JOURNAL OF ENGINEERING AND EARTH SCIENCES

JEES ISSN: 1897-8680

JEES 2021

VOLUME 14 ISSUE NO 1

PAGE 65-74

THE POTENTIALS OF PAWPAW LEAF EXTRACT ON THE PERFORMANCE AND CONTROL OF FIELD INSECT PEST OF THREE VARIETIES OF WATER MELON

(Citrillus lanatus L.)

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ABSTRACT

The experiment was a 3x3 factorial combination arranged in a Randomized Complete Block Design (RCBD) and replicated 3 times. Seed beds were properly prepared by ploughing and harrowing the land, and then plots of 16 m^2 were marked out. 2 seeds of watermelon were planted per hole at the depth of 5 cm and at a spacing of 75 cm ×75 cm. The treatments consisted of Pawpaw Leaf Extract (PLE) and Cypermethrine (CP) insecticide which was incorporated in the study for comparison with the untreated check as control (CL). The seeds of the three water melon varieties used for the study were; Sugar baby (SB), Charleston Gray (CG) and Crimson sweet (CS) obtained from the National Institute of Horticulture (NIHORT), Ibadan. Spraying started when the seedlings emerged and did not stop until the fruits were getting to maturity stage. The data collected included: number of fruit/plant, number of fruit rot, number of cracked fruits and fruit yield (kg/ha). The result of the study revealed that, although, the percentage level of infestation was lowest with the application of Cypermethrine Insecticide for Charleston Grey, (17.9%), it was however closely followed by the application of pawpaw leaf extract for Crimson Sweet (20.0%). The high percentage perforation and damaged leaves recorded in the untreated plots (60.4%, 48.6% and 45.5%) for all the tested water melon varieties were as a result of high level of population of insect pest that perforated a larger proportion of the leaf surface which invariably inhibited photosynthetic ability of the plant, affecting its yield and translocation of assimilates. Similarly, the higher percentage yield increase for all tested water melon varieties recorded in plots treated with pawpaw leaf extract SB, (75.8%), CG, (70.5%) and CS, (80.0%) indicated that the extract contained large amounts of flavonoid, alkaloids, Saponin and Tannin which have a negative effect on respiration of insect pest. The study revealed that Pawpaw leaves extract is effective in the control of field insect pest of watermelon.

KEYWORDS: Cypermethrine; Fruit yield; Insect pest; Pawpaw leaf extract; Water melon

INTRODUCTION

The growth and fruit yield of watermelon is interrupted by various categories of insect pests in the field at all stages of growth and fruit development (Qureshi et al., 2010). These insects can cause severe problems in the production of watermelon, through direct damage to the crop or through transmission of disease agents, such as the aphid-borne mosaic viruses (Qureshi et al., 2010). A number of Insect species including army worms, mites and thrips can cause damage to plants and can generally interfere with the movement of water metabolites through the plant vascular system. This will further inhibit its growth during development while the caterpillars can potentially feed on over 100 species of plants from a wide range of families (CABI, 2018). Common field insects of watermelon are squash bug, silver leaf, whitefly, cucumber beetle, grasshopper, lady beetles (*Harmonia conformis*), Melon worm, (*Diaphania hyalinata*), and melon aphids (*Aphis gossypii*) (Edelson et al., 2002). Good fruits set and development is highly dependent on insects, especially the honeybees

which pollinate the female flowers. Webb (2010) estimated that eight or more visits of honeybees per blossom are necessary for optimum fruit set and normal fruit development in watermelon. Webb also emphasized that, the morning hours are most critical for pollination, so during bloom, application of insecticides harmful to bees should be done in the evening. In order to obtain high yield of watermelon, the farmer should be able to protect the crop against the menace of these insect's pest. However, the only popular and effective methods of controlling these insect's pest in the tropics are largely obtained by the use of synthetic chemical pesticides (Stoll, 1988). The botanical insecticides are generally pest-specific and are relatively harmless to non-target organisms including man. They are also biodegradable and harmless to the environment (Okweche et al., 2013). Globally, over 2500 plant species belonging to 235 families have been reported to have biological activities against pests (Isman, 2006; Roy et al., 2016; Stevenson et al., 2017). Furthermore, unlike conventional insecticides which are based on a single active ingredient, plant derived insecticides comprise an array of chemical compounds which act concertedly on both behavioral and physiological processes. (FAO, 2016). Thus, the chances of pests developing resistance to such substances are less likely (Okweche et al., 2013). Phytochemical analysis revealed the presence of tannin, saponin, flavonoid and alkaloids in the pawpaw leaf plant. (Acero, 2014). The presence of these phytochemical alters some biochemical functions of organisms. Studies have shown that high dose of flavonoid alters the normal body functioning of insects (Acero, 2014). The pawpaw leaves also contains an albuminous enzyme – papain and an alkaloid carpine which are repellent, insecticidal and fungicidal in action (Stoll, 1988). Although components of integrated pest management are now widely applied in developed countries, over reliance on pesticides to control pest outbreaks remains high (Farrar et al. 2016; Vasileiadis et al., 2017). Similarly, commercial preparations of alternatives, such as biological control agents or botanical pesticides ("botanicals"), are often not available and may also be expensive (Amoabeng et al., 2014; Dougoud et al., 2018). Although there is gathering evidence that some of the botanicals used for pest control are less toxic to no targets than synthetic pesticides (Tembo et al., 2018), others may be hazardous to users, livestock, or the environment. Yet, the use of botanicals for pest control is so widespread that it cannot be ignored. Over the last decades, the efficacy of botanicals used in traditional pest management has been widely investigated in research trials. The appropriateness of the recommendation and use of botanicals for pest control can be questioned. In general, the supporting evidence for the use of botanicals is very old and their efficacy needs to be reevaluated. Some of the botanicals that are being used for pest control may lack active ingredients, which would make their use by smallholder farmers a waste of time. Moreover, results may be unpredictable due to varying active ingredient content and concentration in the used plant material (Sarasan et al., 2011), as well as differences in the preparation method. Finally, their toxicity to non-targets (species that are not the intended target) has often not been evaluated. Therefore, the main objective of this study is to evaluate the potentials of Pawpaw Leaf Extract on the Performance and Control of Field Insect Pest of three varieties of Water Melon.

MATERIALS AND METHODS

Study site

The study was carried out at the Teaching and Research Farm of the Federal Polytechnic, Ado-Ekiti, a humid rainforest zone of Southwest Nigeria. The mean annual rainfall ranges between 1300-1600 mm and with an average temperature of 30ºC. The relative humidity ranges between 85 % during the rainy season and less than 60 % during the dry season. The study was carried out in May, 2018 due to the preponderance and high frequency of occurrence of insect pest infestation in the study area.

Land preparation and sowing

A portion of land was cleared in a farm field in the early rainy season of 2018. It was subsequently ploughed and harrowed to soften the land. The number and size of plots used for the experiment was measured from the ploughed and harrowed farm land. The experiment is a 3x3 factorial combination arranged in a Randomized Complete Block Design (RCBD) and replicated 3 times. Seed beds were properly prepared by ploughing and harrowing the land, then plots of 16 m^2 were marked out; 2 seeds of watermelon were planted per hole at the depth of 5 cm and spacing of 75×75 cm. The treatments consisted of Pawpaw leaf extract (PLE), and Cypermethrine (CP) insecticide incorporated in the study for comparison with the extract and the untreated check.as control (CL). The seeds of the three water melon varieties used for the study were; Sugar baby (SB), Charleston Gray (CG), and Crimson sweet (CS), which were obtained from the National Institute of Horticulture (NIHORT), Ibadan.

Preparation of treatments

Preparation of Leaf Extract of Pawpaw

Pawpaw leaves were plucked fresh and shade-dried at room temperature so as to make sure that the process of drying did not affect the potency of the active ingredient. Then, pestle and mortar was used to pound the leaves to pulverize them so that the active ingredient in the leaves can be freely released in water. Afterward, 500g of the pounded leaves were socked in 15 L of distilled water and the mixtures were allowed to stand for 24 h after which the mixtures were filtered using a cloth filter to obtain a homogenous substance that was used for spraying as described by (Wahedi et al., 2013). Flavonoids were determination using the method described by Boham, et al., (1974). The Alkaloids were determined using Harborne method of (1973) while saponin was determination as described by Obdoni et al., (2001). Tannin determination was done using the method of Fohn-Denis calorimeter as described by Kirk et al., (1998). The pawpaw leaf extracts were sprayed twice in a day (morning and evening) at an interval of 3 days before the next spray. The choice of using pawpaw leaf extract in this experiment is because it contains an albuminous enzyme – papain and an alkaloid carpine which are repellent, insecticidal and fungicidal in action (Stoll, 1988). Cypermethrine however is a synthetic pyrethroid that lasts longer than natural pyrethrum and provides long-lasting control and prevention on insect pest on the field. The insecticide was applied in the morning once in every week, at the rate of 30 ml in 15 L of water. Spraying started when the seedlings emerged and did not stop until the fruits were getting to maturity stage, when the insect pest does not have much harmful effect on the plant any more. Most of the commonest insects found on the farm include: whitefly, cucumber beetle, grasshopper and melon aphids (*Aphis gossypii*). The data collected includes: number of leaves, number of branches, vine-length, number of

flowers, number of fruit rot, number of cracked fruits, fruit diameter, number of fruit/plant and fruit weight (kg) as described by Gardner et al. (1985). The percentage damage was calculated as;

$$\%\ damage = \frac{Number\ of\ infested\ plants}{Number\ of\ plants\ observed} \times \frac{100}{1}$$

(Gomez & Gomez, 1984).

Data Analysis

Data collected were subjected to One-way analysis of variance (ANOVA) and Duncan Multiple Range (DMR) Test. Standard deviation and Correlation Coefficient were used to establish the mean differences at 5% level of probability, using SPSS Version 16.0.

RESULT AND DISCUSION

Pre-experiment Soil Chemical Properties

Table 1 shows the result of soil chemical properties before the experiment. The pH of the soil was 6.9. Organic matter contents analyzed was 4.01%. Nitrogen content was (0.07 g/kg). The available P content in the soil was (1.73 mg/kg), K (0.02 cmol/kg), Na (0.02 cmol/kg), Ca (1.47 cmol/kg) and Mg (4.20 cmol/kg). Table 2 presents the phytochemical composition of papaya extract. Flavonoid had (866.53mg/100g), Alkaloid had (1569.13mg/100g), Saponin recorded a mean content of 898.07mg/100g while Tannin had (310mg/100g).

Table 3 shows the number of perforated and damaged leaves plant before and after application of treatments. There was a progressive decrease in the number of perforated and damaged leaves at 1WAT, 2WAT and 3WAT under the application of pawpaw leaf extract. The percentage damage after treatment application at 3WAT shows that the highest percentage damage on perforated leaves was recorded for untreated check or control (109) with Sugar Baby while the lowest perforation was recorded for Charleston Grey with Cypermethrine Insecticide application. Although, the percentage level of infestation was lowest with the application of Cypermethrine Insecticide for Charleston Grey, (17.9%), it was however closely followed by the application of pawpaw leaf extract for Crimson Sweet (20.0%). The percentage yield increase was significantly highest for Charleston Grey under the application of Cypermethrine Insecticide (82.1%) and this was however closely followed by pawpaw leaf extract for Charleston Grey (80.0%). The lowest yield was recorded for the untreated check or control for Sugar Baby (39.6).

The result in Table 4 shows that highest number of leaves was recorded for Charleston Grey, (19.4) with the application of pawpaw leaf extract. Similarly, significantly higher values were recorded on vine length for Charleston Grey, (17.9%) with the application of pawpaw leaf extract. There was no significant difference for number of branches and flowers for all treatments of all the tested varieties. Number of fruit rot was significantly high for Sugar Baby and Charleston Grey with the untreated check as control. Similarly, the highest number of cracked fruits was recorded for all the varieties evaluated with the untreated check, conversely, there were no fruit rots or cracked fruits with the application of pawpaw leaf extract. The result of fruit diameter indicated that highest fruit diameter was recorded for Charleston Grey with pawpaw leaf extract application (48.3cm), this was closely followed by Sugar Baby (43.9cm) with the application of Cypermethrine Insecticide. The highest fruit weight in this study was recorded for Charleston Grey with the application of pawpaw leaf extract and Cypermethrine Insecticide (2.82kg, 2.69kg)

respectively while the lowest fruit weight was recorded for the untreated check as control.

Field results indicated that extract of pawpaw leaf *w*as effective in the control of insect field pest of water melon. The results of this study reveals that the plots treated with extracts of pawpaw leaf and Cypermethrine Insecticide had the lowest percentage of perforated or damaged leaf in all tested varieties of water melon when compared with the untreated check. There was a significant reduction in the perforated and damaged leaves with the application of pawpaw leaf extract and this significantly improved the yield of Charleston Grey, Crimson Sweet and Sugar Baby. The results of this study has shown that aqueous leaf extract of pawpaw contained substances that can confer some level of protection on watermelon growth and fruits production against field insects when compared with the unprotected control. Pawpaw aqueous leaf extract performed better than the untreated control in reducing the number of perforated leaves and damaged fruits. This may be attributed to the fact that the papain in pawpaw leaf has been reported to possess insecticidal and repellent properties (Jewel, 2008). The leaves contain large amounts of flavonoid, alkaloids, Saponin and Tannin which have a negative effect on respiration of insect pest (Perry & Metzger, 1980; Obdoni et al., 2001; Sarasan et al., 2011). On the other hand; the use of chemical insecticide (cypermethrine) offered the most effective control of field insects of watermelon because it possesses an active ingredient that kills the insects out rightly, while the pawpaw leaf extract only exhibited its repellent abilities. However, pawpaw aqueous leaf extract possesses the qualities of performing the same insecticidal properties with the synthetic insecticides, but the mode of extraction of the active ingredients contain in the plant product have been reported to be a major factor influencing their effectiveness as compared to the synthetic insecticide (Ajayi et al., 2005; Ajayi & Lale, 1996). Although, ultimate and comprehensive control of field insect pest of water melon may not be achieved through the use of application of pawpaw leaf extract alone, its use could still guarantee reasonable levels of protection to a growing crop. Application of botanicals could greatly reduce the large-scale use of synthetic insecticides (Dougoud et al., 2018). The comparable but significantly higher fruit yield produced by the treatment than un-treated control showed that pawpaw leaf extracts controlled field pest of water melon in the study area.

The higher percent reduction of perforation and leaf damage recorded due to the effect of pawpaw leaf extract was as a result of the active component of pawpaw leaf. It contains an aluminous enzyme such as saponin and an alkaloid which are repellent, insecticidal and fungicidal in action (Acero, 2014; Stoll, 1988). The lowest yield that was obtained from the untreated plot (control) was attributed to the high insect population recorded on the control. Mochiah et al., (2011) also observed that vegetables in which botanicals were applied produced the highest mean fruit weight and fruit numbers of okra and eggplant, supporting what was discovered in this work as the fruit weight and fruit diameter of melon treated with the pawpaw leaf extract were found to be significantly higher than the fruit weight and fruit diameter of the untreated plot. This could be as a result of high level of population of field insect pest in the untreated plot that perforated and damaged larger proportion of the leaf surface thereby inhibiting cell multiplication, amino acid

synthesis and energy formation which invariably inhibited photosynthetic ability of the plant, affecting its yield and translocation of assimilates to the sinks (Eifedeyi & Remison, 2010).

CONCLUSIONS AND RECOMMENDATIONS

The study revealed that Pawpaw leaves extract is effective in the control of field insect pest of watermelon. Similarly, the higher percentage yield increase for all tested water melon varieties recorded in plots treated with pawpaw leaf extract indicated that the plant serves as an effective botanical. Insecticides of plant origin (bio pesticides) serve as an alternative for synthetic insecticides for the control of field insect pest of water melon. The extract has been found to be cheap, readily available and effective in the control of insect pet of water melon.

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Table 1: Pre soil chemical properties at experimental site

Chemical Properties	Values
pH (H_2O)	6.90
Nitrogen (g/kg)	0.07
Available Phosphorus (mg/kg)	1.73
Exchangeable Na (cmol/kg)	0.02
Exchangeable K (cmol/kg)	0.02
Exchangeable Ca (cmol/kg)	1.47
Exchangeable Mg (cmol/kg)	4.20
Soil Organic matter (%)	4.01

Table 2: Phytochemical concentration of pawpaw leaf extract

Phytochemical	Concentration
Flavonoid	866,53 ±27.24
Alkanoid	1569.13 ±92.58
Saponin	898.07 ±20.67
Tannin	310.50 ±11.51

Mean ±S.D of the triplicate sample

Table 3: Effect of pawpaw leaf extract and Cypermethrine insecticide on number of perforated or damaged leaves of three watermelon varieties

Variety	Treatments	Before Treatment Application (4WAP)	After Treatment Application (1WAT)	(2WAT)	(3WAT)	% damage before treatment	% damage After treatment (1WAT)	% damage After treatment (2WAT)	% damage after treatment (3WAT)	% level of infestation after treatment	% Yield increase	SD	CV
SB	PLE	15.1b	11.0c	8.5c	4.5bc	75.3c	55d	43de	22.8ef	24.2d	75.8b	5.66	0.57
	CP	12.9c	11.5c	7.2c	3.2bc	64.7d	58d	36e	16.5ef	22.1d	77.9b	5.56	0.56
	CL	16.9b	18.9a	19.5a	21.8a	84.6b	95a	98a	109.0a	60.4a	39.6e	7.51	0.75
CG	PLE	14.1b	10.3c	6.5c	2.6bc	70.4c	52d	33e	13.4ef	29.5d	70.5b	5.50	0.50
	CP	16.9b	10.9c	5.4c	1.4bc	84.8b	55d	27f	7.5ef	17.9d	82.1a	5.56	0.56
	CL	12.7c	14.9b	15.6b	17.9b	63.7d	75bc	78c	90.0bc	48.6bc	51.4cd	6.84	0.68
CS	PLE	14.5b	9.90c	6.9c	2.9bc	72.6c	50d	35e	15.0ef	20.0d	80.0a	5.54	0.54
	CP	19.4a	13.5b	8.3c	3.8bc	97.0a	68c	41de	19.3ef	25.7d	74.3b	6.09	0.61
	CL	11.9c	12.6b	15.9b	16.9b	59.7e	63c	80b	84.5c	45.5bc	54.5cd	6.67	0.67

Means carrying the same alphabet along the same columns are not significantly different at 5% probability level.SD-Standard Deviation.CV-Coefficient of Variability. SB-Sugar Baby.CG-Charleston Gray. CS-Crimson Sweet. PLE-Pawpaw leaf extract. CP-cypermethrine insecticide.cl-Control. (WAP)-Week after planting. (WAT)-Week after treatment

Table 4: Effect of pawpaw leaf extract and Cypermethrine insecticide on performance of three watermelon varieties

Variety	Treatments	Number of leaves	Vine Length (cm)	Number of branches	Number of flowers	Number of fruits	Number of seeds/Fruit	Number of fruits Rots	Number of Cracked fruits	Fruit Diameter (cm)	Fruit weight (kg)	Variance	SD	CV
Sugar Baby	PLE	15.1a	156.6b	2.39a	0.8a	10.3a	251.8a	-	-	41.8a	1.47b	48.03	6.93	0.69
	CP	13.0b	149.5b	3.27a	0.9a	11.5a	263.9a	-	2	43.9a	1.51b	48.95	6.99	0.69
	CL	17.0a	151.9b	2.28a	0.7a	9.1b	238.2a	5	4	31.7b	0.90c	46.09	6.79	0.68
Charleston Gray	PLE	14.1b	240.4a	3.09a	1.1a	12.4a	205.3a	-	-	48.3b	2.82a	52.76	7.26	0.73
	CP	16.5a	239.0a	3.70a	1.2a	11.9a	269.5a	-	2	41.9a	2.69a	58.84	7.67	0.76
	CL	12.7b	179.2b	2.23a	0.5a	9.5b	209.4a	5	3	35.5b	1.71b	45.87	6.77	0.68
Crimson Sweet	PLE	14.5b	165.9b	2.64a	0.8a	9.5b	210.5a	-	-	39.3c	1.27b	44.44	6.67	0,67
	CP	19.4a	194.7b	2.10a	1.2a	8.4b	239.8a	-	1	35.7b	1.09b	50.34	7.09	0.71
	CL	11.9b	142.9b	2.40a	0.6a	7.9b	259.5a	4	2	28.5c	0.81c	46.05	6.79	0.68

Means carrying the same alphabet along the same columns are not significantly different at 5% probability level.SD-Standard Deviation.CV-Coefficient of Variability. PPL-Pawpaw Leaf Extract. CP-Cypermethrine Insecticide.CL-Control.SD-Standard Deviation. CV-Coefficient of Variability