IJPAC : **13(1-2),** *(January-June 2018)*

The Management of the Flea Beetle. (*Podagrica uniformis)* on the Okro [*Abelmoschus esculentus* [L] Moench] using fresh extract of the Devil Bean [*Crotalaria retusa* L.]

Wie-Addo Kow Agyapanyin[1*], Botchey Mary[2], Mensah. A. Ben. [2] & Owusu-Ansah, Ernest[3]

[1]*Centre for Continuing Education, University of Cape Coast,Cape Coast, Ghana.*
[2]*Department of Entomology and Wildlife, University of Cape Coast,Cape Coast, Ghana.*
[3]*Department of Chemistry, University of Cape Coast, Cape Coast, Ghana.*

Abstract: The potential of the devil bean, *Crotalaria retusa* L. for the control of the flea beetle*, Podagrica uniformis* [Coleoptera: Chrysomelidae] on the Okro plant, *Abelmoschus esculentus* [L] Moench was investigated.

The investigation involved both laboratory and field studies using crude aqueous extracts of *C. retusa*. The flea beetles were given the option to select and eat either treated or untreated okro leaves with the crude extract in a choice and no-choice situations. The field studies involved the application of the crude extract of *C. retusa* onto a field of okro plants.

Laboratory studies revealed that *C. retusa* had antifeedant properties as a result the beetles preferred to eat significantly more of the okro leaves not treated with the crude extract [63.9+10.3%] than the treated okro leaves [5.5+24%], [t = 5.93; P<0.5].

In the field the crude aqueous extract of *C. retusa* significantly reduced the numbers of *P. uniformis* on the okro plants. Thus decreasing the damage caused to the leaves. [Crude extract: day 4 [053+0.34]. day 6 [1.07=0.42] and day 8 [1.3+ 0.50]. Water: day 4[2.20+ 0.48] day 6 [2.60+0.62] and day 8 [4.27+1.52].

Key words. *Podagrica uniformis*, *Abelmoschus esculentus*, *Crotalaria retusa*, antifeedant

Introduction

The introduction of the use of synthetic chemicals like D.D.T. in insect pest management has brought a lot of environmental hazards such as the destruction of other important flora and fauna.

Man is not spared from the hazardous effect of these chemicals as their accumulation in the food chain has led to diseases in man [1]. Attempts are being made to use extracts from plants to control insects or pests that attack crops on the field or manage post harvest losses. For instance, a research aimed at developing a neem-based insecticide for use in Canada found Azadiractin the active ingredient in the neem plant, to be a potent antifeedant against the pyradlid [*Ostrimia nubilis* [Huber] and the noctuid [*Peirdroma saucia*].

It was also found to have moulting-disrupting action against the acridid [*Melanoplus sanguinipes*] and the lygaeid [*Oncopeltus fasciatus]* [2]. Whilst in Nigeria, it has been found that the aqueous extracts and powders of both neem seed and the kernel to be effective in acting as an insecticide and also disrupting the development of two major cowpea pests, the larvae of the pyralid *Maruca testulalis* [Geyer] and the coreid *Clarigralla tomentosicollis* [3].

Neem products have been proved effective as insecticides, fungicides and nematocides. It is not surprising that the neem plant is described as the wonder plant in Indian agriculture [4]. As an insecticide both the

* *Corresponding author: eowusu_ansah@yahoo.com*

ethanol and aqueous extracts of neem seed kernel were used to inhibit the feeding of the scarabaeid

Apogonia blanchardi and thus controlled the pest, which was damaging flowers and leaves of rose in gardens in Delhi-India [5].

The Okro plant [Abelmoshus esculentus [L] Moench] belongs to the family Malvacae. It is an annual vegetable grown in the tropics and subtropics. It is very nutritious and rich in iron Investigations have shown that the fruits are somewhat better than legumes because they contain vitamins A and C [6].

A survey conducted in Puerto Rico on a number of *Crotalaria* spp showed that C. *retusa*; C. *stipularia* (Dill) and *C. lanceolata* were not susceptible to attacks by the lima bean pod borer *[Etiela zinckenalla* (Triensehike)] [7].

Experimental

Freshly prepared extract of the shoot of *Crotalaria retusa* was obtained by blending 160g of the shoot of *C. retusa* with 100 ml of water in a warning blender. The paste was mixed with 1800 ml. of water at a concentration of. 0.09 g ml^{-1} and then filtered with a suction filter. The filtrate was used for both the field studies and the "choice/ No choice" tests in the laboratory. The field studies were done in the Botanical Gardens of the University of Cape Coast.

Leaves from 5 days old okro seedling were used for the preference experiments. The leaves measured approximately 12–15 mm at their widest parts. The flea beetles [*P. uniformis*] were confined in a petri dish, which was lined with dry filter paper. Two leaves, one treated with shoot extract and the other untreated were placed in the petri dish. This was the "choice test. It was repeated mine times. Similarly two petri dishes were set up for the "No choice test". In one the beetles were provided with one untreated okro leaf and the other with a treated leaf. These were also repeated nine times.

The flea beetles were obtained from a field of okro plants by shaking them from okro leaves into a collecting jar. In the laboratory, the insects were immobilized by dropping a small ball of cotton wool soaked in chloroform into the jar. The jar was closed tight for 3-5 minutes. This treatment enabled easy transfer of the insects into the petri dishes.

After 24 hours, the leaves in each set of petri dishes were examined for any feeding activity by *P uniformis* and, in addition, mortality of *P. uniformis* in each petri dish was assessed. Damage caused by the feeding of the flea beetles was scored on the following damage rating by [8].

Size of leaf area (destroyed /eaten)	*Damage rating (%)*
less than one quarter of the leaf area is destroyed	25
when a quarter of the leaf area is destroyed	25
when half of the leaf area is destroyed	50
when three quarters of the leaf area is destroyed	75
when the whole leaf area is destroyed	100

Control experiments were also carried out with discs dipped in water. Each disc was considered a unit so that if a disc had only one nibbled hole, it is counted as having been eaten. The number of discs eaten and the number of discs not eaten, together with the mortality of *P. uniformis* in each experiment was recorded after 24 hours.

Field Studies

Field Studies were carried out in the Botanical Garden of the University of Cape Coast. A plot of 13 m by 11 m was prepared and divided into square plots of 3 m by 3 m. The plots were in rows 2 m apart. Each plot was planted with an early maturing variety of okro seeds, at a spacing of 75 cm between rows and 60 cm within rows. Each plot had 20 plants, in four rows of 5 plants each. Three plots were chosen randomly for each treatment, which comprised of an aqueous shoot extract of *C. retusa*, an organophosphate insecticide [Fenitrothion] and water for the control. The insecticide was applied at a concentration of 1 ml in 900 ml of water (0.001) and the extract at a concentration of 160 g in 1900 ml of water (0.08g ml^{-1}). The plant extract, the insecticides and water for control were applied four times, every two weeks, 14 days after emergence, until the fruiting period of the older plants. Records of the population of *P uniformis* were taken 4, 6, 8 and 10 days after the application of treatments. The flea beetles present on the upper and lower surfaces of the leaves of the okro plants for each of the five sampled plants were counted. The total number of the flea beetles from the 15 plants from the three plots for each treatment constituted the population of *P. uniformis* per treatment.

Leaf damage assessment was made from the two newly opened leaves near the apex of each of the five sampled plants. Holes freshly made within a 24-hour period by the beetles were assessed. Holes larger than 3 mm to 1 cm in diameter were not counted since the feeding of *P. uniformis*, usually produces small holes about a millimeter in diameter. Other phytophagous insects might have created holes bigger than 3 mm. The damage for each plant was assessed using the following class rating [8].

Feeding hole/range	*Rating*
0 – 9	0
10 – 19	1
20 – 29	2
30 – 39	3

The total class rating for all 3 plots for a particular treatment constituted the damage or consumption per treatment. Assessment of the population of *P. uniformis* and the leaf damage caused were recorded before application of each treatment and thereafter, daily assessment was made for 4 days after each treatment.

Results and Discussion

The Effects of Crude Aqueous Extract of The Shoot of C. retusa on The Population of P. uniformis on Okro Plants Field Studies

For the first application, the mean number of beetles per plant was low for the three treatments, i.e. water, extract and insecticide.

After the second application, the mean numbers of the beetles were low for all the treatments, however, they were higher than the numbers recorded for the first application (Table 1).

Moreover, the mean numbers of beetles recorded for the extract on day 4(0.53±0.34), day 6(1.07±0.42) and day 8(1.3±0.50) were lower than those recorded for the control. There was no difference between the mean numbers of beetles on the extract and insecticide treated okro plants.

At the time of the third application, the mean numbers of beetles had increased significantly on all the plots. However, 4 days after application the mean numbers recorded for the insecticide were lower than those for the extract and water. Furthermore the mean number of flea beetles on okro plants treated with the plant extract were lower (3.6±0.99) than those treated with water (11.07±2.0).

The mean number of beetles on the extract treated plants 4 days after application was not different from that on the insecticide-treated okro plants (1.87.±0.53). On the fourth application, the mean numbers of insects (flea beetles) per okro plant were high for all the treatments. For the insecticide, the mean numbers ranged from 0.53±0.22 to 4.47±0.86. The mean number of beetles on okro plants treated with water and the extract were higher than those on plants treated with insecticide. The numbers observed on plants treated with water and the extract during the fourth application were the same for the 10 days' period. The observation is the result of rains a day after the application that washed the extract off.

Furthermore, for the second and third applications, the differences in values recorded for the extract and the insecticide were statistically not significant for 4 days after application. Six days after the second application the values recorded for the extract and the insecticide were statistically not significant.

Table 2
The response of P. uniformis to okro leaves treated with crude C. retusa extract in the no-choice tests

Replicates	*With Crude Extract of C. retusa*		*Without Crude Extract of C. retusa*	
	Percentage Damage To Okroleaves	*Mean Mortality of P. Uniformis*	*Percentage Damage to Okro Leaves*	*Mean Mortality of P. Uniformis*
1	0	0	75	2
2	25	0	100	0
3	0	0	100	1
4	50	0	75	0
5	25	3	75	0
6	50	1	25	0
7	75	0	25	0
8	50	3	100	0
9	75	0	75	0
Mean±SE	38.9±9.42	0.08±0.15	72.2±5.56	0.03±0.08

• The initial number of flea beetles per petri dish was 10.

Laboratory Studies

The "No-Choice" Tests

The effects of the crude aqueous extract of *Crotalaria retusa* on the flea beetles are presented in Table 2. The flea beetles ate both the treated and untreated okro leaves. However, under no–choice situations, the quantity consumed (38.9±9.4%) of the okro leaves treated with the crude *C. retusa* shoot extract was less than the untreated okro leaves consumed (72.2±5.56%). The difference was significant (t=2.53; P<0.05).

The mortality of the flea beetles *Podagrica uniformis*, which fed on the treated okro leaves was 0.08±0.15% while that of those which fed on the untreated okro leaves was 0.03±0.08%.

Table 3
The response of *p. Unifromis* to okro leaves treated with crude *c. Retusa* extract in the choice tests

Replicates	*Percentage Damage to Okro Leaves*		*Mean*
	With Extract	*Without Extract*	*Mortality of P. Uniformis*
1	0	75	0
2	0	25	0
3	0	25	1
4	0	100	1
5	0	75	0
6	0	75	0
7	25	25	1
8	25	75	0
9	0	100	0
MEAN±SE	5.6 ± 3.7	63.9 ± 10.3	0.03 ± 0.06

*The initial number of flea beetles per petri dish was 10.

The difference in the mortality of the flea beetles that fed on the treated and untreated okro leaves was not statistically significant (t=0.23; P<0.05). This implies that the crude extract does not kill the flea beetles and the observed difference in mortality could be due to chance.

The "Choice '' Tests

Table 3 shows the preference of the beetles in the choice tests when they had the option to choose between treated and untreated okro leaves. The flea beetles showed preference for the untreated okro leaves. The damage (63.9±10.3%) caused to the untreated okro leaves was significantly higher than the damage (5.55+3.24%) caused to the treated okro leaves (t=5.93; P<0.05).

The mortality of the flea beetles exposed to the treated and untreated leaves under the choice situation was 0.03+0.06%. This revealed that the extract acted mainly as antifeedant.

Table I
The Effects of Crude of *C. retusa*, Insecticide and Water on *P.* uniformis

Treatments	*Mean Number of P. uniformis per okro plant days after application of Treatments*			
	4	*6*	*8*	*10*
Water	2.67±0.81	1.0±0.44	1.47±0.42	1.33±0.68
	2.20±0.48	2.60±0.62	4.27±1.52	2.93±0.70
	11.07±2.0	13.33±2.78	15.33±3.76	14.80±3.25
	12.87±2.03	16.40±3.42	14.73±2.78	12.46±3.05
Extract	1.0±0.29	0.53±0.26	0.27±0.15	0.93±0.32
	0.53±0.34	1.07±0.42	1.3±0.50	2.2±0.59
	3.60±0.99	9.87±2.14	11.07±2.84	8.93±1.73
	12.93±2.68	12.20±2.97	11.33±3.01	11.73±3.58
Insecticide	0	0.27±0.15	0.87±0.53	1.47±0.64
	0.07±0.07	0.73±0.21	2.60±0.53	2.93±0.86
	1.87±053	3.47±0.68	4.20±1.39	8.60±1.76
	0.53±0.22	0.80±0.22	2.47±0.52	4.47±0.86

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