Efficacy Evaluation of Selected Biorational Combinations in the Management of Tomato Blight

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Abstract

This experiment was conducted in Katabi Sub-county in Wakiso District from March 2012 to June 2013.The study evaluated efficacy of selected biorational combinations in the management of tomato blight. These biorationals were picked from the local plant materials used as natural pesticides and fungicides. They included (Carica papaya, Phytolacca dodecandra, Jatropha curcas, Capsella Bursa-pastoris and. Tephrosia vogelli.). The major objective was to evaluate efficacy of Carica papaya, Phytolacca dodecandra, Jatropha curcas, Capsella Bursa-pastoris and. Tephrosia vogelli. against tomato blight. This research used a complete Randomized block design in which three treatments (Jatropha curcas and Capsella Bursa-pastoris, Carica papaya and Phytolacca dodecandra and water as a control) were applied at varying biorational concentrations (25%, 50%, and 75%). Data were collected from all treatments and their efficacy evaluated. There were four replicates from each treatment in the experiment. Results revealed that treatments of Carica papaya with Phytolacca dodecandra were more effective in managing tomato blight below economic injury thresholds. This research recommended that Caricapapaya with Phytolacca dodecandra at a concentration of 50% be used by farmers in the management of tomato blight.

Introduction

A number of biorationals are known and used by many organic farmers. According to Ssekyewa, (2001), *Tephrosia vogelli* is a known pesticide among others. Although it is known that combinations of such plant extracts may be effective, it is not clear how best they can be combined to reduce pests and disease levels below economic injury thresholds (Mwine *et al.* 2010). The quantities in which they can be used to manage diseases are also not known, (Henry *et al* 1996). Dosage of the biorationals to water, the rate of application, the interval of application and/or withdraw period are all not clearly established. As result their performance may not be satisfactory. This has brought about lack of confidence among farmers and other practitioners in some of the botanicals as they may sometime appear very ineffective.

Ankli *et al.* (1999) reported that knowledge of such herbs is usually in the hands of a small group of people who guard it jealously for their advantage. This is escalated with death of the elderly people who were custodians of this knowledge; yet there is no sufficient documentation for the same,(Mwine et al 2010). In Cameroon for example, the mean yield loss attributable to late blight damage was as high as 100%, D.A. Fontem (2003).

Where organic agriculture is practiced, efficacy, quantities of biorationals, dosage, frequency of application and rates are all knowledge gaps in Uganda, (Mwine *et al.* 2010). The major objective of this study therefore, was to evaluate efficacy of *Carica papaya*, *Phytolacca dodecandra*, *Jatropha curcas*, *Capsella Bursa-pastoris* and *Tephrosia vogelli* against tomato blight.

The specific objectives were to determine the biorational combinations that can reduce tomato blight to levels below economic injury thresholds, establish the optimum concentration of biorationals used in controlling tomato blight and identify the ecological conditions that influence the effectiveness of biorationals when managing tomato blight.

Materials and methods

The study area

The farm where research was conducted is located at 25km on Kampala-Entebbe road, Nalugala Village, Katabi Sub-county Wakiso District. The soils in this Agro-ecosystem are sandy loams with average fertility, well drained at a gentle slope**.**

This farm is located within Lake Victoria basin where climatic conditions such as rainfall, temperature and humidity are ideal for tomato growing; but make tomato blight proliferate at a high rate,(SSEKYEWA, C. 2001), and(HENRY ELWELL et al (1996).

Data collection

Every two other days the fields were inspected. With direct observation, plant parts affected by tomato blight were counted and recorded with respect to the restrictions of plots in a Randomized Complete Block Design(RCBD). Farmers at the farm were engaged in an interview to collect data on which ecological conditions influence the effectiveness of biorationals when managing tomato blight?
Restrictions of plots were as follows:

Tephrosia vogelli at a 50% concentration was applied all through the plots for purposes of killing insect pests. Such pests include aphids which are vectors for *Phytopthora infestans* and *Alternaria solani* among other diseases. This was prepared by dissolving 50gm of *Tephrosia vogelli* powder and dissolving it in 100mls of water.

Tomatoes in plots marked P1 were sprayed with liquids obtained from dry leaves of *Caricapapaya* and *Phytollacca dodecandra* at a concentration of 25%

Tomatoes in plots marked P2 were sprayed with liquids obtained from dry leaves of *Caricapapaya* and *Phytollacca dodecandra* at a concentration of 50%

Tomatoes in plots marked P3 were sprayed with liquids obtained from dry leaves of *Caricapapaya* and *Phytollacca dodecandra* at a concentration of 75%

Tomatoes in plots marked J1 were sprayed with liquids obtained from dry leaves of *Jatrophacarcus* and *Capsella Bursa-pastoris* at a concentration of 25%

Tomatoes in plots marked J2 were sprayed with liquids obtained from dry leaves of *Jatrophacarcus* and *Capsella Bursa-pastoris* at a concentration of 50%

Tomatoes in plots marked J3 were sprayed with liquids obtained from dry leaves of *Jatrophacarcus* and *Capsella Bursa-pastoris* at a concentration of 75%

Tomatoes in plots marked C1, C2 and C3 were not subjected to any biorational material but were sprayed with water to provide the same degree of wetness as was the case in the test plots. These plots therefore served as a control plots.

This research engaged workers of this farm in an interview to get a wider understanding of the ecology of the tomatoes, blight and all other interacting components; within this agroecosystem.

Data analysis

Genstat software) was used to analyze the differences between group means and their associated procedures (such as "variation"among and between biorational combinations and concentrations). In this case, the observed variance in a particular variable was partitioned into components attributable to different sources of variation such as biorational concentration. This tool provided a test of whether or not the means of several groups were equal, and therefore generalized a *t*-test to more than two groups. For this reason, ANOVA was useful in comparing (testing) means (groups or variables) for statistical significance.

Results

Incidence of *Phytopthora infestans* on leaves

Comparing infection rates of leaves by tomato blight, as shown in figures 1 and 3; infection rate was highest in treatment J(where *Jatropha curcas* with *Capsella Bursa-pastoris* was used at a concentration of 25%). Lowest infection rates were recorded in treatment P (where *Carica papaya* with *Phytolacca dodecandra* was used at a concentration of75%).

Figure 1. **Leaf damaged by tomato blight**

Figure 2. **Symptoms of tomato blight on tomato fruits and leaves**

Fruits

Fruits affected by tomato blight in figure 2.Lowest infection rates were recorded in treatment P (where *Carica papaya* with *Phytolacca dodecandra*) was used. At all biorational concentrations a maximum of one leaf was infected. A highest rate of infection was recorded in treatment J (where *Jatropha curcas* with *Capsella Bursa-pastoris* was used) at 25% concentration.

Leaves

Figure 3 shows efficacy of biorationals used at varying concentrations. This is why a constant value from treatment C (where water was used) against results from treatment P (where *Carica papaya* with *Phytolacca dodecandra* was used) and treatment J (where *Jatropha curcas* with *Capsella Bursa-pastoris*was used). *Carica papaya* with *Phytolacca dodecandra* (in treatment P) at 75% concentration reduced tomato blight on tomato leaves to the lowest level compared to *Jatropha curcas* with *Capsella Bursa-pastoris* (in treatment J) at the same concentration.

Branches

Lowest efficacies were recorded in treatment J (where *Jatropha curcas* with *Capsella Bursa-pastoris* was used at concentration of 25%. The rest of the concentrations and biorational combination (*Caricapapaya* with *Phytolacca dodecandra*) showed high efficacies on tomato blight on tomato leaves, Figure 3.

Fruits

There were variations in performance of biorationals as seen in figure 4. These are results of biorationals used in all plots at varying concentrations, keeping that of the control treatment constant (sprayed with water). High efficacies of biorational combination were recorded by *Carica papaya* with *Phytolacca dodecandra* at a concentration of 75% (in treatment P). Lowest efficacies were recorded in treatment J at 25% concentration of *Jatropha curcas* with *Capsella Bursa-pastoris*.

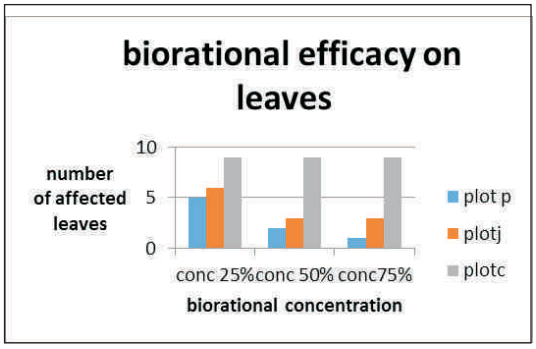

Figure 3.**Efficacy of *Carica papaya* with *Phytolacca dodecandra* and *Jatropha curcas* with *Capsella Bursa-pastoris* against *Phytopthora infestans* on leaveswith *Capsella Bursa-pastoris* against *Phytopthora infestans* on leaves**

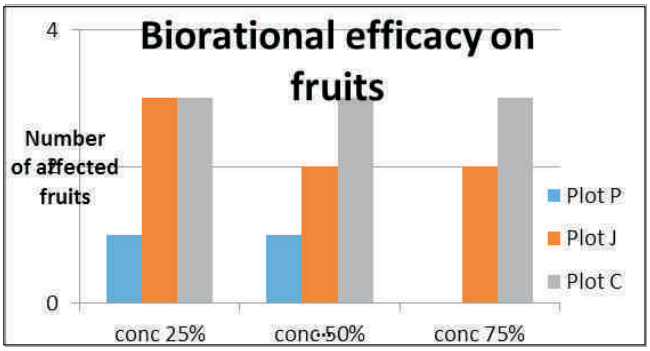

Figure 4. **Efficacies of *Carica papaya* with *Phytolacca dodecandra* and *Jatropha curcas* with *Capsella Bursa-pastoris* against *Phytopthora infestans* on tomato fruits**

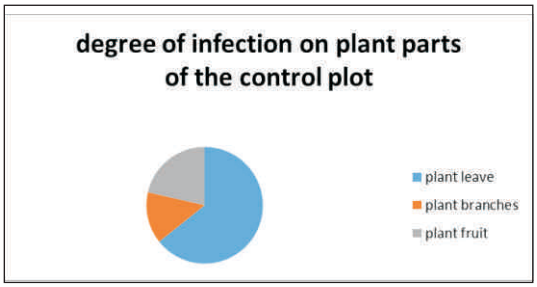

Figure 5. **Infections on plant parts by tomato blight**

Figure 6. **Health tomatoes** (*Photo by Ssagala David)*

Discussion

Biorationals are not independent from the rest of the Agro-ecological components, neither are they useful without human beings, Kakudidi EK (2004). When used effectively, farmers make economic gains which impact the rest of the ecosystem components directly or indirectly. Ecological factors such nutrient availability, soil water, predation and policy among others were reported as key factors that enhance efficacy of biorationals.

Biorationals protected tomatoes against tomato blight on different parts of the tomato plant differently. *Phytopthora infestans* responded differently to each biorational. *Phtolacca dodecandra* with *Caricapapaya* reduced this disease to minimum levels compared with *Jatrophacurcas* with *Capsella Bursa-pastoris*. This is attributed to the known fungicidal properties of the former, (Elwell *et al* 1995).

It was found out that biorationals protected tomato plant parts at varying degrees. In this case braches were protected most, followed by fruits and lastly leaves. This is because leaves open up in the space and have maximum contact with wind than branches. Wind and sunshine are responsible agents for blowing off and evaporating biorationals from leaves before they suppress the spores. This leads to low protection of leaves by biorationals compared to protection exhibited at branches and fruits. The hands and tools of the farmer increase the rateat which tomato blight spreads; making protection of tomato plants by biorationals inefficient.

During field sampling and observations with the use of a still camera healthy tomato plants were recorded in treatment P where *Carica papaya* with *Phytlacca dodecandra* was sprayed at concentrations of 50% and 75%. This observation was consistent all through the growth period of the tomato crop (4 months). This showed that when farmers use *Carica papaya* with *Phytlacca dodecandra*, they can manage tomato blight and produce healthy tomatoes such as the one shown in figure 6. According to Henry *et al*, (1996), these two plants used to make the biorational used *(Carica papaya* with *Phytlacca dodecandra)* have anti-fungalproperties. Thus farmers can make use of them so that they manage tomato blight. A concentration of 50% is recommended basing on results of figures 4 and 5.In all these figures, *Carica papaya* with *Phytolacca dodecandra* managed to keep tomato blight to the lowest levels of up to zero as seen in figures 3 and 4.

Results also revealed that there were several ecological components that had a direct relationship with tomato production. This was evidenced by the presence of several pests such as aphids and American ball worm which was responsible for damaging the crop. Other than damaging tomatoes, biodiversity in the field and around the field caused rotting of plant residues in order to generate crop nutrients. The plant diversity around the experimental site created a conducive environment for several beneficial organisms. Such organisms included playing mantis, lady bird beetles, and wasps which enabled to manage several pest populations (Ssekyewa, 2001). The environment with diverse plant species enhanced biorational efficacy when it provided homage to organisms such as playing mantis that fed onaphids. This nutritional relationship between aphids and beneficial organisms kept pestpopulation low. This was an opportune moment for biorationals to keep tomato blight incidence low, (Rosskopf *et al* 2007). It is imperative to enhance biodiversity if farmers are to benefit from natural interactions such as predation. There were pathogens other than *Phytopthora infestans* which caused wilting of some tomato plants. "In natural settings, many organisms exist despite human interventions" Katende *et al*, (1995). This showed that a mult-dimensional approach must be sought to enhance the efficacy of such selected biorationals.

Conclusion

Biorational combination in treatment P(*Carica papaya* with *Phytolaxcca dodecandra*) at concentrations of 50%and 75% managed to reduce tomato blight to levels below economic injury thresholds. The ecological conditions that influenced the effectiveness of biorationals when managing tomato blight were temperature, humidity, predation and wind.

Recommendations

It is recommended that farmers use a combination of *Caricapapaya* with *Phytolacca dodecndra* at a concentration of 50% to manage *Phytopthora infestans* in tomato plants. They should ensure that they enhance their efficacies by applying them during warm conditions, low humidity, little or no wind and support beneficial organisms.

References

Ankli *et al.* (1999). Medicinal Plants in Mexico: Healers' Consensus and Cultural Importance Soc. Sci. Med. Vol. 47, No. 11, pp. 1859±1871, Great Britain.

D.A. Fontem (2003). Quantitative Effects of Early and Late Blights on Tomato Yields in Cameroon Tropicultura, 2003, 21, 1, 36-41.

Gary L., Obenauf, 1999. *Propargyl bromide, biorationals, and use of alternative fumigants during the spring.* New York: 6 (4) pp.19-31.

Haryan R. A, *et el.* 1979. *"Plasmid DNA from Bacillus thuringiensis ". Microbiologiya* 48(2)226–9.

Henry Elwell and Anita Maas 1996. *Natural pest and disease control.* University press, London.

Kakudidi E.K. (2004). Folk plant classification by communities around Kibale National Park, western Uganda. Afr. J. Ecol., 42: 57-63.

Rosskopf Erin, Ables Camilla, Albano Joseph, I997. *Screening of biorationals for control of phytophthora capsici*. London: 17th International Pepper Conference.

Ssekyewa, C. 2001. *Major Horticultural Crops Diseases Handbook*. UMU: Spiral bound.

Mwine Julius *et al.* 2011. Ethnobotanical survey of pesticidal plants used in South Uganda: Case study of Masaka district Journal of Medicinal Plants Research Vol. 5(7), pp. 1155-1163.