Journal of Horticulture
OPEN ACCESS Freely available online
Research Article

Assessment of *Moringa oleifera* as Bio-Pesticide against *Podagrica spp* on the growth and yield of Okra (*Abelmoschus esculentus L. Moench*)

Adefisoye Mabel Damilola[1]*, Morakinyo Fasipe Olutoye Temitope[2]

[1]*Teaching and Research Farm, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria;* [2]*Department of Crop Science and Production, College of Agricultural Sciences, Joseph Ayo Babalola University, Ikeji- Arakeji, Osun State, Nigeria*

ABSTRACT

In the A field experiment was carried out to determine the effects of varying concentrations of Moringa oleifera leave aqueous extract on growth, yield and control of insect Podagrica spp. The experiment was set up in a Randomized Complete Block Design (RCBD) consisting of five treatments replicated three times. The varying treatment concentrations were; 1:10, 1:20, 1:30 and 1:40. Okra seeds of Clemson spineless variety was planted at a spacing of 60 cm by 30 cm. Plant growth parameters of plant height, stem girth, leaf area and number of leaves were taken at 1, 2, 3, 4, 5 and 6 weeks after bio-pesticides application while yield parameters of number of fruits and pod analysis were taken at harvest with harvesting carried out at four days intervals. Insect count was observed at 1, 2, 3, 4 and 5 weeks after bio-pesticides and percentage defoliation of leaves evaluated. It was observed during the experiment that plant height and stem girth did not show significant differences in the mean value of treatments at 1 and 2 weeks after bio-pesticides application (WAB) while at 3 to 6 WAB, the differences became evidence with treatment 1:30 and 1:40 having significantly higher mean values. Plots treated with 1:30 and 1:40 had significantly higher fruit numbers. The yield in kg/ha also shows significantly higher mean values with treatment concentrations of 1:30 and 1:40 and the control having a low yield. Also, treatment concentration of 1:30 and 1:40 had significant control effect on the population of Podagrica spp and therefore gave lowered percentage defoliation. The different concentration of Moringa oleifera leave aqueous extract had significant control effect on insect Podagrica spp.

Keywords: *Moringa oleifera*; *Podagrica spp* population; Growth; Yield

INTRODUCTION

Vegetables constitute an important food item, supplying vitamins, carbohydrates and minerals needed for a balanced diet. Their value is important especially in developing countries like Nigeria, where malnutrition abounds and among the species grown in Nigeria is Okra (*Abelmoschus esculentus L. Moench*), also known as lady's finger or Bhendi, which belongs to family Malvaceae and is an important crop grown throughout the year [1]. It is mainly cultivated for its "pod" which are cooked and eaten in countries like Sudan, Egypt and Nigeria [2]. Despite its nutritional value, its optimum yield (2-3t/ha) in the tropical countries is low partly because of continuous decline in soil fertility [3]. The yield of okra has been reported to be very low in Nigeria, hardly up to 7t/ha Problems of Okra production in Nigeria is insect pest infestations, disease incidence and poor soil nutrient level. It has become a common sight to find numerous perforations on the leaves of okra usually caused by herbivorous insects, which is almost being accepted as a common feature of the crop [4]. Okra plant is attacked by two flea beetle species, *Podagrica uniformis* (Jac.) and *Podagrica sjostedti* (Jac.) (Coleoptera: Chrysomelidae) which are responsible for heavy defoliation [5]. According to Fasunwon et al., *Podagrica* species attack the lamina of the foliage and matured leaves of the okra plant which results in the reduction of photosynthetic ability of the leaves [6]. The insect is also responsible for transmission of mosaic virus. Whiteflies also feed on plant sap and this can cause okra leaf curl disease and yellow mosaic virus. Okra Mosaic Virus (OMV), which is transmitted by insects belonging to *Podagrica* species, has been reported from Côte d' Ivoire, Kenya, Nigeria and Sierra Leone in Africa [7,8]. The flea beetles and *Syagrus calcaratus* (Fab.) (Col.: Chrysomelidae) have also been implicated in the transmission of OMV in okra [8]. To control the menace of insect pests of Okra, a number of chemical insecticides are liberally sprayed on the vegetable crops, which lead to several problems like, elimination of natural enemies, environmental hazards like air pollution, soil and water pollution and development of resistance by insect pests.

Correspondence to: Adefisoye Mabel Damilola, Teaching and Research Farm, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria, Tel: +234 810 828 7293; E-mail: fasipeolutoye@gmail.com

Received: October 16, 2019, **Accepted:** March 03, 2020, **Published:** March 12, 2020

Citation: Damilola AM, Temitope MFO (2020) Assessment of *Moringa oleifera* as Bio-Pesticide against *Podagrica spp* on the growth and yield of Okra (*Abelmoschus esculentus L. Moench*). J Horttic 7:263. Doi: 10.35248/2376-0354.20.07.263

Also, most of the synthetic chemicals are not available and when available are too costly for resource poor farmers to obtain due to the economic situation of the country. According to Muhammed etal., botanicals are one of the groups of safe insecticides which have a broad spectrum of anti-pest activity, relatively to specific mode of action, low mammalian toxicity and more tendency to disintegrate, in nature or metabolic in a biological system [9]. Botanical insecticides are generally less harmful to the environment and their use avoids the development of insect resistance [10]. Active substances in botanical insecticides degrade easily and rapidly through natural degradation processes; further the presence of multiple active ingredients that act synergistically and exhibit various mode of action prevents resistance developments in pest populations [11]. *Moringa oleifera* (Lam), a multi-purpose tree native to north western India has so many names depending on ethnic or local languages, including Zogalle (Hausa), Ewé ilé (Yoruba) and Okochi egbu (Ibo).; it is a widely cultivated, fast growing edible plant that is naturalized in the tropics; it is grown in settled areas as a backyard vegetable and oftentimes utilized as a border plant. The *Moringa* tree is a deciduous perennial tree that is regarded as one of the world's most useful trees since almost every part of it is useful; an alkaloid and triterpenoids have been reported in *Moringa* [12]. Also Pterrygospermin, a bactericidal and fungicidal compound has been isolated from *Moringa*. *Moringa oleifera* leaves have been found to possess some antibacterial and antifungal characteristics [13,14]. Plant materials were reported to be effective, cheap, and easily available for the control of stored product pests [15]. Incorporation of the green leaves of *M. oleifera* into the soil had been successfully used in preventing damping off disease caused by Pythium debaryanum in seedlings of okra plant [13,14]. Little or no information had been given on the use of *M. oleifera* leaves or the extract as organic pesticide. Hence, the objective of this study was to evaluate the effectiveness of *M. oleifera* leaf extract application at various concentrations on growth components of Okra and its efficacy in controlling *Podagrica spp* infestation on Okra.

MATERIALS AND METHODS

The experimental activities

The experiment was carried out at the Teaching and Research Farm of Joseph Ayo Babalola University, Ikeji- Arakeji, Osun State. Seeds (Clemson Spineless Variety) were sourced from National Institute of Horticulture, (NIHORT). The field was laid out in a Randomized completely block design with five (5) treatments. Treatments were; MLE: water (1:10, 1:20, 1:30, 1:40, Control; no treatment). Okra seeds were planted at two seeds per hole at a spacing of 60 cm by 30 cm on a well prepared bed of 2 m by 2 m dimension.

Moringa **Leave Extract Preparations**

The *moringa* leaf liquid extraction was done by pounding the freshly harvested leaves in a clean mortar and squeezing out the liquid through a filter paper into a container. Lower mature leaves (6th leaf and below) were used for this experiment because of their high composition of phytochemicals [16]. The different concentrations of the *Moringa* Leaf Extract (MLE) were made by mixing the extract with water at the following v/v ratios: 1:10, 1:20, 1:30 and 1:40. After two weeks of planting, treatment with the organic pesticide commenced and this was repeated forth nightly [16].

Data Collection

Plant Height (PHT): This was determined in centimeter (cm) by measuring from the base of the plant (soil level) to the tip of the plants at 1, 2, 3, 4, 5 and 6 weeks after bio-pesticide application (WAB).

Leaf area: The total leaf area of the five randomly selected okra plant per plot were taken at 1, 2, 3, 4, 5 and 6 weeks after bio-pesticide application (WAB).

Number of leaves: This was determined by visual counting at 1, 2, 3, 4, 5 and 6 weeks after bio-pesticide application (WAB).

Stem girth: This was measured using veneer caliper at 5cm from the soil level at 1, 2, 3, 4, 5 and 6 weeks after bio-pesticide application(WAB).

Yield: (Fruit weight measured in kg) Harvesting was done at 10WAP and fruits weighed in Kg at 5 and 6 WAB.

Population of Podagrica spp**: This was also carried out by visual counting of the insects.**

Percentage defoliation: This was carried out by counting the number of infested (defoliated) leaves and the number of leaves. Percentage defoliation is evaluated using this formula:

PD = Number of defoliated leaves × 100

Total number of leaves in a sample

Statistical analysis

The data obtained were Analyzed Statistically Using Analysis of Variance (ANOVA) using the SPSS computing software package and treatment means comparison with Duncan Multiple Test (DMRT) at 5% probability.

RESULTS AND DISCUSSION

There were significant treatment effects on the plant height of okra. At 1 WAB and 2 WAB, the results were similar. At 3, 4, 5 & 6 WAB, the trend was the same for all the treatment which were significantly higher than the control. Tallest plant was produced by the plants treated with 1:30 while the shortest plant was produced by the control (Table 1).

For stem girth, at 1WAB, the results of the treatment were similar. At 2 WAB 1:10, 1:30 and 1:40 were similar but significantly higher than 1:20 and control. The same trend was followed from 3 WAB to 6 WAB. 1:30 gave the highest value for stem girth while control gave the lowest (Table 2). The rate of girth development in all treatments was the same at one and two weeks after bio-pesticide application (Table 2). As presented in Table 3, there were significant treatment effects on the Leaf Area. At 1 WAB there were no significant treatment effects in 1:30 and 1: 40 while at 2 to 4 WAB, 1:40 were significantly higher than all other treatments seconded by 1:30. Control had the smallest value for stem girth which at 5 and 6 WAB was not significantly different from 1:10. In the number of leaf, there were significant differences in all the treatments from 1 to 5 WAB. At 1 and 2 WAB, 1:20 and 1:30 were similar and are significantly higher than the other treatments. At 3, 4 and 5 WAB, 1:20 and 1:30 were significantly higher than 1:10 and 1:40, with control having the smallest number of leaves as seen in Table 4. There were significant treatments effects on the

Table 1: Effect of treatments application on plant height (cm).

Treatments	1 WAB	2 WAB	3 WAB	4 WAB	5 WAB	6 WAB
1:10	8.2 a	17.3 a	26.1 c	45.6 c	51.9 c	58.5d
1:20	8.1 a	17.2 a	27.0 b	49.3 b	52.8 c	71.9 c
1:30	8.9 a	17.8 a	27.9 a	51.9 a	62.8 c	79.2 a
1:40	8.3 a	17.3 a	27.0 b	47.6 b	58.5 b	74.8 b
Control	8.4 a	17.4 a	26.6 c	34.6 d	37.4 d	40.7 d

Means with the same letters in the column are not significantly different at p<0.05 according to DMRT. WAB=Weeks after bio-pesticide application.

Table 2: Effect of treatments application on stem girth (cm).

Treatments	1 WAB	2 WAB	3 WAB	4 WAB	5 WAB	6 WAB
1:10	5.5 a	6.6 a	8.1 c	8.9 b	8.9 c	10.6 c
1:20	5.3 a	6.5 a	8.7 b	8.9 b	9.7 b	10.9 b
1:30	6.3 a	6.6 a	9.6 a	9.8 a	10.0 a	11.8 a
1:40	5.7 a	6.6 a	8.7 b	8.9 b	9.8 b	10.5 c
Control	5.4 a	6.5 a	6.9 d	7.6 c	8.3 d	9.6 d

Means with the same letters in the column are not significantly different at p<0.05 according to DMRT.
WAB=Weeks after bio-pesticide application.

Table 3: Effects of treatment on leaf area.

Treatments	1 WAB	2 WAB	3 WAB	4 WAB	5 WAB
1:10	5	6	7	8	8
1:20	5	7	8	9	9
1:30	5	8	9	10	10
1:40	5	6	7	8	9
Control	5	6	6	6	7

Means with the same letters in the column are not significantly different at p<0.05 according to DMRT. WAB=Weeks after bio-pesticide application.

Table 4: Effect of treatments on number of leaves.

Treatments	1 WAB	2 WAB	3 WAB	4 WAB	5 WAB
1:10	5	6	7	8	8
1:20	5	7	8	9	9
1:30	5	8	9	10	10
1:40	5	6	7	8	9
Control	5	6	6	6	7

Means with the same letters in the column are not significantly different at p<0.05 according to DMRT. WAB=Weeks after bio-pesticide application.

number of fruits of okra as from 5 to 6 WAB. 1:20 and 1:30 plots each with a total of six fruits followed in a significantly decreasing order of magnitude by 1:10 and 1:40 each with 5 fruits with the control with four fruits. It was observed that the number of fruits increased as the number of weeks increased with the exception of the control which remained the same as seen in Table 5. Also there were significant treatment effects on the okra pods as seen in Table 6. For the pod weight, 1:30, 1:20 and 1:40 were significantly high compared other treatments. For pod length, 1:20 and 1:30 were significantly higher than other treatment. For pod girth, 1:20, 1:30 and 1:40 were similar but significantly higher than 1:10 and control.

Effect of treatment on Podagrica spp population

There were significant treatment effects on the population of the insects' *podagrica* spp. At 1WAB, the population was the same for all the treatments. But as treatment continued, there were decrease in the population of the insects with 1:30 and 1:40 having a full control on the population (Table 7).

Effect of treatment on percentage defoliation

As presented in Table 8, there were significant treatment effects on the percentage defoliation of okra leaves. The number of infested okra leaves was significantly higher in the control and 1:10 than the other treatment and consequently, the percentage defolioation were also higher. 1:30 had the lowest percentage defoliation. The growth parameters of plant height, stem girth, leaf area and number of leaves in Tables 1-4 respectively reflected the nutrient availability in the soil and inactivation of the insects *Podagrica spp* provided by the application of bio-pesticides *Moringa oleifera* leaf aqueous extract [17,18]. There were no significant differences in the first two weeks after the application of bio-pesticides. But the plot treated with 1:30 significantly higher plant height; stem girth and number of leaves while 1:40 had significantly plant with higher leave area value all due to the application of bio-pesticides. This result corroborated the earlier result by [16]. The fruit formation with regards to number and size reflected the varying concentration of the bio-pesticides. The significantly higher number of fruits in 1:30, 1:40 and 1:20 is attributed to the properties of *Moringa*

Table 5: Effect of treatments on number of fruits.

Treatments	5 WAB	6 WAB	Total number of fruits
1:10	2	3	5 b
1:20	2	3	5 b
1:30	3	3	6 a
1:40	3	3	6 a
Control	2	2	4c

Means with the same letters in the column are not significantly different at p<0.05 according to DMRT.
WAB=Weeks after bio-pesticide application.

Table 6: Effect of treatments on pod analysis.

Treatments	Pod weight (kg)	Pod Length (cm)	Pod Girth (cm)
1:10	23.1 c	7.1 bc	26.8 b
1:20	41.2 b	8.0 a	29.3 a
1:30	66.8 a	8.4 a	30.1 a
1:40	27.4 b	7.5 b	27.7 ab
Control	15.6 d	6.8 c	24.3 c

Means with the same letters in the column are not significantly different at p<0.05 according to DMRT. WAB=Weeks after bio-pesticide application.

Table 7: Effect of treatment on the population of *Podagrica spp.*

Treatment	2 WAB	3 WAB	4 WAB	5 WAB
1:10	4	3	3	2
1:20	4	3	3	1
1:30	4	2	1	0
1:40	4	3	1	0
Control	4	3	3	3

Table 8: Effect of treatment on percentage defoliation of leaves.

Treatment	No. of infested leaves	Total number of leaves	Percentage defoliation
1:10	21.6	36.02	59.9%
1:20	20.2	36.04	56.1%
1:30	12.0	36.06	33.3%
1:40	15.6	36.05	43.3%
Control	23.4	36.00	65.0%

oleifera as a bio-fertilizer as well as bio-pesticides [19]. *Moringa* has a high content of nitrogen and phosphorus which induced high photosynthetic activities and protoplasm formation of high energy compounds such as Adenosine mono, di, tri-phosphate [20]. The insect infestation on okra as shown in the population and percentage defoliation reflects the varying concentration and the potentials of *Moringa oleifera* as a bio-pesticides 1:30 and 1:40 had significantly lowered population of the insects and hence, the percentage defoliation were significantly lower than the other treatments [13,14]. This also contributed to the morphological characteristics of plants treated with 1:30 and 1:40 [21-23].

CONCLUSION

The field experiment was carried out to determine the effects of varying concentrations of *Moringa oleifera* leave aqueous extract on growth, yield and control of insect *Podagrica* spp on Okra. This experiment showed that among the different concentrations of *Moringa oleifera* leave aqueous extract applied; 1:30 and 1:40 had significantly control the insect *Podagrica spp* and significantly improved the growth and yield of okra plant. The use of organic fertilizers and pesticides which is not costly and within the reach of local farmers should be encouraged instead of the inorganic ones in order to save the earth from global warming, climate change, air and water pollution and human beings from health hazards attributed to the use of inorganic fertilizer and pesticides. The use of organic fertilizers and pesticides which is not costly and within the reach of local farmers should be encouraged instead of the inorganic ones in order to save the earth from global warming, climate change, air and water pollution and human beings from health hazards attributed to the use of inorganic fertilizer and pesticides.

REFERENCES

1. Khan MA, Reddy JD, Rao SV. Effect of different doses of newer insecticides against natural. Pestology. 2001;26(6):618-23.
2. Olaniyi JO, Akanbi WB, Olaniran OA, Ilupeju OT. The effect of organo–mineral and inorganic fertilizers on the growth, fruit yield, quality and chemical composition of okra. J Anim Plant Sci. 2010;9(1):1135-1140.
3. Abdul-El-Kader AA, Shaaban SM, Abdul-El-Fattan MS. Effects of irrigation and organic compost on 0kra plants (*Abelmoschus esculentus I.*) grown in sandy cancerous soil. Agric Biol JNAm. 2010;1(3):225-231.
4. Egwuatu RI. Field trials with systemic and contact insecticide for the control of *Podagrica uniforma* and *P. sjostedti (Coleoptera: Chrysomelidae)* on okra. Tropical Pest Manag. 1982;28(2):115-121.
5. Odebiyi JA. Relative abundance and seasonal occurrence of *Podagrica spp. Coleoptera: Chrysomelidae*) on okra in Southwestern Nigeria. African J AgricSci. 1980;6(1):83-84.
6. Fasunwon BT, Banjo AD. Seasonal population fluctuations of *Podagrica* species on okra plant (*Abelmoschus esculentus*). Res J Agric Biol Sci. 2010;6(1):283-288.
7. https://biology.anu.edu.au/Groups/MES/vide/http%3A/biology.anu.edu.au/Groups/MES/vide
8. Fajinmi AA, Fajinmi, OB. Incidence of okra mosaic virus at different growth srages of okra plants (*Abelmoschus esculentus L. Moench*) under tropical condition. Gen Mol Virology. 2006; 2(1):028031.
9. Muhammed A. Antixenotic and antibiotic impact of botanicals for organic stored wheat insect pests, PhD Thesis. University of Agriculture, Faisalabad, Pakistan. 2009;12(1):4-6.
10. Regnault-Roger C, Vincent C, Arnason JT. Essential oils in insect control: low-risk products in a high-stakes world. Annu Rev Entomol. 2011;57(1):405-424.
11. Miresmailli S, Isman MB. Botanical insecticides inspired by plant–herbivore chemical interactions. Trends Plant Sci. 2014;19:29-35.
12. Isman MB. Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. Annu Rev Entomol. 2006;51:45-66.
13. Rao AV, Devi PU, Kamath R. *In vivo* radioprotective effect of *Moringa oleifera* leaves. Indian J Exp Biol. 2001;39:858-863.
14. Arya V, Yadav S, Kumar S, Yadav JP. Antimicrobial activity of *Cassia occidentalis L.* leaf against various human pathogenic microbes. Life Sci Med Res. 2010;9:1-5.
15. Onifade AK, Alabi RO. Effects of seed extracts of *Azadirachta indica* A. Juss on the transmission of cowpea aphid born mosaic virus *Persicae suiz* (Hemiptera: Aphididae). Niger J Biotechnol. 1998;9:59-67.

16. Ndubuaku UM, Nwankwo VU, Baiyeri KP. Influence of poultry manure on vitamin content, proximate and chemical properties of moringa (*Moringa oleifera Lam*) plants. Albanian J Agric Sci. 2014;13(1):42-47.

17. Copping LG, Menn JJ. Biopesticides: A review of their action, applications and efficacy. Pest Manag Sci. 2000;56: 651–676.

18. Chang E, Ren-Shih C, Yuong-How T. Effect of different application rates of organic fertilizer on soil enzyme activity and microbial population. Soil Sci Plant Nutr. 2007;53:132-140.

19. Faidi N, Makkar HPS, Becter K. The potential of M. *oleifera* for agricultural and industrial uses. In: (ed.) Lowell, J Fuglie The miracle tree: The multiple attribute of Moringa (ed.) 2001;45-76.

20. Nasira M, Khan AS, Basra SMA, Malik AU. Foliar application of moringa leaf extract, potassium and zinc influence yield and fruit quality of 'Kinnow' mandarin. Scientia Hortic. 2016;210:227-235.

21. Tovignan S, Vodouline SD, Dinhan B. Cotton pesticides cause more death in Benin. Pesticide News. 2001;52:12-14.

22. Khan MA, Sajid M, Hussain Z, Rab A, Marwat KB, Bibi S, et al. How nitrogen and phosphorus influence the phenology of okro. Pak J Bot. 2013;45(2):479-482.

23. Schippers RR. African indigenous vegetables: An overview of the cultivated species. Chathan, UK: Natural Resources Institute/ACPEU Technical Centre for Agricultural and Rural Cooperation. 2000;103-113.