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Comparing Efficacy of selected Biopesticides and Lambdacot 500EC for Controlling Leaf-Rollers in Eggplant (*Solanum melongena* L.)

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ABSTRACT

Field experiments were conducted during the 2012 and 2013 cropping seasons at the University of Maiduguri to compared the efficacies of selected aqueous plant extracts on the management of the population of eggplant leaf roller (*Eublemma olivacea* Wlk.) infesting eggplant (*Solanum melongena* L.). The extracts were from neem leaf; bitter melon; black current; ginger rhizome and wild onion. They were compared with a conventional insecticide, Lambdacot 500EC and the absolute control. Extracts were applied at 5 % w/v while Lambdacot was applied at 1.5g a.i/ha. The results indicated that the mean number of leaf rollers in treated plots were significantly ($P < 0.05$) lower than the control. The highest mean number of leaf rollers was 3.01 and 3.93. Lambdacot 500 EC had the lowest eggplant leaf roller counts per plant followed by neem, ginger rhizome and wild onion. The mean number of leaves damaged per plant followed similar trend. There was significantly ($P < 0.05$) higher number of eggplant fruits/plant, fruit weight and fruit yield in the decreasing order of Lambdacot 500 EC, neem, wild onion, bitter melon and black current. The absolute control had the fewest number of eggplant fruits/plant, fruit weight and fruit yield. These aqueous extracts should be adopted by eggplant farmers as they are cost effective and friendly to the environment. However, the actual quantities of these extracts to be applied per plant depending on the variety of eggplant, season and weather condition of the cropping season and canopy architecture remain to be critically explored.

Keywords: Adoption, Eggplant, Plant Extracts, Synthetic Pesticides

INTRODUCTION

Eggplant is a popular and very important vegetable crop grown in the subtropics and tropics (Degri *et al.*, 2012a, Akpabia, 1989). The eggplant is an important source of vitamins, minerals and fibre and plant proteins in human diets throughout the world and is rapidly becoming an important source of income for rural population (Aetiba and Osekre, 2015).

Despite its nutritional, economic and social values, increasing infestation and damage by arthropod insect pests are effecting eggplant production in Nigeria (Degri, 2014). Production of eggplant is hampered by various insect pests such as flea beetle (*Podagrica spp.*). Stem borer (*Euzophera villosa),* leaf roller (*Eublemma olivacea),* fruit and shoot borers *(Daraba laisalis; Leucinodes orbonalis*) and various species of grasshoppers (Owusu-Ansah *et al.,* 2001; Onekuku Omoleye, 2012; Aetiba and Osekre, 2015). Among these complex arthropod pests that attack and damage eggplant, leaf roller is one of the most destructive pests in most major eggplant producing countries (Singh and Singh, 2002). Eggplant leaf roller caterpillars roll leaves and feed on chlorophyll while remaining inside the folds which later wither and dry up. The infestation of the eggplant leaf roller starts right from the nursery and continues till advance stage of the plant (Akapabi, 1989; Singh and Singh 2002; AVRDC, 2008)

The application of synthetic insecticides is the primary control strategy against insect pests of the crop (Aetiba and Osekre, 2015; Degri *et al.,* 2012a). Although application of synthetic insecticides remains the primary agricultural pest control strategy, it is evident that the society cannot continue to tolerate their harmful effects on the environment and beneficial organisms. Degri *et al.* (2012b), Aetiba and Osekre (2005) reported that managing of eggplant leaf roller could be to develop pest management systems that are based on the development of alternative control strategies like the use of bio pesticides. Thus there was a need to screen more indigenous plants that are easy to prepare or use and non-hazardous to humans, animals, and the environment (Isman, 2006). Keeping in view the present investigation was conducted to compare the efficacy of selected biopesticides and Lambdacot 500EC for controlling leaf-rollers on eggplant.

MATERIALS AND METHODS

Description of the Study Area

Field experiments were conducted during 2012 and 2013 cropping seasons at the Teaching and Research Farm of Development of crop protection, University of Maiduguri Nigeria. The field where the experiments were executed is located between longitudes 13°10′ E and latitude 11° 51′N. The mean annual rainfall is 562 mm whereas mean annual temperature is 27.2°c. Rainy seasons start from June to October while short dry seasons are experienced between November and May (Degri *et al.,* 2010). The mean rainfalls recorded during the 2012 and 2013 cropping seasons in the study area were 561 mm and 560 mm, respectively. The experiments were laid down in a randomized complete block design replicated four times including the standard /conventional Lambdacot 500 EC and the absolute control. Materials tested included the extracts of five plants one synthetic insecticide Lambdacot 500 EC (a combination of Lambda cyhalothrin 350EC and dimethoate 150EC).

Table 1: Names of the experimental materials used for the studies

S.N.	Common name	Scientific name
1	Neem leaf	*Azadirachta indica*
2	Bitter melon	*Momordica balsamina*
3	Ginger rhizome	*Zingiber officinales*
4	Black current	*Ribens nigrum*
5	Wild onion	*Allium fistolusum*
6	Lambdacot 500 EC	
7	Control (untreated)	

Eggplant seeds and the synthetic insecticides Lambdacot 500 EC were obtained from a reputable agricultural input distributor African Agro Company (AFCOT) at Bama road, Maiduguri. The five plant materials tested were collected from plants in the Botanical Garden of the Department of Biological Sciences, at the University of Maiduguri.

Experimentation

Each treatment plot measured 4 m × 3 m (120 m^2) in dimensions and plots within a replicate were separated at a 1 m alley. The plots between replications and borders were spaced at 2 m apart. One eggplant seedling was transplanted per planting station. A replacement of dead seedling was done a week after transplanting to maintain the plant population. Aqueous extracts of the five plant materials tested were prepared as described by Degri *et al.* (2012a). These were then applied in all plots except the absolute control at 5% w/v concentration while Lambdacot was applied at 1.5g a.i. /ha using hand sprayer. Spraying of these treatments was re-applied at one week interval. Weeding was done throughout the experiment using a hand hoe. Fertilizer (NPK 20:10:10) was applied three weeks after transplanting at a rate of 15 g/stand.

DATA COLLECTION

Number of Eggplant Rollers on Eggplant

Collection of data on number of eggplant leaf rollers was done weekly commencing from when the insect build- up was becoming high. The leaf rollers were collected from the young leaves with signs of silk webbed and rolled leaves leaf. The silk webbed and rolled were opened and the caterpillars were collected, counted and the number recorded. Sampling was done on randomly selected five plants from the middle rows each plot.

Number of Leaves Damaged by Leaf Rollers

Young leaves with signs of silk web and rolled leaves were visually assessed from each plant and the number of leaves damaged was recorded.

Number of Eggplant Fruits

Fruits of eggplant were harvested from each plant every three day interval when they reached maturity and their number recorded. The actual size of harvest area measured 2 m × 2 m (4 m^2).

Weight and Yield of Eggplant Fruits

All eggplant fruits harvested in each plot were weighed using Metler electronic weighing scale. The weight of eggplant fruits recorded were converted into fruit weight per individual plant and then extrapolated into hectare basis such that:

$$\text{Fruit yield } (kgha^{-1}) = \frac{10000}{AH} \times FWT$$

Where 10000 comes from 1 ha=10000 m^2, AH is the actual plot area (m^2) where eggplant fruits were harvested, and FWT is the weight of eggplant fruit (in kg) harvested in each plot.

Data Analysis

The data collected were subjected to analysis of variance (ANOVA) using Statistics version 9.0 software. These were the mean number of leaf rollers per plant, number of leaves damaged by the leaf rollers per plant, number of fruits per plant, weight of eggplant fruits per plant, and fruit yield. Least significant difference (LSD) was used to separate the treatment means (SE±) at 5% level of probability.

RESULTS AND DISCUSSION

Effect of Biopesticides and Lambdacot on the Number of Eggplant Leaf Roller

The results of eggplant leaf roller counts are presented in Table 2. Results showed that the mean number of eggplant leaf roller in treated plots for both years were significantly ($P< 0.05$) lower than the untreated/control plots. The untreated plots had the highest mean number of leaf rollers of 3.01 and 3.93 for the 2012 2013 cropping seasons, respectively. Results also indicated that Lambdacot 500 EC had the lowest eggplant leaf roller counts per plant followed by plots treated with *A. indica, Z. officinales* and *A. fistolusum*.

Table 2: Effect of Biopesticides and Lambdacot 500 EC on the Mean Number of Eggplant Leaf Roller on Eggplant

Treatment	2012	2013
Azadirachta indica	0.86	0.90
Momordica balsamina	0.91	0.97
Zingibe rofficinales	0.88	0.85
Ribens nigrum	1.33	1.42
Allium fistolusum	0.89	0.92
Lambdacot 500EC	0.63	0.61
Control	3.01	3.13
SE ±	0.03	0.02

The significantly lower mean number of eggplant leaf rollers recorded in plots treated with biopesticides indicate that *A. indica, Z. officinales* and *A. fistolusum* aqueous plant extracts were effective against the leaf roller pest. These three plant biopesticides significantly reduced the rolling (folding), webbing and chewing damage of the larvae during both cropping seasons. Biopesticides contain active ingredients with low half-life period and their effect on the environment is not too detrimental making them more acceptable for pest control (Degri *et al.,* 2012a). The counts of eggplant leaf rollers in plots treated with the three biopesticides were lower than counts in plots treated with *M. balsamina* and *R. nigrum.* This difference could be due to the variety of active ingredients contained in these biopesticides, which are known to have repellent, antifeedant and phagodeterrent effects against the larvae (Banjo and Ode, 1996; Degri *et al.,* 2010; Degri *et al.,* 2012b).

Effect of Biopesticides and Lambdacot 500 EC on the Number of Leaves of Eggplant Damaged

The effect of biopesticides on the number of leaves of eggplant damaged per plant during 2012 and 2013 cropping seasons are presented in Table 3. There were significant ($P < 0.05$) differences among treatments with respect to the number of leaves damaged per plant. Results indicated that the mean number of leaves damaged per plant were significantly ($P < 0.05$) higher in control plots than biopesticides treated plots in both cropping seasons.

Table 3: Effect of Biopesticides and Lambdacot 500 EC on the Number of Leaves Damaged Per Plant.

Treatment	Mean Number of Eggplant Leaf Roller Per Plant	
	2012	2013
A. indica	3.06	3.12
M. balsamina	3.46	3.41
Z. officinales	3.33	3.38
R. nigrum	4.18	4.11
A. fistolusum	3.12	3.17
Lambdacot 500 EC	3.09	3.05
Control	9.78	9.91
SE ±	0.06	0.09

Comparing these different plant extracts, fewer leaves damaged per plant were recorded on Lambdacot 500 EC followed by *A. indica; A. fistolusum* and *Z. officinales.* However, extracts from *M. balsamina and R. nigrum* recorded relatively moderate number of leaves damaged per plant. In addition, the absolute control plots recorded the highest number of leaves damaged per plant. These inconsistent observations could be attributed largely to the effectiveness of the aqueous plant extracts against the eggplant leaf roller. These extracts might have reduced their rolling, webbing and feeding activities of the leaf rollers on the leaves (Sinha and Sharma, 2010; Aetiba and Osekre, 2015). The highest number of leaves damaged in plots which were not treated during both cropping seasons was caused by the highest level of infestation by the leaf roller larvae. These larvae caused rolling, webbing and subsequently damaging of the eggplant leaves. This finding is consistent with those of a study conducted by Banjo and Ode (1996). Their findings indicate that attack by eggplant leaf roller caused leaves damage when the leaves were not protected with insecticides at the appropriate time. The findings of this study indicate that the biopesticides applied were effective in reducing leaf roller infestation but their effectiveness differed among plant extracts and the standard Lambdacot 500 EC. This was due to their differences in pesticidal properties attributable to the active ingredients contained in these plant materials (Stoll, 2001). These active ingredients are reported by Isman (2006) and Degri (2014) to be triterpenes, limonoidssalamin, meliantriol and nimbin which repel and prevent the Leaf roller larvae from feeding on the eggplant leaves.

Effect of Biopesticides and Lambdacot 500 EC on Yield and Yield Components of Eggplant

Results of the effect of biopesticides and Lambdacot 500 EC on yield and yield components of eggplant are presented in Table 4. Results indicated that there was significant ($P < 0.05$) difference among the biopesticides, Lambdacot 500 EC and the absolute control on fruit performance. It was revealed that significantly ($p < 0.05$) higher number of eggplant fruits/plant, fruit weight and fruit yield were obtained in the decreasing order of Lambdacot 500 EC, *A.indica, A. fistolusum, M. balsamina* and *R. nigrum.* In addition, results indicated that the untreated absolute control plots had the smallest numbers of eggplant fruits/plant, fruit weight and fruit yield recorded during the two cropping seasons.

Table 4: Yield and Yield Components of Eggplant as Affected by Biopesticides and Lambdacot 500 EC during the 2012 and 2013 Cropping Seasons

Treatment	Eggplant fruit response Variables and Yield					
	Number/Plant		Mean Weight (Kg/Plant)		Yield (Kg/ha)	
year	2012	2013	2012	2013	2012	2013
A.indica	9.56	9.83	2.80	2.79	757.60	767.54
M. balsamina	8.01	7.98	2.59	2.63	643.96	633.80

Z. officinales	8.41	8.46	2.77	2.87	745.11	741.08
R.nigrum	7.89	7.84	1.87	1.84	603.01	602.97
A.fistolusum	8.70	8.67	2.35	2.37	725.19	725.14
Lambdacot 500 EC	10.72	10.70	3.02	3.00	818.15	838.13
Control	5.11	5.13	1.31	1.28	318.16	217.91
SE±	0.40	0.38	0.90	0.87	23.11	33.08

The higher number of eggplant leaf rollers and higher number of leaves damaged per plant could have resulted to the fewer number of eggplant fruits per plant, lower fruit weight, and reduced fruit yield per land of production. On the other hand, the significantly higher number of eggplant fruits, weight of fruits, and fruit yields obtained from the eggplants treated with biopesticides could be attributed to the marked reduction in the number of leaf rollers. This also was a result of reduced level of damaged caused by fewer leaf rollers to the leaves per plant (Degri *et al.,* 2010; 2012b).

CONCLUSION

The study revealed that aqueous biopesticides extracts of *Azadirachta indica; Zingiber officinales; Allium fistolusum; Ribens nigrum* (5% w/v/ concentration) applied at one week interval were effective against eggplant leaf roller (*E. olivacea*). These findings were also statistically similar with the conventional Lambdacot 500 EC. The application of biopesticides extracts reduced the number of *E. olivacea* on eggplant leaves and reduced the number of eggplant leaves damaged. They also improved performance of eggplant in terms of increased number of fruits, weight of fruits and fruit yield. It is therefore recommended that these aqueous extracts should be adopted by eggplant farmers as they are cost effective and friendly to the environment. However, the actual quantities of these extracts to be applied per plant depending on the variety of eggplant, season and weather condition of the cropping season, and canopy architecture remain to be critically explored.

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