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The impact of insecticide usage in cowpea, *Vigna unguiculata* (L.), productivity in Mokwa, Niger state, Nigeria

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ABSTRACT: A checklist of indigenous pests of cowpea, *Vigna unguiculata* (L.) at Mokwa, Niger state, Nigeria, and their relative abundance were reported. The impacts of two most commonly used insecticides in the locality, i.e. Dimethoate and Cypermethrin, on cowpea productivity were elucidated. Thirteen insect species were listed, three of which were prominent at the seedling and prereproductive stages. These include: - *Ootheca mutabilis, Empoasca dolichi and Medythia quarterna. Maruca testulalis,* Riptortus *dentipes, Megalurothrips sjostedti* and *Clavigralla tomentosicollis* were most prominent in the reproductive stage. Cowpea productivity tripled with the use of insecticides, but the vegetative condition of the plants was better in the screened treatments. The cost benefit analysis of each protectant was carried out and the prospect and problems of each discussed.

Key Words: Cowpea, *Vigna unguiculata*, Productivity, Insecticide, Usage.

Introduction

Cowpea, *Vigna unguiculata* (L.) Walp, is a major grain legume cultivated in Nigeria (Atare and Jackai, 1983). Four-fifth of its major production comes from the northern part of Nigeria where 10 to 12 percent of the arable land is devoted (Raheja, 1976). *V. unguiculata* is the most prominent source of plant protein in Nigeria. Its medicinal and sacred values have also been documented (Singh, 1990). Loss in productivity of cowpea is largely attributable to field pests whose status vary from one region to another (Raheja, 1976; Singh and Monoff, 1980). Jackai (1983) observed that cowpea cannot be grown successfully or sustained in most tropical countries without repeated use of at least one or two insecticide sprays. Booker (1965) recommended 6 to 10 insecticide spray applications for complete protection, but later (Jerath, 1968) reported optimal productivity with 2 to 4 sprays. The degree of improvement in cowpea productivity with insecticide usage depends on the quantity and quality of insect pests within the production region (Singh, 1990). All categories of cowpea farmers now use insecticides in spite of its cost, scarcity, eco-unfriendly nature and the possibility of the insect pest becoming resistant. Thus the cost of cowpea production has increased and hence gradually getting out of reach of peasants, who are not able to afford it. In this work an attempt is made to develop a checklist of insect pest of cowpea and to validate the role of insecticides in respect of cowpea productivity in Mokwa, a major cowpea producing area in Niger state of Nigeria.

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Materials and Methods

V. unguiculata seeds (cultivar L25) were obtained from the International Institute of Tropical Agriculture (IITA). The plant was raised on the experimental plot of Niger State college of Agriculture, Mokwa, Nigeria (lat. 9º 00'N – 9º 30'N; Long. 5º 00'E – 5º 30'E). This region falls within the southern guinea savannah agro-ecological zone of Nigeria, with a mean annual rainfall of 1180mm spanning between the months of April to October.

An experimental plot of about 9.0m X 9.0m located at least 100m away from any cowpea production field was divided into 16 blocks of 1.5m X 2.0m each, with 1.0m spacing between each block lengthwise and breadth wise along the midline, thus allowing three access sides per block. Within each block are three rows of 2.0m ridges, 50cm apart with ten planting holes of 20cm spacing and 2 grains per planting hole.

Two weeks after planting, the plot was carefully examined for insect fauna. Collections were identified and relative abundance determined per block. The blocks were each subsequently subjected to four treatments as stated below and the insect fauna monitored in all cases: -

T1 (control) – Insect fauna enjoyed unhindered access to the *V. unguiculata* plant stands within the block as it was neither screened nor was any insecticide applied.

T2 – Blocks were cleared off all noticeable insect pests and subsequently screened with a physical barrier made of a net without insecticide application.

T3 –Blocks were not screened and Dimethoate, a broad-spectrum insecticide was applied at a concentration of 5ml/500ml weekly as from 14 days after planting (DAP), using a hand compressor sprayer.

T4 – Blocks were not screened and treated with Cypermethrin, a contact insecticide, at a concentration of 5ml/500ml weekly as from14 DAP using a hand compressor sprayer.

A 2m high 16-mesh windbreak screen was erected temporarily during the spraying exercise to minimize drifting of the insecticide. Weeds were handpicked weekly. In the screened plots the uprooting of the weeds was achieved without dislodging the screens and the weeds left within the screen. The quantity and quality of insect pests were noted per block and mean number expressed as individuals per block on a range scale defined as: - Not found (-); 1-10 (+); 11- 20 (++); 21-50 (+++); >50 (++++).

At maturity, prior to harvest, the screens were removed where applicable and the health status of the plants were determined by the degree of freshness and greenness of the leaves, vines and pods on a subjective scale ranging between 1 and 4, where 4 represents the best and 1 the worst. An average value of these ratings per treatment was recorded as reflecting the health status of the plants in the respective treatment.

On the 58DAP pods from each block were harvested by hand picking and their numbers noted, while the vegetative parts of all plant stands per block were carefully uprooted and the attached soil carefully shaken off. The harvests were each put in labeled bags and sun-dried to constant weight. The weights were recorded from a digital weighing balance (Model OHAUS GA 200). The pods were later threshed and winnowed, and the average number of seeds per block and treatment noted. From this the average numbers of seeds per pod, pod filling potential and average weight of each seed were calculated. The viability rate (%) of the harvested seeds were determined in three replicates of 20 randomly selected seeds per block, grown in Petri dishes at room temperature, as a ratio of number which germinated to the number tested, i.e. 20. All results obtained were compared statistically using the Multiple Range Analysis of Variance (ANOVA).

Results and Discussion

Table 1 represents a checklist of the thirteen (13) insect species encountered at various times during the cultivation of cowpea in Mokwa, Niger state, Nigeria. The seedling and pre- reproductive stages of the cowpea cultivation in Mokwa, recruited four insect species namely: - Empoasca dolichi, Ootheca mutabilis, Medythia quarterna that are defoliators and Aphis craccivora, a sap-sucking insect. The densities of these insects increased with time with Oo. mutabilis being the most noticeable. At the reproductive stage of the plant, eight (8) other types of insect pests, which attacked flowers and pods, surfaced and became prominent. These include Maruca testulalis, which occurred earlier than others, *Riptortus dentipes, Megalurothrips sjostedti, Nezara viridula, Mylabris biparti*, *Anoplocnemis curvipes*, *Ophiomyia phaseoli* and *Clavigralla tomentosicollis*. *Me. sjostedti, R. dentipes, Ma. testulalis* and *Cl. tomentosicollis* were more frequently encountered, as their densities reached a level of 50 individuals/ block, i.e. 17 individuals / m2, thus explaining the anxiety of farmers whose hope of bountiful harvest may be dashed by the vast array of insect pest and the high infestation rate.

T1, as expected, recorded a full complement of all the thirteen insect pest species while the unscreened insecticide (Dimethoate) treatment (T3), recorded all except *Op. phaseoli and Cl. tormentosicollis*. T2 was, however, devoid of all the pests except *Ca. pennyslivaricus*, which were discovered in the tunnels within the experimental plot. The screens, no doubt, kept away all the injurious vegetative and flower/pod sucking, insects pests from the cowpea stands. The insecticides were, however, only able to reduce the densities of the vegetative pests, but a similar effect was not noticed with the flower/pod suckers. Aphids occurred between 14 and 36 DAP even where insecticides were applied.

The productivities of cowpea under the different treatments are as shown in Table 2. The health status of the screened cowpea stands (T2) was comparatively better and significantly different ($p<0.05$) from the unscreened ones. The insecticides also improved the status of the plants but this was not significant ($p>0.05$). The order of freshness of the plant stands with treatment was T2>T4>T3>T1. This was corroborated by the values on the total mean weight of the vegetative parts. Most of the leaves of T1 dropped before harvest. Thus showing that screening with a net influenced the vegetative development in Cowpea positively, possibly due to reduction in stress factors such as water loss and pest activities as earlier indicated. This, however, did not reflect in terms of pods and seed productivity (Table 2), as T1, T3 and T4, which were expected to suffer water stress, produced a significantly higher ($p<0.05$) number of pods with T3 being the highest. The lengths of the pods were, however, relatively smaller in T3 and T4, which were treated with insecticides, but the difference was not significant ($p>0.05$). T3 recorded the least length of 13.4cm.

The total weight of pods, however, did not affect the trend noticed for the length, as the insecticide treated group (T3 and T4) presented higher and significantly different ($p<0.05$) weights, i.e. 161.85g and 203.55g, respectively. T1 gave a significantly lower ($p<0.05$) value (67.47g) as compared with the screened treatment T2 (133.67g). Similar trend, i.e. T4>T3>T2>T1, were observed with the mean total weight of seeds, number of seeds and mean weight per seed. Thus explaining the lower pod filling potential recorded from the pods of T1 and T2, which had a relatively higher number of seeds per pod. Seed viability rates, in all cases, were encouraging. The least being 83.8% and no significantly difference ($p>0.05$) was observed between the treatments. High viability rates in all cases including where screens prevented pollinators may not be strange since cowpeas are known to be self-fertilizing (Singh, 1990).

The expected yield from Mokwa falls within the range earlier reported (Raheja and Hayes, 1975) and with improved management and the use of protectants, like insecticides, the yield can be tripled. This observation agrees with earlier reports (Booker, 1965; Jackai, 1983). Hence the use of insecticides is justified. Dimethoate gave a better yield (520.30kg/hectare) as compared with Cypermethrin (473.70kg/hectare); and both were better than the screened treatment (393.60kg/hectare), Possibly because the insecticides also headed off losses that may have accrued due to other pathogens that the screens could not hold back.

The cost benefit analysis shows a net profit margin of ₦13,087 and ₦11,037 per hectare with the use of Dimethoate and Cypermethrin, respectively. Screening with a net does not only result in a loss, its practicability and cost implication are notable drawbacks of the option. It may however have a long- term benefit as the environment is not exposed to any degradation risk and such screens may be reused. Costing environmental degradation of the insecticides tested makes the search for a cheaper and biodegradable option for the farmers alive and germane.

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Table 1: A checklist and relative abundance of various insect species encountered at various times in the cultivated plot of *V. unguiculata* plots subjected to various treatments at Mokwa, Niger State, Nigeria.

Insect species	Common name	Relative abundance															
		Day 14				Day 21				Day 36				Day 51			
		T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
Empoasca dolich	Leafhoppers	xx	-	x	-	xxx	-	xxx	-	xxx	-	xx	-	-	-	-	-
Ootheca mutabilis	Leaf eating beetles	xx	-	x	-	xxxx	-	x	-	xxx	-	xxxx	-	-	-	-	-
Medythia quaterna	Striped foliage beetle	xx	-	x	-	xx	-	x	-	xxx	-	xx	-	-	-	-	-
Camponotus. pennyslivaricus	Carpenter ants	-	-	-	-	-	-	-	xxx	xxx	xxxx	-	xxxx	xxx	xxx	x	xxxx
Aphis crassivora	Aphids	-	-	-	-	xx	-	-	xx	-	-	-	-	-	-	-	-
Megalurothrips sjostedti	Legume pod thrips	-	-	-	-	-	-	-	-	-	-	-	-	xxxx	-	xxx	-
Mylabris biparti	Flower blister beetle	-	-	-	-	-	-	-	-	-	-	-	-	xxx	-	xx	-
Anoplocnemis curvipes	Giant pod beetle	-	-	-	-	-	-	-	-	-	-	-	-	xxx	-	xx	-
Nezara viridula	Green sting bug	-	-	-	-	-	-	-	-	-	-	-	-	xxx	-	xxx	-
Riptortus dentipes	Pod sucking bug	-	-	-	-	-	-	-	-	-	-	-	-	xxx	-	xxxx	-
Marucatestulalis	Legume pod borer	-	-	-	-	-	-	-	-	xxx	-	xxx	-	xxx	-	xxxx	-
Ophiomyia phaseoli	Bean fly	-	-	-	-	-	-	-	-	-	-	-	-	xxxx	-	-	-
Clavigralla tormentosicollis	Spiny brown bug	-	-	-	-	-	-	-	-	x	-	x	-	xx	-	-	-

Key: - = 0; + = 1- 10; ++ = 11- 20; +++ = 21-50; ++++ = >50.

Table 2: Mean productivity values of cowpeas subjected to different treatments and their cost benefits

Plant characters	**T1**	**T2**	**T3**	**T4**
Health status	1.75^{c}	3.75^{a}	2.50^{b}	2.75^{b}
Weight of vegetative parts (g)	245.25^{b}	312.50^{a}	265.50^{b}	270.50^{b}
Number of pods	103.50^{b}	167.25^{b}	229.55^{a}	240.50^{a}
Weight of pods (g)	67.47^{c}	133.67^{b}	161.85^{a}	203.55^{a}
Total weight of seeds (g)	62.58^{c}	118.08^{b}	142.11^{a}	156.08^{a}
Number of seeds	507.75	880.00	981.19	1090.50
Weight per seed (g)	0.1233	0.1342	0.1450	0.1431
Number of seeds per pod	4.93	5.26	4.28	4.54
Pod filling potential (%)	28.50	29.72	31.94	30.88
Seed viability rate (%)	97.50^{a}	83.80^{a}	92.60^{a}	89.50^{a}
Expected yield (kg/hectare)a	208.60	393.60	473.70	520.30
Current market value of Yield (#/hectare)b	15,019.20	28,339.20	34,056.00	37,440.00
Current cost of protectant(#/hectare)c	0.00	I,399,999.06	7,999.90	9,333.80
Gross profit (#/hectare)d	-	13,320.00	19,036.80	22,420.80
Net profit (#/hectare)e	-	-1,386,679.00	11,036.90	13,087.00

Values are means of four replicates
Means followed by same alphabets superscripts within the rows are not significantly different
Current price of 50kg bag of cowpea = #3,600.00; Cypermethrin/litre = #1,200.00; Dimethoate/litre = #1400.00; Quantity of insecticide per hectare = 6.7litres.
b = a(#3,600 i.e. price of cowpea); d = b – #15,019.20 (i.e. value of unprotected yield); e = d – c.

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