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Full Length Research Paper

Comparative studies on the efficacy of neem, basil leaf extracts and synthetic insecticide, lambda-cyhalothrin, against *Podagrica spp*. on okra

Ahmed Oladimeji* and Musa Abdulrasak Kannike

[1]Department of Crop Protection, Faculty of Agriculture University of Ilorin, P. M. B 1515 Ilorin, Nigeria.

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The efficacy of neem (*Azadirachta indica* A. Juss), basil (*Ocimum basilicum* L.) leaf extracts and lambda-cyhalothrin were compared at three levels of concentration against flea beetle, *Podagrica spp*. (Jac.) in okra. The leaf extracts were applied at 5, 10 and 20 ml per litre while lambda-cyhalothrin was applied at 2.5, 3.75 and 5.0 ml per litre. Distilled water only served as control. In this study, treatment of okra plant with the synthetic insecticide and the leaf extracts against *Podagrica spp.* using hand spray significantly suppressed ($P < 0.05$) insect population, reduced leaf damage and enhanced dry pod yield. The treated okra plants performed significantly better ($P < 0.05$) than the control. Percentage reduction in leaf damage ranged between 21 - 43% in *O. basilicum,* 50 - 54% in *Azadirachta indica* and 72 - 81% in lambda-cyhalothrin compared with the control. There was significant linear negative relationship between dry pod yield and surface area of leaf damaged by the insect ($0.001 < P > 0.01$).

Key words: Botanical insecticide, *Azadirachta indica, Ocimum basilicum,* synthetic insecticide, *Abelmoschus esculentus*, flea beetle.

INTRODUCTION

Okra, *Abelmoschus esculentus* (L.) Moench, is one of the most important vegetable crops cultivated everywhere in Nigeria. It originates probably from East Africa and today is widely distributed in the tropics, subtropics and warmer parts of the temperate region (ECHO, 2003). Worldwide production of okra as fruit vegetable is estimated at 6 million tonnes per year. In West Africa, it is estimated at 500 000 to 600 000 tonnes per year (Burkil, 1997).

The crop has its own economic importance on account of its taste, flavour and nutritional values as human food. The fruits are harvested when immature and eaten as a vegetable. A traditional food plant in Africa, this vegetable has potential to improve nutrition, boost food security, foster rural development and support sustainable land care (NRC, 2006). In Nigeria, okra is usually boiled in water resulting in slimy soups and sauces, which are relished. The fruits also serve as soup thickeners (Schippers, 2000) and unspecified parts of the plant reportedly possess diuretic properties (Felter et al., 2007). The dried seed is a nutritious material that can be used to prepare curds, or roasted and ground to be used as coffee additive or substitute (Farinde *et al.,* 2007).

Insects are by far the largest group of crop pests and they cause damage to nearly all types of crops at their different stages of development. *Podagrica* spp. (Coleoptera: Chrysomelidae) is one of the serious insect pests which attack and reduce the yield of okra (Parh *et al.,* 1997). Okra plants are subject to attack by flea beetles (*Podagrica puncticolis, P. paltida*) infests the seedlings and can cause damage of economic importance by feeding on the leaves (Ahmed, 2000). White flies (*Bemisia tabaci*), jassids (*Empoasca lubica*) and aphid (*Aphis gossypii*) attack okra. Pods and flowers are primary targets of spiny bollworm (*Earias insulanaa)*, while the caterpillar of the American bollworm (*Heliothis armigera*) prefers the reproductive parts of the plant, including buds, flowers and fruits (Ahmed, 2000). In Nigeria, control of *Podagrica* spp. is based largely on the use of synthetic insecticides, especially lambdacyhalothrin in most parts of the south-west (Farinde et al., 2007). However, these chemicals are known to have adverse effects on humans and the environment (Hassan et al., 2007) and hence their use has been discouraged. In a bid

*Corresponding author. E-mail: ahmelad2007@yahoo.com. Tel: +2348038365315

to replace these chemicals with alternatives, much plant and plant products have been screened for their pesticidal and antimicrobial properties, Anyaele et al. (2002); Musa et al. (2007). This study was aimed at comparing the efficacy of neem, basil leaf extracts and lambda-cyhalothrin against *Podagrica* spp. on okra with a view to reducing the problems associated with excessive use of imported synthetic insecticides.

MATERIALS AND METHODS

Collection of leaves and preparation of plant extracts

Young fresh leaves of *O. bacilicum* and *A. indica* were plucked from their parent plants where they grow naturally. The leaves were immediately dried to a constant weight in an oven at 80℃ for 72 h. The dried leaves were separately ground into fine powder with pestle in a mortar. The leaf powders were sieved into a particle size of 150 µm with standard sieve and 50 g powder of each was weighed into 1 litre round bottom flask before a 400 ml ethanol (b. p. 56℃) was measured into it. The mixtures were thoroughly shaken with mechanical shaker for 24 h and allowed to settle overnight and later decanted. The decanted solutions were then filtered using Whatman No.1 filter paper and evaporated in a rotary film evaporator to get the solute (J. F. Adetunji, University of Ilorin, personal communication)

Preparation of stock and treatment solutions

A 2.5 g solute of each plant extract was weighed and dissolved in 25 ml of 90% ethanol. The mixture was made up to 100 ml with distilled water to form 2.5% stock solution. Three different concentrations of the two extracts (5, 10, and 20 ml per litre) were prepared from the stock solution. These treatment concentrations were compared with lambda-cyhalothrin 2.5, 3.75, and 5.0 ml per litre (Unpublished data) including a control (distilled water only) making a total of ten treatment concentrations.

Field layout and sowing

Field experiments were conducted at the University of Ilorin Teaching and Research Farm situated at Longitude 4° 35^1 E and Latitude 8° 30^{1}N in the Southern Guinea Savannah of Nigeria. The experimental treatments were arranged in a completely randomized design with three replicates. The okra seeds used in the study (SHRS 47 day) was obtained from the Kwara State Agricultural Development Project (KWADP), Ilorin, Nigeria. At the site, 4 - 5 seeds were sown at 2 - 3 cm depth towards the end of the raining season, which were later thinned to 1 plant per stand. The spacing of 50 cm along row and 75 cm across row was used. No herbicide was applied. Weeding was done at 15, 27 and 42 days after planting (DAP). NPK 10:10:10 fertilizer was applied at the rate of 75 kg/ha at 20 DAP using side dressing method. .

Treatment application

The leaf extracts of *O. basilicum* and *A. indica* each at 5, 10 and 20 ml/l and lambda-cyhalothrin at 2.5, 3.75 and 5.0 ml/l were sprayed three times by the use of hand spray. All treatments were carried out on weekly basis starting from the third week that is, 21 DAP. This continued until 55 DAP. *Podagrica* spp. infestation was purely natural.

Data collection

The data collected include population density of *Podagrica* spp., leaf damage assessment and dry pod yield. For assessing the pest population density, three plants of okra from each plot were selected randomly and tagged. The insect pest was counted on weekly basis on these tagged plants to obtain the total number of *Podagrica* per plot. The counting was done with the aid of mechanical counter. Counting was done in the morning when insects were not active and assuming highest population on the plant.

For estimating the effect of various treatments on leaf damage, the size of the feeding holes varied and were therefore graded, counted and later summed on the basis of the grading. Leaf damage assessment was recorded before spraying (21 DAP) and after spraying that is, during flowering (55 DAP). The grading used is given below:

Standard sized holes------------- 0.1 cm²
Medium sized holes--------------0.5 cm²
Large sized holes-----------------1.5 cm²
Extra large holes------------------2.5 cm²

Leaf damage assessment was determined by finding the mean for the total surface area of leaves damaged.

For estimating the effect of various treatments on dry pod yield components, mature okra pods were harvested, dried and weighed on a sensitive weighing balance METTLER TOLEDO AG 200 × 0.1 g and then stored in polythene bags at room temperature.

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) test. The separation of treatment means was done using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

The stock solutions contained 2.5 g of the crude extracts in 100 ml of the solution (a concentration similar to that of the synthetic insecticide, lambda-cyhalothrin. In a preliminary trial of the treatment solutions, lambda-cyhalothrin at 10 ml/litre and 20 ml/li were highly phytotoxic, killing all the plants but at 5 ml/litre, the plants were not killed and insect population was reduced as in all other treatments.

The mean number of *Podagrica* spp. was monitored on treated and untreated okra plants (Table 1). The different treatments helped in suppressing population of the insect per plant compared to the untreated control (Table 1). Field studies carried out on the effects of *A. indica* and *O. basilicum* leaf extracts on population density of *Podagrica* spp. on okra showed significantly higher *Podagrica* spp. was significantly ($P < 0.05$) affected by reduction in the pest population than untreated plants the treatments. Infestation of the plant continued till harvesting and the insect population was consistently low on okra plants treated with lambda-cyhalothrin from 20 DAP to 55 DAP. Infestation of untreated plants attained a peak at 41 DAP. *Podagrica* spp. population on untreated plants was not significantly higher ($P > 0.05$) than those on

Table 1. Effect of plant extracts and insecticidal treatments on mean weekly *Podagrica* spp. population on okra. (Mean population ± SE).

Treatments	Concentration (ml/l)	20 DAP	27 DAP	34 DAP	41 DAP	48 DAP	55 DAP
O. bacilicum	5	1.8 ± 0.2 a	1.8 ± 0.20 b	3.8 ± 1.60 a	4.0 ± 1.67 b	1.2 ± 0.20 b	2.2 ± 1.96 a
	10	1.6 ± 0.4 a	1.6 ± 0.24 b	3.4 ± 1.03 a	3.0 ± 1.26 a	1.2 ± 0.20 b	0.8 ± 2.31 a
	20	2.4 ± 0.7 a	1.4 ± 0.24 b	2.8 ± 1.58 a	2.8 ± 0.86 a	1.2 ± 0.45 b	0.6 ± 0.60 a
A. indica	5	2.2 ± 0.37 a	1.4 ± 0.24 b	3.0 ± 0.67 a	3.6 ± 1.80 b	1.2 ± 0.00 b	1.8 ± 0.58 a
	10	1.2 ± 0.37 a	1.4 ± 0.40 b	2.6 ± 0.81 a	1.2 ± 0.49 a	0.6 ± 0.24 a	1.6 ± 0.81 a
	20	1.6 ± 0.40 a	1.2 ± 0.20 a	2.4 ± 1.92 a	1.0 ± 0.77 a	0.4 ± 0.24 a	1.0 ± 0.62 a
Lambda-cyhalothrin	2.5	1.2 ± 0.20 a	0.8 ± 0.20 a	0.2 ± 0.2 a	0.2 ± 0.20 a	0.2 ± 0.20 a	0.4 ± 0.24 a
	3.75	2.4 ± 0.24 a	0.8 ± 0.20 a	0.2 ± 0.2 a	0.2 ± 0.20 a	0.2 ± 0.20 a	0.2 ± 0.20 a
	5	1.6 ± 0.60 a	0.4 ± 0.24 a	0.2 ± 0.2 a	0.0 ± 0.20 a	0.0 ± 0.00 a	0.2 ± 0.20 a
Control	Distilled water	2.4 ± 0.51 a	2.0 ± 0.32 b	3.4 ± 2.74 b	5.0 ± 0.84 b	2.3 ± 0.53 c	2.6 ± 0.87 a

Mean values followed by the same letter are not significantly different at 5% level of probability by Duncan's Multiple Range Test (DMRT).

treated plants at 20 DAP and 55 DAP. This was probably due to the fact that treatment application did not start before 21 DAP and that the physiological status of the infested plants may have changed when plants started flowering (from 47 DAP). Treatment with 5 ml/litre of lambda-cyhalothrin was the most effective in achieving reduced infestation or none at all even though it was slightly phytotoxic. The effectiveness of the treatments significantly increased ($P < 0.05$) with increase in their concentration. Lambda-cyhalothrin provided a mean insect population significantly different ($P < 0.05$) when compared to the untreated plants at 27, 34 and 41 DAP. Similarly, the mean insect population was significantly different among treated plants compared to the untreated plants 48 DAP. The performance of *A. indica* leaf extract was better than *O. basilicum* leaf extract but was comparatively less effective than lambda-cyhalothrin on okra. Adedire and Lajide (2000) reported that plants have evolved highly elaborate chemical defenses against insect attack and they have therefore provided a rich source of biologically active chemical compounds which may be used as crop protecting agents. Emosaurie et al. (1998) had earlier reported that petroleum ether extracts of *Monodora myristica* (Gaertn) Dunal and *Jatropha curcas* (L.) seeds at 5% each effectively controlled *Podagrica* spp. on okra monocropping system, though less effective than the synthetic lambda-cyhalothrin. In another experiments, Ogunwolu and Ameh (1999) reported that plant extracts (either aqueous or ethanolic) have been found to be effective against some insect pests of crops but less effective than the synthetics. The findings in this report also corroborate that of Parh et al. (1997) who reported high insect population on untreated okra at the early vegetative phase.

The effects of the plant extracts and lambda-cyhalothrin on the leaf surface area of okra damaged by *Podagrica* spp. are shown in Table 2. This study has shown that *Podagrica* is a leaf feeder of okra at Ilorin, Nigeria. Parh et al. (1997) reported that *Podagrica* spp. is a major okra defoliator and fruit feeder at Vom and Riyom, Jos Plateau, Nigeria. There was 81% reduction in leaf damage by lambda-cyhalothrin at 5 ml/litre, 80% reduction at 3.75 ml/litre and 72% reduction at 2.5 ml/litre (Table 2). *A. indica* at 5, 10 and 20 ml/litre gave 50, 52 and 54% reduction in leaf area damaged respectively while *O. bacilicum* at 5, 10 and 20 ml/litre gave 12, 41 and 43% reduction respectively (Table 2). Plants treated with lambda-cyhalothrin at 5 ml/litre suffered the least damage to their leaves by the insects but the concentration was slightly phytotoxic as the leaves were seen to show deformity. This greatly affected the photosynthetic ability of the plant and hence dry matter accumulation in the pods and yield was affected. In other cases, dry pod yield differed statistically between the treatments ($P < 0.05$).

The effects of the plant extracts and lambda-cyhalothrin on okra dry pod weight are shown in Table 2. The highest yields were recorded for lambda-cyhalothrin followed by *A. indica* and then *O. bacilicum* leaf extracts. There was an inverse relationship between dry pod yield and surface area of leaves damaged. The correlation coefficient was significant ($0.001 < P > 0.01$) (Figure 1). *A. indica* and *O. basilicum* leaf extracts increased yields even though the yields were not as high as those recorded for lambda-cyhalothrin. In this study, the leaf extracts were not as effective as lambda- cyhalothrin in the control of *Podagrica* spp. Sivapragasam and Mohammed Roff (2002) reported that garlic and neem sprays were not as effective as tea tree oil used against flea beetles, *Phyllotrea* spp. In another experiment, Aini and Vimala (2002) recommended the use of *Azadirachtin excelsea* for the control of flea beetles.

The highest concentration of the *A. indica* and *O. basilicum* leaf extracts was not phytotoxic but an increase in their concentration may increase their effectiveness. Neem and basil leaf extracts increased yields even though the yields were not as high as those recorded for lambda-cyhalothrin. There is however, an extent to which concentration of pesticides could be increased to achieve a better effect since total elimination

Table 2. Effect of plant extracts and insecticidal treatments on the leaf surface area and dry pod weight of okra damaged by *Podagrica* spp.

		Surface area of leaves damaged			Dry pod yield		
Treatment	**Conc. (ml/l) of stock solution**	**Total surface area damaged (cm^2)**	**Mean surface area damaged (cm^2 ± SE)**	**Reduction to leaf damage (%)**	**Total dry pod weight (g)**	**Mean dry pod weight (g) ± SE**	**Increase in dry pod weight (%)**
	5	376.7	75.3 ± 25.1 bc	12	24.9	4.98 ± 1.4 a	5.7
O. bacilicum	10	250.8	50.1 ± 10.7 ab	41	29.6	5.93 ± 1.0 ab	25.9
	20	244.5	48.9 ± 13.0 ab	43	31.5	6.30 ± 0.6 ab	34.0
	5	212.0	42.4 ± 9.4 ab	50	33.0	6.61 ± 1.5 ab	40.0
	10	196.1	40.7 ± 8.0 ab	52	35.1	7.02 ± 0.6 ab	49.0
A. indica	20	203.7	39.2 ± 11.8 ab	54	36.4	7.27 ± 1.0 ab	54.0
Lambdacyhalothrin	2.5	120.3	24.1± 7.0 a	72	44.5	8.89 ± 2.2 b	89.0
	3.75	85.7	17.1± 3.6 a	80	47.1	9.42 ± 0.8 b	100.0
	5	81.1	16.2 ± 3.4 a	81	34.3	6.85 ± 1.2 ab	45.0
Control	Distilled water	426.3	85.3 ± 18.3 bc	0	23.5	4.71± 1.2 a	0

Mean values followed by the same letter(s) are not significantly different at 5% level of probability by Duncan's Multiple Range Test (DMRT).

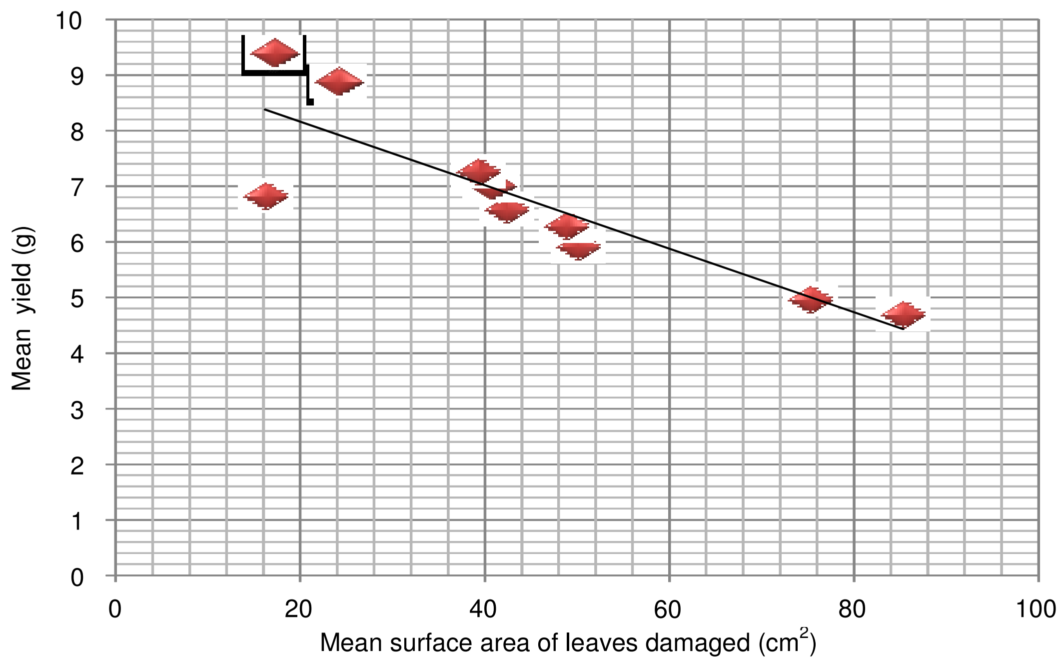

Figure 1. Relationship between pod yield (g) and surface area of leaves damaged (cm^2).

of pest is not possible neither is it necessary. The important fact to establish is the economic injury level of the insects.

Conclusion

Within the first three weeks of planting, there was no difference in the level of infestation of Okra by *Podagrica spp.* because treatment application has not commenced. Application of treatments which followed brought about difference in the level of infestation. The treatments (lambda-cyalothrin, A*. indica* and *O. bacilicum*) were effective but at different proportion following the pattern: lambda-cyhalothrin ≥ *A. indica* ≥ *O. bacilicum* and all better than the control. The insects caused defoliation with consequent reduction in the photosynthetic ability of the plant and therefore the yield*. A. indica and O. bacilicum* are widely available in Nigeria and devoid of human or environmental hazards. The usefulness of these plants in pest management may further be tested by planting them as pest repelling plants in the farm.

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