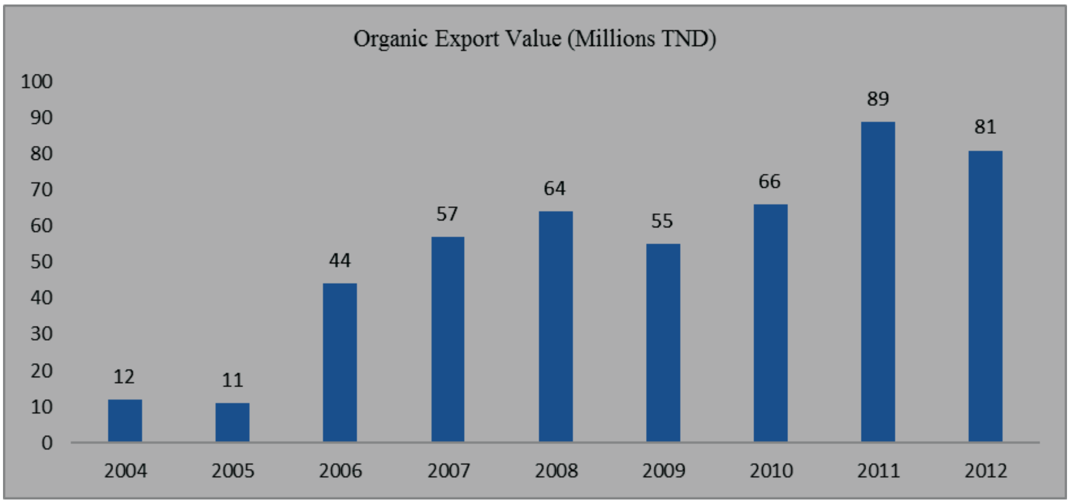

Figure 3: **Organic Export Value**

Institutionalization and Sector Organization

The Tunisian government worked with non-governmental stakeholders to create specialized public OA institutions, which are tasked with well-defined sector-wide duties. This includes, the Directorate General of Organic Agriculture (DGAB), the main administrative body and authority within the Ministry of Agriculture that directs and steers the development of the organic sector. The DGAB facilitates the creation and implementation of national OA development plans and strategies and supervises the activities of organic inspection and certification bodies operating in the country. It also facilitates organic market development by (1) offering one-stop service, which provides market information and direction on organic produce exports, (2) connecting traders with producers; and, (3) organizing promotional campaigns, locally and internationally (Kilcher & Belkhiria, 2011; DGAB, 2011).

The Tunisian government also established the National Commission for Organic Agriculture (CNAB). The CNAB is housed by the DGAB, which also supervises its activities. The CNAB is structured as a multi-sectoral and multi-stakeholder public OA institution, comprising members from many government and non-governmental establishments. Among others, these include the representatives of the ministries of commerce, environment and public health, organic farmers, consumer defense organization, certification bodies and agriculture research institutions (Journal Officiel De La République Tunisienne, 2012). The CNAB is the national consultative and advisorial body on all matters regarding OA development. It also reviews documents related to OA, and proposes plans on how the organic sector can be better supported and administered. Also, together with the DGAB, the CNAB coordinates and audits the activities of organic certifiers and inspectors in the country. Here, the CNAB specifically advises the government to issue, refuse, withdraw, or re-affirm the authorization for OA certifiers and inspectors to operate in the country. Also, the CNAB hosts, keeps and updates a record system of Tunisia's certified organic products, their production volume and markets. This duty is jointly carried out with the DGAB, which helps the CNAB to manage the database. The database comprises the identity of certified organic operators in the country, details of their operations, their compliance and infringements of the rules guiding certified organic operations. This helps with the maintenance of the integrity and competitiveness of Tunisia's organic products (Carey, 2008; Kilcher & Belkhiria, 2011; Morgera *et al.,* 2012).

The Tunisian government also established the Technical Centre of Organic Agriculture (The CTAB). The CTAB sits on the board of the DGAB and on the organic audit and certification committee set up by the DGAB. The main duty of the CTAB is to offer technical support services and organize human capacity development trainings for organic operators in the country. It does this through means including, field visits, demonstrations, and by organizing refresher trainings for organic farmers, extensionist and researchers. The CTAB also conducts applied research on OA and adapts domestic and international OA research results to local and regional farm conditions in the country. The CTAB also fosters organic technology transfer and information exchange, through field trips, seminars and by organizing local, regional and national workshops (CTAB, 2012; Mami, 2013).

The government also created the Regional Center of Research in Horticulture and Organic Agriculture (CRRHAB). The CRRHAB conducts and disseminates research in all aspects of organic horticultural production systems, the outcomes of which are simplified and adapted to local conditions by the CTAB to ensure full-scale application by organic operators (*MAHRF, 2013a, 2013b).* Moreover, the CRRHAB works with the CTAB and other stakeholders to foster organic technology transfer. This is done, for example, by publishing the outcomes of its research activities, by conducting trainings and organizing specialized technical education for students, farmers, researchers and extension officers (Daami-Remadi, 2010). Finally, some of OA specialized enjoy budgetary autonomy, and all of them are well-funded and adequately staffed with competent staff. This largely accounts for their ability to effectively carry out their duties (Commission Européenne Direction Générale de la Santé et des Consommateurs, 2012).

Investment Supportive Environment and Financial Instruments

The Tunisian government created a supportive environment that favored the adoption of OA and stimulated investment in the organic sector through the use of subsidy package and tax breaks, such as OA conversion subsidy. The conversion subsidy covers certification and inspection cost by 70% for both individual and group organic producers. This is to help mitigate the financial barriers hindering organic farmers from certifying their operations. Individual farmers can benefit from the conversion subsidy for the first 5-year of adoption of OA, with a total subsidy amount not exceeding $3,013.87 per annum. Group producers and associations can access not more than $6,027.73 per year as conversion subsidy for the first 7-year of conversion (Ben Khedher, 2012; CTAB, 2012; Morgan, 2010). The government also introduced subsidy packages and tax break aimed at increasing farmers' productivity, reducing production costs and enhancing organic produce exports. Accordingly, organic equipment is subsidized by 30% and the analysis cost of organic products for exports by 50%. Also, organic farming equipment and supplies are exempted from valued-added tax and custom duties (CTAB, 2012; Lamboley, 2012).

To stir investment in the sector, measures which enticed local and foreign investors were introduced. This includes supporting organic farming projects with a matching grant of about 30%, a full income tax exemption through the first ten-year of operation and by another 10% exemption thereafter (CTAB, 2012; Diefendorf *et al.,* 2012). Also, full tax relief is provided on income and benefits reinvested as part of the starting capital in OA companies. A special subsidy covering 1% of the investment amount is also dedicated to support organic project study fees. The contract expenses incurred when securing organic farmland is also repaid by the government. The government also encouraged and incentivized local-foreign investment partnership with foreign investors allowed to have up to 60% ownership. Also, the government relaxed the conditions for hiring foreign experts and workers whose services are secured in the organic sector. Concerning this, four foreign project experts can be employed by entirely-export companies without government's prior approval (Ben Khedher, 2004; CTAB, 2012). Finally, the government introduced annual presidential prize for the best organic producer in the country (Kilcher and Belkhiria, 2011; Morgan, 2010).

As a result of the above policies and other related measures, between 2005 and 2010 the investment in the organic sector averaged £5.3 million per annum (Oxford Business Group, 2010). In 2012, this underwent a 43.21% increment as the investment in the organic sector reached £7.59 million, a figure which represents more than 52% of the total investment in the agriculture sector for that year (Mami, 2013). The policies also facilitating an increase in the volume of organic exports and the number of organic projects in the country (Diefendorf et al., 2012; Morgan, 2010; Tlili, 2012). Generally, the effects of the policies transcend the organic sector as they contributed to over 250% increment in investment in the agriculture sector between 2005 and 2009 (Diefendorf et al., 2012).

Policy Lessons and Recommendation for African Organics

The Tunisia OA development experience seems to suggest that institutions matter. As shown above, for Tunisia's organic sector to take form and manifest its potentials, it took the establishment of sector-wide coordinating institutions, with well-defined specific and interrelated functions. This seems to suggest a need for the creation of national umbrella OA coordinating body as the first step towards the development of African organics. This is particularly instructive for African countries without a coordinating organic body, be it stated-facilitated or private-stakeholders' prompted.

Second, the Tunisia success story illustrates that, to be successful, organic coordinating bodies need to devise means, which will help foster a broad participation of public and private organic stakeholders that are linked to the organic sector. As Tunisia's CNAB exemplifies, doing this may require establishing a multi-stakeholder/multi-sectoral deliberative body with well-defined functions to work with the central coordinating body. Third, the Tunisian experience also draws attention to the need to fortify organic coordinating institutions with the human and financial capacity required to undertake various organic cross-sectoral activities. Finally, the Tunisian OA success story indicates that financial dis/incentives are necessary for stimulating the growth of an organic sector. This is one area where African governments can partner with private organic stakeholders to formulate wide-ranging financial policy instrument to support the development of African organics.

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Organic Production of Silver Nanoparticles

ADEEYO, A.O AND LIASU M.O.
Department of Pure and Applied Biology, Ladoke Akintola University of Technology,
PMB. 4000, Ogbomoso, Nigeria.
Corresponding Author: firstrebby@gmail.com

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Abstract

Silver nanoparticles (AgNPs) have been reported to be useful in various fields and have received considerable attention in order to develop efficient methodology for its synthesis. Currently, nanoparticles are mainly produced classically by physical and chemical methods involving techniques like heating and irradiation. These methods are costly, toxic and hazardous, hence the need for alternative, eco-friendly approach. Biological methods of nanoparticle synthesis have shown very promising solutions to those posed by classical approaches. This paper explains the generation of an improved mutant strain of L. edodesfrom its Wild type using Ultraviolet irradiation and the application of Wild and Mutant strains in the production of exopolysaccharide (EPS) with excellent application in green synthesis of AgNPs. AgNP was characterized by visual observation of colour pattern in the reaction vessel, and UV-Visible spectroscopy. The synthesized nanoparticles were confirmed through the appearance of yellowish (Wild) and purple (Mutant) colours which are characteristic colours of nanoparticles. To the best of our knowledge, this is the first report of using exopolysaccharide from L. edodes in the synthesis of silver nanoparticles. This research reveals the application of L. edodes in synthesis of nanoparticles and adds to the pool of organic materials available for green synthesis of nanoparticles. Hence L. edodes can be explored for development of AgNPs with novel applications in industrial sector.

Introduction

Nanoparticles are being viewed as fundamental building blocks of nanotechnology and the development of biological process for synthesis of nanoparticles is evolving into an important branch of nanotechnology (Amkamwar *et al*., 2005; Cataleya, 2006). Biologically synthesized nanoparticles have been implicated in many applications including production of spectrally selective coatings for solar energy absorption, intercalation materials for electrical batteries, optical receptors, catalysts in chemical reactions, biological labeling, bio sensors, drug delivery, antibacterial and antiviral materials, detection of genetic disorders, gene therapy and DNA sequencing (Chandran *et al*., 2006).
It has been emphasized that methods of nanoparticle synthesis through biological systems may include the use of bacteria, fungi, yeasts and diatoms which make the nanoparticle product of such systems more biocompatible. Fungi are preferred mediators of nanoparticle synthesis because they are easy to handle, require simple nutrient, possess high wall-binding capacity as well as intracellular metal uptake capabilities (Verma, 2009). Different fungi and fungal extracts have been used for synthesis of silver nanoparticles (Bhattacharya and Gupta, 2005; Gericke and Pinches, 2006; Mohanpuria *et al*., 2008; Das and Marsili, 2010).

This paper explains the generation of an improved mutant strain of *L. edodes* using Ultraviolet irradiation in the production of exopolysaccharide (EPS). The EPS produced from wild and mutant strains were subsequently used in the production of AgNPs. AgNP was characterized by visual observation of colour pattern, UV-Visible spectroscopy, and Scanning electron microscopy. The synthesized nanoparticles were confirmed through the appearance of yellowish (Wild) and purple (Mutant) colours which are characteristic colours of nanoparticles.

Materials and Methods

Collection of *L. edodes* strain:
L. edodes strain was obtained from Mushroom Research Centre, Himachal Pradesh Solan, India.

Induction of Physical Mutation:
Induction of physical mutation through ultraviolet light was carried out using the method of Adebayo *et al*., (2012). An actively growing culture of 14 day old Wild *L.edodes* on Potato Dextrose Agar (PDA) plate was exposed to UV light (254nm) for 10 minutes to obtain UV10 mutant strain.

Production of EPS:
A 14 day old Wild and UV10 mutant strain were subsequently used to inoculate 50 ml of fermentation medium in 250 ml Erlenmeyer flask consisting in g/L of glucose (10.0), yeast extract (1.0), peptone (2.0), KH_2PO_4 (0.5) and $MgSO_4$ (0.5). Other fermentation conditions include temperature (27 ± 2 ^oC), agitation (100 rpm) and incubation time of 7 days. This is a modified method of George *et al*. (2010).

EPS Extraction and Quantification:
Extraction of EPS was done by mixing cell free supernatant from respective fermentation medium with 2 volume of cold absolute ethanol (v/v) and refrigerated at 4 ^0C overnight for EPS precipitation. Precipitate was collected as crude EPS fraction after centrifugation (4000 rpm, 15 min.) as specified by Majolagbe *et al*. (2013) and re-dissolved in 20 ml of sterile distilled water. The concentration of EPS per ml was determined by measuring the absorbance at 490 nm of digested EPS using phenol-sulphuric acid method of Dubois *et al*. (1956) and calibrating to total sugar contents using glucose as standard (Fig. 1).

Figure 1: **AgNPs Colour patterns of and silver nitrate solution (A), Wild (B) and Uv10 mutant (C) after 24 hours**

Synthesis of Silver Nanoparticles (AgNPs)

A 1 ml volume of EPS extract of Wild and UV10 strains was dispensed into 5 ml 1mM $AgNO_3$ in a 10 ml capacity test tube. A third test tube contains 6 ml of 1 mM $AgNO_3$ which serve as control. The 3 tubes were vigorously shaken for 10 minutes and reaction was afterward allow to continue under room temperature, intermittent shaking and under bright light condition (Thirumurugan *et al.*, 2011). The bioreduction of silver nitrate into AgNPs was monitored periodically by visual inspection and in a UV-visible spectrophotometer (Genesys 10 UV, Thermoelectron Coperation, UK).

Results and Discussion

EPS yield of Wild and Mutant of *L. edodes*:

Comparing the EPS productivity of Wild and UV10 mutant, UV10 obtained at 10 minutes of exposure to Ultraviolet irradiation gave the highest exopolysaccharide productivity of 2783.97mg/ml while the Wild strain has a productivity of 1044.35mg/ml. The 10 minutes UV improved strain has an enhanced capacity 266 % over the Wild strain which shows that UV mutagenesis is an effective strategy for EPS optimization. Result of EPS production by UV mutant strain is as shown in Table 1.

Table 1. **EPS production by strains of *L. edodes***

Strains	Sugar (mg/L sample)	Percentage increase in production over wild (%)
Wild	1044.35	-
UV10	2783.97	266.66

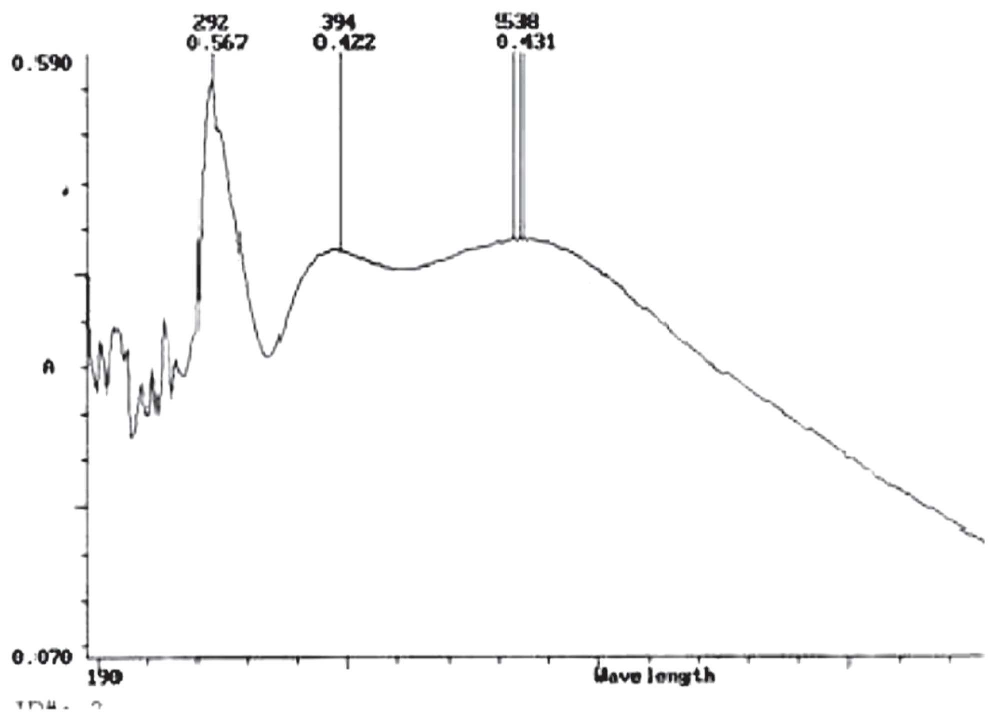

Figure 2a: **UV-Vis sprectrum of EPS extract of Wild and Silver nitrate with peak at 394 nm**

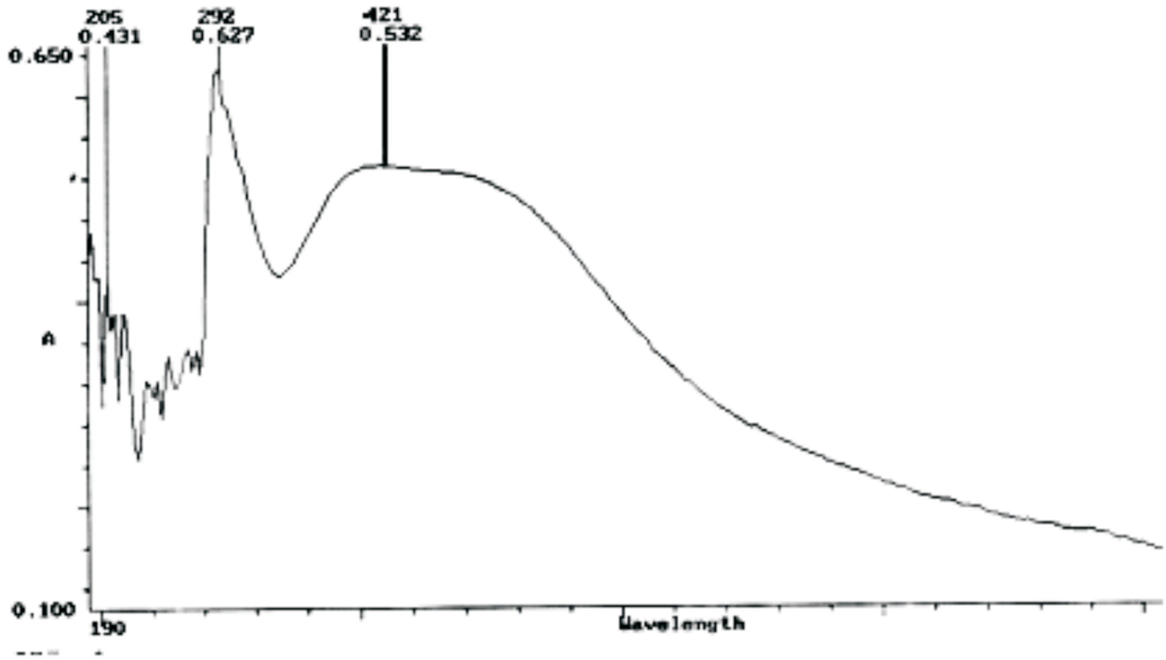

Figure 2b: **UV-Vis sprectrum of EPS extract of UV 10 and Silver nitrate with peak at 421 nm**

Colour Change

Aqueous silver nitrate ions were reduced during exposure to the EPS extract of wild and mutant strain of *L. edodes*. The colour of the reaction mixture changes from colourless to yellowish-brown for extract of wild strain and purple in the case of UV10. Observed colour pattern became stable after 24 hours as indicated earlier in Fig 1. Yellowish-brown and purple colour developments have been reported in association with nanoparticle production and due to excitation of Surface Plasmon vibration in metal nanoparticle (Vanmathi and Sivakumar, 2012). Typical AgNP colouration previously reported from bacteria exopolysccharide, and mushroom culture extract as well as mycelia include yellowish brown (*Lactobacillus rhamnosus*) (*Paulraj and Seung 2013*), yellow (*Pleurotus ostreatus*, *Agaricus bisporus* and *Ganoderma lucidum*), reddish brown (*Calocybe indica*) (*Mirunalini et al. 2012)*, light-grey (*Schizophyllum comune*) (*Yeanet al*., 2012), and dark brown (*Stachybotrys chartarum*) (Abdel 2013). The variation in colour is attributed to the variation in composition of biomolecules involved in nanoparticle synthesis and due to the excitation of surface Plasmon vibrations in metal nanoparticles (*Mulvaney 1996*). Time for development of AgNPs as reported by previous authors include 10 hrs (*Paulraj and Seung 2013)*, 24 hrs (Abdel 2013), and 48 hrs (*Mirunalini et al. 2012*). It was an observation in this research that EPS of *L. edodes* rapidly react with $AgNO_3$ solution to form AgNPs in 24 hrs.

UV Visible Studies

UV-Visible absorption spectroscopy has proven to be a versatile technique in analysis of AgNP (Vanmathi and Sivakumar, 2012)and may provide information about morphology, size and stabilization of AgNPs. Figure 2a-b show the UV visible spectra of biosynthesized AgNPs of Wild and UV10 strains respectively after 24 hours in the range of 190-1100. The result indicates a broad Surface Plasmon Resonance (SPR) peaks obtained at 421 and 394 nm. Several authors have reported peaks of absorption spectra of AgNPs in the range of 391-440 (Lateef *et al*., 2014). Peaks at this range are characteristics of spherical, triangular or hexagonal shaped nanoparticles as reported by Brennan *et al*., 2006; Zaki *et al*., 2011; Vanmathi and Sivakumar, 2012; Chan and Mat-Don, 2012 and Philip, 2009. This result indicates that the extracts of the Wild and UV10 strains produces nanoparticles of similar or diverse morphology under the conditions investigated.

Conclusion

In this work, result obtained confirms that an alternative technique for synthesis of silver nanoparticle using and organic approach is feasible. To the best of our knowledge, this is the first report of this technique for modulation of product of nanoparticles in biosynthesis. This procedure can be employed in the production of various types of nanoparticles and will constitute a useful tool in the amplification of organically driven bioprocesses in organic agriculture.

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POSTERS

ENGENDERING ECOLOGICAL ORGANIC AGRICULTURE (EOA) PRACTICES IN SCHOOL CURRICULUM WILL FACILITATE ENTREPRENEURSHIP DEVELOPMENT AND REDUCE RISKS OF FOOD AND HUMAN HEALTH

Meludu Nkiru T.; Nnanna Chuks; Okonlawan Oluwatoyin and Olarinwaju Peter
Department of Agricultural Extension and Rural Development, University of Ibadan
E-mail: nkiru_m@yahoo.com

ECONOMIC, SOCIAL AND ENVIROMENTAL BENEFITS OF INCULCATING A RURAL LIFESTYLE INTO A CITY (CIVILIZED) SETTING – TRANSFORMATION OF THE AFRICAN RURAL WOMEN - A PERSONAL STORY AND EXPERIENCE

Odukoya Oluyinka Iyabode
Dasyooh Limited (Farms), Ogun State, Nigeria
E-mail: oluyinkaodukoya@yahoo.com

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Navrongo-Bolgatanga Catholic Diocesan Development Office (NABOCADO),
Post Office Box 351, Bolgatanga, Ghana
E-mail: nabocado@gmail.com

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E-mail: saadiadaaka@yahoo.com

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GEROLD RAHMANN
TIMOTHY IPOOLA OLABIYI
VICTOR IDOWU OLOWE

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THE 3RD AFRICAN ORGANIC CONFERENCE NIGERIA

Association of Organic Agriculture Practitioners of Nigeria (NOAN)
National Headquarters, Room 25,
Department of Agronomy,
University of Ibadan, Ibadan, Nigeria
Phone: +2347057457676, +2348023422759
Email: noannigeria@gmail.com,
contact@noanigeria.net
Website: www.noanigeria.net

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