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COMPARATIVE EFFICACY OF *Tephrosia vogelii* and *Moringa oleifera* AGAINST INSECT PESTS OF WATERMELON (*Citrullus lanatus* Thumb)

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ABSTRACT

Despite the fact that synthetic insecticides are fast acting, they constitute environmental hazard thereby necessitating the use of ecologically based alternative such as plant based insecticide. This experiment was conducted during the late and early planting seasons of 2011 to determine the insecticidal efficacy of *Tephrosia vogelii* and *Moringa oleifera* extracts at three tested concentrations (5, 10 and 20% v/v) against insect pests of watermelon. The experiment was set up in a randomized complete block design with three replicates. The results showed that *M. oleifera* extracts had 62% reduction of *Phyllotreta cruciferae* compared with *T. vogelii* which had 45% control. However, *T. vogelii* extracts had 64% control of *Diabrotica undecimpunctata* and *Bactrocera curcubitea* but *M. olefera* extracts had 50% control. The plant extracts proved effective against studied insects when compared with untreated plots. However, the effectiveness of the two plants extracts were concentration dependent. Therefore, the two plant extracts can be used in the control of insect pests of the watermelon.

1. INTRODUCTION

Watermelon (Citrullus lanatus (Thumb.)) belongs to the family cucurbitae and it is believed to have originated from Kalahari and Sahara deserts in Africa (Iarret et al, 1996; Schippers, 2000). Watermelon is a major source of vitamins (Vitamins A – 590iu; Niacin – 0.2mg/kg and vitamin C – 0.7 – 7.0mg/100g). Literature has it that Watermelon is a good source Lycopene, a reddish carotene pigment which acts as antioxidant during normal metabolism and protects against cancer (Perkins and Collins, 2004).

In Nigeria, major cultivation of watermelon comes from northern part of the country due to the favourable environmental condition but in recent years, farmers in other parts of the country have started with the cultivation of watermelon. However, insect infestations have constituted a great setback in the production of this crop in western part of this country.

Among the insect pests, Flea beetle (*Phyllotreta cruciferae (*Goeze) has been reported to have caused economic damage to the leaves, flowers, roots and young immature fruits which in most cases resulted to yield lost. According to the literatures, there are different species of flea beetle but the prominent among them are *Podagrica* spp. and *Phyllotreta* species. Melon fruit fly (*Dacus cucurbitae (*Coquuillet) has also been implicated to have caused serious economic damage to this crop. It attacks the flowers, young fruits and matured fruits (Dhillon, *et al* 2005).

In view of destructive potential of the aforementioned insect pests, control of these insects becomes necessary but the common practice of insect control in developing country depends largely on the use of synthetic insecticides, this can be attributed to their quick knock-down effect. However, synthetic insecticides were reported to have associated with environmental hazards, insect pest resistant and resurgence and unavailability at critical period and lastly most of them are carcinogenic. In the light of these problems, botanical insecticides have been reported as alternative to synthetic insecticides. Plants have been reported to have produced unique secondary metabolites to protect themselves from the attack of various herbivores (Olaifa and Adebayo, 2003; Oparaeke, 2005; Yaktar and Isman, 2004). However, natural products investigated to date have been shown to have less impact on beneficial and non-target insects than conventional pesticides (Isman, 2006). In addition, they are less expensive and easily available because of their natural occurrence (Singh and Saralchand, 2005; Sadek, 2003; Egho and Emosarrue, 2010).

Tephrosia vogelii, hook F. is a small leguminous shrub which grows to a height of about three to four meters. The plant is widely distributed in the tropical, sub-tropical and regions of the world (Al-Zahrani, 2007). This plant has been described as potential source of rotenone, an important non-residual insecticide and Tephrosin which is the main active compound useful in killing fish (Adebayo, 2003; Neuwinger, 2004; Silesshi *et al* 2005; Sirrine et al, 2010; Nyiranda, et al, 2011). However, biological activities of this plant species have also been reported against the field and stored product insects (Wanjala, *et al*, 2006; Diwan and Saxena, 2010 Bentel, *et al* 1987; Olaniran, *et al* 2013). Also, *Moringa oleifera* Lam (Moringacea) is a highly valued plant, distributed in many countries of the tropics and subtropics (Anwar F, et al 2007). Several reports have indicated the medicinal as well as insecticidal properties of the phytochemicals isolated from *M. oleifera*. The roots of this plant are used in folk medicine to treat a number of medicine(Fahey, 2005) and various plant products of this plant have also been reported as larvicidal and repellent against mosquito (Sukumar *et al*, 1991).

This current experiment was therefore conducted to evaluate the potential of *Moringa oleifera* and *Tephrosia vogelii* in the control of major field insect pests of watermelon and to determine the optimum concentration of each of the plant extracts.

2. MATERIALS AND METHODS

Study Site

The field experiment was conducted at Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Farm, Ogbomoso, Oyo State. It is located on longitude $4^0$30'E and latitude $10^0$5'N. The region climate could be described as hot humid tropical falls in southern guinea savannah of Nigeria with a mean temperature of 27^0C and annual rainfall of 1400mm. Marked with dry and wet seasons, characterized by a bi-modal rainfall pattern with peaks in July and September.

Experimental Design and Management

The experimental land was ploughed and harrowed once. There were four treatments and each of the treatment was replicated three times in a Randomized Complete Block Design (RCBD). The plot size was 3 m by 3 m and each plot had four plant rows. The test crop was watermelon variety (baby sugar). Two to four seeds were sown per hole which was later thinned after 14 days to achieve one plant per stand. Weeding was done manually.

Preparation of Plant Extracts

The leaves of *M. oleifera* and *T. vogelii* were air-dried for two days and each of the plant material was crushed separately with mortar and pestle. 500 g of the crushed plant materials were weighed separately with sensitive scale after which each of the paste was put into a separate 10-litre plastic buckets containing 1000 ml of water. The soaked materials were allowed to stay overnight. The filtration was done with muslin cloth and filtrates collected were stored in a 5-litre plastic keg as stock solution. 1000 ml of each of the plant extracts was measured out from the stock solution of which three concentrations (5, 10 and 20%) were calculated. This method was in line with the established fact by Alao and Adebayo (2011)

Treatment Application

Application of the treatment commenced three weeks after planting and this was done early in the morning with hand held sprayer of 2-litre capacity. Each of the concentration of the plant extracts and synthetic insecticide were further diluted with 1000 ml of clean water to achieve the same spraying volume. Untreated plots were sprayed with ordinary water and synthetic insecticide was applied at 400 ml/ ha. Spraying was done at seven- day intervals and four- weekly observations were made.

Data Collection

Population densities of adult *Phyllotreta cruciferae*, *Diabrotica undecimpunctata* and *D. cucurbitea* were made by visual observation and this was done a day after each weekly treatment. Random sampling of the insects was done from the two mindle plant rows. This was done early in the morning when they were relatively inactive (Owolade *et al*, 2008; Alao and Adebayo, 2011).

Percentage number of matured fruit damaged: Three months after planting when the fruits were fully matured, total number of marketable fruits were harvested and sorted into undamaged fruits and damaged fruits. The fruits with hole being perforated by melon fruit fly were regarded as being damaged. Percentage fruit damaged was calculated using the formula stated below:

$$\% \text{ mature fruit damaged} = \frac{\text{Total no. of matured fruit damaged per plant} - \text{No. of undamaged matured fruit}}{\text{Total number of matured fruit damage}} \times 100$$

Percentage Defoliated flowers: The number of flowers showing evidence of defoliation was recorded from four randomly selected plants in the two middle plant rows in each plot and total number of flowers produced were also counted. This was done when 50% of the plant stands had produced flowers. Percentage defoliated flower was determined using the formula described below:

$$\% \text{ Flower damaged} = \frac{\text{Total no. of flowers produced per plant} - \text{No. of undamaged flowers}}{\text{Total number of flowers produced}} \times 100$$

Percentage Young fruit damaged: Number of immature fruit was visually counted when 50% of the plant stand successfully produced fruits and the fruits were sorted into infected fruits and uninfected fruits. The fruits that were bored by the insects were regarded as being damaged and the percentage of young fruit was determined using the formula stated below:

$$\% \text{ Young fruit damaged} = \frac{\text{Total no of young fruit damaged/plant} - \text{No. of undamaged young fruit}}{\text{Total number of young fruit damaged}} \times 100$$

Yield: Three months after planting, the matured fruits were harvested and weighed on the field with manual scale in kilogram (kg) which was later calculated in ton per hectare (t/ha).

Data analysis

Data collected were subjected to analysis of variance (ANOVA) and significant difference was separated with DUCAN multiple range tests at 5% probability level. Economic implication of each of the treatment options was estimated using the method described by Ajeigbe and Singh, 2006.

3. RESULTS

Table 1 shows effect of the treatments on *D. cucurbitae* infestation as presented, although there was no significant difference between botanical insecticides protected plants and unprotected plants at 1st WAT but the protected plants had the least infestation of *D. cucurbitae* compare to unprotected plants. Plants treated with plant extracts did not show any significant difference with respect to three concentrations (5, 10 and 20% v/v) at 1st and 2nd WAT. At 2nd WAT, plant extracts were significantly effective in the control of *D. cucurbitea* compared with untreated. Plants treated with plant extracts at highest concentration had a significant ($P < 0.05$) reduction in the infestation level *D. cucurbitae* as observed in the synthetic insecticide (Lambdacyalothrin) treated plants. Although there was no significant difference between plots treated with *M. oleifera* at 10% and 20% v/v at 3rd and 4th WAT but the population densities of *D. cucurbitae* was slightly higher in the plots treated with 10% v/v.

As presented in table 2, all the applied treatments exhibited insecticidal control of *P. cruciferae* when compared with unsprayed plants. Meanwhile, plant extract applied at highest concentration had significant highest insecticidal control of the *P. cruciferae* compared with other tested concxetrations at 1st and 2nd WAT. At 3rd WAT, significant difference was not observed between *T. vogelii* and *M. oleiferera* applied at 20% v/v but the plants sprayed with *M. oleifera* had lower *P. cruciferae* infestation than that of *T. vogelii* treated plants. However, *M. oleifera* and *T. vogelii* applied at highest cocntration compete effectively with Lambdacyalothrin. The same significant insecticidal effect was observed in the *M. oleifera* applied at 5% and 10% v/v whereas *T. vogelii* applied at 10% v/v proved to be more effective than that of 5% v/v at 4th WAT.

The result presented in table 3 shows that the least plant extract concentrations applied did not significantly suppress the infestation of *Monolepta* species throughout the studied period when compared with untreated plants at 1st WAT. However, plant extracts applied at 10% v/v was equally effective in the control of *Monolepta* species as 20% v/v at 2nd WAT. Although there was no significant difference between plants protected with Lambdacyalothrin and those that were protected with plant extracts at highest concentration but the former had the least *Monolepta* species infestation at 3rd and 4th WAT.

Among the concentrations tested, significant difference was detected irrespective of plant extracts, plots treated with 20% concentrations had highest yield while plots treated with 5% concentrations had the least yield (Table 4). Although there was no significant difference between plants treated with *T. vogelli* at 20% v/v and *M. oleifera* at 20% v/v but *T. vogelii* extracts had higher yield (20.9 t/ha) than *M. oleifera* extracts treated plants (18.3 t/ha). All plant extracts treated plots protected matured and young fruits from being damaged by *D. cucurbitae* compare with untreated plots which had highest percentage of matured fruit and aborted young fruit damaged (49.2% and 42.7%) respectively. *T. vogelli* and *M. Oleifera* treated at 20% v/v statistically protected matured fruit and aborted young fruit from being damaged compared with other tested concentrations (Table 4). *Monolepta* species and *P. cruciferae* not only attacked the leaves but also attacked flowers consequently leading to abortion of fruits. Botanical treated plots statically protected the flowers from being damaged than unprotected plants. Statistically, plants sprayed with synthetic insecticide had similar effect on yield with the plots treated with T. vogelii at highest concentration thought synthetic insecticide treated plants had highest yield (Table 4).

Generally, Insect infestation was statistically low in the late planting season compared to the early planting season (table 6).

Table 1. Effect of Treatment on *D. cucurbitae* population

Treatments	WEEK AFTER TREATMENT			
	1	2	3	4
Control	3.33^{a}	4.00^{a}	3.83^{a}	3.33^{a}
Lambdacyalothrin	1.17^{b}	0.33^{C}	0.00^{d}	0.00^{c}
T. Vogelii 5%	2.83^{a}	2.67^{b}	2.67^{ab}	1.83^{bc}
10%	2.67^{ab}	2.50^{b}	2.00^{bc}	1.00^{bc}
20%	2.17^{ab}	1.67^{b}	1.17^{cd}	0.33^{c}
M. Oleifera 5%	2.67^{ab}	2.83^{ab}	2.17^{bc}	1.67^{b}
10%	2.33^{ab}	2.83^{ab}	1.83^{bc}	1.50^{b}
20%	2.17^{ab}	2.50^{b}	1.33^{bcd}	0.00^{c}

Mean with the same alphabet(s) are not significantly difference

Table 2. Effect of Treatments on *Phyllotreta cruciferae* Population

Treatments	WEEKS AFTER TREATMENT			
	1	2	3	4
Control	5.89^{a}	6.17^{a}	5.17^{a}	3.50^{a}
Lambdacyalothrum	2.83^{d}	1.17^{c}	0.00^{c}	0.00^{d}
T. Vogelii 5%	5.00^{ab}	4.33^{b}	3.00^{b}	2.83^{ab}
10%	4.50^{abc}	4.00^{b}	2.33^{b}	1.83^{bc}
20%	3.50^{cd}	2.67^{bc}	1.83^{b}	0.67^{cd}
M. Oleifera 5%	4.33^{bc}	4.33^{b}	3.00^{b}	2.83^{bc}
10%	4.50^{bc}	4.00^{bc}	2.83^{b}	2.00^{bc}
20%	3.83^{bcd}	2.83^{bc}	1.50^{bc}	0.67^{cd}

Mean with the same alphabet(s) are not significantly difference

Table 3. Effect of Treatments on *Monolepta* species Population

Treatments	WEEKS AFTER TREATMENT			
	1	2	3	4
Control	5.00[a]	5.00[a]	4.67[a]	3.50[a]
Lambdacyalothrum	1.67[d]	0.83[d]	0.00[d]	0.00[d]
T. Vogelii 5%	5.00[a]	4.67[ab]	3.50[ab]	3.50[ab]
10%	3.17[bcd]	3.33[bc]	2.67[cd]	2.33[ab]
20%	2.50[cd]	2.17[cd]	1.5[cd]	0.67[d]
M. Oleifera 5%	4.17[ab]	3.67[abc]	3.50[ab]	2.67[ab]
10%	3.50[abc]	2.50[bc]	2.83[bc]	2.17[bc]
20%	3.00[bcd]	2.50[c]	1.67[cd]	1.00[cd]

Mean with the same alphabet(s) are not significantly difference

Table 4 . Effect of treatments on yield parameters

Treatments	Yield (t/ha)	Matured Fruit damaged (%)	Young Aborted Fruit (%)	Defoliated Flower (%)
Control	5.4[e]	49.2[a]	42.7[a]	45.9[a]
Lambdacyalothrum	25.8[a]	8.5[e]	8.4[d]	6.2[e]
T. Vogelii 5%	7.9[ed]	28.8[bc]	26[bc]	38[b]
10%	13.1[cd]	23.3[cbd]	23.9[bc]	28.1[c]
20%	20.9[ab]	19.6[d]	20.3[c]	18.4[d]
M. Oleifera 5%	8.2[ed]	29.8[b]	28.7[b]	36.4[b]
10%	10.6[ed]	24.1[cbd]	28.2[b]	27.4[c]
20%	18.3[bc]	21.2[cd]	24.7[bc]	20.2[d]

Mean with the same alphabet(s) are not significantly difference

Table: Population densities of observed insects as affected by the season

D. cucurbitea	**1st**	**2nd**	**3rd**	**4th**
Early	3.63[a]	3.67[a]	2.92[a]	2.13[a]
Late	1.21[b]	1.17[b]	0.83[b]	0.29[b]
P. cruciferae				
Early	7.67[a]	6.58[a]	4.42[a]	3.00[a]
Late	1.08[b]	0.79[b]	0.33[b]	0.17[b]
***Monolepta* spp**				
Early	6.71[a]	6.13[a]	4.96[a]	3.88[a]
Late	0.29[b]	0.25[b]	0.13[b]	0.08[b]

4. DISCUSSION

This experiment demonstrated the effectiveness of *T. vogelii* and *M. oleifera* extracts as insecticides against three major field insect pests of watermelon. The plant extracts were significantly effective against the observed insects – *Monolepta* species, *P. cruciferae* and *D. cucurbitae*. But the efficacy of each of the plant extracts varied among the studied insects, for instance, plots treated with *M. oleifera* had 62% reduction of *P. crucifera* populations while *T. vogelii* treated plots had 45% control. Plots treated with *T. vogelii* had 64% control of *Monolepta* species and *D. cucurbitae* but *M. oleifera* had 50% reduction. This is an indication that the susceptibility of the observed insects to the active ingredients reportedly derived from the tested plant extracts is quite different from each other. Meanwhile, this result goes in line with the observation raised by Isman and Yakatar, 2004 who reported that there is variation in the susceptibility of insect to different species of plant extracts.

Though, there was a slight difference in the efficacy of the two plant extracts but statistically they exhibited the same insecticidal effects on the studied insects. This shows that plant extracts can be used in the control of the major field insect pests of watermelon. In our earlier report by Alao and Adebayo (2011), *T. vgelii* and *P. alliacea* had been established as plant based insecticides against post- flowering insect pests of cowpea. Also, Hussain *et al* 2011 reported that neem seed extracts, *Parthenium hystensphorus* and Eucalyptus leaves extracts protected bitter gourd extracts from being damaged by *D. cucurbitae*.

Data also suggest that the effectiveness of plant extracts depend on the dosage applied. Plants treated with 20% v/v had highest efficacy in the control of studied insects followed by plots treated with 10% v/v while plants treated with treated 5% concentration had least efficacy. This might have been due to the quantity of the bioactive compound in the solution applied in the control of these insects. This agrees with earlier report by Seljasen and Meadow, 2005 who reported the effectiveness of plant extracts as insecticides are does dependent. The observation also revealed that plant extracts applied at 10% concentrations had the same siginificant insecticidal effect with the plants treated with 20% concentration during the late planting season meaning that application of plant extracts at 10% v/v is adequate in protection of watermelon against the observed insect pests in the minor season.

In the late planting season, the level of insect infestation was considerably low when compared with that of early planting season. The number of damaged flowers and number of aborted fruits were significantly higher in the early planting season than late planting season, this clearly shows that the level of damage being done to the productive part of the crop depend largely on the population densities of insect pests. Irrespective of concentrations applied, plant extract exhibited more insecticidal action in the late planting season this could be attributed to excessive rainfall which is responsible for leaching of the chemicals from the target plant couple with high level of insect infestation during early planting season. However, plots treated with plant extracts at 20% v/v were effective as synthetic insecticide during the late planting season.

5. CONCLUSION

This result clearly shows that plant extracts are potential materials in the management of field insect pests of watermelon and variation in the efficacy of the selected plant extracts suggested that the susceptibility of the insects to the selected plant extracts to the secondary plant metabolites is quite different from each other. Meanwhile, the application of the plant materials at highest concentrations gave reasonable plant protection to the target crop against the observed insects which is slightly far better than other concentrations but application of plant extracts at 10% concentrations also demonstrated adequate protection of the plants when compared with untreated plants. Comparatively, the tested plant extracts compete effectively with synthetic insecticide in the late planting season at the highest concentration. Therefore, this result revealed that the use of plant extracts in the management of insect pests will go along way with the principle of organic farming.

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