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Integrated Pest Control of the Eggfruit and Shoot Borer Leucinodes Orbonalis Guenee on the Garden Egg Solanum Aethiopicum L in Southwest Nigeria.

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***Abstract*-** Indiscriminate use of insecticides in the control of the EFSB and other vegetables makes it expedient to seek for safe and eco-friendly measures. In two separate experiments, the first compared the effect of integrating nylon net barrier with weekly cutting of infested shoot, and the other the effect of integrating use of nylon net barrier, weekly clipping of infested shoot with application of 150ltrs/ha of Karate® 5EC. Treatments were arranged in a Randomized complete block design with three replicates each. Integrating nylon net and weekly cutting of infested shoots significantly reduced EFSB infestation by 27.61% in 2006 and 7.87% in 2007 compared to the control. Single application of Karate® 5EC at 150lts/ha at four weeks interval gave comparatively the same control as more frequent applications. However, integrating nylon net, weekly cutting of infested shoot and monthly application of karate at 150lts/ha significantly reduced EFSB infestation by 92.03% compared to control. Therefore integrating physical barrier of nylon netting, weekly clipping of infested shoot and monthly application of Karate® 5EC is recommended for effective control of field infestation by the pest. This study shows that the integration of different control techniques can significantly reduce damage by the eggfruit and shootborer.

***Index Terms*-** Nylon net barrier, Eggfruit and shootborer(EFSB), Leucinodes orbonalis, Solanum aethiopicum, Integration, Karate®5EC

I. INTRODUCTION

Garden egg, also known as African eggplant (*Solanum aethiopicum*), is one of the most important vegetable crops in West Africa (Owusu-Ansah *et al*., 2001; Grubben and Denton, 2004). It is cultivated all-year round in different parts of Nigeria and West Africa and serves as the main source of income for many rural farmers and households. Production is however constrained by a wide range of pests and diseases reducing total production as well as production quality. A great diversity of species of insects from different Orders and Families have been recorded on the garden egg of which very few are of economic importance (NRI, 1997). The egg fruit and shoot borer (EFSB) *Leucinodes orbonalis* (Lepidoptera: Crambidae) is one of the most important insect pest of this vegetable crop with fruit damage as much as 80% recorded sometimes.

Insecticides are currently the main method used in the control of of this all important pest with farmers relying on them exclusively in order to be able to produce blemish-free fruit (Kabir *et.al*., 1994; Alam *et al.*, 2003). Complications associated with indiscriminate use of these insecticides are well documented. Non optimal and non-judicious use of pesticides results in a series of problems related to both loss of effectiveness on the long-run and certain externalities such as pollution and health hazards (AVRDC, 2003). The use of these chemicals has to reduce drastically and effort put into the production of safer crops.

The application of Integrated pest management (IPM) is desirable and sustainable in managing these pests because it combines biological, cultural, physical, and chemical tools in a way that minimizes economic, health and environmental risks (Rechcigl and Rechcigl, 2000). Chakraborti (2001) assessed the effectiveness of a biorational integrated approach for the management of *L. orbonalis* and found that it reduced the heavy use of synthetic chemicals and produced results superior to the chemical method. Sasikala *et al*. (1999) reported that the combination of mechanical destruction of infested shoots and fruits, neem oil and the release of the egg parasitoid *Trichogramma japonicum* Ashwood gave good control of *L. orbonalis* in Bapatla, India. Arida *et al*. (1999) and Alam *et al*. (2003) reported that the combination of physical barrier and prompt destruction of infested shoots (sanitation) significantly reduced EFSB damage to eggplant crops. Alam *et al*. (2003) recommended a net barrier 2m high which significantly reduced migration of EFSB adults. Kaur *et al*, (2004) in the bid to reduce the use of insecticide in the control of *L. orbonalis* Guenee transplanted 6 cultivars of eggplant under net house and field conditions. Fruit damage in the net house was nearly 50% lower than the fruit damage recorded under field condition.

Karmakar and Bhattacharya (2000) showed that a pest population can be maintained at well below the economic injury level using mechanical methods of control, this Gapud *et al*. (1998) affirmed. AVRDC in consultation with some other agricultural research agencies developed an Integrated Pest Management Program aimed at developing a safe and sustainable control strategy that would reduce farmer's dependence on toxic chemicals (Alam *et al.* 2003). They concluded that the successful adoption of an IPM program will increase profits, protect the environment, and improve public health (Alam *et al*. 2003; Rashid *et al*. 2003). Raju *et al.* (2007) in his report 'Scenario of infestation and management of EFSB' also concluded that the development of location specific pest management modules to combat ESFB through farmers' participatory research approaches could be appropriate in sustainable management of this pest.

This investigation is aimed at employing two different integrated measures that had been reported successful in the control of EFSB on *S.melongena*.. The first combines use of net barrier with clipping of infested shoots while the second integrates the use of net barrier, weekly clipping of infested shoots together with application of a commonly used insecticide, Karate® 5EC.

II. MATERIALS AND METHODS

2.1 Location and site attributes

The experiment was carried out at the research farm of the National Institute for Horticultural Research (NIHORT), Ibadan located on latitude 3° 5'E, 5° 3'N at 168m above sea level in the wet season of 2006 and 2007.

2.2 Land preparation, raising and transplanting of seedlings

Clean healthy seeds of *S. aethiopicum* -local variety Lv Makurdi, were sown in nursery of the Institute for a period of 5 weeks. Meanwhile, two plots of land 15.7 x 11.4 m were cleared and sub-divided into 12 sub-plots made into elevated beds (2.8 x 2.8 m) with 1.5 m spacing between them. At the end of 5 weeks the seedlings were transplanted on each of the sub-plots very early in the morning and spaced 0.7 x 0.7 m within and between rows, giving a total of 25 stands per sub-plot. The plots were maintained following normal agronomic practices.

2.3 Experimental design and treatments

2.3.1 Effect of integrating weekly clipping of infested shoots and a net barrier on fruit infestation of *S. aethiopicum* by *L. orbonalis*.

This experiment involves the erection of nylon net barrier as in Alam *et al*. (2003) and the clipping of infested shoots 1cm below the wilting point. In the first experiment the seedlings were administered 4 different treatments replicated thrice and arranged in 4 X 4 Randomized Complete Block Design (RCBD). The treatments are: i) erection of 2 m high nylon net (mesh 16), ii) weekly clipping of infested shoots (sanitation), iii) erection of 2 m high nylon net (mesh 16) combined with weekly clipping of infested shoots, and iv) untreated control. Mature fruits were harvested weekly from 15 randomly selected stands and bulked in separately labeled polythene bags. Sampling was for a period of 12 weeks. All the harvested fruits were cut open and properly examined for EFSB larva. The number of infested and un-infested fruits were counted, recorded and expressed as percentage of total fruits collected per week per sub-plot.

2.3.2 Effects of integrating weekly cutting of infested shoots, nylon net barrier and insecticide (Karate® 5EC) on fruit infestation of *S. gilo* by *L. orbonalis*.

A trial experiment integrating different control measures with Lambda-cyhalothrin Karate® 5EC (one of the most commonly used insecticides among vegetable farmers) was carried out in 2007. The seedlings were administered 4 different treatments, with each treatment replicated thrice and arranged in a 4 X 4 Randomized Complete Block (RCBD). The individual treatments integration were: nylon net barrier erected 2m high round the sub-plot as in Alam *et al*. (2003), monthly application of 150 mls/ha of Karate® 5EC as recommended in Onekutu *et al*. (2010) and weekly clipping of infested shoot as in Gapud *et al*, (1998). The 4 treatments were combined and applied as follows; i) Nylon net + weekly cutting + Karate® 5EC(150 mls/ha) ii) Nylon net + Karate® 5EC (150 mls/ha) iii) Weekly cutting + Karate® 5EC (150 mls/ha) and iv) Karate® 5EC only (150 mls/ha). At the onset of fruiting mature fruits were harvested weekly from 15 randomly selected stands and bulked in separate labeled polythene bags. Sampling was for a period of 12 weeks. All the harvested fruits were cut open and properly examined for infestation by the EFSB. The number of infested and uninfested fruits were counted and expressed as percentage of total fruits collected per week per sub-plot.

Statistical analysis

Data collected were arcsin transformed, subjected to Analysis of variance (Anova) and means separated using Duncan's new multiple range test (DNMRT).

III. RESULTS

Effects of integrating periodic clipping of Infested Shoots of *S .aethiopicum* and net nylon barrier on *S. gilo* infestation by *L. orbonalis*.

The combined effect of periodic clipping of infested shoot and nylon net barrier on percentage infestation of *S.aethiopicum* fruits by *L.orbonalis* in 2006 and 2007 is presented in Table 1. The combination of nylon net barrier and weekly clipping of infested shoot significantly reduced mean percentage infestation in both years. In 2006, the lowest mean percentage infestation of 19.58% was recorded on plots treated with net barrier and clipping of infested shoots while the highest of 53.13% was recorded on plots subjected to prompt and weekly clipping of infested shoots only. The use of net barrier plus clipping of infested shoots (19.58%) and use of net barrier only (31.51%) were significantly lower than records obtained from the untreated plot (47.16%). Clipping of infested shoot only had no significant effect on mean percentage infestation when compared with the control. Mean percentage infestation of 53.13% recorded on plots treated with cutting of infested shoot only was not significantly different from the untreated plots. No significant difference was observed between plots with net barrier only and untreated plots.

The results in 2007 were similar to what was obtained in 2006. Net barrier plus clipping of infested shoots (26.02%) and use of the net barrier only (30.66%) significantly reduced mean percentage infestation when compared with untreated plots (33.89%). No significant difference was observed when plots treated with net barrier + clipping of infested shoots (26.02%) were compared with net barrier only treated plots (30.66%) and plots subjected to clipping of infested shoot only (32.52%). No significant difference was observed between plots treated with clipping of infested shoot only (32.52%) and untreated plots (33.89%)

Table 1 Effect of nylon net barrier and clipping of infested shoots of *S. aethiopicum* on percentage infestation of *L. orbonalis* in 2006 and 2007

Treatments	Percentage infestation (%)	
	2006	2007
Net only	31.51bc*	30.66bc
Net + clipping of infested shoots	19.58c	26.02c
Clipping of infested shoots only	53.13ab	32.52ab
Untreated control	47.16a	33.89a

Values are means of 3 replicates.*Means with the same letter in a column are not significantly different (P>0.05) using DNMRT

Effects of integrating nylon net barrier, weekly clipping of infested shoots and insecticide application (Karate® 5EC) on fruit infeststion of *S. aethiopicum* by *L. orbonalis*.

The effect of integrating nylon net barrier, weekly clipping of infested shoot and the application of Karate® 5EC at the rate of 150 mls/ha is presented in Table 2. The combined treatments significantly reduced mean percentage infestation of *S.gilo* fruits by *L.orbonalis.*

The lowest mean percentage infestation of 4.34% observed on plots treated with the combination of nylon net, weekly clipping of infested shoot and Karate® 5EC was significantly lower than mean percentage infestation recorded on plots treated with Karate® 5EC only (9.87%) and plots treated with weekly clipping of infested shoot + Karate® 5EC (8.58%). It was however not significantly different from plots with nylon net + Karate® 5EC (6.76%). No significant difference was observed when the mean percentage infestation on plots treated with Karate® 5EC only was compared with mean infestation from plots treated with Karate® 5EC + cutting of infested shoots. Combined effect of all three treatments significantly reduced infestation.

Table 2 Effect of integrating nylon net barrier, cutting of infested Shoot and application of karate 5EC on percentage infestation in 2007.

Treatments	Percentage infestation (%)
Nylon net barrier + Karate® 5EC	6.76a*
Nylon net barrier + clipping of infested shoot + Karate® 5EC	4.34a
Clipping of infested shoot + Karate® 5EC	8.58b
Karate® 5EC only	9.87b

Values are means of 3 replicates.*Means with the same letter in a column are not significantly different (P>0.05) using DNMRT

IV. Discussion

Combination of a physical barrier and sanitation (removal of infested plant parts) was utilized to minimize EFSB damage to garden egg crops. In this study the combination of nylon net as a physical barrier and weekly cutting of infested shoot significantly reduced mean percentage infestation in 2006 and 2007. This findings agrees with Alam *et al*. (2003), Arida *et al*. (2001), Rahman *et al*. (2006) and Kaur *et al*. (2003), that reported the positive effect of using net barriers combined with prompt destruction of pest-damaged shoots. Combining removal of infested plant parts with other measures as reported by Alam *et al*. (2003) can be adopted in to cut cost and reduce immigration of pest adults into the farm area. In a similar experiment Rahman *et al*. (2006) reported that combined sanitation of the environment and removal of infested plant part did not significantly reduce damage when compared with the removal of plant part alone. Combining insecticidal treatments with removal of plant part has been reported to be very effective having significantly reduced damage. Consequently that prompt clipping and removal of pest-damaged shoots can be combined with other community-wide measures in the bid to combat the EFSB.

When compared with all other treatments employed in the control of the eggfruit and shootborer, integration of different control measures remains one of the most effective ways of reducing damage done to the garden egg and related crops. In this study integrating use of Karate with prompt clipping of infested shoot with erection of 2m high net barrier significantly reduced infestation to as low as 4.34% when compared with 60% infestation recorded in Onekutu *et al*. (2010).The measure

reduced infestation by a significant margin. Rahman *et al*. (2006) reported a similar result when they combined prompt removal of infested fruits and shoots at weekly interval with application of Cymbush 10EC at 1 ml/litre of water and a routine spray of Cartap 50SP at 1.2g/litre of at weekly interval. The treatment significantly lowered shoot and fruit infestation by as much as 38.9% when compared with the control they pointed out. Higher percentage infestation was recorded on plots treated with Karate® 5EC only and it was significantly higher than records from other treatments, affirming the fact that continuous dependence on insecticides might not at all times produce the best results as far as pest control is concerned. Kabir *et al*. (1994) had reported that chemical insecticide was not solely effective against the EFSB. Khorsheduzzaman *et al*. (1998) achieved significant reduction in fruit infestation when chemical and non-chemical approaches were integrated for the management of ESFB. Kumar *et al*. (2000; 2001); Biradar *et al*. (2001); Rashid *et al*. (2003); Alam *et al*. (2003) and Rahman *et al*. (2006) all attest to the effectiveness of insecticides in the control of the eggfruit and shoot borer and many other pest, but consider the integrated approach a better option. It is obvious therefore that the use of insecticides in combination with other control measures always proves more effective than when used alone.

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