Insecticidal Efficacy *Mitrocarpus villosus* and *Momordica charantia* Extracts for the Control of Flea Beetles *Podagrica* spp. Jacq. (Coleoptera: Chrysomelidae) on Okra *Abelmoschus esculentus* (L.) Moench

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**Abstract**
Okra is one of the most important and commercially cultivated and consumed vegetable crops in Nigeria. However, a number of insects are known to attack both the leaves and fruits. In light of recent increased interest in developing plant based secondary chemistry into products suitable for integrated pest management, the objective of the present study was to investigate the efficacy of *Momordica charantia* and *Mitrocarpus villosus* crude extracts against the flea beetles on V 35 okra variety under field conditions. The field experiment was laid out in Randomized Complete Block Design (RCBD) replicated three times. The plant extracts were obtained by pounding 1 kg of plant materials using mortar and pestle and soaked overnight in 3 lts of cold water. Synthetic insecticide (Lambda cyhalothrin) was used as check to monitor the effectiveness of the plant extracts. All treatment was applied from crop establishment till harvest. Result obtained showed that at 50 days after planting (DAP) all the treatments significantly (P<0.05) suppressed flea beetle infestation. Fresh fruit (pods) weights obtained from plot sprayed with plant extract were not significantly different from synthetic insecticide treated plots. While pod density per plant in the plots treated with *M. villosus* and *M. charantia* leaves extract in the study was significantly (P<0.05) different from the insecticide (Lambda cyhalothrin) treated plots, the control treatment produced highest pod density (23.50 pods/plant) followed by *M. villosus* (20.33 pods/plant) and *M. charantia* (19.20 pods/plant). It is evident from the study that crude extracts of *M. villosus* and *M. charantia* could be used as plant based biocides as alternatives to synthetic insecticides to manage flea beetle on okra. They have proven to be effective and could be exploited and used by small to medium scale okra farmers.

**Keywords** Check; Crude extracts; Fresh fruit (pods) weights; Infestation; Pod density; Synthetic insecticide

**Background**
Okra, *Abelmoschus esculentus* (L.) Moench, is one of the most important and commercially cultivated and consumed vegetable crops in Nigeria. It has its own importance, taste, flavour and nutritional values as human food. It has good nutritional value particularly high content of protein, calcium, potassium, vitamins and other minerals needed for the development and maintenance of human body (Tindall, 1986; Anitha and Nandihalli, 2008). One of the most important constraints in production of okra is insect pests. In spite of the high nutritional value of this crop, it is reported to be attacked by many insects in different parts of the world (Ahmed et al., 2003), among which *Podagrica uniforma*, Jacoby and *P. sjostedi* Jacoby (Coleoptera: Chrysomelidae) are the most damaging insect. The adult beetles eat the leaves and make numerous holes resulting in yellowing, drying and falling of the leaves. This reduces the photosynthetic activity of leaves as well as plant growth and pod yield and especially when the terminal shoots are of serious attack, the whole plant may be defoliated. The larvae feed on roots of the crop (Egwuatu, 1982; Wood and Ambridge, 1986; Iremiren, 1988; Emosaire and Ukaegbu, 1994; Ahmed et al., 1998). Furthermore, the two flea beetles not only causes direct damage to okra plant, they are important vectors of okra mosaic virus (OMV), that is, a tymovirus, which is a widespread disease in most okra growing area in Nigeria (Odebiyi, 1979), okra is heavily infected by this virus if grown without controlling the flea beetles (Lana and Taylor, 1976).
Awareness regarding the 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). In response to the high costs of pesticides and their negative side effects is the need for a paradigm shift to the development of non-chemical technologies which may eliminate the use of insecticides and could have economic and health benefits to the applicators, consumers and the environment (Murdock et al., 1997). Botanical insecticides have long been touted as attractive alternatives to synthetic chemical insecticides for pest management (Isman 2006; Echereobia et al., 2010) and under organic okra production; the use of botanical insecticides in pest management is considered an ecologically viable proposition which overcomes pest problems.

In view of the nutritional importance of okra in the diet of Nigeria teeming population, considerable low crop yield caused by flea beetles activities and the health and environmental hazards that result from the use of synthetic insecticide to control insect pests of okra, this study was conducted to evaluate the biological efficacy of *Momordica charantia* and *Mitrocarpus villosus* crude extracts against the flea beetles of okra under field conditions.

**Discussion**

Plants are rich sources of natural substances that can be utilized in the development of environmentally safe methods for insect control (Sadek, 2003). The results of the study indicated that the extracts of the plant species exhibited moderate level of insecticidal activity in effectively reducing flea beetle population. Peta and Pathipati (2008) reported that crude extract of *M. charantia*, was found to exhibit both feeding deterrent and toxic activity (>80%) to larvae, *S. litura* and *A. janata* and also reveal that aphid’s mortality was maximum with *M. charantia* on sugarcane woolly aphid. The mode of activity of *M. villosus* and *M. charantia* crude extracts in suppressing pest pressure on okra and ensuring high pod numbers is not very clear. Yet since the beetles live and feed on the vegetative parts, any chemical that shows a remarkable efficacy against it must have contact toxicity, repellent or anti-feeding action. Several authors have reported that, the deleterious effects of crude plant extracts on insects are manifested in several ways, including toxicity (Hiremath et al., 1997), feeding inhibition (Klepzig and Schlyter, 1999; Wheeler and Isman, 2001). Thus reducing beetle infestation level and increased okra pod carrying capacity; this confirmed the earlier report of Thirumalai et al (2003) who observed the effective reduction of mite population with application of neem seed kernel extract. The plant extracts used were not inferior to the synthetic insecticide treatment. This result is consistent with the reports of Ogunlana et al (2002).

**Conclusion**

The findings from this study has clearly demonstrated the potential of extracts as plant based biopesticides as alternatives to synthetic insecticide to manage flea beetle on okra, they have proven to be effective and could be exploited and used by small to medium scale okra farmers. There is also the need to further test the plant material to ascertain their effective dose and spraying schedules. Research is also needed to identify, isolate and characterize the active ingredients responsible for insecticidal toxicity exhibited by plant materials.

**Materials and Methods**

The experiment was conducted in a randomized complete block design (RCBD) replicated 3 times at the Teaching, Research and Commercial Farm of Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria (7°11'43" N, 5°33'57" E) during the wet season of 2011. The experimental plot was previously cultivated with cassava and was later fallowed for three years. The soil is sand loamy in texture. Seeds of V 35
variety were planted at two seeds per hole at a spacing of 60 cm×60 cm within row and 60 cm between plants in row in plots of 6 m×6 m, which were later thinned to one plant per stand at two weeks after emergence. Prior to planting, seed viability test was conducted using floating method few hours before planting (Adesina and Idoko, 2013). Weeding was done as necessary but no fertilizer application was made. The selection of plants used in the study was based on previously reported insecticidal properties of the plants against insect pests of stored grains (Adesina et al., 2012). The plants was collected from within the polytechnic campus; the plant materials after collections were washed with borehole water to remove dust and other contaminants; crude aqueous extracts of each plant (Table 1) was prepared by pounding 1 kg of plant materials thoroughly using mortar and pestle and thereafter soaked in 3 litres of cold water for 24 hours, then sieved trough fine cloth. Synthetic insecticide (Lambda cyhalothrin) was used as reference to compare the efficacy of plant extract at recommended rates of 1~3 mL per litre and was replicated 3 times. The insecticides used in the management study were applied as foliar sprays with a spray fluid of 500 l/ha using hand operated knapsack sprayer with double cone jet swirl nozzle and forwarded at an angle of 45° with spray bottom upwards moving the lance straight in the inter row to ensure good coverage on the under surface of the leaves. The spraying was done under fairly calm weather condition to avoid drifting of insecticides to adjacent plots. The treatments were imposed at an interval of 8 days commencing from crop establishment (20 days after planting (DAP)) to harvesting. Totally, four sprays were taken up in the crop season.

To assess the effect of the plant extracts and synthetic insecticide on the Podagrica beetles visual count of the insect was carried out daily early in the morning (6.00~7.00 am) while still inactive (Onunkun, 2012). Variables assessed included number of Podagrica spp counted a day before treatment application (pre-spray), number of Podagrica spp post application of treatment and number of fresh fruit and weight of okra on 5 randomly selected and tagged plants per plot from 2 middle rows. Reduction in number of flea beetles was converted to percent reduction by the use of Henderson and Tilton formula (1995). Data collected were subjected to analysis of variance and treatment means were separated using Least Significant Difference at 5% probability level. All statistical analyses were done by SPSS version 17.0 for windows.

The data (Table 2) indicated that the number of beetles before spraying, i.e. 20 DAP was statistically non-significant and beetle population ranged from 14.67~20.67 beetles/plant. At 50 DAP the results of field trial showed that all the treatments significantly suppressed infestation of the two flea beetle species, with M. villosus extract having 11.67 beetles/plot; closely followed by M. charantia with 12.33 beetles/plot. However, the plant extracts were not as effective as the insecticide lambda-cyhalothrin, in lowering populations of the insects per plant.

The fresh fruit weights obtained in the field trial were not significantly different from the control (Synthetic insecticide) (Table 3). Though, the synthetic insecticide treated plots (control) produced the highest yield, this was significantly (P<0.05) different from the fresh yield recorded in the plots sprayed with M. villosus and M. charantia leaves extracts.

Table 1 Pesticidal plants evaluated for insecticidal properties in the control of Podagrica beetles infesting okra.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Family</th>
<th>Plant part used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitrocarpus villosus</td>
<td>Asthma plant</td>
<td>Rubiaceae</td>
<td>Whole plant</td>
</tr>
<tr>
<td>Momordica charantia</td>
<td>Bitter gourd</td>
<td>Curcubitaceae</td>
<td>Whole plant</td>
</tr>
</tbody>
</table>
Table 2 Podagrica beetles population before and after application crude aqueous plant extracts and synthetic insecticide to okra plants

<table>
<thead>
<tr>
<th>Treatments</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitrocarpus villosus</td>
<td>20.33</td>
<td>12.33</td>
</tr>
<tr>
<td>Momordica charantia</td>
<td>20.67</td>
<td>11.67</td>
</tr>
<tr>
<td>Control</td>
<td>14.67</td>
<td>7.0</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>NS</td>
<td>2.52</td>
</tr>
<tr>
<td>SE ±</td>
<td>2.48</td>
<td>1.18</td>
</tr>
</tbody>
</table>

Note: A: Mean no of beetles/plant before spraying at 20 DAP; B: Mean no of beetles/plant after 4 spraying at 50 DAP

Table 3 Effect of crude aqueous plant extracts and synthetic insecticide on the yield of okra

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pod density/plant</th>
<th>Mean fruit weight (kg/plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitrocarpus villosus</td>
<td>20.33</td>
<td>0.15</td>
</tr>
<tr>
<td>Momordica charantia</td>
<td>19.20</td>
<td>0.12</td>
</tr>
<tr>
<td>Control</td>
<td>23.50</td>
<td>0.16</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>3.31</td>
<td>NS</td>
</tr>
<tr>
<td>SE ±</td>
<td>1.41</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Pod density per plant in the plots treated with *M. villosus* and *M. charantia* leaves extract in the study was not significantly different from each other but was significantly different compared to the insecticide treated plots (Table 3). The control treatment produced highest pod density (23.50 pods/plant) followed by *M. villosus* (20.33 pods/plant) and *M. charantia* (19.20 pods/plant).

Percentage flea beetle population result is presented in figure 1. The chart shows that all the treatments significantly (P<0.05) reduced flea beetle infestation level on the treated okra plants. Okra plants sprayed with synthetic insecticide recorded the lowest infestation level (17.86%), while *M. villosus* treated plot recorded 27.28% reduction and *M. charantia* extract treated okra plot recorded 28.87% reduction in flea beetle population.

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