

EVALUATION OF SOURSOP (*Annona muricata* L) LEAF EXTRACT ON THE CONTROL OF FLEABEETLES (*Podagrica* spp.) AND YIELD OF OKRA (*Abelmoschus esculentus* L. Moench)

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ABSTRACT

*The study was carried out to find the effect of different concentrations of Soursop (*Annona muricata* L) leaf extract on control of *Podagrica* spp. and yield of okra plant (*Abelmoschus esculentus* (L. Moench.), at the Teaching and Research Farm at Imo State University, Owerri. The experiment was laid out in a randomized completely block design (RCBD) with five treatment levels and four replications. The treatment levels were 0% control(T₁), diluted ethanol(T₂), 25%concentration(T₃), 50%concentration(T₄) and 75%concentration(T₅) leaf extracts of *Annona muricata*. Application of these treatments were done weekly and data were collected on number of *Podagrica* spp., number of damaged leaves, number of infested plants. Results indicate that the application of 75% leaf extract effectively reduced the number of (0.5) *Podagrica* spp. at maturity stage which was significantly different ($p < 0.05$) from control (9.5). Higher Yield, (248.59kg/ha), mean number of fruits (35.75) and mean fresh weight (43.732g) were significantly recorded from higher dose (75%) of leaf extract of *Annona muricata*. Number of damaged leaves, number of infested plants were reduced significantly by all the treatments compare to control. The result showed that *Annona muricata* Leaf extract possess insecticidal potential in controlling this pest hence could be use as alternative to synthetic insecticide because it is environmentally friendly and cost effective*

Keywords: *Annona muricata*, *Podagrica* spp., Okra, Leaf extracts and yield

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INTRODUCTION

Okra *Abelmoschus esculentus* L. (Moench), is a commercial vegetable crop with considerable area under its cultivation in Africa and Asia. Okra is a major vegetable crop in many countries (Bisht and Bhat, 2006). In 2009-2010, the total world area under cultivation was 0.43 million hectares and the production stood at 4.54 million tons; with India being largest producer (67.1%), followed by Nigeria (15.4%) and Sudan (9.3 %) (Varmudy, 2011).

Okra plays an important role in the human diet (Kahlon *et al.*, 2007, Saifullah and Rabbani 2009). By supplying plant fats, proteins, carbohydrates, phosphorus, calcium, iron, sulphur, fibre, minerals and vitamins (Owolarafe and Shotonde 2004, Gopalan *et al.*, 2007, Arapitsas 2008, Dilruba *et al.*, 2009). Okra fruit is usually boiled in water resulting in slimy soups and sauces, which are relished. The fruits also serve as soup thickeners. Okra seed can be dried, and the dried seeds are a nutritious material that can be used to prepare vegetable curds, or roasted and grind to be used as coffee additive or substitute (Moekchantuk and Kumar, 2004). Industrially, okra mucilage is usually used for glaze paper production and also has a confectionery use. Okra has found medical application as a plasma replacement or blood volume expander (Lengsfeld *et al.*, 2004, Adetuyi *et al.* 2008, Kumar *et al.*, 2010) and it is said to be very useful against genito-urinary disorders, *spermatorrhoea* and chronic dysentery (Adesina, 2013)

Insect pest infestation is one of the most limiting factors for accelerating yield potential of okra. The crop is prone to damage by various insects; various growth stages of the crops are susceptible to the different insect pests and diseases (Ek-amnuay 2007, Fasunwon and Banjo 2010). Insect pests like crickets can be a problem during germination/seedling stage of the crop while the thrips, whitefly and other phloem feeders are common during vegetative stage (Fajinmi and Fajinmi, 2010). The most destructive insect pests are two flea beetle species, *Podagrica unifirma* (Jac.) and *P. Sjostedti* (Coleoptera: Chrysomelidae) which are responsible of heavy defoliation (Odebiyi, 1980) and Important yield losses are reported in Nigeria and Ghana (Obeng-Ofori and Sackey, 2003; Ahmed *et al.*, 2007).

The control of field insect pests of okra remains a major production constraint of farmers. In Nigeria, use of chemical insecticides is in vogue for the control of insect pest. Although synthetic insecticides application is popular and effective means of pest control but their use in okra production is limited because the crop was regarded as low value cash crop.

There is a need to explore alternative approaches to reduce the sole dependence on insecticides. The use of plants derived insecticides are in recent time being investigated by researchers as possible replacement for synthetic insecticides because they are supposedly safer and may be more readily available and affordable (Dudu and Williams 1991).

Insect pests' infestation is one of the major factors counting against cultivation of okra in Nigeria. Among the insect pests, *Podagrica* species are known to cause economic damage. According to Fasunwon and Banjo (2010), *Podagrica* species attack the lamina of the foliage and matured leaves of the okra plant which results in the reduction of the photosynthetic ability of the crop leaves. The insect is also responsible for the transmission of mosaic virus which can reduce yields by 20 – 50 %. Aphids and thrips are the other major insect pests of both tomato and okra and they suck plant sap causing various diseases (Fanjimi and Fanjimi, 2010). Generally, synthetic insecticides are the most effective means of controlling insect pests due to their quick action and long lasting effect. However, most of these synthetic insecticides have been banned in developed countries (Emerso *etal.*,2014).

From the foregoing, a study on the efficacy of Leaf of *Annona muricata* aqueous extracts on the control of Fleabeetles (*Podagrica spp*) infestation of okra (*Abelmoschus esculentus*) and yield was carried out.

MATERIALS AND METHOD

Location

This study was carried out in the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri. Owerri lies between the latitudes 5°10'N and 6°0'N and longitudes 6°35'E and 7°0'E with an altitude of 91.0m within the Southeast rain forest agricultural zone of Nigeria. The area maintains an average annual rainfall of 2,500 mm, mean minimum and maximum temperature of 23.5°C and 32.1°C respectively, with relative humidity ranging from 70-85% and the annual evapotranspiration is 1450 mm (NIMET, 2010).

Source of Materials

Plant materials that were used in this study were collected from Imo State University Teaching and Research Farm, while reagents that were used for extraction was purchased from the local market. Okra plant seeds were source from Imo ADP. Other materials include, a piece of land measuring 11 x 15m, soursop leaf. Blender, weighing scale was used for this experiment.

Preparation of extracts and the stock solution

Fresh leaves of *A. muricata* were collected from a tree behind the plant house at the Faculty of Agriculture. The leaves were pounded in a wooden mortar with a wooden pestle. One hundred grams (100 g) of the pounded leaves was added to 100 ml of ethanol and left overnight. The mixture was filtered and the filtrate poured into a flat bottom flask as stock for the field spraying.

Field experimental design and botanical treatments

The field studies were carried out in crop growing season. The field design is a randomized complete block design with five replications. There were five treatments levels; control (T₁) diluted ethanol (T₂), 25% concentration (T₃), 50% concentration (T₄) and 75% concentration (T₅). Starting from one week after planting, each plot was sprayed once a week, until the fruits were matured for harvesting, with a knapsack sprayer. Treatments were applied four times during the growing season. Weeding was done manually when necessary.

Data collection and evaluation of the effects of the treatments

Different criteria were used to evaluate the effect of different extracts in this study.

1) The count of insects: This was done by counting the number of insects on 5 different plants, which was selected randomly (5 plants from each crossed line of the plot). In each plant 5 leaves was selected, two from the upper, one from the middle, and two leaves from the lower section of the plant.

At the beginning, the count was twice weekly, 4 days after treatment and one day before the next treatment. Later, it was done once weekly. The result of this experiment was demonstrated by a continuous number of insect counts. The average number of insects detected in each count was computed for each treatment.

2) The count of damaged leaves: The number of damaged leaves per plant was counted to study the effects of the treatments on the flea beetle.

3) The count of infested plants: The number of the infested plants in each plot was counted.

4) Fruit yield (Kg/ha): The yield was the major criteria taken into consideration to evaluate treatment effect. The yield of okra was done by picking-up the fruits every two to three days. The weight of the collected fruits in each plot was recorded. The fruit yield was weighed and calculated using the formula (Umar Musa Tanko, (2015).

$$\frac{\text{Fresh Weight}}{\text{Land Area}} \times \frac{10,0000}{1}$$

Data Analysis

Data collected were subjected to statistical analysis, using the analysis of variance (ANOVA) of the SAS software 17.0 version. Means separation was done using the Least Significant Difference (LSD) method as described by Onuh and Igwemma, 2007.

RESULTS

Effect of *Annona muricata* Leaf Extract on Number of Infected Okra Plant

The result showed that the leaf extract from *Annona muricata* (Soursop) have significant effect on the number of infected okra plant throughout the cropping season. The mean number of infected okra plant in response to application of extract is presented in table1, showed a reduction in T₃ (0.2500) and T₅ (0.2500) respectively compared to the control which recorded significantly (P<0.05) highest (2.250) number of infected plant at 4WAP. At 6 and 8WAP, T₅ recorded the lowest numbers of infected plant (0.7500 and 1.000 respectively) which were significantly different (P<0.05) from the highest (3.000 and 6.500 respectively) recorded from control. At 10 and 12WAP T₃ recorded the least number of infected plant (1.000 and 1.000 respectively) which was significantly different (P<0.05) from the highest (7.000 and 7.75000 respectively) recorded from control as shown in table 1.

It was observed that toward the maturity stage T₃ followed buy T₅ and T₄ reduced infection as shown in table 1 compare to treatment 2.

Effect of Treatment on Damaged Leaves on Okra Plant

The result presented on table 2 showed that *Annona muricata* leaf extract significantly influenced the ($P < 0.05$) the number of damaged leaves. There was no leaf damaged at 2WAP. At 4WAP numbers of leaves damaged were higher in control (2.00) than of number (0.2500) obtained from T₅. Similarly, at 6, 8, 10 and 12 WAP, control recorded the highest number of damaged leaves (3.75, 5.75, 8.50 and 9.50 respectively) which were significantly different ($P < 0.05$) from the lowest number of damaged leaves (1.750, 1.750, 1.250 and 1.250 respectively) from T₂.

Effect of *Annona muricata* Leaf Extract on Number of *Podagraca* Species

The result on the number of *Podagraca spp.* was significantly influenced by treatment levels as shown in table 3.

At 2WAP, there was no significant reduction in number of *Podagraca spp.* among the treatment levels. Although the least (0.500) was recorded by T₄ compare to the higher recorded from control (2.250). At 4WAP the highest number of *Podagraca spp.* (2.250) was recorded in control which was not significantly different from the least (0.750) recorded from the T₅. While at 6 WAP, there was significantly higher (5.00) number of *podagraca spp.* recorded from control than that (2.00) recorded from T₃. Whereas at 8, 10 and 12WAP there was significantly ($P < 0.05$) reduction in number of *podagraca* (2.00, 1.25 and 0.500) recorded from T₅ compare to the highest number recorded in control (7.250, 9.50 and 9.50 respectively). As shown in Table 3.

Effect of Treatment on Number *Mollusca* on Okra Plants

The result in Table 4 reflected the presence of this pest in the field of study. Their presence was noticed from week 6. At 6WAP, treated plot recorded more of *Mollusca* than in control. However, at 8, 10 and 12WAP, their number were more in control (1.50, 2.50 and 2.750 respectively) than recorded from all the treated plots. Whereas at 12WAP precisely, there was no trace of *Mollusca spp.* among all the treated plots (0.00) which were significantly different from the value (2.750) recorded in control plots.

Effect of Treatment on Yield and Yield Components

Number of Fruit

The effect of different concentration of *Annona muricata* leaf extract on number of fruit is presented in Table 5. There was significant difference ($P < 0.05$) between control and all the treated plots. There was significant different ($P < 0.05$) between number of fruit of the treated plots (highest being 35.750, lowest being 19.750 among the treated plots) and control (12.250)

Fruit Weight

The result of fresh fruit weight showed that there was significant different in fresh fruit weight between the four treated plot and the control. T₅ recorded significantly higher fresh weight (43.752g) than the lower fresh weight (18.57g) recorded from control. This was followed by T₂ with fresh weight (34.405g) and T₄ with (33.753g) as shown in Table 5.

Yield

Similarly, all the treated plot produced significantly higher yield than control. It was observed that T₅ produced the highest (248.59kg/ha) which was significantly different from the lowest (43.50kg/ha) recorded in control plots. It was observed that T₅ gave the highest number of fruits (35.75), fresh fruit weight (43.752g) and yield (248.59kg/ha). Whereas T₂ which recorded lowest number of fruit (19.75) among the treated plots recorded higher weight (34.405g) and yield (195.48kg/ha) that obtained from T₃ and T₄ respectively as shown in Table 5.

DISCUSSION

The results of this study throughout the period have shown, that ethanol leaf extract of *Annona muricata* contained active ingredients that can confer some level of protection on growth and fruits production of okra plant against field insects when compare to the untreated control plots. This is in conformity with several documented studies where extracts, isolated compounds or mixture of products have been evaluated for their efficacy against a variety of pests as comprehensively reviewed (Hussein *et al.*, 2006; Rosell *et al.*, 2008 and Arnason *et al.*, 2011). The three levels of concentration of *Annona muricata* possessed some level of insecticidal properties in effectively, reducing the population of *Podagrica spp.* and other associated field insects observed in this study. Also it was observed in this study that action of *Annona muricata* leaf extract is dose-dependended.

The ethanol leaf extract of *Annona muricata* was found to have effectively reduced number of plant infested, number of damages leaves, and number of *Podagrica spp.* compare to the control and ethanol, although dose dependent, *Annona muricata* contain Acetogenins, the major active ingredients that is capable of repelling and inhibiting activities of field insects of okra plant.

Acetogenins is the major active ingredient in *Annonaceae* (Bermejo *et al.*, 2005) which is a slow- acting stomach poison like rotenone (Rosell *et al.*, 2008). Leatemia and Isman, (2004) conducted an experiment and found that 1% crude ethanolic seed extract of *A. Squamosa* was 2.5 times more effective than 1% rotenone against *Plutellaxy costella* L. larvae on cabbage. This could be reason why it was only between 4WAP and 6 WAP that we observed presence of larva of some field insect thereafter they disappeared. This suggests that the *Annona muricata* leaf extract could completely control the larva which is destructive stage by poisoning the larvae when they ingest the treated leaf surface in process of feeding on them. This correspond to the works of Russel and Lane, 1993 and Adesina, 2013., who reported that plant extracts often consist of complex mixtures of bioactive constituent's plant metabolites which may produce toxic effects if ingested leading to rejection of the host plant.

The observations from this study shows that the leaf extract of *Annona muricata* insecticidal potential manifested greatly from 8WAP to 12 WAP. This indicates that the plants extract is a slow acting insecticide and support the work of Okuku *et al.*, 2007; Adesina and Afolabii, (2014) who both reported the slow action of plant extract(s) in the control of coca mirids and Flea beetles on cocoa and okra respectively..

The lower number of fruits, fresh weight and yields recorded in control plots could be as resultant damage of leaves by high population of field insect during reproductive stage thereby destroying the photosynthetic apparatus of test crop which resulted in lower yields. In other words, this study suggests that leaf extracts of *Annona muricata* effectively reduced level of the insect infestations, which subsequently lead to high yield. This corresponds to the findings of other workers (Ogungobi and Ofuya 2007; Adesina and Idoko, 2013; Adesina and Afolabi, 2014) who reported that okra plants treated with the plant extracts recorded higher yield as compared to the yield of the untreated control.

In conclusion, this study shows that extracts of *Annona muricata*, which is readily available in our local environment all year round, could be exploited for successful formulation and commercialization of biopesticides, it is safe, easily biodegradable and environmentally friendly. It is recommended that the insecticidal potential of *Annona muricata* extracts be further explored in order to ascertain application rates that will be more efficacious in the control of insect pests of okra while attaining optimum yield in okra production

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APPENDIXES

Table 1: Effect of Treatment on Number of Infected Plant of Okra

	Mean Number of Infected Plant					
Treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
T ₁	0 ^a	2.2500 ^a	3.000 ^{ab}	6.500 ^a	7.0000 ^a	7.7500 ^a
T ₂	0 ^a	1.0000 ^a	2.500 ^{abc}	4.000 ^b	4.2500 ^b	4.2500 ^b
T ₃	0 ^a	0.2500 ^b	1.0000 ^{bc}	1.250 ^d	1.0000 ^d	1.0000 ^c
T ₄	0 ^a	0.7500 ^b	1.5000 ^{ab}	2.500 ^c	2.5000 ^c	2.50000 ^b
T ₅	0 ^a	0.2500 ^b	0.7500 ^c	1.000 ^e	1.2500 ^{cd}	1.2500 ^b

Means in the same column with the same letter are not significantly different (P<0.05)

Table 2: Effect of Treatment on Damaged Leaves on Okra Plant

	Mean Number of Damaged Leaves					
Treatments	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
T ₁	0 ^a	2.0000 ^a	3.7500 ^a	6.7500 ^a	8.5000 ^a	9.5000 ^a
T ₂	0 ^a	1.5000 ^{ab}	2.5000 ^a	3.0000 ^b	2.2500 ^b	1.2500 ^b
T ₃	0 ^a	0.7500 ^{ab}	2.2500 ^a	2.7500 ^b	1.7500 ^b	1.5000 ^b
T ₄	0 ^a	1.2500 ^{ab}	2.7500 ^a	2.7500 ^b	1.7500 ^b	1.7500 ^b
T ₅	0 ^a	0.2500 ^b	1.7500 ^b	1.7500 ^b	1.2500 ^b	1.2500 ^b

Means in the same column with the same letter are not significantly different (P<0.05)

Table 3: Effect of Treatment on Number of *Podagrica*

Mean Number of *Podagrica*

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
T ₁	0 ^a	2.250 ^a	5.0000 ^a	7.250 ^a	9.5000 ^a	9.5000 ^a
T ₂	0 ^a	0.750 ^a	2.7500 ^b	2.500 ^b	1.7500 ^b	1.0000 ^b
T ₃	0 ^a	1.500 ^a	2.0000 ^b	2.250 ^b	1.2500 ^b	1.0000 ^b
T ₄	0 ^a	2.250 ^a	3.0000 ^{ab}	2.250 ^b	1.5000 ^b	1.5000 ^b
T ₅	0 ^a	0.750 ^a	3.0000 ^{ab}	2.000 ^b	1.2000 ^b	0.5000 ^b

Means in the same column with the same letter are not significantly different (P<0.05)

Table 4: Effect of Treatment on Number *Mollusca* on Okra Plant

Mean Number of *Mollusca spp.*

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
T ₁	0	0	0.250 ^a	1.500 ^a	2.500 ^a	2.750 ^a
T ₂	0	0	1.000 ^a	0.250 ^a	0.750 ^b	0.000 ^b
T ₃	0	0	0.500 ^a	0.500 ^a	0.000 ^b	0.000 ^b
T ₄	0	0	1.000 ^a	0.750 ^a	0.000 ^b	0.000 ^b
T ₅	0	0	1.000 ^a	1.250 ^a	0.250 ^b	0.000 ^b

Means in the same column with the same letter are not significantly different (P<0.05)

Table 5: Effect of Treatment on Okra Yield and Its Components

Treatments	Mean Number of Fruits	Mean Fresh Weight(g)	Fruit Yield (kg/ha)
T ₁	12.250 ^c	18.57 ^{cb}	43. 50 ^c
T ₂	19.750 ^{bc}	34. 405 ^a	195. 48 ^{ab}
T ₃	21.750 ^b	32.169 ^b	182. 79 ^b
T ₄	24.500 ^b	33. 753 ^a	191. 85 ^{ab}
T ₅	35.750 ^a	43. 752 ^a	248. 59 ^a

Means in the same column with the same letter are not significantly different (P<0.05)