



## Response of the Leaf Roller, *Eublemma olivacea* Wlk to Applications of Weeding and Insecticidal Treatments on Eggplant, *Solanum melongena* L.

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### Abstract

Different strategies had been used for controlling the pest and stabilizing the productivity of the cropping systems. Weeding and insecticide application are some of the crop management practices that minimize the incidence and damage of insect pests in eggplant crops in order to enhance its growth and yield performance. Eggplant (*Solanum melongena* L.) is a popular and very important vegetable crop that is infested and damaged by arthropod pests in Nigeria. Field experiments were conducted to evaluate the effect of weeding frequency and conventional insecticide application in the control of leaf roller (*Eublemma olivacea* Wlk.) in eggplant. Five application concentrations of insecticide (0.0, 0.5, 1.0, 1.5, and 2.0L/ha) and four weeding frequencies (0, 1, 2, and 3) were assessed using split-plot laid out in randomized complete block design (RCBD) replicated three times. Results showed that three weedings and the application of insecticide at 1.5 L/ha were found to be effective in reducing the population of *E. olivacea* and eggplant leaves damage. It further showed that these practices improved the number of eggplant fruits, fruit weight and fruit yield during the 2019 and 2020 cropping seasons in the study area. The study therefore, showed that combining three weedings with an appropriate insecticide (1.5 L/ha) concentration rate is recommended for the control of eggplant leaf roller (*E. olivacea*) to poor resource farmers in the study area.

**Keywords:** Eggplant, *Eublemma olivacea*, Weeding, insecticide, Concentration.

### INTRODUCTION

Eggplant, *Solanum melongena* L. is a popular and very important food and commercial vegetable crop grown in the tropics and subtropics Degri *et al.*, (2012). It is an important source of vitamins, minerals,

fiber, water and plant proteins in human diets throughout the world (Akpabi, 1989; Onekuku and Omoloye, 2012; James *et al.*, 2010; Oshomah and Degri, 2016). Eggplant is rapidly becoming an important source of income for rural poor-resource farmers in

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Africa and Asian countries (Youdewei, 2002; Aetiba and Osekre, 2015; Food and Agriculture Organization, 2020).

Despite its nutritional, economic and social values, increasing incidence, infestation and damage by arthropod pests are affecting eggplant production in Nigeria ((AVRDC), 2008; IITA, (2010); Degri, 2014; Oshomah and Degri, 2016). According to James *et al.*, (2010) eggplant production is being hampered by various insect pests such as leaf caterpillar (*Selepa docilis*); flea beetles (*Podagrica* spp.); Leafminer (*Liriomyza* spp.); stem borer (*Euzophera villosa*; shoot and fruit borers (*Daraba laisalis*); Leafroller (*Eublemma olivacea*); aphids (*Aphis* spp.), fruit borer (*Leucinodes orbonalis*), and various species of grasshoppers, weeds, mites and nematodes (Alam *et al.*, 2003, Degri *et al.*, 2010, Onekuku and Omoloye, 2012; Degri, 2014). Among these complex arthropod pests that attack and damage eggplant, leaf roller is one of the most destructive insect pests in most major eggplant -producing countries (Singh and Singh, 2002; AVRDC, 2008; FAO, 2020; Aetiba and Osekre, 2015).

The infestation of the eggplant leaf roller (ELR) starts right from the nursery and continues until the advance stage of the plant by feeding inside the folded leaves which later wither and dry up (Akpabi, 1989, Singh and Singh, 2002; AVRDC, 2008, James *et al.*, 2010).

Uncontrolled weed growth interferes with the growth of eggplants and crop yield (Stagnari and Pisante, 2011). Regular weed control in eggplant is beneficial to the crops and minimize the effect of weed competition with the crop; as they alter environmental factors within the crop (Youdewei, 2002). The presence of weeds can serve as a source of diseases, including both diseases of insects and of crop plants (Capinera, 2005; Norris and Kogan, 2000). In eggplant cultivation,

weeds reduce fruit yield and quality by 67-96% respectively apart from being a food resource for insects and diseases. According to Capinera (2005) the presence of weeds in crops is detrimental to insect management. Frequent weeding in crops help to eliminate or control at the earliest possible stage, potential insect vectors, insect pests incidence, infestation and damage (Mustapha *et al.*, 2001). Weeds are a special problem for area-wide insect pests management programs if the host insects, because the number of insect pests that must be managed is higher, and the area that must be treated/sprayed is greatly increased (Capinera, 2005; AVRDC, 2008; James *et al.*, 2010).

The application of synthetic insecticides is the primary control strategy against insect pests of the crop (Degri *et al.*, 2010; Sinha and Sharma, 2010; Degri *et al.*, 2012; Aetiba and Osekre, 2015). Although, the application of synthetic insecticides remains the primary agricultural pests control strategy, it is evident that society cannot continue to tolerate their harmful effects on the environment and beneficial organisms. The application of the insecticide on the crops alone without timely and proper weeding regimes cannot control the insect pests. This is because of the increase in weeds incidence which sets the stage for insects that are attracted to these weeds to also feed on the crops and affect also the efficiency and effectiveness of the chemical.

The relationship between weeds and insect pests must be broken if insect pest control is to be optimized (Norris and Kogan, 2000; Capinera, 2001; Capinera, 2005). Aetiba and Osekre (2005) and Degri *et al.*, (2012) reported that managing eggplant leaf roller (ELR) could be to use a pest management system that is based on the use of alternative and minimum use of synthetic insecticides. This study therefore, was conducted to investigate the impact of

weeding frequency and insecticide application rates in the management of eggplant leaf roller (ELR) in eggplant.

## MATERIALS AND METHODS

### Study Site

Field experiments were conducted during the 2019 and 2020 cropping seasons at Gombe State Agricultural Development Program Farm Centre, Putoki, Balanga Local Government Area of Gombe State. The mean annual rainfall of the area is 762mm and mean temperature 25°C respectively. The rainy season starts from May to October while dry season is experienced between November and May (Gombe State Agricultural Development Program, 2013).

### Source of Experimental Materials

Insecticides used for the experiment (which is a combination of Lambda-cyhalothrin 15g/l + dimethoate 300g/l), eggplant seeds and the NPK compound fertilizer used for the experiment were purchased from a reputable agricultural input distributor Alhaji Adamu Minangi at Gombe Main Market.

### Experimental Design and Layout

The experiments were laid down in split-plot fitted into a randomized complete block design (RCBD) with a plot size of 4.5m x 4.5m (gross plot) and 3.5m x 2.7m (net plot). Plots within replication were separated by a 1.5m alley while replications between plots were separated by a 2.0m alley and were replicated three times. The main plots were the weeding frequencies (zero weeding; one weeding at 3 weeks after sowings (3WAS); two weeding at 3 and 6 WAS and three weeding at 3, 6 and 9 WAS) while insecticide application was allocated to subplots (0.0L/ha; 0.5L/ha; 1.0L/ha; 1.5L/ha, and 2.0L/ha).

### Seed Material and Sowing

The eggplant variety used for the study was a short stem, perennial, round-shaped fruit cultivated for food and commercial purposes. It is well adapted to the Sudan Savanna ecological zone of Nigeria under rainfall and irrigated conditions which attain maturity between 130 -210 days with a potential yield of 1600 -2000 kg/ha. The seeds were treated with Allstar 40DS (20% metalaxyl, 20% imidacloprid), a seed treatment chemical manufactured by Jiangsu Weunite Fine Chemical Co. Ltd. Registered and distributed by Miagro Limited, Kaduna, Nigeria at 8g/kg before sowing).

### Seedling Raising and Transplanting

Eggplant (*Solanum melongena* L.) seeds were planted in well prepared seed bed and watered twice (morning and evening) for four weeks before transplanting. The seedling was kept and managed under shade to reduce high solar heat that may likely cause scorching. When the seedlings were ready for transplant, they were watered before removing the good, healthy and vigorous seedlings to the field for transplanting. The transplanting was done during cool evening weather, and removed gently with a ball of earth around roots to avoid exposure to harsh weather and to minimize damage. After transplanting, the seedlings were watered daily.

The seedlings were transplanted in the already prepared and laid out field at 45m x 45cm apart on 75 cm ridges. After the eggplant seedlings were established, gaps were filled one week after transplanting (1 WAT) to maintain the plant population in the experimental plots. The experimental plots were weeded as designed in the treatments (0, 1 weeding at 3 WAT, 2 weeding at 3 and 6 WAT, 3 weeding at 3, 6, and 9 WAT). A

compound fertilizer NPK 15:15:15 was applied at 200kg/ha (4 bags/ha) in the field.

### Application of the Insecticide (Magic Force)

The insecticide used (a combination of Lambda-cyhalothrin 15g/l + dimethoate 300 g/l) was applied using knapsack sprayer (Jecto, 16 Litres) as designed in the treatment (0.0, 0.5, 1.0, 1.5, and 2.0 L/ha at 3, 6, and 9 WAT.

### Data Collection

During the study, data were collected on the following parameters:

- a) The number of leaf rollers/plants: a collection of data on several eggplant leaf rollers was done weekly commencing from when the leaf roller population was becoming high. The leaf rollers were collected from the young and old eggplant leaves with signs of silk web and rolled leaves. The silk web and rolled leaves were opened and the caterpillars were collected, counted and the number recorded per plant. Sampling and collection were done on randomly selected five plants from the middle rows of each plot.
- b) Number of leaves damaged by leaf rollers: young and old leaves of eggplant with signs of silk web and rolled leaves were visually assessed from the five randomly tagged plants and the number of leaves damaged by the pest was counted and recorded per plant.
- c) Number of eggplant fruits: Fruits from the five randomly tagged eggplant from each plot were harvested every three-day interval when they reach physiological maturity and they were counted and recorded against each plant.

- d) Eggplant fruit weight and yield: All eggplant fruits harvested in each plot were weighed using a meter electronic weighing scale. The weight of the eggplant fruits was recorded. The weight from each plot was later converted into fruit weight per hectare thus:

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

Where 10000 comes from 1 ha = 10000m<sup>2</sup>;

AH = Actual plot area in m<sup>2</sup> where eggplant was harvested,

FWT = 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. Where there was a difference in treatment means, the least significant difference (LSD) was used to separate them at 5% level of probability.

## RESULTS

There was significant difference among the weeding frequency and application rates (Table 1). Three weedings (0.72, 0.81 and 1.5L/ha) (0.56 and 0.55) application significantly ( $P < 0.05$ ) reduced the number of eggplant leaf roller (*Eublemma olivacea*) during the study period. These trends were closely followed by two weedings (1.33 and 1.28) and 2.0L/ha applications (0.60 and 0.63). Zero weeding (4.01 and 3.91) and untreated plots (4.11 and 3.89) had the highest population of eggplant *E. olivacea* during the 2019 and 2020 cropping seasons (Table 2).

**Table 1:** Effects of weeding frequency and insecticide application on mean number of *Eublemma olivacea* population

Treatment	Mean number of <i>E. olivacea</i> / plant	
	2019	2020
<b>A. Weeding frequency (WF)</b>		
Zero weeding	4.01	3.91
One weeding	2.61	2.64
Two weeding	1.33	1.28
Three weeding	0.72	0.81
SE ±	<b>2.18</b>	<b>1.62</b>
<b>B. Application Rate L/ha(AR)</b>		
0.0	4.11	3.89
0.5	4.01	4.05
1.0	2.18	2.33
1.5	0.56	0.55
2.0	0.60	0.63
SE ±	<b>1.97</b>	<b>1.67</b>
<b>C. Interactions WF x AR</b>		
	NS	NS

The number of eggplant leaves damaged by *E. olivacea* was significantly  $P < 0.05$  lower on plots weeded three times (3.41 and 3.56) and sprayed with insecticide at 1.5L/ha (3.11 and 3.09). In contrast, zero weeded plots (10.11 and 10.09).

**Table 2:** Mean a number of eggplant leaves damaged per plants in 2019 and 2020.

Treatment	Mean No. of eggplant damaged leaves/plant	
	2019	2020
<b>A. Weeding Frequency (WF)</b>		
Zero weeding	10.11	10.09
One weeding	4.67	5.15
Two weeding	3.16	3.22
Three weeding	3.14	3.56
SE±	<b>5.12</b>	<b>4.71</b>
<b>B. Application Rate L/ha(AR)</b>		
0.0	5.20	5.17
0.5	5.16	5.19
1.0	3.46	3.47
1.5	3.11	3.09
2.0	3.18	3.19
SE±	<b>1.06</b>	<b>1.09</b>
<b>C. Interactions WF x AR</b>		
	NS	NS

Table 3 showed that there was significant difference among the treatments. There were few fruits (3.71 and 3.69), lower fruit weight (1.33 kg/plant and 1.31 g/ha), and lower eggplant fruit yield (322.61kg/ha and 318.91 kg/ha) on plots that were not weeded (zero weeding) while plots weeded thrice had higher fruits (9.70 and 9.88); higher fruit weight (3.11 kg/plant and 3.5) and higher fruit yields (820.50 kg/ha and 819.16 kg/ha). When the application rates were compared

among the treatments, the results showed that plots that were not prayed (control) had a lower number of fruits (3.11 and 3.18), lower fruit weights (1.56 kg/plant and 1.49 kg/plant) and lower fruit yield (311.71 kg/ha and 309.63 kg/ha) while plots sprayed with insecticide at 1.5L/ha produced higher fruits (10.89/plant and 10.61/plant), higher fruit weights (3.08kg/plant and 3.09 kg/plant) and higher fruit yield (851.19 kg/ha and 8.57.44 kg/ha).

**Table 3:** Yield and yield components of eggplant as affected by weeding frequency and Insecticide application in 2019 and 2020.

Treatment	No. of fruits/plant		Mean fruit weight (kg/plant)		Yield (Kg/ha)	
	2019	2020	2019	2020	2019	2020
<b>A. Weeding frequency (WF)</b>						
Zero weeding	3.71	3.69	1.33	1.31	322.61	318.91
One weeding	4.88	4.72	1.71	1.69	352.14	351.92
Two weeding	6.67	7.11	2.35	2.37	745.12	751.06
Three weeding	9.70	9.88	3.11	3.51	820.50	819.16
SE±	<b>0.45</b>	<b>0.40</b>	<b>0.88</b>	<b>0.90</b>	<b>24.11</b>	<b>35.09</b>
<b>B. Application Rate (L/ha)</b>						
0.0	3.11	3.18	1.56	1.49	311.71	309.63
0.5	4.76	4.61	1.81	1.79	366.44	359.11
1.0	6.31	6.83	2.29	2.32	517.16	534.31
1.5	10.89	10.61	3.08	3.09	851.19	857.44
2.0	9.87	10.58	3.03	2.97	827.13	829.20
SE±	<b>0.44</b>	<b>0.43</b>	<b>0.86</b>	<b>0.89</b>	<b>26.13</b>	<b>33.19</b>
<b>C. Interactions WF x AR</b>						
	NS	NS	NS	NS	NS	NS

NS = not significant at 5% level of probability.

## DISCUSSION

Weeding frequency and use of the correct application rate are strategies of combining cultural and chemical control methods for managing weeds and pests on the field (Capinera, 2005). Regular weeding helped to minimize the effects of weed competition with the crops and also prevents weeds from harboring insect pests that could attack and transmit diseases to the crops (Norris and

Kogan, 2001; Capinera, 2005). Weed competition in eggplant led to a serious build-up of insect pests that could feed on both vegetative and reproductive parts of the crop thereby causing serious economic damage and colossal income loss to the poor-resource farmers who are the major producers of eggplant (Stagnari and Pisante, 2001). The population of *E. olivacea* was higher on zero and one weeding plots. This

indicates that the presence of the weeds in those plots provided a very good habitat and conducive environment for the leaf rollers to breed and cause damage to the crops, thus the corresponding lower number of fruits, fruit weight and fruit yield during the 2019 and 2020 study period (Norris and Kogan, 2000). The regularly (three weedings) weeded plots had a lower number of *E. olivacea* because there were no weeds to provide favourable environment (shelter) for the breeding and build-up of the pests (Owusu-Ansah *et al.*, 2001; Takim and Uddin II, 2010; Yusuf *et al.*, 2015). This indicates that weeding can help greatly in reducing the population of the pest in the field (Mustapha *et al.*, 2001). Total removal of weeds in the three weeding plots could have effectively reduced competition between the weeds and the crop and made more assimilates available to support eggplant growth and development and thus its weight and higher yield.

This is the reason eggplant leaves were less damaged, had higher fruit numbers, higher fruit weight and higher fruit yield on plots that were weeded regularly (three times) than others.

Further in the study, it was found that among the magic force concentrations used during the study, 1.5L/ha concentration was found to be more effective in reducing the number of eggplant leaf roller (*E. olivacea*) population; a number of damaged leaves resulting in improved number of fruits/plants, fruit weight/plant and fruit yield/ha than the other concentrations. This showed that insecticide applied at 1.5 L/ha was the appropriate concentration for the control of eggplant leaf roller (*E. olivacea*) when regularly weeded (three weedings) in the study area (Sinha and Sharma, 2010). The insecticide used in treating the eggplant at 0.5L/ha, 1.0L/ha and 2.0L/ha was not effective. This implies that this insecticide

application at these concentrations was not the appropriate rate for the control of *E. olivacea*. Aetiba and Asekre (2015) reported that the application of insecticides at the recommended rate and concentrations will give the needed control of eggplant insect pests while the application of wrong (either low or high) concentrations will not be effective against the pests and may even cause pest resistance and resurgence. The performance of the magic force insecticide depended primarily on its concentration and the right time of its application to the crop. Degri *et al.* (2012) reported that when an insecticide, either botanical or synthetic insecticide is applied at the right time, regime and concentration, the desired results for optimum growth and yield performance will be obtained. This was the case with the results obtained when eggplant was weeded three times and sprayed with magic force at 1.5L/ha during the study.

## CONCLUSION

This present study showed that eggplant leaf roller (*Eublemma olivacea* L.) is a major insect pest of eggplant in Nigeria. It caused serious damage and reduced fruit yield in the study area and is therefore a major constraint to eggplant production. The practice of regular weeding of the crop treated with magic force insecticide at 1.5L/ha was found to be effective in the control of the pest. Three weeding regimes combined with the application of insecticide at 1.5L/ha concentration significantly reduced the population of *E. olivacea*, and eggplant leaves damage and improved the number of fruits, fruit weights and fruit yield during the 2019 and 2020 cropping seasons. This technique of combining regular weeding with appropriate insecticide application (1.5L/ha) is therefore recommended for the control of

eggplant leaf roller (*Eublemma olivacea* L.) in the study area.

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