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ON - FARM EVALUATION OF NATURAL TOXICANTS FROM *TEPHROSIA VOGELII* AND *PETIVERIA ALLIACEA* ON *MEGALUROTHRIPS SJOSTEDTI* AND *APION VARIUM* OF COWPEA *(Vigna Unguiculata* (L) WALP)

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Abstract

The field study was conducted during the planting season of cowpea to evaluate the natural toxicant from *Tephrosia vogelii* and *Petiveria alliacea* and their mixture against *Megalurothrips sjostedti and Apion varium at* three different concentrations (5, 10, and 20% v/v). The experiment was set up in randomized complete block design. The field observations showed that the two insect pests were effectively controlled by the botanical insecticides compared with untreated plants. Also, the plant extracts at 20% and 10% v/v significantly protected cowpea pods and grains from the damage. However, higher grain yield was obtained from the plant treated with 20% v/v compared to those treated with 10%, 5% v/v and untreated plants. Combination of the two plant extracts at 20% v/v had the same efficacy with synthetic insecticide (Decis). Thus, these plant extracts can be used in organic farming.

Keywords: *Megalurothrips sjostedti, Apion varium, Tephrosia vogelii, Petiveria alliacea,* concentrations.

Introduction

Cowpea is an important crop for farmers in most of the West African countries, where Nigeria and Niger account for 87% of world cowpea harvested (Ortiz, 1998). It is one of the most important protein sources in the diet of Tropical Africa. Despite its importance, the production is yet to meet the demand of consumers due to the low yields being experienced by the farmers (Karungi *et al.,* 2000). Insect pests have been reported to have caused economic damage to the crop (Ajeigbe and Singh, 2006; and Karungi *et al.,* 2000). However, the following insect pests have been reported to have caused approximately 70% yield loss: bud thrips *(Megalurothrips sjostedti* trybom), pod borer *(Maruca vitrata* Fabricius) and pod sucking bugs, such as *Clavigralla tomentoscollis* Stal; *Riptortus dentipes* Fabricius; *Anoplcnemis Curvipes* Fabricius and *Nezara viridula* Linnaeus.

Since pests constitute the main limiting factors in the production of cowpea, the quickest and most pragmatic way of controlling these pests is the use of conventional insecticide (Adebayo and Olaifa, 2004). However, synthetic insecticides have been reported to have some side effects, such as high

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mammalian toxicity, environmental pollution, insect resistance and resurgence, high cost and unavailability at critical periods (Duke, 1997). Those aforementioned problems have stimulated interest of pest-management specialists in developing alternatives pest control in recent years.

Plant-based insecticides have been reported as a better option to synthetic insecticide (Isman, 2008). Environmental and ecological suitability of botanical insecticide enhance its acceptability among the entomologists as a sustainable alternative to the conventional insecticide. In Nigeria, there are several insecticidal plants; among these, *Tephrosia vogelii* which contains Rotenone as the active ingredient and has been reported to be useful against most of the sucking and bitting insects (McDavide and Lesseps, 1995 and Stoll, 2001). However, *Petiveria alliacea* contains *Dibenzyltrisulfide,* which is the active insecticidal compound (Lyndon *et al.*, 1997; Kubec and Musah, 2000 and Kubec *et al.,* 2002).

Developing alternative option to synthetic insecticide from plants, especially in developing countries like Nigeria will go a long way in alleviating the poverty level of farmers and put to rest problem of low productivity due to insects attack. Also, protection of consumers from taking pesticides contaminated food stuffs will be realized (Adebayo and Olaifa, 2004). Therefore, the present study aimed at evaluating the natural toxicant from the two plants against the two major destructive insect pests of cowpea and to determine whether the plant extracts can be a substitute to synthetic insecticide (Decis) in controlling the major pests of cowpea.

Materials and Method

The field experiment was conducted at Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Farm, Ogbomoso, Oyo State. Ogbomoso is located on longitude 4°30°E and Latitude $10^{0}5^{1}$N. The climate could be described as hot humid tropical falls in Southern Guinea Savanna of Nigeria with a mean temperature of 27°C, annual rainfall of 1400mm and marked with dry and wet seasons.

The experimental site was 0.06 hectare of land, which was ploughed and harrowed once. Thirty three plots were demarcated and arranged in a randomized complete block design with three replications of twelve treatment combinations. Each plot had five rows. The plot size was 3 m × 3 m with 1 m × 2 m gaps between adjacent plots and blocks.

The cowpea variety was Ife brown. Planting was done in 2007 cropping season, two to three seeds were sown per stand and thinning was done one week after planting to achieve one plant per stand. The crop was spaced out at 30 cm x 60 cm. Two weeks after planting, all the plants were treated with synthetic insecticide to prevent pre-flowering insects attack. The plant materials used were collected from botanical garden LAUTECH.

Five hundred grammes (500g) each of fresh leaves of *T. vogelli* and root of *P alliacea* were crushed separately and applied at concentrations of 5, 10, and 20% v/v, while 20 ml/ha was applied as synthetic insecticide. However, each of the concentration was further diluted with 1 litre of water before the application. Thereafter, applications which commenced 35 days after planting were made weekly over a 4-week period giving a total of four applications. This was done in the early hours of the day to avoid photo decompositi on of the plant extracts.

Population densities of nymph of *M. sjostedti* was measured by random picking of 5 flowers per plot at 50% flowering stage. The flowers were placed in a glass vials containing 30% alcohol. After dissection, the flowers were opened and the insects found were counted and recorded. *Apion varium* was sampled after each weekly spraying.

At full ripening (65 days) stage, 30 pods were picked randomly from the middle row in each plot. The pods were observed and rated for pod damaged by twisting, stunting, infested, constricting, and shriveling and were used as a measure to determine pod damage. The grain yield was determined per hectare. Hundred grains were picked randomly from extracted seeds. Wrinkle and grains showing feeding punctures from 100 grains were used to rate grain quality (Oparaeke, 2005)

Data collected were subjected to analysis of variance (ANOVA) using RCB design as explained by Gomez and Gomez (1987) significant means were compared using Ducans multiple range test (DMRT) at 5% probability level.

Results

Efficacy of plant extracts on populations of *Megalurothrips sjostedti*

Table 1 shows a general decreasing trend of *M. sjostedti*. The highest mean populations of this insect were recorded from unsprayed plots and plots treated with *T. vogelii* at 5% concentrations were ranked next to it at all the weeks of treatment. However, the least mean population was observed from plots treated with Decis.

Among the plant extracts, highest mean populations of *M. sjostedti* were observed from plots treated with plant extracts at 5% concentrations with significant high populations at 1st and 2nd week. Also, no significant differences of population was observed from plots treated with 20% v/v plant extracts either singly or as a mixture. However, at 3rd and 4th week, the application of plant extracts at 20 % v/v either singly or as a mixture caused significant reduction of *M. sjostedti* as exhibited by Decis. All plant extracts irrespective of the concentrations were significantly effective than the unsprayed plots.

Table 1. Mean number of *M. sjostedti* in response to weekly application of plant extracts.

Treatment	Weeks after treatment			
	1	2	3	4
Control	38.0a	32.6a	30.7a	16.0a
Decis	2.67d	2.33e	0.00e	0.00d
T.v (5%)	32.7a	27.3ab	17.7b	10.0b
T.v (10%)	13.0bcd	11.3cde	9.67bc	6.33bc
T.v (20%)	13.0 bcd	7.33cde	4.3 3 de	0.33d
P.a (5%)	22.0a	20.0cde	8.33 dc	6.67bc
P.a (10%)	14.3bc	11.6cde	8.33cd	5.67bc
P.a (20%)	13.0bcd	6.33 d e	4.67de	0.33d
T.v+Pa (5%)	21.7b	16.3bcd	12.7bc	7.00bc
T.v+Pa (10%)	12.3bcd	9.33cde	5.00de	2.67cd
T.v+Pa (20%)	12.3bcd	6.00de	3.67de	0.33d

T.v = *Tephrosia vogelii* P.a = *Petiveria alliace*

Mean having the same alphabet (s) in a column are not significantly different ($p<0.05$ test)

Efficacy of plant extracts on populations of *Apion varium*

The population of *A. varium* decreased as the number of treatments increased although the same trend was not observed in the unsprayed plots. Also, plots treated with *P. alliacea* at 10 % v/v had the highest mean population (0.78) at $_2$nd week compared with mean population recorded as 1st week after treatment (0.67). At 2nd and 3rd week, no significant differences were observed among plant extracts-treated plots (Table 2)

Throughout the four weeks of treatment, plots treated with plant extracts caused significant reduction of *A. varium* than the unsprayed plots. However, at the 4th week, the application of plant extracts at 20% concentrations significantly controlled this insect in the same way as Decis. The application of Decis and combination of two extracts at 20% concentrations at 3rd and 4th week indicated the efficacy of the two treatments in repelling the *A. varium* owing to absence of the insect in the plots. Also, the insect was not observed in the plots treated with T. *vogelii*, *P. alliacea* at 20% concentrations and combination of the two extracts at 10 % concentrations at 4th week (Table 2). It was observed that the efficacy of the combination of the two plant extracts at 10% v/v was comparable with the single application at 20% concentrations.

Table 2. Mean number of *A. varium* in response to weekly application of plant extracts.

Treatment	Weeks after treatment			
	1	2	3	4
Control	2.00a	2.22a	1.67a	1.22a
Decis	0.22bc	0.1lb	0.00b	0.00c
T.v (5%)	0.67c	0.67b	0.56b	0.45bc
T.v (10%)	1.1 lb	0.44b	0.78b	0.22bc
T.v (20%)	0.22b	0.22b	0.22b	0.00c
P.a (5%)	1.1 lb	1.00b	0.78b	0.68ca
P.a (10%)	0.67bc	0.78b	0.67b	0.44bc
P.a (s20%)	0.45bc	0.33b	0.33b	0.11bc
T.v+Pa (5%)	0.78bc	0.45b	0.22b	0.22c
T.v+Pa (10%)	0.56bc	0.22b	0.11b	0.00c
T.v+Pa (20%)	0.45bc	0.1 lb	0.00b	0.00c

Mean having the same alphabet (s) in a column are not significantly different (p<0.05 test)

Table 3. Grain yield, pod damage and grain quality of cowpea after application of the plant extracts.

Treatments	Yield (kg/ha)	Pod damage (%)	Grain quality (%)
Control	1591	93a	15f
Decis	967a	lof	96a
T. vogelli 5%	162gh	80ab	19ef
T. vogelli 10%	459e	33d	47c
T. vogelli 20%	616c	23ef	71b
P. allicea 5%	214g	73b	26ed
P. allicea 10%	441e	36cd	43c
P. allicea 20%	600c	37ef	69b
Tv + P.a 5%	326f	43c	31d
Tv + P. a 10%	526d	23ef	61 b
Tv + P.a 20%	766c	17f	87a

Mean having the same alphabet (s) in a column are not significantly different (p<0.05 test)

With reference to yield parameters, all the extract-treated plots were significantly effective than unsprayed plots with the least yield of 159 kg/ha.

Higher yield of 967 kg/ha was recorded from Decis-treated plots, which was almost closely followed by the combination of two plant extracts at 20% v/v (767 kg/ha) (Table 3). Ninety three percent pods were damaged by *A. varium* in the unsprayed plots. Pods were effectively protected with extract applied at 20% v/v. However, the botanical treatments protected grains from infestation than the unsprayed plants.

Discussion

Attempt was made to investigate the natural toxicant from two plant extracts – T. *vogelli* and *P. alliacea* and their synergistic effects at three tested concentrations (5, 10, and 20%v/v) in the suppressing *M. sjostedti* and *A. varium.* In this study, the plant extracts applied singly at 20% v/v had 80% reduction of the target pests but extracts applied at 5% v/v had least efficacy ranging from 31 – 45 %. This indicated that the application of these plant extracts at 20% v/v were sufficient to bring the target insects below economically critical infestation threshold level. This work agrees with Adipala *et al.* (2005) who reported that plant extracts effectively controlled pod-sucking insects.

Interestingly, combination of these two extracts at 20% v/v was significantly effective as synthetic insecticide (Decis) in controlling the target insects and combination of the two extracts at 10% v/v had equal efficacy (80%) with single application at 20% v/v against the target insects. This agrees with earlier report made by Adebayo, 2003 who observed that formulation of *T. vogelii* with locust lotion was effective as Lambda-cyalothrin in controlling insect pests of cowpea.

The data also suggest that there was an increased repellent activity with increasing concentrations of the plant extracts against target insect pests of cowpea indicating that the active ingredients derived from these two plants were active at a very high concentration and probably demonstrated why less number of pods were damaged, from plots treated with 20% concentrations followed by 10% v/v, while 5% v/v extract treated plots had nearly equal number of pods damaged as recorded from unsprayed plots. Therefore, the effectiveness of the two active ingredients as insecticides depend on dosage applied. This agrees with Seljasen and Meadow (2006) who reported that effectiveness of neem as insecticide was dose-dependent.

The final yield in any crop is determined by many factors both environmental and physiological factors, and damage by insects has reported by Adebayo, 2003 is an integral component of the two factors, this accounted for the reason why the plots not treated with insecticides had the highest number of insects population and hence the least number of yield.

Matsmura (1985) reported that among six roteniods which occur naturally from *T. vogelii*, rotenone was found to be the most insecticidal which can act as either a contact or stomach poison, while Dibenzyltrisulfide, an insecticidal compound isolated from *P. alliacea,* acts as repellant (Mansingh and Williams 1998). This was probably why pods and grains from the unsprayed plants were severely damaged compared to the plant extracts treated plants. However, Rotenone and Dibenzyltrisulfide reportedly derived from *T. vogelii* and *P. alliance,* respectively, exhibited slow activity in the first two weeks after treatment against the target insect pests compared to synthetic insecticide suggesting the repellant activity of the two active ingredients. Delayed effect is one of the major problems of botanical insecticides (Isman, 2008). Ajeigbe and Singh (2006) observed that synthetic insecticide has quick effect on insect pests of cowpea compared to plant-derived insecticide.

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