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Effect of Poultry and Green Manure Sources on the Productivity of Popcorn (*Zea Mays Everta* L.)

G.L. Luka, E.C. Odion and M. M. Maiyaki

Institute for Agricultural Research, Ahmadu Bello University, Zaria

Corresponding author: graceluka@yahoo.com

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Abstract

A trial was carried out at the Institute for Agricultural Research field Samaru during the 2013 and 2014 rainy seasons to determine the effect of poultry manure and sources of green manure on the productivity of popcorn. Treatments included four poultry manure rates (0, 2, 4 and 6 t ha^{-1}) and green manure from two cowpea varieties (SAMPEA 6 and Kananado). Green manures were obtained by clipping the cowpea foliage at 5cm from the soil surface and incorporated in 6th week to serve as green manure. Data were collected on shoot dry weight and grain yield and significant increases were recorded. It can therefore be said that good popcorn yields can be obtained by using 2 t ha^{-1} of poultry manure in addition to green manure from either of the cowpea varieties.

Introduction

Food production in many parts of Africa is limited primarily by nutrient deficiencies and soil degradation rather than just water availability (Cassman, 1999, Pablo and Ken, 2013). Soil nutrient deficiency could be largely attributed to the decreased soil organic matter as most farmers fail to incorporate or allow their crop residues decompose and recycle nutrients back into the soil. Research has shown that nutrient extraction by crops can be significant. For example in an average wheat harvest in Germany of 8 t ha^{-1} takes 180kg of N, 37kg of P and 124kg of K from the soil. Thus if only the grain is harvested and the straw is left on the land to be worked into the soil or spread in stables and returned to the fields as manure, the volumes that are taken from the system would be significantly lower (Johannes, 2013). In addition, Mulvaney *et al.,* 2009 reported that loss of organic nitrogen decreases soil productivity and agronomic efficiency of fertilizer N and that this has been implicated in the widespread reports of yield stagnation or even decline in grain production. The decline in crop production has resulted in food insecurity manifested as starvation and malnutrition. In order to increase crop production, farmers adopt intensive agriculture using mineral fertilizers and this is often associated with reduced yield due to soil acidity and nutrients imbalance. This challenge could be overcome through the adoption of strategies for better soil management such as the use of manures as nutrient sources.

Materials and Methods

A trial was carried out at the Institute for Agricultural Research field, Samaru (11°11'N, 07°38'E and 686m above sea level) during the 2013 and 2014 rainy seasons. Treatments included four poultry manure rates (0, 2, 4 and 6tha^{-1}) and green manure from two cowpea varieties (SAMPEA 6 and Kananado). Cowpea was clipped at 5cm from the soil surface at six weeks after sowing which was about the peak lush plant material and dry matter accumulation. Clipped foliage was incorporated to serve as

green manure. The research was carried with the objectives of improving the nutrient status of the soil and to determine the effect of poultry and green manure on the productivity of popcorn.

Results

These include the nutrient composition of cowpea foliage (green manure), poultry manure analysis, shoot dry weight and grain yield of popcorn. Table 1 shows the nutrient composition of the cowpea foliage incorporated into the soil as green manure. Nitrogen content (%) of SAMPEA 6 tended to increase with increase in the rate of poultry manure applied while with Kananado the converse was true (Table 3a). Organic carbon content was inconsistent. C: N ratio decreased with increase in poultry manure rate in SAMPEA 6 indicating a high rate of decomposition.

The N, P and K contents of the poultry manure used during the experiment in 2013 and 2014 rainy seasons (Table 2) showed that the total nitrogen (N) and available potassium (K) content of the poultry manure used in the trial during 2014 rainy season were higher than that in 2013. While the available phosphorus (P) content was higher in 2013 than the one used in 2014.

Table 1. **Mean nutrient composition of the cowpea varieties incorporated as green manure at Samaru during the years of experiment**

		Percentage (%)			Mg kg		
Treatments	N	P	K	OC	Calcium	Magnesium	C: N
SAMPEA 6							
0tha^{-1} Pm	1.40	0.370	1.53	44.89	2111.10	6734.50	32.06
2 tha^{-1} Pm	2.10	0.455	2.50	33.58	1979.10	7808.44	15.99
4 tha^{-1} Pm	4.73	0.436	1.96	42.46	2106.30	4789.55	8.98
6 tha^{-1} Pm	3.71	0.394	1.42	37.11	1784.50	6347.42	10.00
Kananado							
0tha^{-1} Pm	4.10	0.443	1.71	52.34	2165.40	3846.33	12.77
2 tha^{-1} Pm	4.87	0.374	1.56	47.52	1987.30	4983.72	9.760
4 tha^{-1} Pm	2.63	0.483	1.28	45.88	2066.62	13572.21	17.44
6 tha^{-1} Pm	1.75	0.284	1.18	55.20	2022.60	1368.46	31.54

Pm = Poultry manure, OC = Organic carbon

Table 2. **N, P and K contents of poultry manure used during the experiment in 2013 and 2014 rainy seasons**

Nutrients	2013	2014
Total N (%)	1.70	1.74
Available P (mgkg^{-1})	1.59	1.32
Available K (Meq/100g)	0.63	0.89

Poultry manure analyzed at the analytical laboratory, Department of Agronomy, Ahmadu Bello University, Zaria

Table 3 showed that in 2013, significant increases in shoot dry weight was recorded with increase in application of poultry manure up to 4 t ha^{-1} and further increase to 6 t ha^{-1} gave similar increases. In the 2nd year however, significant increases in dry weight was recorded from 2 t ha^{-1} poultry manure in addition to the green manure from SAMPEA 6. Significant increases were also recorded from 4 t ha^{-1} of poultry manure where Kananado served as source of green manure.

Results on table 4 showed that grain yield of popcorn increased at 2 t ha^{-1} of poultry manure with addition of clipped cowpea foliage from either variety. Application of higher poultry manure rates resulted in statistically similar grain yield increases. This trend was observed in 2014 although the yield increases were higher than the first year.

Table 3. **Effect of poultry manure and green manure sources on the shoot dry weight of popcorn at Samaru during 2013 and 2014 rainy season**

	2013		2014	
Poultry manure (tha^{-1})	SAMPEA 6	Kananado	SAMPEA 6	Kananado
0	131.7b	108.9c	81.7b	92.8b
2	136.8b	128.4bc	102.3ab	92.9b
4	169.3ab	178.0a	104.7a	104.0a
6	191.9a	188.1a	128.0a	108.4a
	SE± 15.67		SE± 9.68	

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT

Table 4. **Effect of poultry manure and green manure sources on the yield of popcorn at Samaru during 2013 and 2014 rainy season**

	2013		2014	
Poultry manure (tha^{-1})	SAMPEA 6	Kananado	SAMPEA 6	Kananado
0	1077c	1325bc	1605c	1941b
2	1668ab	1827a	2307a	2257a
4	1916a	1889a	2390a	2298a
6	1899a	1971a	2335a	2398a
	SE± 124.12		SE± 109.19	

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT

Discussion

The incorporation of poultry manure into the soil enhanced the increases in the parameters taken and this was evident especially in the second year of the trial. This could be because poultry manure fertilization boosted the nutrient status of the soil particularly in the supply of N, P and K. In the first year the result of the soil analysis showed low rates of N (0.063%), P (3.5) and organic carbon (0.5) but in the second year there was a boost to 0.15%, 6.85 and 1.25 for N, P and OC respectively. Increases in soil organic carbon results in release of nutrients for plant growth as well as promote the structure, biological and physical health of the soil. This may imply that continuous feed of feeding of the soil with organic manures will build up the organic matter content of the soil which will result in increase in soil fertility and over time very little or no fertilizers may be required to be added to the soil to cultivate crops. Organic matter serve as a store house for nutrients, improves nutrient recycling, builds soil structure, increase infiltration and water holding capacity and serves as a buffer against rapid pH changes and energy source for micro organisms (Perrings, 1999). Poultry manure helps in soil amendment (improves bulk density, aggregation, organic matter, water infiltration and retention), in addition to provision of nutrients to crops (Agbede *et al.,* 2013, 2014, 2017, Atankora *et al.,* 2014, Warren *et al*., 2006**).** Analysis of the

clipped cowpea showed that C: N ratio of SAMPEA 6 foliage decreased with increase in poultry manure rates and that indicated a higher rate of decomposition of the foliage and as mineralization takes place the nutrient status of the soil is improved. These resulted in increased dry matter production of the crop which was consequently converted into grain yield. Good popcorn yields can therefore be obtained by using 2 t ha^{-1} of poultry manure and green manure from either of the cowpea varieties.

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