Comparative Bio-Efficacy of Aqueous Extracts of *Loncparus Cyanescens* and *Trema Orientalis* Against Flea Beetle (*Podagrica Spp*) (Coleoptera: Chrysomelidae) Infestation And Yield of Okra

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Abstract In Nigeria, Okra (*Abelmoschus esculentus*) is attacked by two flea beetle species, *Podagrica uniforma* (Jaq.) and *Nisotra dilecta* (Jaq.) (Coleoptera: Chrysomelidae) which are responsible for heavy defoliation and causes significant yield losses and synthetic insecticides with its attendant problems is currently being employed for insect pest control. A field experiment was conducted at the Teaching and Research Farms of Rufus Giwa Polytechnic, Owo, Ondo State between June – August, 2013, to investigate the insecticidal potentials of *Loncparus cyanescens* and *Trema orientalis* against flea beetle infestation on okra in Randomised Completely Block Design (RCBD) and treatments replicate three times. Synthetic insecticide (*Lambda cyhalothrin*) was used as check to compare the effectiveness of the plant extracts. Crude aqueous extracts of each plant was prepared by pounding 1 kg of plant leaves using mortar and pestle and soaked in 4 litres of cold water for 24 hours, sieved using muslin cloth. Spraying of okra plants were carried out at 5 spraying regimes beginning from crop establishment (4 weeks after planting (WAP) to harvesting period (50 days after planting (DAP) at weekly intervals using Knapsack 15 L sprayer under fairly calm weather condition. To assess the effect of the plant extracts and on the flea beetles; variables assessed included number of beetles were counted a day before treatment application, number of beetles post application of treatment and number of fresh fruit, fruit length and weight on 5 randomly selected plants per plot. Data collected were subjected to analysis of variance (ANOVA) and treatment means were separated using Least Significant Difference at 5% probability level. Results obtained shows that at 40 and 50 DAP i.e. at 4th and 5th spraying regimes, plot sprayed with *L. cyanescens* and *T. orientalis* extracts caused significant beetles infestation suppression (P<0.05) and not significantly different (P>0.05) compared to synthetic insecticide when compared. Plot control with *L. cyanescens* extract recorded the highest number of harvested fresh fruits (34.7) and fruit weight (0.78 kg), while *T. orientalis* extracts had 24.0 fresh fruits and longest fruit length (21.5 cm) and synthetic insecticide had the least number of fruits (22.0) and fruit length (18.7cm). Statistically, yield recorded from okra plant protected with plant extracts was significantly higher (P<0.05) compared to synthetic insecticide control plots. In light of the foregoing, it is evident from the study that the plant evaluated possess insecticidal properties which could be exploited as bio-insecticide as alternative to synthetic insecticide in the control of *Podagrica uniforma* (Jaq.) and *Nisotra dilecta* (Jaq.) infestation under organic okra production.

Keywords Heavy defoliation; Insecticidal potentials; Spraying regimes; Suppression; Synthetic insecticide

Introduction

‘Okra’, *Abelmoschus esculentus* (L.) is an important vegetable crop of the tropical and subtropical parts of the temperate region (Akinaye and Osekita, 2006) and because of a high consumer demand and better price; it is widely grown by the farmers, throughout agro-ecological zones of Nigeria. Nigeria ranks second in the world with 1.1 million tonnes of okra produced from over 0.387 million hectare land (FAOSTAT, 2008). Okra plays an important role in the human diet by supplying carbohydrates, proteins, fats, minerals and vitamins that are usually deficient in the staple foods in developing countries (IBPGR, 1990) and is particularly rich in ascorbic acid and iodine which helps control goiter (Som, 2007). The essential and non-essential amino acid which Okra contains is comparable to that of soybean (Farinde, 2007). The average nutritive value of “okra” is higher than that of tomato, eggplant and most of the cucurbits, except bitter gourd (Nonnecke, 1989). The importance of okra lies in the “draw” or mucilaginous properties of the immature fruits and young leaves
which aid easy consumption of bulky staple foods like pounded yam, garri, fufu etc.

Okra’ plants are attacked by a number of pest insects, during their different growth stages, which are major constraints, in getting higher yields (Gulati, 2004). Among the insect pests, Podagrica uniforma (Jaq.) and Nisotra dilecta (Jaq.) have been reported to have caused economic damage. According to Fasunwon and Banjo (2010), P. uniforma and N. dilecta attack the lamina of the foliage and matured leaves of the okra plant which result to reduction of the photosynthetic ability of the crop leaves. The insect is also responsible for transmission of mosaic virus; this infection could result to 20%~50% yield reduction (Fajinmi and Fajinmi, 2010).

In view of the aforementioned destructive activities of these insects, the control of those insects becomes imperative in order to have a high yield. In Nigeria, control of P. uniforma and N. dilecta is based largely on the use of synthetic insecticides, especially lambda-cyhalothrin in most parts of the South-west Nigeria (Farinde et al., 2007) due their quick action and long lasting effect. 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 to replace these chemicals with alternatives, plants and plant products have been screened for their pesticidal properties (Anyele et al., 2002; Musa et al., 2007). Thus, the development of safe and cost-effective insecticides using indigenous plants is being investigated by researchers. Also, awareness regarding food safety has increased the demand for organically produced food, which necessitates evaluating the performance of biopesticides as safer alternatives to conventional insecticides (Muhammad et al., 2010). The potential of using plant materials as deterrent against pest in crops, on the field and during post-harvest period, is a study that is presently gaining acceptance as a result of the indiscriminate use of chemical pesticides which have given rise to many well-known problems.

Result

The beetles population before spraying was not significantly different (P>0.05) from each other in all the three treatments evaluated. Though, plot assigned to be treated with synthetic insecticide (Cypermethrin) had the highest beetle population (1.2 beetles/plant), while plot assigned to be sprayed with T. orientalis and L. cynanescens had same population respectively for both the insect species (Figure 1A).

![Figure 1 Mean population of flea beetles](image)

Note: A: Before spraying at 20 days after planting (DAP); B: After first spraying; C: After the second spraying; D: After the third spraying; E: After fourth spraying; F: After the fifth spraying
Treatment means of flea beetle population on okra plant after first spraying is presented in Figure 1B. The result revealed that plant sprayed with Synthetic insecticides exercised significant (P<0.05) reduction in insect population for both Podagrica uniforma and Nisota dilecta 7 days after spraying (DAS). While plots sprayed with aqueous plant extracts were statistically similar to each other. Though, plot sprayed with T. Orientalis is significantly different exhibiting the maximum population of P. uniforma days after spraying. Also, plot sprayed with L. cynanescens has the highest population for both P. uniforma and N. dilecta 7 days after first spraying.

The result presented in Figure 1C shows that days after second spraying (DAS), plot sprayed with synthetic insecticides maintained significant (P<0.05) reduction in insect population for both P. uniforma and N. dilecta. There was significant differences (P<0.05) among the plots sprayed with aqueous plant extracts. Plots sprayed with L. Cynanescens having lower mean insect population for both species at day 1 and plots sprayed with T. Orientalis recorded lower insect population for N. dilecta and P. uniforma.

Figure 1D shows the result for third spraying with aqueous plant extract indicates that there is significant different (P<0.05) among the treatments evaluated in which the synthetic insecticide significantly (P<0.05) maintained reduction in insect population for both species days after spraying (DAS). Though, the aqueous plants extracts does not exhibit any significant difference (P>0.05) to one another.

Result for fourth spraying presented in Figure 1E. The result shows that there was no significant different (P>0.05) among the plots treated with synthetic insecticides and T. Orientalis days after spraying (DAS). Also, plots sprayed with L. cynanescens exhibit non-significant difference (P>0.05) for P. uniforma species days after spraying (DAS). However, plots sprayed with L. cynanescens extract were significantly different (P<0.05) having the maximum mean insect population for N. dilecta species days after spraying (DAS). Result represented in figure 5 above showed that the action of the aqueous plant extracts especially, T. Orientalis was effective after the fourth spraying having no significant different (P>0.05) with the synthetic insecticide.

Figure 1F shows the result for the mean number of insect population after fifth spraying with aqueous plants extracts. The result shows that there are no significant difference (P>0.05) between the plots sprayed with synthetic and the aqueous plants extracts days after spraying (DAS); except for the significant differences in plots sprayed with L. cynanescens days after spraying (DAS) for both beetles species.

The effects of aqueous plants extract on okra yield attributes in presented in Figure 2. The results show that there was no significant difference (P>0.05) between synthetic insecticides and the aqueous plant extract (Trema Orientalis) in terms of number of fruits and fruits weight (kg) excepts for L. cynanescens which have the maximum mean number of fruits and fruits weight. However, in terms of fruit lengths (cm), both aqueous plants extracts are not significantly different (P>0.05) from one another while the synthetic insecticide have the lowest mean values for fruit length. The result clearly shows that the aqueous plant extracts are more effective on the okra yield attributes having high number of fruits, fruit weight and fruit length respectively. While the synthetic insecticides having lower values in terms of number of fruits and fruit length.

Figure 2 Effects of aqueous plant extracts on okra yield attributes

Discussion

Plant derived insecticides are believed to be safer, less expensive and more readily available (Jackai and Daoust, 1986; Jackai, 1993). The impetus for screening medicinal plants for insect pest control ability is to identify the most effective which may serve as replacements for the usually imported synthetic insecticides whose supplies are inconsistent and are quite expensive and environmentally
unfriendly (Ofuya, 2003). The results of the field screenings in this study therefore generally confirmed the insect controlling characteristics of the plant screened. Okra plants in the plots sprayed with plant extracts were less invaded by flea beetles and were at par with plots sprayed with synthetic insecticides. This study confirmed previous study by Adesina and Idoko (2013) who reported on the efficacy of Chenopodium ambrosiodes and Spondia mobin crude extracts in suppressing flea beetle infestation on okra plants. The reduction in the number of flea beetles on okra plants sprayed with aqueous plant extracts resulted in superior vegetative growth which in turn produced higher okra fruit yields. Folorunso (2004) observed that okra plant protected with aqueous plant extracts had more leaves and grew taller compared with unprotected plants and Epidi (1986) reported that when presented in sufficient numbers, Podagrica spp is known to normally significantly cause leaf damage, reduced photosynthesis and consequently reduced okra fruit yield. The yield attributed were correspondingly significantly higher in plots sprayed with aqueous plants extracts than sprayed with synthetic insecticides. This result correspond positively with earlier works of Nderitu et al (2008) who observed that without pesticides, aphids infestation on okra can lead to high yield losses. The result also confirms the findings of Adesina and Idoko (2013), Folorunsho et al (2007), Adewumi et al (2007), Ogunjobi and Ofuya (2007). The non-significant differences observed in fruit length compared to synthetic insecticides; is possible because plant extracts were most effective against insects pests of cowpea and okra (Pahwar, 2002).

Plant materials are known to contain a vast amount of secondary metabolites which confer pesticidal activity on them (Dales, 1996). The insecticidal component of the aqueous extracts of the plants screened in this study were however not evaluated but the mechanism of action through which plant extract control flea beetles can be suggested to include avoidance, antifeedant and growth and reproductive inhibitory effects rather than direct kill (Jacaki, 1993; Adewumi et al., 2006). The insecticidal action of the extracts was initially observed to be slow but at 4th and 5th spraying regime it manifest substantial suppression effects on the flea beetles, through starvation resulting from feeding deterrence. This confirmed the findings of Okuku et al (2007) that Azadirachta indica extract was observed to be initially slow but resulted in 89% killed of cocoa mirids in residual action of extracts.

The finding from this study confirmed that there is a vast array of plant products with insecticidal properties that could be screened for reducing insect pest depredation to okra in the field. The use of plant extracts which have low mammalian toxicity will help reduce the environmental hazard and other short comings associated with synthetic. The evaluated plants could be used to suppressing flea beetles infestation and improved okra yield. The chemical constituents of the plants need to be determined and isolated to determine its mode of action.

**Materials and Methods**

The experiment was conducted at the Teaching and Research Farm of Rufus Giwa Polytechnic, Owo, during the wet season of 2013. The land was predominated by elephant grass (Pennisetum purpurem) and spear grass (Imperata cylindrical), though the land has being under continuous cultivation for 3 years prior to the experiment, the land was ploughed and harrowed to obtain a clean fine tilt soil.

The experiment land was divided into 3 blocks of 7 m×5.9 m (41.3 m$^2$) each and giving a discard of 0.4 and 1 m between each plot, which produced a total number of 9 plots. The total area of land used was 24 m×19 m (456 m$^2$).

The Okra (Abelmoschus esculentus) L. Moench, seed, NH47 variety was obtained from Agricultural Project Inputs Units, Akure, Ondo State. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three treatments, replicated thrice on each blocks. The seed was sown at two seeds per hole in a spacing of 60cm X 60cm within rows and 60cm between plants on the 27th May, 2013. Three (3) weeks after planting (WAP), weeding operation was carried out manually with the used of hoes and cutlass.

The plant leaves were collected from Irun Akoko and Owo, Ondo State and 1 kg each of the plant leaves was weighed using electronic balance. The plants were washed with water to remove dirt and thereafter
the leaves were pounded with mortar and pestle into a fine soft from and soaked with 4 litres of water overnight respectively. The soaked plant residues were removed next day while the extracts were sieved using muslin cloth. The sieved extracts were stored in 4 litres respectively till the time to be applied (Table 1).

Table 1 Plant Extracts used as botanical insecticides

| Common name     | Family name | Botanical name         | Parts used |
|-----------------|-------------|------------------------|------------|
| Pigeon wood     | Cannabaceae | *Trema orientalis*     | Leaves     |
| Indigo vine     | Fabaceae    | *Loncocarpus cyanescens* | Leaves     |

The botanical extracts and the synthetic insecticide were assigned to the plots using the ballot method of application. Four (4) litres of each plant extracts was sprayed with the use of Knapsack sprayer, both upper and lower surfaces of the okra leaves were sprayed. Also, the small lid (cover) of the insecticide’s bottles was used to measure it into the sprayer and agitated with water before spray. Each extracts was thoroughly washed from the sprayer before application of another extracts and synthetic insecticides to avoid contamination. The treatment application was carried out every 7 days interval i.e on weekly basis.

To assess the effect of aqueous plants extracts on flea beetles of okra, insect count was carried out a day before spraying i.e four (4) weeks after planting (WAP), thereafter the insects were counted 1, 3, 5 and 7 days after spraying (DAS). The counting of the insects was done at the early hour of 6am-7am when the insects are still inactive and not able to fly. The counting was done for both the blue and the brown beetles at upper and lower leaves. Five (5) randomly tagged plants from each plot were used for the data collection. Harvest of the okra fruits started 64 days after planting (DAP) when the fruit is still fresh by twisting the fruit stalk and harvesting was carried out at 4 days interval. The total numbers of freshly harvested fruits were recorded while the fruit weight was determined using Electronic digital balance and fruit length using ruler.

Data collected were subjected to analysis of variance (ANOVA), prior to analysis data on insect count were subjected to square root transformation, while significant treatment means were compared using Duncan’s Multiple Range Test (DMRT).

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