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EVALUATION OF PLANT MATERIALS FOR THE CONTROL OF LEAFWORM (*Acraea terpsicore* L.) ON JUTE MALLOW (*Corchorus olitorius* L.) IN LAPAI SOUTHERN GUINEA SAVANNAH OF NIGERIA

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ABSTRACT

Jute mallow, (Corchorus olitorius L.) is an important vegetable grown in most part of sub-saharan Africa and classified as Neglected and Underutilized Species (NUS). But insect pests are serious hindrance to its production. The present research was conducted at the teaching and research farm of Ibrahim Badamasi Babangida University, Lapai, Niger State in the growing season of 2017 - 2018. The research aimed at evaluating the efficacy of three plant materials (alligator pepper (Aframomum melegueta K. Schum,), black pepper (Piper nigrum L.) and neem seed (Azadirachta indica A. Juss.) for the control of Acraea terpsicore (L.) (Leaf worm) on jute mallow. The plant materials were grounded separately into powder and weighed into 100g per litre of water. A day to spraying, the materials were soaked in water separately for 24hours and thereafter sieved with a muslin cloth and further filtered with Whatman filter paper to remove all fine particles. The extracts were then transferred in to the sprayer for onward spraying of the plant. Before spraying, the number of leafworms were counted, the count was repeated a day after spraying. The spraying was done at 3days interval. The numbers of damaged leaves were also counted at 4, 6 and 8 week after planting (WAP). At the end of the research, neem seed extract caused significantly highest mortality after each spray and the least number of damaged leaves at 4, 6 and 8 WAP, followed by black pepper. But contrarily, alligator pepper, on the other hand, had no significant effect on the leaf worm. The control presents the highest number of leaf worms and highest number of damaged leaves at 4, 6 and 8 WAP. Conclusively, with further research, neem seed extracts can be encouraged to be used in the control of vegetable insect pests as this is cheaper than synthetic pesticides and not toxic to man and his environment.

Keywords: Aligator pepper, Black Pepper, Neem seed, Jute mallow, Leaf worm.
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INTRODUCTION

Jute mallow, (*Corchorus olitorius* L.) belongs to the Family Tiliaceae. It is a native to the tropical and sub-tropical regions of the world. It is widely spread all over the tropics and it probably occurs in all countries of tropical Africa (PROTA, 2010). It is one of the most important vegetable grown in sub–Saharan Africa (Schippers, 2000). It is an erect annual herb that varies from 60 cm to approximately 150 cm in height depending on the cultivar (Husselman and Sizane, 2006). It is grown in fields next to the houses and in the market gardens around the world.

Jute mallow plays an important role in nutrition and household food security. The leaves contain an average of 15% dry matter, 4.8 g of protein, 259 mg of calcium, 4.5 mg of iron, 4.7 mg of vitamin A, 92 mg of folates, 1.5 mg of nicotinamide and 105 mg of ascorbic acid per 100 g of leaves (Harborne *et al*.,1999; Grubben and Denton, 2004). It is an important vegetable in Nigeria and it is called Ewedu, Ooyo and Eeyo in

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Yoruba and Ayoyo in Hausa (Musa *et al.*, 2010). It is commonly used as soup and serves as a condiment to other starch-based food such as Amala, Pounded Yam, Eba and Fufu. It plays an important role in human diet as it contains protein, mineral elements (iron and calcium) energy, riboflavin, niacin, thiamin, folate, hormone precursors and dietary fiber (Antia *et al.*, 2006). Furthermore, jute mallow is not just a meal, its fibers is strong and water proof, making it perfect for making burlap sacks, furnishings and even clothing (Grubben, 1997).

Despite its nutritional and economic importance, there is paucity of scientific research and development on this vegetable in Nigeria, hence categorized under Neglected and Underutilized Species (NUS). Many farmers, especially in marginal areas, rely on NUS for their livelihoods. Consequently, cultivated varieties run the risk of genetic erosion and their cultivation is in serious decline due to pest and diseases (Ayodele *et al*., 2006; Hedrick, 2010). Specifically, insect pests constitute a major menace to the production of jute mallow in many parts of the tropics especially the leaf worm (*Acraea terpisicore* L.). Leaf worm which is a semilooper larvae is a major leaf feeding pest of jute plant that causes severe damage to the host plant (Agrawal, 2004). During severe infestation leaf worms feed up to 90% jute leaf that ultimately leads to 50% fibre yield loss (Rahman and Khan, 2012). To fulfill the market demand and use of more and more fertilizers and insecticides, jute pests becomes resistant to stress and become major threat for production yield (Savci, 2012). Jute plants are devoid of physical resistance like epicuticular wax, resin or thorns. Therefore, jute leaves are easily accessible food for semilooper larvae (Agrawal 2011; Sadat and Chakraborty, 2015). To minimize this pest damage, the combination of cultural practices and the use of chemical methods have been employed by most farmers in the tropical and sub-tropical regions of the world (Sadat and Chakraborty, 2015.). In Nigeria, especially in the Savannah regions where vegetable irrigation farming is common, it has been observed that farmers heavily use (miss-use and miss-application) pesticides to control insect pests prior to the harvesting of these vegetables for sale. These synthetic pesticides are hazardous to human health and the environment of which their use is emphatically discouraged to the favour of some saved botanicals to produce organic farm produce for healthy human consumption. Therefore, the present research work explore the use of some plant materials (alligator pepper (*Aframomum melegueta* K. Schum,), black pepper (*Piper nigrum* L.) and neem seed powder (*Azadirachta indica* A. Juss.) in controlling leaf worms on jute mallow. These materials are readily available in the Nigerian markets and they do not constitute any harm to man and the environments.

MATERIAL AND METHOD

Experimental site

This research work was conducted at the teaching and research farm of Ibrahim Badamasi Babangida University (IBBU), Lapai, Niger State.

Experimental Design

The experiment was conducted at IBBU.The experiment was designed in a Randomized Complete Block Design (RCBD) with four treatments replicated four times adopting standard cultivation practices. Before sowing, N, P_2O_5 and K_2O at the rate of 20 kg ha^{-1} were applied as basal application.The jute seeds were sown in a row spacing of 25 cm in small plots of 4×4 m with a gap of 1 m between each plot and 3m guard rows. Maize was

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planted on the guardrows to avoid cross effects of the treatments.At completely grown condition (3 WAP), plant to plant distance was maintained at 6-8 cm apart after thinning.

Plant materials

Plant materials used were obtained from authorized marketers from Zaria. The materials are; Alligator pepper, Black pepper, Neem seed.

Preparation of Plant Extract

a. Pounding of plant materials

All plant materials were bought dried, but further air dried separately under shade for the period of 24 hours. The plant materials were then pounded in wooden mortar with the aid of wooden pestle separately till they turned into fine particles / powder. These were sieved to further obtain the finest particles.

b. Extraction using water

The weight of 100g of the plant materials were separately dissolved in a litre of water each for the period of 24 hours. The mixture was stirred at intervals with the aid of a stirring rod. Mixtures per weight for each plant materials were then sieved with muslin cloth to collect the liquid extracts.Each plant extracts were further being cleaned of fine particles by filtering with Whatman filter paper.

Spraying

The extract, separately was transferred into hand–pump sprayer (5 liters). Before spraying, the number of leafworms wascounted from 8 randomly selected plants from each replicate. The count was repeated a day after spraying. Spray regimes was at 3 days interval.

Jute mallow leaf damage categorization

Five (5) points Visual Damage Scale was developed to categorize the damaged (numbers of holes) observed on the jute mallow leaves. The scale was categorized as thus:

1. Undamaged (0 hole / cm^2)
2. Light damage (up to 2 hole / cm^2)
3. Medium damage (3-4 hole / cm^2)
4. Medium – high damage (5-9 hole / cm^2) with physical damage of the leaf surface
5. Severely damage: when leaf surface is physically damaged and the number of holes are no longer countable

Control

Control devoid of test botanical spray but sprayed with water at the same rate of a liter per plot.

Data analysis

The numbers of damaged leaves were counted at 4, 6 and 8 WAP. These were categorized using 5 point scale and leaves damaged pattern discussed. Numbers of surviving and dead leafworms were converted by using square root to meet the assumption of Analysis of variance. Then the data were analyzed using the statistical tool of GenStat version 10.3DE (2011) Ltd. (Rothamsted experimental station).

RESULTS

The effect of plant materials on the population of leaf worms was determined and the results observed were presented in table 1. Before every spray regimes (1st – 4th), the means of leaf worm were determined. 1st spray regime before spray revealed similar means for the numbers of leaf worm for all the treatments which were not significantly different (Table 1). 2nd, 3rd and 4th spray regimes before spray elucidated a similar trend of reducing order in the means of leaf worm population (table 1) which were all significant differences ($P>0.05$) (table 1). After regimes spray from the 1st to the 4th regimes, there were significant reductions in the mean population of leaf worm. The reduction in the mean population of the leafworm was progressive

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as the spray regime increases. This mean that the population of leaf worm continued to reduce from one regime of spray to the other (1st - 4th) (table 1). Furthermore, the aqueous solution of Neem seed powder showed a very high reduction in the population of leaf worm which was significantly different ($P<0.05$) from other treatments throughout the spray regimes. This was followed by the black pepper, which revealed a similar trend of mortality rate on the leaf worm population. Contrarily, alligator pepper presents the lowest kill in the population of leaf worm. The control (no spray) exhibited no reduction or kill on the leaf worm population (table 1). This impact of control is not uncommon.

Percentage mortality of leaf worms

The population of leaf worms after each spray were converted into percentage mortality and used to plot a chart (figure 1). The result shows that the highest mortality rate was recorded with neem seed extract which was followed by black pepper extract. Alligator pepper extract presents the lowest mortality rate. The control revealed no any form of mortality rate. This is not uncommon. All mortalities observed at different spray regimes for all the treatments were significantly different ($P<0.05$).

Effect of leaf worm on jute mallow leaves and weight of plant at maturity

Feeding holes on jute mallow plant leaves treated with plant materials is presented in table 2. Comparing the treatments in the columns for the ages of the jute mallow (4, 6, and 8 weeks), this showed that jute mallow treated with the neem seed powder aqueous solution suffers less damage from leaf worm and this was evident from the number of holes on the leaves (Table 2).

The numbers of holes observed continued to reduce from age 4 week to 8 week. Similarly, fewer holes were observed on jute mallow plant leaves treated with extracts from the black pepper. But the holes were significantly ($p>0.05$) more than those observed for jute mallow treated with neem seed extracts. Alligator pepper extracts performed significantly ($P>0.05$) less in the protection of jute mallow against leaf worm damage, hence presents high number of holes. The control jute mallow plant leaves were severely damaged. Apart from the holes on the leaves, the leaves surfaces were scarified and in some cases skeletonised. This is not unexpected as there was no plant extracts used to control the leaf worm. Therefore, the order of damages observed is presented as neem seed> black pepper > alligator pepper > control. The mean number of holes observed for jute mallow treated with neem seed extract was 0.78 – 2.09, that of black pepper was 2.11 – 3.28, 3.29 – 4.31 for alligator and 5.69 – 5.96 for the control (table 2). From the forgoing, jute mallow treated with neem seed extracts can be classified as lightly damage, those treated with black pepper extracts are medially damage, similarly, those treated with alligator pepper extracts were also medially damaged and the control jute mallow falls within the classification of medium-high damage to severely damaged.

The dry matter weight of the jute mallow was taken at maturity for each of the treatment accordingly (Table 2). It was observed that the dry matter weight observed for plant treated with neem seed extracts was significantly more than those observed for all other treatments. This was followed by the weight of jute mallow treated with black pepper. The alligator pepper presented more significantly less dry weight of jute mallow and this was followed by the dry matter weight from the control (Table 2).

DISCUSSION

The present study revealed that the plant materials used against *A. tepsocore* did

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elucidate different levels of control. Neem seed extracts was better than the extracts from black pepper and alligator pepper, while the black pepper performed better than the alligator pepper. The neem seed extract have been recognized for long to be a good control botanical against insect pests of both field and stored importance (Aziz *et al*., 2019). The black pepper was known for its control impacts on only stored products (Ashouri and Shayesteh, 2010) and alligator pepper was known for its control on bacteria (Doherty *et al.,* 2010). From the forgoing, neem seed extract do effectively control *A. tepsicore* when compared with other materials used. This was not surprising as many authors have reported the control impacts on many pests of agricultural importance (Schmutterer, 1990; Isman, 2006; Siddiqui *et al*., 2009; Degr *et al*., 2013), and Shannag *et al*., 2014). The extract of neem affected the physiological activities of *A. tepsicore* ranging from prevention of feeding (antifeedants), repelling and toxicity (Lengai *et al.,* 2020).

The extract of black pepper was found to have prevented feeding and repelled the leaf worm in a minimal way. This could be due to its quick breakdown of potency on the field. The pungency of the extract quickly diffused with the air on the field and are blown away. This could be the reason why it has much impacts on stored products as its pungency characteristic can be confined within the store (Donald*et al.,* 2008; Ashouri and Shayesteh, 2010). The extract from alligator pepper only present little pesticidal pressure on the *A. terpsicore*. This could also be due to quick degradation of the phytochemicals by sunlight and by air drift (Lengai *et al.,* 2020).

The active chemical compounds in neem are azadirachtin, nimonol, epoxyazadiradione (Mahmoud *et al.,* 2011). That of black pepper are Estragole, 1,8-cineole, trans- α-bergamotene (Sienkiewicz *et al.,* 2013) and the phytochemcial analysis carried out on alligator pepper revealed the presence of alkaloids, tannins, saponin, steroids, cardiacglycoside, flavonoid, terpenoids and phenol (Neeraj *et al*., 2017). The presence of these phytochemcials supports the use of these plants as pesticidal agents. But their inability to exert relatively equal pressure on the control of insect pests can be attributed to the differences in their chemical components (Lengai *et al.,* 2020).

The overreliance on synthetic pesticides is discouraged due to their detrimental effects on human health, the environment, and development of resistant pest and pathogen strains. This, coupled with increasing demand for organically produced foods, stimulated search for alternative approaches and botanical pesticides are particularly gaining importance. Botanical pesticides are efficacious in managing different crop pests, inexpensive, easily biodegraded, have varied modes of actions, their sources are easily available and have low toxicity to non-target organisms. Their varied modes of action are attributed to the phytochemical composition in different plants. Therefore, they can be incorporated into integrated pest management systems and would contribute to sustainable agricultural production.

CONCLUSION

From the data collected and analyzed, it was discovered that the plant materials used were effective for the control of *A. terpsicore*. Although effective at different levels of performance, however their effectiveness can be improved through the use of further specific scientific methods to obtain the concentration of the most active components.

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APPENDICES

Table 1: Effect of plant materials on the population of Leaf worms

Treatment	1st bf spray	spray af spray	2nd Bf spray	Spray af spray	3rd bf spray	Spray af spray	4th bf spray	spray af spray
Alligator Pepper	4.62a	3.66b	3.97a	3.22b	3.28b	2.66b	2.72b	2.25b
Black Pepper	4.37a	1.72c	3.25b	0.87c	1.97c	0.84c	1.91c	0.88c
Neem Seed	4.15ab	0.90d	2.40c	0.69d	1.28d	0.47d	1.09d	0.22d
Control	4.44a	4.34a	4.06a	3.99a	4.00a	3.88a	4.25a	4.19a
SE ±	**0.205**	**0.055**	**0.273**	**0.213**	**0.115**	**0.116**	**0.177**	**0.245**
LSD	**0.465**	**0.124**	**0.628**	**0.482**	**0.26**	**0.263**	**0.401**	**0.554**

*****Means followed by different small letters in the column are significantly different at ($p<0.05$)

SE = Standard Error of means

LSD = Least Significant different

bf = before; af = after

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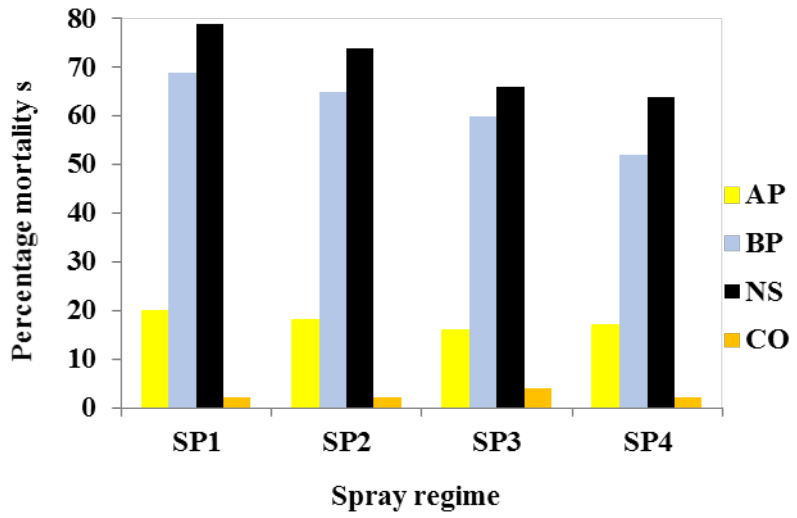

Figure 1: Leaf worm percentage mortality rate at different spray regimes

SP1-SP2 = Spray regimes; AP = Alligator pepper, BP = Black pepper, NS = Neem seed & CO = Control

Table 2: Effect leaf worms on jute mallow leaves and weight of plants at maturity

Treatments	NDL at 4wks	NDL at 6wks	NDL at 8 wks	WPM
Alligator Pepper	4.31[b]	3.31[b]	3.29[b]	71.81[b]
Black Pepper	3.28[c]	2.88[c]	2.11[c]	100.31[c]
Neem Seed	2.09[d]	1.38[d]	0.78[d]	112.78[d]
Control	5.69[a]	5.73[a]	5.96[a]	48.75[a]
SE ±	**0.098**	**0.195**	**0.21**	**1.39**
LSD	**0.221**	**0.442**	**0.475**	**1.159**

*Means followed by different small letters in the column are significantly different at ($p<0.05$)

SE = Standard Error of means

LSD = Least Significant different

NDL =No of damage leaves; WPM=Weight of plant at maturity

WPM = Weight of Plant at Maturity