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COMPARATIVE EFFICACY OF SOME BOTANICAL INSECTICIDES IN THE CONTROL OF EGGPLANT FRUIT AND SHOOT BORER (Leucinodes orbonalis Guenee)

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ABSTRACT

An Experiment was conducted from December, 2021 to April, 2022 in an open field of the Teaching and Research Farm of Akwa Ibom State University, Obio Akpa Campused to evaluate the efficacy of botanical insecticides in the control of eggplant (Solanum melongena L.) fruit and shoot borer (EFSB) Leucinodes orbonalis Guenne), Four week-old eggplant seedlings (ARJANI FI) were transplanted to bags filled with 30kg top soil, each. There were nine insecticide treatments (T_0 = Control (No insecticide), T_1 = Scent leaf extract (SLE 10% w/v), T_2 = Pawpaw leaf extract (PLE 10% w/v), T_3 = Neem leaf extract (NLE 5% w/v), T_4 = Neem oil (N.O 3% v/v), T_5 = Neem oil (N.O 5% v/v), T_6 = Garlic bulb extract (GBE 3% v/v), T_7 = Emamectin Benzoate (EB 1.33g/L) and T_8 = Neemsol (0.2% v/v). Plants were sprayed three times: four weeks after transplanting (4WAT), 6WAT and 8WAT. The experiment was laid out in a completely randomized design. Data obtained were subjected to analysis of variance and means compared at 5% probability level using Student-Newman-Keuls Test. The results obtained showed that the insecticide treated plants significantly ($P< 0.05$) had lower percentage of fruit and shoot infestation by EFSB relative to the untreated plants. The unsprayed plant significantly ($P< 0.05$) had the highest percentage of Fruit infestation by both number and weight basis. Fruits from the untreated plants had significantly ($P< 0.05$) more number of bored holes and larvae than the insecticide treated plants. Among the insecticide treatments, EB and N.O 5% had plants with significantly lower shoot infestation (10.42 and 12.50%), fruit infestation by weight (17.07 and 25.60%), number of larvae/fruit (0.33 and 1.00), respectively. The botanicals tested in this work could be incorporated into integrated pest management programme of eggplant fruit and shoot borer. Therefore, Emamectin Benzoate was observed to be the best and hence recommended treatment based on parameters measured.

KEYWORDS: Efficacy, Botanical Insecticide, Eggplant, Shoot borer

INTRODUCTION

Eggplant is a vegetable crop belonging to Solanaceae, an important family in the division Magnoliophyta, the angiosperms of flowering plant division (Bremer et al., 2003). It is the most economically important solanaceuos crop. Eggplant is a good source of vegetable which can be eaten raw, cooked or fried with spices in stews (Fayemi, 1999). Statistics showed that the global production of eggplant is around 54 million tonnes annually, with China as the largest producing country, (34.1 million tonnes), followed by India (12.8 million tonnes), Egypt (1.4 million tonnes), Turkey (0.80 million tonnes) and Iran (0.70 million tonnes) (FAO, 2018).

The eggplant also possesses numerous health benefits which are essential for the overall development of the human body. The fiber, potassium, vitamin C, vitamin B-6, and antioxidant in eggplants greatly support heart health. According to Ware (2019) eating food containing certain flavonoids, including anthocyanins, helps reduce inflammatory markers that increase the risk of heart disease.Besides, eggplant helps in the reduction of blood pressure and stuttering of the arteries. The anthocyanins in eggplant prevent neuro-inflammation and facilitate blood flow to the brain. This can aid prevent or reduce memory loss and other aspects of age-related mental decline. Eggplant is an embodiment of antioxidants, which help in age health

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and prevent age-related macular degeneration, that usually result in vision loss in older people (FAO, 2018).

Eggplant cultivation in Nigeria is hampered by many challenges like poor soil, unavailability of good and viable planting materials, weed and insect pests' infestation and diseases. The attack by insect pests can result to extensive damage of the plant parts, thereby affecting their yield and marketability. The insect pests of eggplant include grasshoppers, locusts, crickets, larvae of Lepidoptera (Caterpillar), beetles (Coleoptera), which are associated with biting and chewing of plant materials. Other pests are bugs and thrips that relate to the sucking of the plant sap from the phloem system and from general tissues of foliage, roots and fruits. The damage caused by insect pests to eggplant is evidenced in plant tissues, reduction in leaf surface available for photosynthesis, distortion of growing shoot, diminution of plant growth and vigor, wilting of shoot, and branches as well as transmission fungal, bacteria or viral infections to the plant. The most significant insect pests of eggplant causing yield reduction are the white flies that transmit viral diseases, thrips, and the eggplant fruit and shoot borer (Owusa-Ansah et al. 2001).

The productivity of eggplant in Nigeria is very low and this has been linked to pests and diseases; the most important insect pest of eggplants is the eggplant fruit and shoot borer (EFSB) Leucinodes orbonalis. Infestation of fruit and shoot by insect pest has been reported to be in the range of 20 – 90%. Infested fruits are not wholesome and are unmarketable. The control of this pest through resistant varieties appears not feasible as natural sources of resistance are scarce. The use of synthetic insecticides seems to be a viable option for many farmers. The factors from chemical pesticide such as harm to the environment and human health, pest resurgence, insecticide resistance, high cost of insecticides and scarcity necessitate the need for alternative control options like botanical insecticide which can stand the taste of time according to its advocates (FAO, 2018).

Different parts of plants are used in protecting crops from the menace of pests. Prakash et al. (2008) were of the opinion that direct spray application of various extracts of biologically active plant products such as leaves, stems, roots and whole plants can be used especially for the control of soft bodied insect pests which feed on the leaves and tender plant parts. Thus, this research work was limited to insecticide treatments such as scent leaf extract, pawpaw leaf extract, neem leaf extract, neem oil, garlic bulb extract, emamectin benzoate and neemsol. Therefore, the objectives of this study were to evaluate the efficacy of some botanical insecticides in the control of L. orbonalis infecting eggplants in Akwa Ibom State University, Obio Akpa Campus.

MATERIALS AND METHODS

The Field experiment was conducted from December, 2021 to April 2022 at the Akwa Ibom State University Teaching and Research Farm, Obio Akpa Campus. Obio Akpa is located in the tropical rain forest belt of Nigeria and is subjected to marked wet and dry seasons with a bimodal rainfall pattern. The heaviest rainfall is in June for the first rainfall peak and September for the second maximum, which is interrupted by a short dry spell in August traditionally referred to as "August break" (Ekong and Uduak, 2015).

The area lies between Latitude $4^{0}30^{1}$ and $5^{0}30^{1}$ N Longitude $7^{0}30^{1}$ and $8^{0}30^{1}$ E. The rainfall is usually heavy, with a mean range of 2,500 mm to 3000 mm per annum. The dry season starts from November and lasts till February with the mean annual temperature of between 26^{0}C and 28^{0}C. The highest temperature is experienced between January and February. The period which coincides with overhead of the sun and high relative humidity of 75 – 90 % is common December (SLUS-AK, 1989).

Top soil (0-15cm) was obtained from the Teaching and Research Farm. The soil was heat-sterilized by heating in a half-drum of 18 inches to a temperature of 100^{o}C by naked fire. The soil was allowed to cool under shade for one week. Fifteen plastic baskets of 4 x 6 inches were filled with the heat sterilized soil after amendment with poultry manure at the ratio of 3:1 (soil: poultry manure) volume. Eggplant seeds were drilled on each plastic basket filled with the soil. The seedlings were raised in a sun-lit screenhouse of the Faculty of Agriculture. They were watered appropriately on daily basis.

The experiment was laid out as a completely randomized design with three replications. The treatments were the insecticides sprays denoted as T_0 = Control (unsprayed plots), T_1 = Scent leaf extract (10% w/v), T_2 = pawpaw leaf extract (10% w/v), T_3 = Neem leaf extract (5% w/v), T_4 = Neem oil (3% v/v), T_5 = Neem oil (5% v/v), T_6 = Garlic bulb extract (3% w/v); T_7 = Emamectin Benzoate (1.33 g/L) and T_8 = Neemsol (0.2% v/v). A treatment had 16 (sixteen) plant stands making a plot while a replicate had 144 (one hundred and forty four) plant/ stands (9 plots). The treatments were randomly assigned by the use of random numbers. The experiment was made up of nine treatments (To = unsprayed plots (control); T1 = Scent leaf extract (10% w/v), T2 = pawpaw leaf extract (10% w/v), T3 = Neem leaf extract (5% w/v), T4 = Neem oil (3% v/v), T5 = Neem oil (5% v/v), T6 = Garlic bulb extract (3% w/v); T7 = Emamectin Benzoate (1.33 g/L) and T8 = Neemsol (0.2% v/v), arranged in completely randomized Design with three replications. Each treatment plot consisted of 16 plant stands; therefore, 9 treatments gave 144 plant stands, while 144 plant stands multiply by 3 replicates equals 432 plant stands.

Symptoms of eggplant shoot and fruit borer infestation were observed on the plants four weeks after transplanting. The terminal shoots had holes and withered and some leaves wilted. The larvae (caterpillars were found inside the holes. The insecticides were extracted using solvent method. Neem seed oil can also be obtained by solvent extraction of the neem seed, fruit, oil, cake or kernel. This solvent-extracted neem oil is of a lower quality as compared to the standard cold pressed neem oil and is mostly used for soap manufacturing. Neem cake is a by-product obtained in the solvent extraction process for neem oil and sprayed with the help of a Buerkle™ Pressureless LDPE spray bottle with capacity (metric) 250mL-500mL height (metric) 220mm-240mm, and Nozzle diameter 0.6mm that Spray 1.2m+ 0.1 volume per stroke. The control plots were covered with sheets of polythene (water proof) material at each spray time. Spraying was done based on the treatment label. Two more sprays were done at 6 and 8 weeks after transplanting (WAT).

All the data collected were subjected to analysis of variance (ANOVA) using GenStat 8th Edition Software and means were compared with Student-Newman-Keuls test (SNKT) at 5% probability level. Data expressed as percentages whose ranges were more than Forty (40) percent, were arc sin (Sin-1$\sqrt{x}$) transformed to conform to the assumptions of ANOVA (Little and Hills, 1972).

RESULTS AND DISCUSSION

Results

Effects of different botanical insecticides and synthetic insecticide (Emamectin Benzoate) on shoot infestation of eggplant by L. orbonalis

The results of the effects of different botanical insecticides and synthetic insecticide (Emamectin Benzoate) on shoot infestation of eggplant by L. orbonalis are presented in Table 1. At symptom expression in which no insecticide spray was made, there were no significant (P> 0.05) differences among the treatments. However, the shoot infestation by EFSB ranged from 18.75 to 41.50%. At 6 WAT, percentage shoot infestation of eggplant by EFSB was significantly (P< 0.05) lower in insecticide treated plots relative to the untreated (control) plots T_0. However, the percentage shoot infestation by EFSB was statistically similar (P> 0.05) among the insecticide treated plants although the least infestation was observed in (T_7) Emamectin Benzoate (EB) treated plants. At 8 WAT insecticide application significantly (P≤ 0.01) reduced percentage shoot infestation by EFSB compared with unsprayed (control) plot T_0. Plants treated with EB (T_7) and Neem oil (T_5) at 5% significantly (P< 0.05) had the lowest percentage shoot infestation. Generally, there was an increase in percentage shoot infestation by EFSB in the control plots and those sprayed with. Neemleaf extract NLE (T_3) 5% with increase in sampling period from 4 WAT to 8 WAT. However, the reverse was the case for EB (T_7), Garlic bulb Extract GBE (T_6), and N.O 5% (T_5) treated plots.

Effects of EFSB percentage infestation of fruits by number and weight as influenced by different botanical insecticides treatment

Table 1: Effects of botanical insecticides on shoot infestation (Incident) of eggplant by Leucinodesorbonalis at different sampling periods

Treatments	Percentage Shoot Infestation (Incident)		
	4WAT**	6WAT	8WAT
Control (T_0)	21.00[a]	41.50[a]	60.33 (51.13)*[a]
Scent leaf extracts (10% w/v) (T_1)	25.50[a]	23.25[b]	23.25 (29.07)[b]
Pawpaw leaf extract (10% w/v) (T_2)	23.25[a]	18.75[b]	21.00 (27.43)[b]
Neem leaf extract (5% w/v) (T_3)	18.75[a]	23.25[b]	25.50 (30.70)[b]
Neem oil (3% v/v) (T_4)	21.17[a]	18.92[b]	18.75 (25.80)[b]
Neem oil (5% v/v) (T_5)	21.17[a]	18.75[b]	12.50 (21.10)[c]
Garlic bulb extract (3% w/v) (T_6)	18.92[a]	23.25[b]	18.75 (25.80)[b]
Emamectin Benzoate (1.33g/L) (T_7)	23.25[a]	14.58[b]	10.42 (18.80)[c]
Neemsol (0.2% v/v) T_8	21.00[a]	18.92[b]	18.75 (25.80)[b]

*Values in parentheses are arc sin (Sin-1$\sqrt{x}$) transformed data

**WAT: Weeks after transplanting

Means within of column followed by the same letters are not significantly different at 5% level of probability according to student-Newman-Keuls test.

The results of the effects of EFSB percentage infestation of fruits by number and weight as influenced by different botanical insecticides treatment are presented in Table 2. The unsprayed plant had significantly (P< 0.05) the highest percentage of Fruit infestation by both number and weight basis. On fruit number basis, EB treated plants (T_7) had the least infestation (incident) although did not differ significantly (P< 0.05) from GBE scent leaf extract (T_6), SLE (T_1) and N.O 5% (T_5) treated plants. On the other hand, EB (T_7) treated plants significantly (P< 0.05) had the lowest percentage fruit infestation on weight basis relative to other insecticide treatments. NLE (T_5) and Neemsol (T_8) had significantly higher proportion of fruits infested on weight basis compared with the other botanical insecticides.

Effects of botanical insecticides on the number of bored holes and larvae per fruit of eggplant infested by Leucinodes orbonalis at 6 WAT

Table 2: Effects of botanical insecticides on eggplant fruit infestation (Incident) of eggplant by Leucinodesorbonalis

Treatments	Percentage fruit infestation (incident)	
	By number (%)	By weight (%)
Control (T_0)	53.30 (46.93)^{a}	56.40 (48.63)*^{a}
Scent leaf extracts (10% w/v) (T_1)	23.33 (28.80)^{bcd}	23.10 (28.67)^{c}
Pawpaw leaf extract (10% w/v) (T_2)	26.67 (31.00)^{bc}	21.03 (27.30)^{c}
Neem leaf extract (5% w/v) (T_3)	36.67 (37.20)^{b}	31.27 (34.23)^{b}
Neem oil (3% v/v) (T_4)	26.67 (31.00)^{bc}	22.73 (28.37)^{c}
Neem oil (5% v/v) (T_5)	23.33 (28.80)^{bcd}	18.65 (25.60)^{c}
Garlic bulb extract (3% w/v) (T_6)	20.00 (26.60)^{cd}	21.75 (27.97)^{c}
Emamectin Benzoate (1.33g/L) (T_7)	13.33 (21.13)^{d}	8.43 (17.07)^{d}
Neemsol (0.2% v/v T_8	26.67(31.00)^{bc}	28.63 (32.50)^{b}

*Values in parentheses are arc sin (Sin-$\underline{1}\sqrt{x}$) transformed data
Means within a column followed by the same letters are not significantly different at 5% level of probability according to student-Newman-Kuels test.

The results of effects of botanical insecticides on the number of bored holes and larvae per fruit of eggplant infested by Leucinodes orbonalis at 6 WAT presented in Table 3. The number of holes bored per fruit by the larvae of L. orbonalis was significantly (P< 0.05) higher in the (T_1) unsprayed plots relative to the insecticide treated plots (Table 3). Plants treated (T_7) EB had fruits with significantly the least number of holes followed by those treated with (T_6) GBE and (T_8) Neemsol. Among the insecticide treated plants, (T_3) NLE and 3% N.O had fruits with the highest number of holes. Similarly, significantly (P< 0.05) more larvae were found in fruits from the unsprayed (control) plots compared with the insecticide treated plots. Among the insecticide treated plots, EB treated plants significantly had fruits with least number of larvae followed by GBE and Neemsol treated plants.

Table 3: Effects of botanical insecticides on the number of bored holes and larvae per fruit of eggplant infested by Leucinodes orbonalis at 6WAT

Treatment	Number of holes/fruit	Number of larvae/fruit
Control (T_0)	3.43^{a}	3.33^{a}
Scent leaf extracts (10% w/v) (T_1)	2.27^{cd}	1.67^{b}
Pawpaw leaf extract (10% w/v) (T_2)	1.93^{de}	1.67^{b}
Neem leaf extract (5% w/v) (T_3)	2.60^{bc}	2.00^{b}
Neem oil (3% v/v) (T_4)	2.80^{b}	2.00^{b}
Neem oil (5% v/v) (T_5)	1.80^{e}	1.33^{b}
Garlic bulb extract (3% v/v) (T_6)	1.43^{f}	1.00^{bc}
Emamectin Benzoate (1.33g/L) (T_7)	0.80^{g}	0.33^{c}
Neemsol (0.2% v/v) T_8	1.37^{f}	1.00^{bc}

*Values in parentheses are arc sin (Sin-$\underline{1}\sqrt{x}$) transformed data
Means within a column followed by the same letters are not significantly different at 5% probability level according to Student-Newman-Keuls test.

DISCUSSION

The result obtained from this study showed that shoot infestation of the eggplant hybrid "ARJANI FI" by eggplant shoot and fruit borer, L. orbonalis started at four weeks after transplanting (4WAT). The percentage infestation was statistically similar among the treatments as no insecticide was sprayed then. However, as treatment continued after symptom expression, the unsprayed plots had a steady increase in percentage of infestation up to 60% at 8 WAT while there was a gradual decrease in plots treated with EmamectinBenzote (EB), Neam oil (3% and 5%) and Neemsol. This finding is in agreement with the findings of Ukeh et al. (2007) who Observed that crude neem oil at 5% and Neem seed kernel extract at 5% were very effective in reducing the infestation of stem borers (Busselo fusca and Sesamia calamistis) on maize in Calabar. This finding is also supported by the findings of Mochiah et al. (2011) who maintained that the eggplant hybrid (ARJANI FI) is susceptible to EFSB and the decrease in percentage shoot infestation by the synthetic insecticide (EB) and other botanical indicates their potency in controlling this insect pest.

Insecticide treatments significantly reduced percentage fruit infestation in terms of number and weight relative to the control. Fruit infestation by number and weight were 53.30 and 56.40%, respectively in the control plots. Moreover, the authors revealed that fruit infestation ranged from 31% to 90% and a single larva is reported to damage 4-6 healthy fruits. This finding agrees with the opinions of Alam et al. (2006) that fruit infestation is affected by many factors including location, season, environment, crop cultivar, plant age and pest management method adopted. Again, this observation is also in consonance with the findings of Chakraborti and Sarkar (2011) who reported that Emamectin Benzoate spray and Neem oil (5 %) reduced fruit infestation to 8.43 % and 18.65 % respectively. These results attest that Emamectin Benzoate and some botanicals are effective in reducing fruit damage of eggplant by L. orbonalis. The number of larvae/fruit, number of holes/fruit, number of leaves and flowers damaged per plants were significantly reduced with insecticide treatment relative to the control (unsprayed) plots. This observation is line with the findings of Mochiah et al. (2011) who reported the efficacy of tested insecticides in the control of EFSB on eggplant was in the order: Emamectin Benzoate> Neem oil (5 %) > garlic bulb extract in other regions.

CONCLUSION AND RECOMMENDATIONS

It could be concluded from the results of work that botanical insecticides differed significantly in their efficacy in controlling (L. orbonalis) infestation of eggplant. Among the botanicals, Neem oil (5% v/v), Garlic bulb extracts (3% w/v) and Scent leaf extract (10% w/v) were the most effective.

It is therefore recommended that:

- Neem oil (5% v/v), Garlic bulb extract (3% w/v) and Scent leaf extract (10% w/v) can be used by farmers to control eggplant fruit and shoot borer (L. orbonalis) for increase yield.
- There is still room for further research or subsequent work be carried out to evaluate the efficacy of all the botanicals tested in this work at higher concentrations and frequency of application in combinations with other methods of control like cultural, physical and mechanical.

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