HOST PREFERENCE OF FLEA BEETLES ON THREE *MALVACEAN* CROPS IN ADAMAWA STATE, NIGERIA

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ABSTRACT

Flea beetles are essential insect pests of most vegetable malvacean crops, posing a serious threat to their production and, as a result, lowering yields. Therefore, this study was conducted to assess the host choice of flea beetles on three malvacean crops grown in the 2015 cropping seasons in Yola and Ganye. The studies were set up in a Split Plot Design (SPD) with three malvacean crops (okra, roselle, and kenaf) as the main plot factor and five sub-plot treatments: no spray (negative control); physic nut; pawpaw leaf extract; onion bulb extract and cypermethrin) as the sub-plot treatments (positive control). The studies were set up to find out which of the two flea beetle species favored which host crop, as well as the influence of plant extracts on yield decrease induced by the flea beetle species on the three host crops. Data on the flea beetle population before and after spraying, crop damage estimations, and growth and yield metrics were collected. ANOVA was used to analyze the data, and the means were separated using the Students Neumann Keuls (SNK) test of significance. The results showed that okra had the highest population of both P. uniformis and N. dilecta in both locations. Okra had the greatest P. uniformis (12.47) and the least N. dilecta (8.67) at 6 WAS after sowing (WAS) in Yola, while roselle had the least P. uniformis (8.0), indicating okra is the most favoured host crop, followed by Roselle, and finally kenaf. In the okra, there was more damage to the leaves, flowers, and a percentage drop in yield of 62.2 percent in Yola and 43.37 percent in Ganye. Based on the findings of this study, it is suggested that Okra be employed as a trap crop for Flea beetles by intercropping it with other economically important malvacean crops like cotton.

Keywords: Host, Preferences, Flea Beetles, Crops, Adamawa State

INTRODUCTION

Malvaceae is a flowering plant family with over 200 genera and around 2300 species. They are rarely small trees with a global spread. The leaves are alternate, simple, palmate veined, and stipules are present. The stems are often fibrous, and the plants usually have stylets indumentums. Fiber crops are members of these groupings. They are used for a variety of purposes, including domestic consumption, animal feed ingredients, and industrial raw materials (Ndor*et al*., 2012). The Malvaceae family is known to be a possible host for a variety of insect pests in the field. Insect pests such *Nezeravirdula*, *Earias* spp., *Podagrica* spp., *Helicoverpaarmigera*, *Bemisiatabaci*, *Dysdercusvolkeri*, and *Zonocerus variegatus* are prevalent to the Malvaceae family, according to Fajinmi and Fajinmi, (2010). *Podagrica* spp., or flea beetles, are a well-known pest of malvaceae. In Nigeria, two species of *Podagricauniformis* and *Nisotradilecta*, previously *Podagricasjostedti* (Coleoptera: Chrysomellidae), are prevalent (Malgwi and Omuminya, 2000; James *et al*., 2014). Their damage pattern is comparable and noticeable on leaves, but it has the potential to expand to floral parts and fruits. When they attack a crop at a young stage, such as the two-leaved stage, mortality is a possibility. Infestation at a later crop phenology might result in lower yields due to the loss of photosynthetic surface imposed on the crop by the insect's feeding activity, and the pest can also serve as an okra mosaic virus carrier. Insect pest infestation is one of the most serious challenges in the cultivation of malvacean crops in Nigeria. Economic damage has been documented as a result of *Podagrica*spp. (Fasunwon and Banjo, 2010). Therefore, the purpose of this study is to investigate the host choice of Flea Beetles on three Malvacean Crops in Adamawa State, Nigeria's Yola and Ganye local government districts. The study's particular aims were to discover which of three malvacean crops (okra, kenaf, and Roselle) was the most favoured host crop for flea beetles, as well as the yield loss caused by the flea beetles on each of the test crops.

MATERIALAND METHODS

Description of the experimental site

The experiment was conducted in two locations, Yola and Ganye between August to December, 2015. In Yola, it was carried out at the Teaching and Research Farm of the Department of Crop Protection, Modibbo Adamawa University of Technology, Yola, while in Ganye, the College of Agriculture school farm was used. Yola is located on latitude 9°9'N and longitude 12°30'E at an altitude of 158.5m above sea level. The mean annual rainfall of Yola was between 1100mm and 1200 mm. Meanwhile, Ganye is located on latitude 8°25'N and longitude 12°4'E at an altitude of 472 m above sea level. The mean annual rainfall of Ganye is about 1100 -1600 mm (Adebayo and Tukur, 1999). Local varieties of okra, roselle and kenaf were purchased from local markets in Ganye Local Government Area and synthetic insecticides cypermethrin used as a positive control was obtained in an agrochemical shop at the Jimeta Modern Market. The plant materials that were used as botanical insecticides include, *Jathrophacurcas* leaves, (Bini da zuri) *Caricapapaya*leaves (Gwanda) were obtained from Agricultural Skill Development Centre, Damare, Girei Local Government Area, Adamawa state while, Onion bulbs were purchased at the Jimeta Modern Market.

The experimental design that was used in this research was the split plot design (SPD) with the three (3) malvacean crops assigned to the main plot while the plant extracts were assigned as the sub-plots and replicated three (3) times. The total plot size for the experiment was 40x21m (840m^2), sub plot size of 3x3m with 1.5m pathways between treatments and 2m between replication. The field layout was marked out using measurement tape, rope and wooden pegs in demarcating boundaries of each sub plot as shown in figure I**.**

Cultural practices

On the 5th of August, 2015 in Yola and the 11th of August in Ganye, the selected field was ploughed with a tractor, with the purpose of destroying weeds and breaking the earth's crust for good drainage. Later, the field was harrowed with a hoe to tilt huge clots of dirt for better crop establishment and aeration. Thereafter, the field was built using experimental design principles, and appropriate beds were created to ensure proper and enough germination. Following the design of the experimental field, okra seed was sowed in both locations. The seed was planted using the dibbling method at a rate of 3 seeds per hole, with a spacing of 0.40m x 0.60m and a planting depth of 2-2.5cm (Akpam, 2008). Kenaf seed was also sowed at a rate of four seeds per hole at a spacing of 0.75mx0.5m, with two (2) plants per stand and later trimmed. Similarly, the roselle was sowed at a spacing of 0.75mx0.50m with 4 seeds per hole and thinned to two plants per stand afterwards (Schippers, 2000). At two, four, and six weeks after emergence, weeding was done with hoes. Weeding operations were normally carried out two days after a big rain. This is to make operation easier and expose the herb to sunlight. At three weeks following emergence, N.P.K 15:15:15 was applied at a rate of 45kg/ha.

Data Collection

At 2, 4, and 6 weeks after planting, data on the number of each of the flea beetle, *Podagricauniformis*, and *Nisotradilecta* in each plot was collected before spraying and 48 hours after spraying. The population of both flea beetle species was enumerated, and their means were recorded after five plants were randomly picked from the middle rows in each plot. The beetles were counted early in the morning, between 6-7 a.m., when they were less active. Five plants from each plots at the two middle rows were chosen at random, and the number of holes in two middle leaves were tallied, with the mean number of perforations per afflicted leaf recorded. This was done eight weeks after the seeds were planted. The number of flowers infested by flea beetles was counted and their mean was reported as number of infested flowers per plant in each plot at 6 WAS in okra and 10 WAS in Roselle and kenaf. The yield drop due to flea beetle infestation of several malvacean crops was calculated using the following formula:

$$\frac{a-b}{a} \times 100$$

Where a = treated plots

b= untreated plots. (Malgwi, 1999)

The data was examined using an appropriate analysis of variance for the split plot design, and the means were separated using the student Newmannkeul's (SNK) test of significance at p=0.05 (SAS, 2002).

RESULTS*Effects of Host Crops and Plant extracts on the Population of Podgricauniformis*

The study found that there were significant variations (p=0.05) in the number of *P. uniformis* before spraying at 2WAS in Yola among the Malvacean crops (Table 1). Okra had the highest population of *P. uniformis* (7.53), whereas kenaf had the lowest population (4.20). In Ganye, the highest *P uniformis* population was found on okra (11.33) per plant, while the lowest *P uniformis* population was found on kenaf (4.33). The combined research also revealed that okra (9.43) had the highest number of *P. uniforma* and kenaf had the lowest number (4.23). In Yola, 48 hours after spraying, okra still had the highest *P. uniformis* population of 2.87, followed by roselle (2.40), and kenaf had the lowest population of 1.53 per plant. Similarly, okra had a greater population of 5.33 in Ganye, whereas kenaf had the lowest number (1.93). The combined research also revealed that okra had the greatest mean number (4.20) and kenaf had the lowest (1.73). Before spraying, there were no significant differences between the various plant extracts and cypermethrin in Yola, Ganye, or the combined location (p=0.05). In Yola, plots treated with physic nut leaf extracts had the highest population of 5.91, while plots treated with pawpaw leaf extracts and onion bulb extracts had the lowest population of 5.44 apiece. The maximum mean value of 8.22 *P. uniformis* was found in the pawpaw leaf extract plot (control) in Ganye, while the lowest was achieved in the no spray plot (control) with 7.44. Similarly, plots treated with pawpaw leaf extracts had the largest population of *P. uniformis* at 6.83, whereas plots treated with onion bulb extracts had the lowest population of *P. uniformis* at 6.50. The results demonstrate that 48 hours after spraying at 2 WAS, there was a significant difference (p=0.05) between the control measurements in both sites. In Yola, plots treated with cypermethrin had a lower population of *P. uniformis* with a mean number of 0.56 per plant, followed by plots treated with pawpaw leaf extract with 0.89, and the control plots with the highest population (6.78). (No spray). In Ganye, cypermethrin still had the lowest number of *P. uniformis* (0.78), followed by pawpaw leaf extracts (2.11), with the untreated control having the highest number (8.44). In the combined analysis, the plots that were not treated with cypermetrin had the highest number (7.61) and the plots that were treated with cypermetrin had the lowest (0.67).

Table 1: Effect of host crops and control measures on the number of *P. uniforma* at 2 and 4 WAS.in 2015 growing season.

Treatment	2WAS						4WAS					
	30 minutes before spraying			48 hoursafterspraying.			30 minutes before spraying			48 hoursafterspraying		
	Yola	Ganye	Combined mean	Yola	Ganye	Combined mean	Yola	Ganye	Combined mean	Yola	Ganye	Combinedmean
Host Crops (A)												
Okra	7.53^{a}	11.33^{a}	9.43^{a}	2.87^{a}	5.53^{a}	4.20^{b}	8.60^{a}	10.00^{a}	9.30^{a}	4.27^{a}	6.07^{a}	5.17^{a}
Roselle	5.26^{b}	7.60^{b}	6.43^{b}	2.40^{b}	3.40^{b}	2.90^{b}	8.40^{a}	7.73^{b}	8.07^{b}	3.80^{a}	4.20^{b}	4.00^{b}
Kenaf	4.20^{c}	4.33^{c}	4.27^{c}	1.53^{b}	1.93^{c}	1.73^{c}	7.33^{a}	7.20^{b}	7.47^{b}	2.93^{b}	3.40^{b}	3.17^{c}
P<F	0.02	0.003	0.025	0.043	0.001	0.001	0.21	0.03	0.001	0.02	0.001	0.001
Plant extracts(B)												
No Spray	5.89^{a}	7.44^{a}	6.70^{a}	6.78^{a}	8.88^{a}	7.61^{a}	10.2^{a}	12.90^{a}	11.56^{a}	11.28^{a}	13.44^{a}	12.61^{a}
Physicnutleafextract	5.91^{a}	7.56^{a}	6.72^{a}	1.56^{b}	3.22^{c}	2.39^{b}	8.44^{b}	8.00^{a}	8.22^{b}	2.56^{b}	3.56^{b}	3.05^{b}
PawpawLeafextract	5.44^{a}	8.22^{a}	6.83^{a}	0.89^{b}	2.11^{b}	1.50^{c}	7.11^{b}	6.56^{c}	6.83^{c}	1.3^{cd}	1.78^{c}	1.56^{c}
Onion bulb extract	5.44^{a}	7.50^{a}	6.50^{a}	1.56^{b}	3.56^{b}	2.56^{b}	8.56^{b}	8.67^{b}	8.61^{b}	2.1^{cb}	3.44^{b}	2.78^{b}
Cypermethrin	5.67^{a}	8.00^{a}	6.83^{a}	0.56^{c}	0.78^{d}	0.67^{d}	6.89^{b}	5.44^{c}	6.17^{c}	0.56^{d}	0.82^{c}	0.70^{d}
Mean	5.67	7.75	6.71	2.27	3.62	2.94	8.21	8.31	8.27	3.70	4.56	4.12
P<F	0.89	0.675	0.93	0.001	0.002	0.001	0.04	0.001	0.021	0.02	0.001	0.001
CV(%)	21.90	17.10	19.20	30.20	24.67	26.62	17.96	17.33	17.83	25.8	28.52	27.34
AXB	NS	NS	NS	**	**	**	*	**	**	**	**	**

Means with the same letters in the same column are not significantly different at P=0.05 using the student Newmannkeuls(SNK) method of mean separation. NS = Not significant; *=significant; **= Highly significantThe results showed that there was no significant difference (p=0.05) in the number of *P. uniforma* per plant before spraying at 4WAS among the host crops in Yola, however okra had the highest number (8.60), followed by roselle (8.40), and kenaf had the lowest number (7.33). However, there was a significant difference (p=0.05) among the malvacean crops in Ganye, with okra having the greatest population (10.00) and roselle having 7.20. Similarly, a significant difference (p=0.05) exists among the crops in the combined data, with okra having the maximum number of 9. 30P.uniformis per plant, followed by roselle (8.47). Yola okra had the largest population (4.27), followed by roselle (3.8), and kenaf had the lowest population (2.93 per plant) 48 hours after spraying. Similarly, at 4WAS in Ganye, okra had the highest mean population of *P. uniforma* with a mean of (6.07), followed by roselle (4.20), and the kenaf had the lowest population (3.40). The various plant extracts in Yola and Ganye, as well as the combined before spraying, showed a significant difference (p=0.05). *P. uniformis* population (10.20) per plant was highest in plots that were not treated (control) in Yola, followed by pawpaw leaf extract (8.89). In Ganye, the control (no spray) plots had the largest number of *P. uniformis* before spraying at 4 WAS, with a mean of 12.90, followed by onion bulb extracts (8.67), and plots treated with cypermethrin recording the lowest number (5.44). The combined analysis also revealed a significant difference (p=0.05) between the treatments, with no spray (control) having the highest (11.56) *P. uniforma* per plant, onion bulb extracts having 8.22, and cypermethrin treated plants having 6.17 *P. uniformis* per plant before spraying 4 weeks after sowing. The population of *P.uniformis* 48 hours after spraying revealed that there were highly significant differences (p=0.05) between the treatments in Yola, with the unsprayed plot (control) recording the highest number of 11.28 *P. uniformis* per plant, followed by physic nut leaf extract with a mean of 2.56, and the plots treated with cypermethrin (0.56) *P.uniformis* per plant. In Ganye, there was likewise a significant difference (p=0.05) between the treatments, with no spray (control) having the most (13.44) *P. uniformis* per plant, followed by physic nut leaf extracts with (3.56) per plant, and cypermathrin with 0.85 number of *P. uniformis* per plant.

The combined analysis revealed that there was a highly significant difference between treatments (p=0.05). The unsprayed plots had the highest number of *P.uniformis* per plant (12.01), followed by the physic nut leaf extract plots (3.05 *P.uniformis*), while the plots treated with cypermethrin had the lowest population (0.70 *P.uniformis* per plant).The population of *P.uniformis* in Yola, Ganye, and the combined location before and after spraying at 6 weeks after sowing is shown in Figure 1. (Table 2). Before spraying, the population count of *P.uniformis* per plant in Yola was significantly different (p=0.05) across the host crops, with okra having the highest number (12.57), followed by roselle (8.53), and finally kenaf (8.07). Okra had the greatest score (12.27) in Ganye, while kenaf had the lowest (8.33). The combined research revealed a similar trend: okra had a mean number of 12.37 *P.uniformis* per plants, whereas kenaf had the least (8.30). The use of several control measures prior to spraying at 6 WAS revealed a significant difference (p=0.05) between the treatments in both locations. In Yola, plots that were not treated (control) had the most *P.uniformis* per plant with a mean of 14.22, followed by physic nut leaf extract with 11.56, and the least with 6.89 *P.uniformis* per plant in the positive control (cypermethtrin). In the Ganye location, there was a highly significant difference (p=0.05) in the number of *P.uniformis* before spraying at 6 weeks after sowing between the treatments. Plants that were not treated (control) had the greatest mean population (15.78), followed by onion bulb extracts (9.00), while plots that were treated with cypermethrin had the lowest.

In terms of *P.uniformis* population, there was a significant difference (p=0.05) between the malvacean crops 48 hours after spraying. In Yola, the highest population of 5.60 insects was found in okra, followed by 3.67 insects in roselle, and 3.47 insects in kenaf. There was no significant difference between roselle and kenaf (p=0.05). Similarly, there is a significant difference (p=0.05) among the crops at the Ganye area. The maximum number of *P.uniformis* per plant was still found in okra (6.5), followed by roselle (4.47), and kenaf (4.00). Furthermore, in the combined research, okra had the greatest mean of 6.07 insects per plant, whereas kenaf had the lowest (3.73) population.

Effects of host crops and plant extracts on plant height

The result on the effect of host crops and plant extracts on the plant heights at various periods is presented in (Table 10). In Yola, there was a highly significant difference (p=0.05) between the malvacean crops at 3WAS, where kenaf had a mean plant height of 41.73cm followed by okra having (19.65cm) and the lowest height of 15.27cm was observed on the roselle plants. Similar trend was recorded in Ganye, where kenaf plants were tallest (39.93cm) and the lowest height was obtained on roselle (11.73cm). In the combined analysis a significant difference (p=0.05) do exist between the crops with the kenaf having a mean height of 40.80cm and the lowest was obtained in roselle having a mean of 13.40cm. Application of various control measures showed that there were no significant differences (p=0.05) between the treatments at 3WAS in both locations. In Yola, cypermethrin treated plots were the tallest (26.11cm) followed by those treated with onion bulb extracts (26.00cm) and the lowest plant height of 24.89cm was obtained in plants that were treated with Jathropa leaf extracts. Plants treated with cypermethrin gave the tallest mean height of 24.10cm followed by pawpaw leaf extracts (23.00cm) and the lowest height of 22.00cm was obtained in plants that were sprayed with onion bulb extracts in Ganye. The result on the combined analysis shows that there was no significant difference (p=0.05) between the control measures. The tallest plant was obtained in crops that were treated with cypermethrin followed by pawpaw leaf extract and onion bulb extracts having 24.00cm each. Interactions were not significant at 3 WAS. The result on the mean plant height at 6WAS indicates a highly difference p=0.05 between the malvacean crops in terms of plant height in both locations. In Yola, kenaf had the tallest mean height of 89.40cm, followed by okra, (44.53cm) and the lowest plant height of 37.93cm was obtained in roselle plants. Similarly, in Ganye kenaf had the tallest mean height of (84.07cm) followed by okra (38.26cm) and the shortest mean height 35.07cm was obtained on the roselle plant. The combined analysis also showed a highly significant effect (p=0.05) between the crop, where kenaf had the tallest mean height of 86.73 and the least was observed in roselle having (36.50cm). Application of various plants extracts shows a highly significant differences (p=0.05) on the plant height at 6 WAS in both locations. In Yola location, plants that were treated with cypermethrin had the tallest mean height of 70.22cm followed by pawpaw leaf extracts having 64.00cm and the least was obtained in the control (no spray). Similarly, in Ganye location, cypermethrin had the tallest mean plant height of 62.00cm followed by pawpaw leaf extracts with a mean of 59.22cm and the shortest mean height of 33.70cm was obtained in the unsprayed plots. The result in the combined analysis also showed that tallest plant was recorded in the cypermethrin treated plant with a mean of 66.11cm followed by pawpaw leaf extracts (61.62) and the least was obtained in plots that were left unsprayed (control) having a mean of height of 34.61cm.

Table 10: Plant height of malvacean plants treated with various plant extracts in Yola and Ganye

Treatments	Plant height (cm)								
	3WAS			6WAS			9WAS		
	Yola	Ganye	Combined	Yola	Ganye	Combined	Yola	Ganye	Combined
Host Crops (A)									
Okra	19.67^{a}	17.07^{a}	18.379^{a}	44.53^{a}	38.26^{a}	41.40^{a}	56.13^{a}	59.53^{a}	57.83^{b}
Roselle	15.27^{b}	11.73^{b}	13.40^{b}	37.93^{b}	35.07^{b}	36.50^{b}	59.33^{b}	25.27^{a}	57.30^{b}
Kenaf	41.73^{c}	39.93^{c}	40.80^{c}	89.40^{c}	84.07^{c}	86.73^{c}	129.60^{c}	118.33^{b}	124.00^{a}
P<F	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.003	0.002
Plant Extracts									
No Spray	25.78^{a}	22.78^{a}	24.30^{a}	35.44^{d}	33.70^{e}	34.61^{d}	51.57^{c}	50.89^{d}	51.22^{d}
Physicnutleafextract	24.89^{a}	22.70^{a}	23.78^{a}	57.78^{c}	55.33^{c}	56.56^{c}	82.00^{b}	77.44^{c}	79.72^{c}
PawpawLeafextract	25.00^{a}	23.00^{a}	24.00^{a}	64.00^{b}	59.22^{b}	61.62^{b}	87.44^{b}	87.33^{ba}	87.40^{b}
Onion bulb extract	26.00^{a}	22.00^{a}	24.00^{a}	59.00^{c}	52.00^{d}	55.50^{c}	84.00^{b}	81.44^{bc}	82.72^{cb}
Cypermethrin	20.11^{a}	74.10^{a}	25.11^{a}	70.22^{a}	62.00^{a}	66.11^{a}	103.44^{a}	91.44^{a}	97.44^{a}
Mean	25.56	22.91	24.23	57.28	52.50	54.88	81.69	77.71	79.70
P<F	0.88	o.50	0.65	0.001	0.001	0.001	0.03	0.001	0.001
CV(%)	12.4	10.93	11.66	5.90	3.86	5.05	11.29	8.08	9.76
Interaction	NS	NS	NS	**	**	**	**	**	**

Means with the same letters in the same column are not significantly different at P=0.05 using the student Newmannkeuls(SNK) method of mean separation

NS=Not significant **=Highly significant

In both locations, the application of different plant extracts results in a highly significant difference (p=0.05) in plant height. In Yola, cypermethrin produced the tallest plants (103.44cm), followed by pawpaw leaf extracts with a mean of 98.4.00cm, while the unsprayed plots produced the least mean height of 51.57cm. Furthermore, at 9WAS, a similar trend was detected in Ganye in terms of mean plant height. The tallest plant was treated with cypermethrin (91.44cm), followed by pawpaw leaf extracts (87.33cm), while the control plant had the least mean height of 50.89cm (no spray). In terms of plant height, the combined study revealed highly significant differences (p=0.05) between the beetle control strategies. The tallest mean height was achieved in the cypermethrin-treated plots (97.44cm), followed by 87.40cm in the pawpaw leaf extracts, and 51.22cm in the unsprayed plots (control).

DISCUSSION

Effect of host Crops and plant extracts on the population count of *P. uniformis*and *N. dilecta*.

The flea beetle's abundance on okra, roselle, and kenaf varies, which could be attributable to the leaf's morphological structure or a secondary metabolite. Due to the differences in leaf hardness caused by phagostimulants and other secondary metabolites, phytophaghous insects are known to differentiate among hosts. The outcomes of this study corroborate the findings of Malgwi and Omuminya, (2000), who discovered that *P. uniforma* and *Nistoradilecta* were the most prevalent and harmful insect pests of okra in Yola, Adamawa state. Similarly, Adebayo *et al.* (2013) found that the flea beetle is one of the most common insect pests of okra in Nigeria's southern region. In both sites, all of the plant extracts are effective at controlling the number of flea beetles on various malvacean crops. The insecticidal effects of the three plant extracts pawpaw, physic nut leaf extracts, and onion bulb extracts possessed great level of insecticidal properties. Synthetic insecticides (cypermethrin) were more effective than botanical insecticides, which could be due to the active components in botanical insecticides being easily volatilized or denatured, especially in the sun, resulting in their limited activity. On the other hand, pawpaw leaf extracts were more effective than onion bulb and physic nut leaf extracts. Pawpaw leaf extracts outperformed bush tea and moringa extracts in reducing the population of insect pests attacking watermelon, according to Ndor*et al*. (2012). The active components in pawpaw leaves, which include albuminous enzymes papain and alkaloid carpine, which are repellent, insecticidal, and fungicidal in action, may account for the larger reduction in flea beetle species in the pawpaw leaf treated plots (Stoll, 2000). Onion bulb extracts have been reported to inhibit *Callosobruchus maculatus* oviposition, according to James *et al.* (2014). This could be due to the presence of allicin, a chemical component that is one of the main ingredients (James *et al.*, 2014).

Effects of Host Crops and Plant Extracts on the leaf, flower damage and Percentage Reduction in Yield

The substantially larger perforation on okra could be attributed to the increased population of flea beetle's species detected on it, which could be translated to the okra plant's higher leaf area and phagostimulants. This study's findings are consistent with those of Adeola *et al*. (2014), who discovered that okra has more leaf area damage than other malvacean crops such as kenaf, jute mallow, and cotton. In terms of less holes on the treated plants, the reduced number of perforations detected in the plant extracts treated plants proves efficient. The untreated plots had a higher number of holes in both sites when all of the botanical extracts had a low number of perforated leaves. This could be due to the extracts' efficiency in reducing flea beetles, which resulted in less damage to the leaves. This is consistent with Stoll's (2000) findings, which found that pawpaw leaf extracts and onion bulb extracts are potent botanical insecticides. Plant extracts from *Jathrophacurcas*, *Aseratumconyzoides*, *C. ordonata*, and *Annona squamosa* showed promising insecticidal activities against flea beetles, according to Onunkun (2012). The flea beetle has been known to drill holes in leaves, reducing their ability to photosynthesize (Dabire-binso, 2009). Okra's higher flower damage may be related to the two flea beetle species' preference for it over the other host crops. The number of affected blooms on treated plants was lower than on untreated plants, demonstrating the efficiency of the botanicals and cypermethrin. This is consistent with the findings of Onunkun (2012), who found that pawpaw leaf extracts and garlic extracts reduced flower infestation in okra. The toxicity of physic nuts was related to various components found in the plants, including saponin lectin, phytate protease inhibitors, and phorbol esters (Makher*et al*., 1997). As a result, it was shown to be efficient against flea beetles in general, which have stomach poison as a result of the physic nuts' contents (James *et al*., 2014). The biggest percentage yield drop due to flea beetle infestation in okra, compared to roselle and kenaf, could be related to the number of flea beetles on okra and the harm they cause. The flea beetle was the most devastating pest targeting okra, according to James *et al*. (2014), and it serves as a vector for the okra mosaic virus, resulting in a 50 percent drop in yield.**Conclusion and Recommendations**The study concludes that Okra is the most preferred host crop among the three malvacean crops tested as higher population of both *P. uniformis* and *Nisotradilecta* were recorded on the okra and also higher damages were obtained on the crop. Yield reduction due to Flea Beetles infestation was 60% in okra, 58% in roselle and 48% in the untreated plots. Based on the findings of the study, it is recommended that Okra should be used as a trap crop to *P. uniformis*and *N. dilecta*through intercropping with other malvacean crops, like Cotton

REFERENCES

Adebayo, T.A., Alao, F.O and Olaniran, O.A. (2013). Control of Foliage Pests of Roselle (*Hibiscus sabdariffa* (L). Using plant extracts of *Tephrosiaregelli* and *Azadiractaindica* in Ogbomoso, Nigeria. *Journal of Science* and *Technology*, 3:51-62.

Adebayo, A.A and Tukur, A.L. (1999). Mean annual rainfall. *Adamawa state in map* 1st edition parcelete publishers Nigeria limited Yola. 23-26.

Akpam, H.C. (2008). Effects of Weeding Regime and Intra row spacing on the growth and yield of okra. M.Tech Thesis in Agronomy. Department of Crop Production and Horticulture. Federal University of Technoloy, Yola. 4-20 unpublished.

Dabire-binso C.L. (2009). Preliminary Studies on the incidence of insect pest of okra in Central Burkina faso. *Journal of Pest Management*, 57: 161-168

Fajinmi, A.A. and Fajinmi, O.B. (2010). Incidence of Okra Mosaic virus at different growth stages of okra plants under tropical conditions *Journal of General Molecular Virology*, 2:28-31.

Fasuwon, B. and Banjo, A.D. (2010). Efficacy of some Synthetic Insecticides against insect pests of roselle. *Journal of Agricultural and Biological Science*, 6:283-288.

James A.O., Akinrinade, A.O and Olufisayo, I. (2014). Evaluation of botanical insecticides against flea beetles *Podagricauniformai s*and *P. sjostedti* on Okra. *International Journal of Advanced Research,* 2:234-244.

Makher,H, Francis, G and Becker, K (1997). Studies on Nutritive potential and toxic constituents of different provenances of *Jathropacurcas*. *Journal of Agriculture and Food Chemistry,* 4:315-317.

Malgwi, A.M and Omuminya, J.J. (2000). A survey of some dry season insect pests of some vegetable crops around Lake geriyo farms, Yola, Adamawa State. *Proceedings of the conference on the revitalization of Agriculture in the National Economy held at School of Agriculture and Agricultural Technology Federal University of Technology, Yola 13-16th Nov.2000.*

Ndor E., Dauda, S.N., Anda D., Chamang , H.B and Faringoro U.D, (2012). Assessing the efficacy of aqueous leaf extracts of some botanical insecticides for control of insect pests of water melon (*Citruluslanatus*) in Southern Guinea Savannah, Nigeria. *Asian Journal of Agricultural Science,* 23:329-332.

Onunkun, O. (2012). Evaluation of aqueous extracts of five plants in the control of flea beetles on okra.*Journal of biopesticides* 5: 62-67

SAS (2002) SAS/STAT users guide version8 (2). Statistical Analysis System. Institute inc., Cary, North Carolina, U.S.A.

Schippers, R.R. (2000). African indigenous vegetable. An overview of the cultivated species. National Resources Institute NRI. University of Green Witch London. U.K 214.

Stoll, G (2000). *National Crop Protection in the Topics.* Magraf Verlag, WeikerShein345