Agrosearch, 21(1&2), 80-88, (2022) https://dx.doi.org/10.4314/agrosh.v21i1-2.7

EFFECTS OF SOME BOTANICAL EXTRACTS ON THE CONTROL OF MAJOR INSECT PESTS OF OKRA IN THE SUDAN SAVANNAH AGRO-ECOLOGICAL ZONE OF NIGERIA

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ABSTRACT

Two location trials were conducted in 2018 dry season at the Teaching and Research Farm, Faculty of Agriculture, University of Maiduguri (Unimaid) and demonstration site of the Mohamet Lawan College of Agriculture (MOLCA) Maiduguri to assess the insecticidal potentials of three botanicals and a control in the management of *Attractomorpha acutipennis*, *Amarasca biguttula biguttula, Aphis gossypii* and *Bemisia tabaci* infestation on okra. These treatments were laid out in randomized complete block design **(**RCBD) replicated three times. Data collected include the number of damaged and undamaged leaves and the number of insect pests. Using Analysis of variance (ANOVA), results showed that the extracts significantly ($p < 0.05$) reduced the population of the insects and the number of damaged leaves when compared with control in both locations. Plots treated with *Balanite aegytiaca* extract recorded the lowers population of *Attractomorpha acutipennis*, *A. biguttula biguttula, A. gossypii* and *B. tabaci*. Similarly, *Balanite aegytiaca* extract recorded the lower leaves damaged than plots treated with *Eucalyptus camaldulensis* extract in both locations. Among all the treatments evaluated, Plots treated with *Balanite aegytiaca* extract significantly recorded the least number of *A. gossypii* and *A. biguttula biguttula* in both locations. However, plots treated with *Balanite aegytiaca* extract significantly gave the least number of *B. tabaci* at MOLCA while plots treated with *Eucalyptus camaldulensis* extract gave the least number of the insect at UNIMAID. There was no significant difference in the performance of *Balanite aegytiaca* and *Eucalyptus camaldulensis* extract. *Balanite aegytiaca* extract also recorded the least number of damaged leaves in both locations.

Keywords: *Balanite aegytiaca*, *Ricinus communis*, *Eucalyptus camaldulensis* Okra, Grasshopper, Leafhopper, Aphid, Whiteflies

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) family Malvaceae, is one of the most important sources of nutrition (4550 kcal/kg) for human consumption. It ranks first before tomato, eggplant, and most of the cucurbits (Babatunde *et al.*, 20017). The crop is widely grown both as irrigated and as rain-fed in Northern Nigeria. The plant is a robust erect herb 1-2m tall depending on the variety and the fruit has high mucilage content. It grows well on the lowlands of tropics and sub-tropics under warm temperatures, but the best variety of okra is produced on well manure soil (Mays *et al*., 2012). Okra is a good source of dietary fibers and distinct seed protein balance in both lysine tryptophan and amino acid, unlike the proteins of the pulse (Hassan and Jamil, 2015). The fruits also serve as a soup thickener. Okra fiber content is made up of both soluble and insoluble fibers. The soluble fiber of okra helps to prevent diabetes and high blood cholesterol while insoluble fiber regulates the function of the digestive system (Sohail *et al*., 2015).

In spite of the nutritional value of okra, its production in Nigeria is faced with a number of limitations among which is insect damage. So many insect pests attack okra plants from planting up to harvesting (Hassan and Jamil, 2015, Sohail *et al*., 2015). Among these insect pests, the most frequent and destructive are aphids; they cause 9 to 10% reductions in yield at vegetative stages as well as the severity of the attack (Hassan and Jamil, 2015). Jassid and whitefly cause heavy damage that leads to economic loss by sucking cell sap from tender leaves and reducing the yield (Pimentel, 2012). To decrease such yield losses in Nigeria about 15,000 metric tons annually of pesticides are used, thus making Nigeria one of the largest pesticide users in Sub-Saharan Africa (Sohail *et al*., 2015). Farmers depend on synthetic insecticides to curb the menace of insect pest infestation, which has led to increased production cost, environmental pollution, pesticide resistance, elimination of beneficial fauna and different human health problems. The World Health Organization and the United Nations Environmental Program 2016 estimate that each year, three million workers in agriculture experience severe poisoning from synthetic pesticides and about 18000 of whom die, and as many as 25 million workers in developing countries may suffer mild pesticide poisoning yearly (Gogate, 2016). Although these pesticides are effective, they are expensive, imported, and persistent in the environment. These problems emanating from synthetic chemicals necessitated the idea of developing effective, cheap and easily biodegradable alternative products. The use of bio-pesticides by researchers in recent times as a possible replacement for synthetic insecticides is because they are easily biodegradable, environmentally friendly, safe, more readily available, easy to formulate and affordable (Gogate, 2016). This study, therefore, evaluates the efficacy of leaf ethanolic extract

of *Balanite aegytiaca*, *Ricinus communis*, and *Eucalyptus camaldulensis* for the control of *Attractomorpha acutipennis*, *Amarasca biguttula biguttula, Aphis gossypii* and *Bemisia tabaci* of okra fruits in Sudan Savannah agro-ecological zone of Nigeria.

MATERIALS AND METHODS

Experimental Sites

Field trials were conducted at Teaching and Research Farm of the Faculty of Agriculture, University of Maiduguri (UNIMAID) (11^0 15' 0"N and 13^0 51' 0"E) and Demonstration Site of the Mohamet Lawan College of Agriculture, Maiduguri (MOLCA) (11^0' 5"N and 13^0' 5"E) under irrigation in October 2018 seasons. Both locations are in the Sudan Savannah Agro-ecological zone of Nigeria. The soil of the area is sandy loam (Chiroma *et al*., 2004). The experiment was laid out in a randomized complete block design (RCBD) with four treatments replicated three times. Treatments tested include three botanicals (leaf ethanolic extract of *B. aegytiaca*, *R. communis*, *E. Camaldulensis*) and control. The entire field was cleared, ploughed, harrowed. The surrounding secondary vegetation was cleared with cutlasses and hoes and the debris removed from the site (Ojiako *et al*., 2018). The experimental units comprised 28 beds, each measuring 2.0 m x 2.0 m in size with 1.0 m inter plot space, 1.5 m alley and 1.5 m outside border prepared. The total area of the land used for the trial was 175 m^2. Okra seeds were sown to the field at the spacing of 60 cm between rows and 30 cm between plants and 2 seeds were sown per hole maintaining the depth of 2 cm, giving a total of 15 stands per plot. Those stands that failed to germinate after one week of planting were supplied to get the accurate number of stands on each bed. The first and second weeding was done manually two and six weeks after sowing, respectively. Water was supplied to the plants thrice a week.

Preparation and Application of Treatments

Mature leaves of *B. aegytiaca*, *R. communis* and *E. camaldulensis* were collected at the University of Maiduguri campus. The plant materials were washed, air-dried for four days under shade at the prevailing temperature of the immediate surrounding (32°C). The dried leaves were pounded using pestle and mortar into fine powder. 100g of each plant powder was measured using the Camry™ weighing scale in the laboratory unto which 500 ml of ethanol was added and then stirred. The supernatant of each plant material was left for 24 hours, and thereafter, filtered through a 1.0 mm sieve into a plastic bottle. The treatments (extracts from each of the three plant materials were applied on the plots with a 2 L capacity manually operated hand sprayer.

This commenced two weeks after crop establishment and was done at one week interval and for six times.

Data Collection

Number of damaged and undamaged leaves

Crop damage was assessed based on the number of holes/punctures on the leaves, number of defoliated leaves, yellowing, leaf curling, and spots on the leaves per plot.

Number of *A. acutipennis*, *A. biguttula biguttula, A. gossypii* and *B. tabaci* per plant

Insect collection and identification started ten days after crop emergence. This was done using the direct count method by carefully walking along the rows of each plot and counting the number of insects seen and at four-day intervals in the early hours of the day (6.00 am). Assessment of infestation was based on the population of the insect pests.

Insects were collected in sample bottles and preserved in 70% ethanol and later taken to the Insect Museum of the Department of Crop Protection, Institute for Agricultural Research Ahmadu Bello University Zaria for identification.

Adult *Attractomorpha acutipennis*

Data Analysis

Data collected from the trial were subjected to statistical analysis. Analysis of variance (ANOVA) tests was conducted and means were separated using the least significant difference (LSD) at 5% level of probability.

RESULTS

Table 1 shows the effects of extracts of *B. aegyptiaca*, *R. communis*, *E. camaldulensis* on the number of damaged and undamaged leaves of okra in two locations in Maiduguri, There was no significant ($p > 0.05$) difference in the number of damaged leaves between the plant extracts in MOLCA and UNIMAID locations. In MOLCA, plots treated with *R. communis* had a significantly ($p < 0.05$) higher number of undamaged leaves than the control. In UNIMAID, *R. communis* and *B. aegyptiaca* had a significantly higher number of undamaged leaves than the control. Also in UNIMAID, it was observed that plots treated with *E. camaldulensis* gave a reduced number of undamaged leaves which was not significantly different from the control.

Table 1: Effects of plant extracts on the number of damaged and undamaged leaves on okra per plant in 2018

	Damaged leaves		Undamaged leaves	
Leaf extracts	**MOLCA**	**UNIMAID**	**MOLCA**	**UNIMAID**
R. communis	24.33	29.44	29.22	25.33
E. camaldulensis	25.00	19.67	25.44	17.22
B. aegyptiaca	19.00	19.00	26.00	22.11
Control	68.89	55.11	20.67	11.33
$LSD_{(0.05)}$	7.89	10.89	6.21	10.14

Table 2 represents effects of leaf extracts of *B. aegyptiaca*, *R. communis*, *E. camaldulensis* on the population of *A. gossypii* and *B. tabaci* on okra, All the treatments were significant in reducing the mean population of *A. gossypii* and *B. tabaci* in both locations compared to the control. *B. aegyptiaca* extracts induced a reduction of *A. gossypii* and *B. tabaci* on treated plots. Similarly, In the two locations, *E. camaldulensis* and *R. communis* extracts significantly ($p < 0.05$) reduced the population of the insect pests compared to the control. However, there was a significantly higher population of *A. gossypii* and *B. tabaci* on plants treated with control plots in both locations.

Table 2: Effects of plant extracts on the population of *A. gossypii* and *B. tabaci* on okra per plant in Maiduguri, 2018

	Population of *A. gossypii*		Population of *B. tabaci*	
Leaf extracts	**MOLCA**	**UNIMAID**	**MOLCA**	**UNIMAID**
R. communis	25.00	20.11	19.65	28.00
E. camaldulensis	23.78	17.00	15.44	15.33
B. aegyptiaca	18.67	16.89	13.00	21.33
Control	64.89	55.78	59.00	63.00
$LSD_{(0.05)}$	7.85	11.69	9.17	7.85

Results in Table 3 show the effects of leaf extracts of *B. aegyptiaca*, *R. communis*, *E. camaldulensis* on the population of *Attractomorpha acutipennis* and *A. biguttula* on okra in Maiduguri. In MOLCA there was no significant ($p>0.05$) difference in the mean population of *A. acutipennis* in plots treated with all the leaf extracts. Similarly, in UNIMAID there was a significantly ($p < 0.05$) higher mean population of *A. acutipennis* on the plots treated with *R. communis* extract. Also, There was no significant ($p>0.05$) difference in the population of *A. acutipennis* on plots treated with *B. aegyptiaca* and *E. camaldulensis* extract.

In MOLCA there was no significant ($p > 0.05$) difference in the population of *A. biguttula biguttula* recorded in plots treated with *R. communis* and *E. camaldulensis*. Also, there was no significant difference in the population of *A. biguttula biguttula* recorded in plots treated with *E. camaldulensis* and *B. aegyptiaca.* Similarly, there was no significant difference in the population of *A. biguttula biguttula* recorded in *R. communis* and *B. aegyptiaca.*
Similarly, in UNIMAID there was significantly ($p<0.05$) higher population of *A. biguttula biguttula* in plots treated with Plant extracts compared to the control. The plots treated with *R. communis* extract had the highest number of *A. biguttula biguttula* followed by *E. camaldulensis* and then *B. aegyptiaca* which had the least number of insect. The highest mean population of *A. acutipennis* and *A. biguttula biguttula* were observed on the untreated, control plots in both locations.

Table 3: Effects of plant extracts on the Population of *Attractomorpha acutipennis* and *A. biguttula* on Okra per Plant in 2018

	Population of *A. acutipennis*		Population of *A. biguttula*	
Leaf extracts	**MOLCA**	**UNIMAID**	**MOLCA**	**UNIMAID**
R. communis	21.00	30.89	21.00	23.11
E. camaldulensis	20.67	23.89	18.22	22.67
B. aegyptiaca	17.89	23.44	15.56	17.44
Control	50.55	55.78	58.11	59.78
$LSD_{(0.05)}$	8.31	11.03	5.35	12.03

DISCUSSION

The results of this study have shown that the application of plant-derived insecticides significantly reduced the population of grasshopper, leafhoppers, aphids and whiteflies on okra plants, thereby minimizing leaf damage compared to the control. Also, there were lower populations in plots treated with *B. aegyptiaca* extract. This showed that *B. aegyptiaca* extract reduced these insect pest populations by forcing them to move to an alternative host (Adesina and Afolabi (2014)). These research findings support the earlier reports of Emimal (2010) that plant extracts consist of complex mixtures of bioactive constituents and plant metabolites which produce toxic effects if ingested by the insect pests and lead to rejection of host plants. The highest reduction recorded in plots treated with *B. aegyptiaca* leaf extract as compared to leaf extract of *R. communis* and *E. Camaldulensis* was in accordance with the findings of Fasunwon (2010) showed that *E. Camaldulensis* leaves were found to be the least effective against *Aedes aegypti* when compared with *Anona squamosa, Azidirachta indica* and *Codiacum variegatum*.

Fasunwon (2010) reported that *Podagrica* spp. attack the lamina of the foliage which results in a reduction of the photosynthetic ability of crop leaves. Their reports corroborate the findings of this present study that okra if left unprotected in the field will record a high defoliation rate as a result of infestation by grasshopper, leafhoppers, aphids and whiteflies. Findings from this study reveal that all the plant-derived insecticides significantly reduced the population of these insect pests, thereby reducing their infestation and enhanced plant growth. These findings agree with the reports of Ogunjobi and Ofuya (20017), Adesina and Idoko (2013) and Adesina and Afolabi (2014), who reported in their various works that okra plants treated with plant extracts recorded higher growth as compared to the untreated okra plants.

CONCLUSION AND RECOMMENDATION

The plant extracts were effective in reducing the number of insects and damaged leaves of okra. However, *B. aegyptiaca* leaf extract proved to be the most promising plant extract with the least number of insect pests and damaged leaves. Thus, *B. aegyptiaca* could be a reliable candidate of okra in the Sudan Savannah Agro-ecological zone of Nigeria.

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