



Comparative efficacy of botanicals in the management of *Podagrica* spp of okra (*Abelmoschus esculentus* L. Moench) in Yobe State Nigeria

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Abstract

An experiment was conducted in Potiskum; southern sudan savanna and Geidam; sahel savanna zones of Yobe state Nigeria to compare the effects of onion bulb extract and balanite fruit extract with the synthetic insecticide cypermethrin in the control of okra flea beetle *Podagrica* spp infesting okra. The experiment was laid out in split plot design with four treatments replicated three times. In each block the okra variety ladyfinger was assigned to the main plots while onion bulb extract (125 g/ l), balanite fruit extract (10% w/v), Cypermethrin (10 ml/ liter of water) and untreated- control were assigned to the subplot. Each experimental plot was sprayed with the treatments according to the experimental design. Parameters assessed include number of flea beetles (*Podagrica* spp) per plot, number of feeding holes per plant per plot, number of fresh fruit yield and plant height per plot. The data obtained revealed that in both locations (Potiskum and Geidam) significantly lower number of okra flea beetles and feeding holes on okra leaves were recorded in the plots sprayed with cypermethrin which was followed by the onion bulb extract and the balanite fruit extract treated plots while significantly higher number of flea beetles and feeding holes on okra leaves were recorded in the untreated controls. It was also observed that significantly higher mean number of fresh fruits per plant per plot and higher plant heights were recorded in the plots sprayed with the synthetic insecticides; cypermethrin which was followed by the onion bulb extract and balanite fruit extract treated plots while lower number of fresh fruits and plant heights were recorded in the untreated control. Both of the two tested botanicals are as effective as the synthetic insecticide; cypermethrin and both can be recommended for use by the resource poor farmers since both botanicals are cheap and readily available in the two location.

Keywords: *Abelmoschus esculentus*, onion bulb extract, balanite fruit extract, flea beetle, *Podagrica* SPP

Introduction

Okra, *Abelmoschus esculentus* (L) Moench is one of the most important vegetable crops known world-wide. It is one of the most important vegetable crops grown in Nigeria; Its seed contains oligomeric catechins (2.5mg/g of seeds) and flavonol derivatives (3.4mg/g of seeds), while the mesocarp is mainly composed of hydroxycinnamic and quercetin derivatives (0.2 and 0.3mg/g of skins). Pods and seeds are rich in phenolic compounds with important biological properties like quatering derivatives, catechin oligomers and hydroxycinnamic derivatives (Arapitsas, 2008) [1]. These properties, along with the high content of carbohydrates, proteins, glycol-protein, and other dietary elements enhance the importance of this foodstuff in the human diet (Arapitsas, 2008) [1]. The crop is grown at elevation of 1600 m. Okra is sensitive to frost and temperatures below 12°C (www.infonet-biovision.org-okra). It can be grown on a wide range of soils but grows best on a well-drained sandy loam with a PH ranging from 6- 7 with high organic matter (Akanbi *et al.*, 2010) [2]. It is grown on about two (2) million hectares annually in Nigeria (FMAWRRD, 1989) [3]. Its cultivation is gaining popularity in the Sudan Savannah region of Nigeria because of its high demand and economic return being derived by both youth and women (Degri, 2010) [4].

The production of Okra in Nigeria like in many other African countries is associated by so many insect pests which results in poor production. These insect pests include *Zonocerus variegatus*, *Helicoverpa armigera*, *Bermicia tabacci*, *Podagrica* SPP etc. Among these insect pests the *podagrica* spp is a major insect pest of Okra in Nigeria. The beetles appear immediately after the first rain and a large number of them may be observed feeding on the leaves, tender stems or growing tips of okra plant (Degri and Okafor, 2009) [5] it was also reported that the adult flea beetle causes damage not only on the leaves and flowers of okra plant but also causes pre-mature falling of pods, Komolafe (1997) [6]. This reduces the photosynthetic capacity of the leaves with consequent reduction in yield. In case of serious attack, the whole plant may be defoliated (Iremare, 1988) [7]. Similarly, Hill (1983) [8] reported that infestation of okra plant by *Podagrica* spp. could lead to stunted growth and delayed fruit setting with a marked reduction in yield.

Farmers in most okra producing area in Nigeria like other parts of the world rely on synthetic insecticides to control and manage the flea beetle. The use of synthetic insecticides is however associated with so many disadvantages such as introduction of toxic residues into the food of man and other mammals, environmental pollution, destabilizes the micro-ecosystem by eradicating natural enemies, development of

insecticide resistance strains by insects and increases pest population levels. Therefore, it has become necessary to manage okra flea beetle due to its high economic damage to okra crops in a way that neither the environment nor human beings and other mammals are harmed.

Several plant extracts and powders are effectively used in the management of insect pests of field crops such as okra. These plant products belonged to many plant families of both annual plants and perennial plants. In general botanical insecticides are considered (with some exceptions) as plant protection which are environmentally safe and harmless to health. In the present world, botanical insecticides are often applied where the production of safe food stuffs is expected. Safe food stuffs are produced especially by ecological farms. Beside ecological producers, plant insecticides have been used ever more by vegetable producers to provide protection against common greenhouse pests, such as aphids, spider mites, flea beetles, or caterpillars of phytophagous Lepidoptera (Isman, 2005, 2006; Pavela 2007) ^[8, 9, 10]. As a result of these, in this study, the botanicals; onion bulb extract and balanite fruit extracts were used for the management of okra flea beetle which causes high losses to okra crop. At the end of this study this method shall reduce the farmer's reliance on the use of synthetic pyrethroids as the only means of controlling okra pests particularly okra flea beetle.

This study focusses mainly on the investigation of the effects of onion bulb extract and balanite fruit extracts as insecticides in the management flea beetle affecting okra plants.

Materials and method

Experimental site

The experiment was conducted at Potiskum; Southern sudan savanna and Geidam; Sahel savanna zones of Yobe state Nigeria between July to November 2023, during the raining season.

Source of planting materials

The variety of okra lady finger was used in this research as it is commonly cultivated by the farmers in Yobe State. The seed was sourced from Yobe State Agricultural Development Program (YOSADP).

Source of synthetic insecticide

The synthetic insecticide cypermethrin was purchased at the market in Damaturu, Yobe State, Nigeria.

Source of plant materials

The desert date (*Balanites aegyptiaca*), and onions (*Allium cepa*)

Extracts of the fruits of desert date and Onion bulb was prepared from the desert dates and onions purchased at Geidam Local Government Area of Yobe State.

Extraction of plant materials

Extraction of the desert date fruits and Onion bulbs were carried out manually.

Extraction of onion bulb extract

Five hundred grams (500 g) of onions was mixed with two liters of water (2 lit.) which was grounded with a blender to obtain an onion juice. The onion bulb juice obtained was thoroughly mixed with additional two liters of water. The

mixture was then sieved using a fine cloth to obtain an onion bulb extract and this was ready for spray using a knapsack sprayer at a concentration of 125 g/l.

Extraction of desert date extract

A fresh, clean fruits of desert date was sun dried and pounded using pestle and mortar which was sieved. About 50g of the powder obtained was weighed and soaked in 100 ml of water (w/v) for about 24 hours. The liquid obtained was then squeezed and sieved using a fine Mushin cloth. The final volume was adjusted to 10% (w/v) concentration of the desert date fruit extract which was sprayed on the crop using a knapsack sprayer.

Cultural practices

Land preparation

The land was cleared, harrowed by a tractor and leveled manually using a hoe into plot of units of 5 m x 4.5 m.

Planting

The Okra seeds obtained was planted directly in the prepared plots during rainy season at a standard spacing of 60 cm x 60 cm inter and intra row spacing. Four seeds were planted per hole and later it was reduced to two plants per stand. Where germination fail replanting of seeds was done one week after germination in order to ensure maximum stand population.

Experimental design and treatments

The experiment was conducted between July to November of 2023 under raining condition. The Okra Variety Lady finger was used in the experiment. The experiment consists of four (4) treatments namely: Onion bulb extract (125 g/l), Balanites fruits extract (10% w/v), Cypermethrin (10 ml/liter of water) and Contol (0 g/l). The experiment was laid out in split plot design with three replications. In each block the okra variety ladyfinger was assigned to the main plots while four (4) treatments namely: Onion bulb extract (125 g/l), Balanites fruits extract (10% w/v), Cypermethrin (10 ml/liter of water) and Contol (0 g/l) were assigned to the sub-plots. Each experimental plot was sprayed with the treatments according to the experimental design. Spraying of treatments was done using a knapsack sprayer at a weekly interval. The experiment consists of 4 plots/replication with a total of 12 sub-plots for the three replications, each plot measures 5 m x 4.5 m separated from each other by 1 m alley and 2 m was kept between borders.

Data collection

Number of flea beetle/Plot

Data on the number of flea beetle per plot was determined by directly counting the number of flea beetles from each plant in each plot at three (3), six (6) and nine (9) weeks after planting.

Number of feeding holes/ plant/ plot

This was determined by directly counting and recording the number of holes on Okra leaves per plant per plot at three (3), six (6) and nine (9) weeks after planting.

Fresh fruit yield

Number of fruit per each plot was determined by directly counting the total number of okra produced after nine weeks of planting.

Plant height

Height of plants was taken at three (3), six (6) and nine (9) weeks after planting by measuring each plants per plot from ground level up to the apical bud of the plant using a measuring tape.

Data analysis

All data collected were subjected to analysis of variance (ANOVA). Significant means were separated using least significant difference (LSD) at 5% probability level

Results and discussion

Results obtained in this study showed that significant differences exist among the treatments used in the control of okra flea beetle; podagrica spp infesting okra in the two study zones.

Number of flea beetles

Table 1 presents results on the effect of onion bulb extract, balanite fruit extracts and cypermethrin on the number of flea beetles/plot on okra plant at 3, 6, and 9 Weeks After Planting (WAP) in Geidam and Potiskum. It can be observed that significantly higher number of flea beetles were recorded in the untreated controls in both Potiskum and Geidam, while significantly lowest number of flea beetles were recorded in the cypermethrin treated plots which were followed by the onion bulb extract and balanite fruit extract treated plots. In 3 WAP, it can be observed that in Potiskum Significantly higher number of flea beetles were recorded in the untreated control (40.38^a), while the lowest number of flea beetles was recorded in the cypermethrin treated plots (12.91^d) which were followed by the onion bulb extract (25.88^b) and balanite fruit extract (21.81^b) treated plots respectively. Similar results were recorded at 6 WAP and 9 WAP. This result is in agreement with that of Musa *et al.*, (2013) [11] who reported that application of *A. squamosa* and *T. vogelii* plant extracts significantly reduced the population Podagrica spp. Khadija *et al.*, (2023) [12] also revealed that applying different concentrations of aqueous neem leaf extracts in managing podagrica spp infesting different varieties of Roselle; *Hibiscus sabdariffa* can significantly reduce flea beetle population when compared with untreated control. Olaniran *et al.*, (2016) [13] also reported that *A. squamosa* and *M. oleifera* extracts showed insecticidal properties against Podagrica spp infesting okra. Amugi *et al.*, (2012) [14] reported that plant extracts conferred significant protection to okra with the synthetic insecticide; Lambda-cyhalothrin in the control of flea beetles.

Number of feeding holes on okra leaves

Table 2 present result on the effect of onion bulb extract, balanite fruit extracts and cypermethrin on the mean number of holes on okra leaves /plant/plot at 3, 6, and 9 Weeks After Planting (WAP). In both locations cypermethrin treated plants significantly had lower number of holes on okra leaves which is followed by onion bulb extract and balanite fruit extract treated plots. Significantly higher number of holes on okra leaves was recorded on the untreated controls. In Potiskum, at 9 WAP, significantly lower number of holes on okra leaves was recorded in the cypermethrin treated plots (2.44^d) which is followed by onion bulb extract treated plots (3.20^c) and balanite fruit extract treated plots (3.61^c), Significantly higher number of

holes on okra leaves was recorded in the untreated control (7.68^b). Similar result was recorded in Geidam at 9 WAP in which the number of holes recorded on okra leaves after treatment with cypermethrin, onion bulb extract, balanite fruit extract and untreated control were 2.58^d, 3.58^c, 3.66^c and 7.33^a respectively. Similar results were recorded at 3 WAP and 6 WAP. This result corroborates with that of Danjuma *et al.*; (2020) [15] who revealed that applying plant extracts from *Z. zanthoxyloides* and *P. biglibosa* performed significantly ($p < 0.05$) better than untreated control in reducing holes on okra leaves as a result of infestation by Podagrica spp. Similarly, Silas, *et al.*; (2011) [16] reported that spraying balanites products at 10% w/v concentration at 7 days' spray interval can be used to control insect pest of vegetable plants such as podagrica spp. The results of this finding also corroborated with the findings of Parh *et al.*, (1997) [17] who reported that significantly higher beetle infestation and number of holes on okra leaves was recorded in the untreated okra plot to those of the plots treated with the botanical neem seed extract. Similarly, Dzemo *et al.*, (2010) [18] reported that aqueous plant extracts can significantly reduce the infestation of leaf borers, pod borers and pod sucking bugs (PSBs) on cowpea thereby reducing leaf, pod and seed damage and increasing grain yield. Stoll (2000) [20] also observed extract of onion bulbs to be effective against leaf eating insect pests.

Number of fruits

Table 3 presents result on the effect of onion bulb extract, balanite fruit extracts and cypermethrin on the mean number of okra fruits/plot at nine weeks after planting (9 WAP). The data obtained revealed that in both locations significantly higher number of okra fruits was recorded in the cypermethrin treated plots, which was followed by onion bulb extract and balanite fruit extract treated plots, while significantly lower number of okra fruits was recorded in the untreated control. In Potiskum the mean number of okra fruits recorded after treatment with cypermethrin, onion bulb extract and balanite fruit extracts were 8.27^a, 6.95^b, 6.67^b and 5.15^c respectively. Similar results were recorded in Geidam in which the mean number of okra fruits recorded after treatment with cypermethrin, onion bulb extract and balanite fruit extracts were 9.19^a, 7.80^b, 7.75^b and 5.06^c respectively. This finding is in line with that of Degri, (2010) [21] who reported that the bioactivity of saponins compounds present in *B. aegyptiaca* help in reducing the severity of the insect pest infestation in the field thereby improving the growth and yield of crop in the areas where they are grown. This observation is also in line with that of Isman, (2014) [22] who reported that there is a correlation between the insect infestation and crop yield since the synthetic insecticide and botanicals treated plots produced the highest yields and the untreated control produced lowest yield. In a similar finding by Mochiah *et al.*, (2011) [23], it was observed that vegetables in which botanicals were applied produced the highest mean fruit weight and fruit numbers of okra and eggplant. This observation corroborates with Aderolu *et al.*, (2012) [24], who reported that neem leaf extract, modified neem leaf extract and wood ash enhanced better yield of Amaranthus when compared with untreated control.

Plant height

Data recorded on the effect of onion bulb extract, balanite fruit extracts and cypermethrin on okra plant height after three, six and nine weeks after planting (3, 6 & 9 WAP) in Potiskum (southern sudan savannah) and Geidam (Sahel savannah) are presented in table 4. The results obtained showed that in both the study zones significantly higher plant heights were recorded in the cypermethrin treated plots, which were followed by onion bulb extract treated plots which was followed by the balanite fruit extract treated plots, significantly lower plant height were recorded in the untreated controls. It can be seen from table 1 that after three weeks of planting in Potiskum significantly higher plant height was recorded in the cypermethrin treated plots (8.16^a) and the onion bulb extract treated plots (8.06^a) which were followed by balanite fruit extract treated plots (7.82^b), significantly lower plant height was recorded in the untreated control (6.93^d). Similarly, in Geidam significantly higher plant height was recorded in cypermethrin treated plots (9.07^a) and onion bulb extract treated plots (8.99^a) which are followed by balanite fruit extract treated plots (7.32^b) while lower plant height was recorded in the untreated control. Similar results were observed in six weeks after planting (6WAP) and nine weeks after planting (9WAP). The results obtained from this work agrees with the work of Odewole *et al.*, (2014) [25] who reported that plant extract applied singly and in combination with cypermethrin increased okra plant height and yield. Also, Damilola *et al.*, (2020) [26] reported that *Moringa olifera* extracts applied at the rate of 1:30 and 1:40 at six weeks after application significantly increased okra plant height over the untreated control.

Table 1: Effect of Onion bulb extract, Balanite fruit extract and cypermethrin on the mean number of flea beetle of okra/plot in Geidam and Potiskum, Nigeria

Treatments	3 WAP		6 WAP		9 WAP	
	Potiskum	Geidam	Potiskum	Geidam	Potiskum	Geidam
T ₁	40.38 ^a	37.10 ^a	44.86 ^a	48.17 ^a	50.95 ^a	48.92 ^a
T ₂	25.88 ^b	23.65 ^b	30.38 ^b	26.09 ^c	27.10 ^c	23.74 ^b
T ₃	21.81 ^b	20.34 ^b	21.87 ^b	21.32 ^c	25.98 ^c	20.84 ^b
T ₄	12.91 ^d	11.89 ^d	12.61 ^d	12.23 ^d	14.76 ^d	14.90 ^d
LSD	9.55	8.66	10.09	10.06	11.07	9.88

Means followed by similar letter(s) along the column are not statistically different at 5% probability level, T1= Untreated control, T2= Balanite fruit extract, T3= Onion bulb extract, T4= Cypermethrin (10 ml/ liter of water), LSD= Least significant difference, WAP= Weeks after planting.

Table 2: Effect of Onion bulb extract, Balanite fruit extract and Cypermethrin on the mean number of feeding holes on okra leaves /plants/plot in Geidam and Potiskum, Nigeria

Treatments	3 WAP		6 WAP		9 WAP	
	Potiskum	Geidam	Potiskum	Geidam	Potiskum	Geidam
T ₁	5.13 ^a	4.20 ^a	6.40 ^a	6.33 ^a	7.68 ^a	7.33 ^a
T ₂	3.02 ^c	2.93 ^c	4.82 ^b	4.00 ^b	3.61 ^c	3.66 ^c
T ₃	2.99 ^c	2.89 ^c	3.96 ^c	3.85 ^b	3.20 ^c	3.58 ^c
T ₄	2.80 ^d	2.62 ^d	2.99 ^d	3.00 ^c	2.44 ^d	2.58 ^d
LSD	0.62	0.50	0.91	0.84	1.28	1.18

Means followed by similar letter(s) along the column are not statistically different at 5% probability level, T1= Untreated control, T2= Balanite fruit extract, T3= Onion bulb extract, T4= Cypermethrin (10 ml/ liter of water), LSD= Least significant difference, WAP= Weeks after planting

Table 3: Effect of Onion bulb extract, Balanite fruit extract and Cypermethrin on the mean number of fruits/plot in Geidam and Potiskum, Nigeria at nine weeks after planting (9 WAP)

Treatments	Number of fruits/plot	
	Potiskum	Geidam
T ₁	5.15 ^c	5.06 ^c
T ₂	6.67 ^b	7.75 ^b
T ₃	6.95 ^b	7.80 ^b
T ₄	8.27 ^a	9.19 ^a
LSD	1.03	1.38

Means followed by similar letter(s) along the column are not statistically different at 5% probability level, T1= Untreated control, T2= Balanite fruit extract, T3= Onion bulb extract, T4= Cypermethrin (10 ml/ liter of water), LSD= Least significant difference

Table 4: Effect of Onion bulb extract, Balanite fruit extract and Cypermethrin on Plant height (cm)/plot in Geidam and Potiskum, Nigeria

Treatments	3 WAP		6 WAP		9 WAP	
	Potiskum	Geidam	Potiskum	Geidam	Potiskum	Geidam
T ₁	6.93 ^d	6.77 ^d	20.5 ^d	20.0 ^d	117.7 ^d	103.6 ^d
T ₂	7.82 ^b	7.32 ^b	25.4 ^b	25.3 ^b	126.9 ^c	114.5 ^c
T ₃	8.06 ^a	8.99 ^a	28.7 ^a	28.3 ^a	140.9 ^a	130.4 ^a
T ₄	8.16 ^a	9.07 ^a	29.4 ^a	28.6 ^a	149.0 ^a	140.3 ^a
LSD	0.34	0.57	2.11	1.69	10.08	11.7

Means followed by similar letter(s) along the column are not statistically different at 5% probability level, T1= Untreated control, T2= Balanite fruit extract, T3= Onion bulb extract, T4= Cypermethrin (10 ml/ liter of water), LSD= Least significant difference, WAP= Weeks after planting

Conclusion

It can be concluded from this study that both onion bulb extract and balanite fruit extract are as effective as the synthetic insecticide cypermethrin in the protection of okra against the flea beetle; podagrica spp in both the two locations. It is recommended that the extracts of onion bulb and balanite fruit should be produced in commercial quantities for use by the resource poor farmers in the two zones since the use of synthetic insecticides are cost effective and associated with health hazards.

Acknowledgement

We are thankful to Tertiary Education Trust Fund (Tetfund) for giving us the financial support in conducting and publishing this research work.

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