Journal of Community & Communication Research
ISSN: 2635-3318
Volume 5, Number 1 (Special Edition), March 2020
Pp. 25-30

Evaluation of Neem Leaf Extract As A Substitute For Chemical Insecticides In The Control of Fall Armyworm (*Spodoptera frugiperda*) And Yield of Maize In Umudike Abia State, Nigeria

Accessible at: https://jccr.sccdr.org.ng

Anyim, A.
Department of Crop Production and Protection, Abia State University, Uturu (Umuahia Campus), Nigeria
Corresponding Author's Email: alozieanyim@gmail.com
Umeh, O.J.
Department of Agricultural Extension and Rural Development, Michael Okpara University of Agriculture, Umudike
Ufondu, C.C.
Department of Crop Production and Protection, Abia State University, Uturu (Umuahia Campus), Nigeria

Review Process: Received: 05/09/19 Reviewed: 05/10/19 Accepted: 16/02/20

ABSTRACT
Field experiments were conducted to compare the effectiveness of a botanical insecticide (Neem aqueous leaf extract) and chemical insecticides (cypermethrin, dimethoate and chlorpyrifos) in the control of fall armyworm (Spodoptera frugiperda) and yield of maize. The aim of the study was to assess the effect of the botanical insecticide (Neem leaf aqueous extract) (NLAE) and the chemical insecticides (cypermethrin, dimethoate and chlorpyrifos) on the population of S. frugiperda larvae, ascertain level of maize leaf damage as well as yield of maize in relation to different insecticidal treatments. The maize variety used in the experiment was OBA SUPER 2 (yellow seeded). The experiment was laid out in a Randomized Complete Block Design with four replications. Seeds were sown on ridges spaced 1m apart and 50cm between stands at 2 seeds per stand and later thinned down to one healthy plant 10 days after planting (DAP) in 5m² plots. Application of insecticide started at 21 days after sowing (DAS) and continued at fortnightly interval. Data were collected on the number of larvae of S. frugiperda, damaged and undamaged plants and grain yield of maize. All data were subjected to analysis of variance (ANOVA) and separation of mean done using Duncan's New Multiple Range Test (DNMRT). During both years, it was found that the insecticides (botanical and chemical) significantly (P<0.05) reduced the larvae populations when compared with the control, with neem aqueous leaf extract (NLAE) being the most effective. The study found that the insecticides significantly increased the yield of the crop when compared with the control. Seed yield reductions of 38.0 % and 23.0 % were recorded in the control when compared with neem leaf extract treated plots in 2017 and 2018 trials, respectively. This suggests that neem leaf extract could be used as a substitute in the control of fall armyworm for increased yield of maize in Umudike, Abia state, Nigeria.

INTRODUCTION

Maize (*Zea mays* L.) is an important annual cereal crop in Nigeria and other tropical and sub-tropical regions of the world (Udo *et al*., 2005). It belongs to the grass family poaceae. The crop is widely cultivated throughout the world and a greater proportion is produced each year than any other grain (Osipitan *et al*., 2012). In Nigeria, two main varieties are cultivated, white and yellow (Sam-worley, 2016). Nigeria is the largest producer of maize in Africa followed by South Africa (IITA, 2012; Umar *et al* 2013). The crop is an important source of carbohydrate, Vitamin C and cornstarch (maize flour), a major ingredient in home cooking and in many industrialized food products. It is also a major source of cooking oil (cornoil) and maize gluten (Consultative Group on International Agricultural Research, (1996) and Sam-worley 2016). Besides, it forms about 50-70% of the livestock feed (Thornton, 2011).

However production is currently being threatened by fall armyworm *Spodoptera frugiperda* (Lepidoptera : Noctuidae) (Roberts and All, 1993; Ibenegbu, 2018; Odeyemi, 2018). The insect is a common pest in many African countries throughout sub-sahara Africa and elsewhere. Damage is caused by larvae, which feed on leaves of young plants. Young larvae initially consume leaf tissues from one side, leaving the opposite epidermal layer intact. Later, larvae burrow into the growing point (bud, whorl among others) destroying the growth potential of maize plants or clipping the leaves. Feeding injury on leaves ranges from small shot holes to large ragged and elongated holes. Deep feeding in whorl may destroy developing tassel. Consequently the defoliation reduces photosynthetic area, which may stunt plants and reduce yield. In severe attack, especially if the growing point is damaged, yield can be reduced significantly (Marenco *et al*., 1992; Ibenegbu 2018, Odeyemi, 2018). The approximate loss of farmers from the attack can be as high as $6.2 billion per year (Ibenegbu, 2018).

Currently, to cope with the spectrum of fall armyworm attacking maize, farmers in the area are using chemical insecticides. However, its use is constrained by high cost and ecological hazards. Information on environment friendly method of insect pest control in crop has grown in recent times (Ibenegbu, 2018). On the other hand, neem leaf extract is still used in various parts of the world for pests in different crops (Anyim, 1990; Sahi *et al.*, 2010; Mondédji *et al*., 2015). It has many desirable properties. It is less toxic, biodegradable, target specific and maintenance of ecological balance (Rahaman and Motoyama, 2000; Venkatashwarlu, 2008; Bhushan *et al*., 2011). Therefore, the aim of the study was to assess the effectiveness of neem leaf extract and cypermethrin, dimethoate and chlorpyrifos in the control of fall armyworm and yield of maize with the view to finding a good substitute for chemical insecticides which produces adverse side effects.

MATERIALS AND METHODS

Field experiments were conducted in 2017 and 2018 at the Research and Teaching Farm of the Faculty of Agriculture, Abia State University, Umudike-Umuahia Campus to evaluate the effectiveness of a botanical insecticide (Neem leaf extract) and chemical insecticides (cypermethrin, dimethoate and chloropyrifos) in the control of fall armyworm (*Spodoptera frugiperda*) of maize. The study area is located (latitude 05˚29'N; longitude 07˚ 33'E and Altitude of 122m above sea level (ASL)) in the rain forest belt of Nigeria.

A land size of 320m² was ploughed and harrowed. The experiment was laid out in a Randomized Complete DesignRCBD with four replicates. Each treatment was applied onto a 5m² plot separated by 2m walking alley. Certified maize with 97% germination was used. Two seeds were sown by dibbing per hole spaced at1m apart and 50cm between stands. A maize variety, OBA SUPER 2 (yellow seeded) was used. Thinning was done 10 days after planting (DAP) for each treatment to one plant per stand. The farm was manually weeded 20 DAP and the second weeding was done on 59 DAP. Compound fertilizer NPK 15:15:15 was applied by band of maize plant 4 weeks after planting (WAP) at the rate of 75kg/ha. 10g pounded paste of Neem leaves was weighed into 250ml conical flask; unto which, 100ml clean water was added and then manually stirred for 20minutes. The supernatant was left for 24hours, and thereafter filtered through a 1.0mm sieve into a plastic bottle (Fuglie; 1998, Sithamtham *et al*., 2003; Babarinde *et al*., 2008; Degri and Mailafiya, 2013 and lawan

et al., 2016). The treatment application started 21 days after sowing (DAS) using knapsack sprayer at the rate of 0.8L/plot. Similarly, cypermethrin, dimethoate and chlorpyrifos were applied at the recommended rates of 0.02kg, 0.02kg and 0.02kg ai/ha, respectively (Anyim, 2003). Subsequently, applications of the treatments were carried out at fortnightly intervals in the same manner. Control plots were sprayed with ordinary water.

The number of *S. frugiperda* was visually counted together once per week per plot using a Tally counter (A quick counting device). Maize cobs were harvested 90 (DAP) and the weight of the cobs per plot was determined by harvesting all the plants in each plot and weighing them fresh in kg using electronic balance. The cobs were later sundried by spreading them out on benches in screen-house for 2-3weeks. Maize grains were weighed after extraction from the cobs in kilograms and recorded at about 14% moisture content. which was determined using a moisture meter. The yields were expressed in tons/ha. Damaged and undamaged leaves in each plot were visually counted. A plant with 25% and more of its leaves damaged was considered a damaged plant otherwise it was undamaged (Ademir *et al.,* 2006). The number of plant leaf damaged and undamaged were expressed in percentage. The counts were subjected to analysis of variance and Fisher's Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

The effect of the botanical insecticide (Neem leaf aqueous extract) (NLAE) and the chemical insecticides (cypermethrin, dimethoate and chlorpyrifos) on the population of *S. frugiperda* larvae per $5m^2$ is shown in Table 1.

Table 1. Effect of botanical and chemical insecticides on population of *S. frugiperda* larvae/$5m^2$

Insecticide	Larvae/$5m^2$ 2017	Larvae/$5m^2$ 2018
NLAE	3.10b	4.05b
Cypermethrin	3.40b	4.35b
Chlorpyrifos	3.80b	4.70b
Dimethoate	3.65b	4.30b
Control	7.25a	8.13a

Means followed by the same letter within a column are not significantly different at P=0.05, using DNMRT

The results indicate that treated plots have significantly lower larvae infestation of *S. frugiperda* at 5% significant level compared to the control. The numbers of *S. frugiperda* were lower in NLEA treated plots, followed by cypermethrin, dimethoate and chlorpyrifos plots, in that order. However, population of *S.frugiperda* larvae was more in 2018 than 2017. The fewer *S. frugiperda* larvae per maize plant in the plot treated with NLAE and chemical insecticides showed that the insecticides were effective in reducing the number of *S. frugiperda*. Similarly, Neem extract was found to be effective against major post-flowering insect of cowpea (Degri *et al*.,2012) melon leaf beetles (Anyim, 1990) and Diamond moth (Mondédji *et al*.,2015). In the same vein, the present study corroborate those made by karel and Mughogho (1985), Ogunwolu (1992), Anyim (2003) and Mgbeahuru (2017), who found insecticides to have reductive effects on different pest species.

The mean percentage leaf damage in relation to different insecticidal treatments is shown in Table 2.

Table 2. Mean percentage leaf damage per plant in relation to different insecticidal treatments

Insecticide	% leaf damage/plant (2017)	%leaf damage/plant (2018)
NLAE	10.30b	10.45b
Cypermethrin	10.57b	10.68b
Chlorpyrifos	11.45b	11.48b
Dimethoate	10.75b	10.86b
Control	30.15a	32.60a

Means followed by the same letter within a column are not significantly different at P=0.05, using DNMRT.

The result indicates that untreated plots had more leaf damaged than the treated plots. However, the leaf damage was higher in 2018 than in 2017 at 5% level of significance. The lower leaf damage recorded in the insecticidal treated plots showed that insecticidal sprays had significant effect on the leaves damaged per plant. This could be attributed to lower number of *S. frugiperda* found on the plants treated with the various insecticides. In 2017, grain yield was highest in the plot treated with NLEA (2.5tons/ha), followed by those treated with cypermethrin (2.3tons/ha), dimethoate (2.2tons/ha) and chlorpyrifos (2.0tons/ha) (Table 3).

Table 3. Mean grain yield of maize in different insecticidal treatment in 2017 and 2018

Insecticide	Grain yield of maize 2016 (tons/ha) 2017	Grain yield of maize 2017(tons/ha) 2018
NLAE	2.5a	2.3a
Cypermethrin	2.3a	2.0a
Chlorpyrifos	2.0a	1.6a
Dimethoate	2.2a	1.8a
Control	0.95b	0.9b

Means followed by the same latter within a column are not significantly different at P=0.05, using DNMRT.

It was lowest at 5% significant level in the control plots (0.95tons/ha). When grain yield obtained from plots treated with NLAE was compared with that of untreated plots, there was a grain yield reduction of 38.0% in the untreated plots. In 2018, the result followed a similar trend. Grain yield was highest in the plot treated with NLEA (2.3tons/ha), followed by those treated with cypermethrin (2.0tons/ha), dimethoate (1.8tons/ha) and chlorpyrifos (1.7tons/ha) (Table 3). It was also lowest in the control plots (0.53tons/ha). When grain yields obtained from treated plots were compared, there was a grain yield reduction of 23.0% in the untreated plots. However, there were no significant differences at 5% significant level in grain yield in the plots treated with NLAE and cypermethrin, dimethoate and chlorpyrifos. The higher grain yield in the plots treated with insecticide showed that insecticides were effective in controlling *S. frugiperda*. This agrees with the findings of Ogunwolu (1992), Adamu and Dike (1995), and Anyim (2003) and Mbah and Anyim (2009) which showed that insecticidal application significantly increased yields of different crops.

CONCLUSION

There was no difference among the botanical insecticide and the chemical insecticides evaluated in terms of their response to damage caused by the larvae. Both the Neem leaf aqueous extract and the chemical insecticides (cypermethrin, dimethoate and chlorpyrifos) were effective against the larvae of *S. frugiperda*, with neem leaf aqueous extract being the most effective. Therefore, Neem leaf aqueous extract could be used to control *S. frugiperda* of maize as a substitute to synthetic insecticides with good grain yield.

REFERENCES

Adamu, R. and Dike, M.C. (1995). Major field pests of soybean and their control at Samaru, Zaria. Paper presented at the 24th Annual conference of the Nigerian Society for Plant Protection, held at National Root Crops Research Institute, Umudike, Umuahia, 28-31, may 1995.

Ademir, D.N, Ricardo, F.O and Jose, R.P.P. (2006). A new concept for insect damage evaluation based on plant physiological variables. *Annals of the Brazilian Academy of Sciences*. 78(4): 821-835

Anyim, A. (1990). Population development, damage and control of melon leaf beetles (Coleptera: Chrysomelidae) on melon (*Colocynthis citrullus*). PGD Thesis. Department of Parasitology and Entomology, Anambra State University of Technology, Awka Campus.

Anyim, A. (2003). Effect of insecticidal treatment on the yield and control of major insect pest of soybean (*Glycine max* (L.) merrili) in south-eastern Nigeria. *Int. J. Agric. Rural Dev*., 2003, 4: 100-109.

Babarinde S.A., Adebayo, M.A and Odeyemi, K. (2008). Insecticidal properties of some plants as crop protectants against pests. *African Journal of Biotechnology*: 7, 1187-1191.

Bhushan S., Singh, R.P. and Shanker, R (2011). Bioefficacy of Neem on pod borer, *Helicoverpa armigera*, *J. Biopest*. (1): 87-89.

Consultative Group on International Agricultural Research (CGIAR) (1996). Consultative Group on *Int. Agric. Res. News*. 3 (1): 2-3

Degri, M.M, Maima, Y.T. and Richard, B.I. (2012). Effect of plant extract on post flowering insect pests and grain yield of cowpea (*Vigna unguiculata* (L.) walp) in Maiduguiri, semi-arid zone of Nigeria. *Journal of Biology, Agriculture and Healthcare:* 2 (3), 46-52.

Degri, M.M. and Mailafiya, M.D. (2013). Potentials of *Mitracarpus villosus* (L.) and *Balanites aegyptiaca* (Del.). Plant Extracts and cypermethrin in the management of Tomato Fruitworm (*Helicoverpa armigera* Hubner) damage in Maiduguri, Nigeria. *International Journal of Agricultural Research, Sustainability and Food sufficiency*. 1 (1): 1-6.

Fuglie, F.J. (1998). Producing food without pesticides: local solutions to crop pest control in West Africa. CTA. The Netherlands.

Ibenegbu, G. (2018). What is fall Armyworm and how should you treat it? https://www.google.com.

International Institute of Tropical Agriculture IITA (2012). Growing in Nigeria. Commercial Crop Production Guide Series. Information and communication support for Agricultural growth in Nigeria. USAID pp1-8.

Karel, A.K. and Mughogho, R.M.K (1985). The effect of insecticide application and plant populations on the insect pests and yield of common bean (*Phaseolus vulgaris* L.). *Journal of Economic Entomology*, 78: 917-921.

Lawan, M., Muhammad, I.M. and Maina, U.M. (2016). Effect of Chilli Pepper Extract in the control of Diamond Moth (*Plutella xylostella* L.) caterpillar infestation in *Amaranthus* in Maiduguri, Borno State. *Journal of Agriculture and Environment*. 12 (1); 75-80.

Marenco, R.J., Foster, R.E and Sanchez, C.A. (1992). Sweet corn response to fall armyworm (Lepidoptera: Noctuidae) damage during vegetative growth. *Journal of Economic Entomology,* 85: 1285-1292.

Mbah, O.I. and Anyim, A. (2009). Effect of Pyrethroids on the population of *Podagrica uniformis* (Coleoptera: Chrysomelidae) on Okra in south Eastern Nigeria. *International Journal of Agricultural and Rural Development*, (2): 18-20.

Mgbeahuru, G.I. (2017). Population dynamics, damage and chemical control of maize stalk borer (*Busseola fusca*) and yield of maize. BSc Thesis. Department of Crop Production and Protection, Abia State University Uturu, Umuahia campus. Pp.36

Monde'dji, A.D.; Nyamador, W.S.; Anievoni, K.; Ketoh, G.K.; Giordanengo, P. and Glitho, I.A. (2015). Treatment and post treatment effects of neem leaves extracts on *Plutella xylostella* (Lepidoptera: Plutellidae). *African Journal of Agricultural Research,* 10 (6): 472-476.

Odeyemi, O. (2018). Fall armyworm (*Spodoptera frugiperda* J.E. Smith) (Lepidoptera: Noctuidae). The Journey so far in Nigeria. Saturday, 22 sept, 2018-14:33. https://fscluster.org>nigeria>document.

Ogunwolu, E.O. (1992). Field infestation and damage to soybean and cowpea by pod sucking buds in Benue State, Nigeria. *Insect Science Application*, 13(6): 8901-8905.

Osipitan, A.A., Odedina, J.N.,Adigbo, S.O., Fabunmi, T.O. and Afolabi, C.C. (2002). Assessment of insect pest infestation in maize-cassava intercropping system. *Niger J. Pit. Prot.* 26(1) 190-202 (2012).

Rahaman, G. M. and Motayama, N. (2000). Repellent effect of garlic against stored product pest. *Journal of pesticide science.* 25(3): pp 247-252.

Roberts, P.M. and All, J.N.(1993). Hazard for the fall armyworm (Lepidoptera: Noctuidae) Infestation on maize in double-cropping systems using sustainable agricultural practices. *Florida Entomology*, 76: 276-283.

Sahi, A.A., Ellaithy, M.E. and Mohamed, A.E. (2010). Insecticidal activities of neem (*Azadirachta indica* A. Juss). Seeds under laboratory and field conditions as affected by different storage durations. *Agriculture and Biology Journal of North America*, 1 (5): 1001-1008.

Sam-Worley, E. (2016). The difference between white and yellow corn. Article 2, P 1-5.

Sithanntham, S.C.M., Matok, K.A., Nyarko, K.V.S., Reddy, G. and Sileshi, O.F. (2003). Occurrence of insect pests and associated yield loss on some African indigenous vegetable crops in Kenya. *African Crop Science Journal*, 10 (4); 281-310.

Thornton, P. K., Jones< P. C. and Eriken, P. J. (2011). Agriculture and food systems in sub-sahara Africa in a fourth degrees C. world Phil. Trans Royal Society, 139. Pp 117-136.

Udo, D. J., Ndem, B. A., Asuquo, P. E. and Ndaeyo, N. U. (2005). Crop Production Techniques for the Tropics. Concept Publications Limited, Lagos, Nigeria. Pp 130-135.

Umar, U.A., Muhammad, M.B and Aliyu, A.S. (2013). Maize production and yield improvement in Nigeria (1994-2013). www.iita>org>crop>maize.

Venkatashouarlu, B. (2008). Role of bio-fertilizers in rainfed agriculture: Central Institute for dry land agriculture. *Hyderabad*. Pp 85-95.