PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 9 (2): 158-161, 2010
ISSN 1680-5194

Comparative Protection of Cowpea, *Vigna unguiculata* (L.) Walpers Against Field Insect Pests Using Cashew Nut Shell Liquid and Cypermethrin (Cymbush)

O.F. Olotuah[1] and T.I. Ofuya[2]
[1]Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba, Akoko, Nigeria
[2]Department of Crop, Soil and Pest Management, The Federal University of Technology, Akure, Nigeria

Abstract: The efficacy of ethanolic extract of Cashew Nut Shell Liquid (CNSL) in protecting Cowpea, *Vigna unguiculata* L. against field insect pests was ascertained through two field trials at two different planting seasons by comparing with a suitable insecticide, Cymbush 10 EC containing 100 g Cypermethrin per litre of water under natural infestation at Akungba-Akoko, Nigeria. The liquid which is viscous and contains Phenolic compounds was first standardized in the screen house using concentrations of 0.01, 0.1, 0.25, 0.5 and 1.0% to determine a marginal position of high protective capability and non-toxicity to the leaves. About 1.0% proved most effective and it was subsequently transferred to the field for comparison with Cymbush. CNSL was evaluated through the assessment of Insect Pest Number and Percentage Flower Infestation. From these, results were obtained on pod characteristics, yield and yield components, which showed that the 1.0% formulation of CNSL selected was as effective as Cymbush showing a comparatively higher protective ability.

Key words: Cowpea, cashew nut shell liquid, protection, akungba-akoko, cypermethrin

INTRODUCTION

Due to the devastating effect of insect pests of Cowpea at almost every stage of its development, several approaches have been adopted in its control. Research into the control of these insect pests has centred primarily on the use of synthetic insecticides (Echendu, 1991). Amongst the insecticides are Azodrin, Thiodan, DDT, Dursban and Dimecron, which have been found to be effective against the leafhoppers. The use of leafhopper resistant cowpea varieties was also adopted at the International Institute of Tropical Agriculture (IITA, 1974). The varieties include Tvu59, Tvu123, VITA -1, VITA -3 that do not need insecticide protection against leafhoppers.

Research in recent years has been turning more towards selective biorational pesticides, generally perceived to be safer than the synthetic (Arnason *et al*., 1989), while, extensive works on the use of plant extracts in pest control were also documented (Mordue and Blackwell, 1993) and the use of inexperience and safe protectants of plant origins was extensively reviewed (Lale, 1995).

The use of CNSL has been gaining more attention due to its possession of the active Phenolic compounds, Anacardic acid and Cardol, which also have corrosive and abrasive properties, JOF Ideal Farm, Unpublished. It was demonstrated that low concentration of CNSL could be effective in controlling *Callosobruchus maculatus* (Echendu, 1991). Similar work was also reported in preventing oviposition in *C. maculatus* (Ofuya and Fayape, 1999).

This study reports the results of fieldwork at Akungba-Akoko on the comparative control of Cowpea using a protectant of plant origin, CNSL and a recognized synthetic insecticide, Cymbush 10 EC, which contains 100 g Cypermethrin per litre.

MATERIALS AND METHODS

The study was first conducted at Adekunle Ajasin University, Akungba-Akoko in 2005 but later reviewed at the same site between 2006 and 2007. The first field trial was conducted during the late planting season (August – November) of 2006 while, the second trial took place during the early planting season (April-June) of 2007.

The Cashew Nut Shell Liquid was obtained from a cashew processing factory in Owo, Ondo State, Nigeria. Different formulations of 0.01, 0.1, 0.25, 0.5 and 1.0% were made for screening in the screen house. The most effective concentration (1.0%) was subsequently transferred to the field for evaluation with cypermethrin in controlling cowpea against insect pests. The field experiments consisted of five blocks each measuring 2.1 m wide by 11 m long and consisting of three main plots corresponding to treatments. Planting distances were 80 cm between rows and 25 cm within rows. The plots were planted in randomized block design. The spray of Cymbush 10 EC, which contains 100 g

Corresponding Author: O.F. Olotuah, Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba-Akoko, Nigeria

Cypermethrin per litre was done at a recommended reduced dosage of 25 mL in 20 L of water in a full load of a conventional knapsack CP 20 sprayer. Spray treatments in the field studies resumed 2 Weeks after Planting (WAP), progressed forth nightly and terminated at eight WAP. Natural infestation of experimental plots by the insects was not monitored.

Evaluation of CNSL for the control of pest

Assessment of insect pest number: The number of insects present in each plot was determined through count forth nightly. Both sides of all the leaves on each plot were examined for the insects. Sampling consisted of counting in situ *Ootheca mutabilis, Aphis craccivora* and *Maruca testulalis*. Total insect count was computed for each plot.

Percentage flower infestation: Percentage flower infestation was measured by randomly collecting 20 flowers from the two outer rows of each plot (i.e. 10 flowers row^{-1}). The flowers were examined for any sign of insect presence or injury. Insect flowers were expressed as a percentage of the total number of flowers collected from each plot.

Effect of CNSL on yield and yield components

Pod analysis: Ten pods were randomly harvested at crop maturity from each plot. Each pod was examined for characteristic insect entry / exit holes. Pod damage was computed for each plot. Scores were thus, taken on Pod Load (PL), which measures the degree of successful pod production and Pod Damage (PD) as represented by entry holes and the presence of frass, both using a 1-9 scale (one the inverse of the other) developed at IITA (IITA, 1987, 1988; Jackai and Singh, 1988) as shown in Table 1.

From these scores, using [PL x (9-PD)], a Pod evaluation index (Ipe) was calculated for the determination of the extent of damage/the quality of cowpea as shown in Table 2. The performance of concentration was expressed on the pods using this index.

Evaluation of trial: The evaluation of trial was based on the determination of efficacy using Henderson-Tilton's formula (Puntener, 1981).

$$\%\ \text{Efficacy} = \left(1 - \frac{Ta}{Ca} \times \frac{Cb}{Tb}\right) \times 100$$

Tb = Infestation in the treated plot before application (1.0% Extract or Cymbush)

Ta = Infestation in the treated plot after application (1.0% Extract or Cymbush)

Cb = Infestation in the check plot before application

Ca = Infestation in the check plot after application

Data collection and analysis: The data collected up to the date of termination of experiment included the flea beetle and aphid infestation count, *Maruca* flower infestation, pod-sucking bug damage and yield. All data were subjected to Analysis of Variance (ANOVA) and means compared for significance differences using Least Significance Difference (LSD) values at the 5% level of probability of Tukey's Honestly Significance Test. Counts were normalized by square root and arc sin transformations $(x + 0.5)^{1/2}$.

RESULTS

The selection of 1.0% from the screen house experiment and its transfer to the field was based on its higher mortality rate compared to other lower concentrations.

Table 1: Scores for Pod Load (PL) and Pod Damage (PD) and selection criteria for field evaluation of cowpea resistance to selected insect pests

PL score	PD score
1	9
2	8
3	7
4	6
5	5}
6	4}
7	3} Selection range
8	2}
9	1}

Table 2: Matrix of pod evaluation index (Ipe) used for the screening of the extent of damage done by pod insects

	Pod Damage (PD)								
	Undamaged							Heavily damaged	
PL	1	2	3	4	5	6	7	8	9
Poor 1	8	7	6	5	4	3	2	1	0
2	16	14	12	10	8	6	4	2	0
3	24	21	18	15	12	9	6	3	0
4	32	28	24	20	16	12	8	4	0
5	(40)	(35)	(30)	(25)	(20)	15	10	5	0
6	(48)	(42)	(36)	(30)	(24)	18	12	6	0
7	(56)	(49)	(42)	(35)	(28)	21	14	7	0
8	(64)	(56)	(48)	(40)	(32)	24	16	8	0
Heavy 9	(72)	(63)	(54)	(45)	(36)	27	18	9	0

Equation: Ipe = PL x (9 - PD), Values in parenthesis ( ) represent the selection range derived from Table 1. Underlined '--' numbers are outliers, which are within the selection range

Table 3: Cumulative means of parameters of cowpea in the two field trials

Treatment (%)	Mean insect count	Flower infestation (%)	Pod load	Pod damage	Pod evaluation index (Ipe)	Mean seed count	Converted (Ipe) values
1.0	14.18±3.6a	0.1±0.0a	7.5±0.5b	1.7±0.1a	54.47±2.5b	1598.8±14.4b	6.8b
Cymbush	7.55±3.7a	0.06±0.0a	8.0±0.1b	1.5±0.1a	60.11±3.6b	1624.0±12.5b	7.5b
Control	47.15±2.5b	0.28±0.1b	5.0±0.0a	2.4±0.0b	32.64±2.1a	488.8±6.8a	4.1a

Means in each column bearing the same letter are not significantly different at the 5% level of probability by Tukey's test

Table 4: Correlation matrix showing the relationships of the cumulative of the various parameters measured in the use of cymbush in the two field trials

	(%) Flower infestation	Ipe value	Seed count
Insect count			
Flower infestation (%)	+0.99771		
Ipe value	-0.90869	-0.84216	
Seed count	-0.99206	-0.97209	+0.93964

Table 5: Correlation matrix showing the relationships of the cumulative of the various parameters measured in the use of 1% concentration in the two field trials

	(%) Flower infestation	Ipe value	Seed count
Insect count			
Flower infestation (%)	+0.95665		
Ipe value	-0.99926	-0.95389	
Seed count	-0.99842	-0.95434	+0.99551

Table 3 shows the cumulative of the means of yield parameters of cowpea obtained in the two field trials. This result shows that a direct relationship exists between insect count and other parameters (Ofuya, 1989; Annan, 1992) that pest density threshold is an important factor in influencing aphid damage to plant growth and yield. The highest infestation was observed in the control. The parameters observed in Cymbush and 1.0% concentration showed no significance difference. Since, infestation has the tendency of influencing yield (Ofuya, 1989; Annan, 1992) and severe infestation could greatly reduce pod production (Jackai, 1995), the different levels of infestation in Cymbush and extract protected plants have resulted in no significant difference $p<0.05$ in the other yield parameters. The converted Ipe Values in Table 3 were derived from the Ipe Equation where, heavy pod is assigned the value of 9 to which, other values were related. Table 4 and 5 show the Correlation Matrix of the various parameters measured in the use of Cymbush and 1.0% Ethanol extract of Cashew Nut Shell Liquid.

The insect count was positively correlated to Flower infestation and the seed count was also positively correlated to the Pod Evaluation Index while, other relationships were negatively correlated. From the determination of %. Efficacy using Henderson-Tilton, Cymbush and 1.0% Extract of CNSL have 84.00 and 70.00%, respectively.

DISCUSSION

Considerable efforts have been made world-wide to find safer biodegradable substitutes for synthetic insecticides (Crombie, 1990). Among these efforts is the use of Cashew Nut Shell Liquid (CNSL), whose efficacy as seed protectant against *C. maculatus* L. on cowpea seeds in storage was reported (Echendu, 1991; Ofuya and Fayape, 1999.). Similar work on the protection of Okra, *Abelmoschus esculentus* L. against *Podagrica* beetles was also documented (Olotuah, 2003). CNSL is a viscous liquid, although it has been confirmed to contain the phenolic compound, which is active in pest control and has been tested and found successful as bactericide (Unpublished). Since the use of plant products in pest control had been documented and had been found reliable, the use and economic of use of CNSL is as well desirable. Moreover, the hazards often associated with the use of some synthetic insecticides have not been reported from the use of CNSL. Due to the viscosity of CNSL, it became pertinent to standardize this liquid using a suitable solvent and also to determine its optimal level of protective capability in the screen house to obtain a concentration that will be non-toxic to the plant but will effectively protect it against insect pests.

The observed Yield vigour results from efficacy of insecticide in pest control while, the Low Ipe value indicates that there is no resistance to flower damage and that severe damage at the flowering stage could result in poor production, with concomitant low Ipe values (Jackai, 1983).

It must be stressed that the more effective the insecticide the more its protective capacity and consequently the greater the yield.

The determination of efficacy of CNSL against the use cypermethrin in this study had revealed that severe damage due to high pest densities could result in poor yield and the application of 1.0% CNSL, a natural plant extract in ethanol could be an effective protectant and a substitute to the synthetic insecticides.

ACKNOWLEDGEMENT

This research work will be incomplete without mentioning the contributions of Prof. Tom Inomesan Ofuya, the Dean, School of Agric. And Agricultural Technology, The Federal University of Technology, Akure for rendering adequate assistance and scrutiny during the research work.

REFERENCES

Annan, I.B., 1992. Mechanism of aphid resistance in cowpea and population dynamics of aphid, *Aphis craccivora* (Koch) Ph.D. Dissertation, Carnell University, Ithaca, N.Y., pp: 195.

Arnason, J.T., B.J.R. Philogen and P. Morand, 1989. Insecticides of Plant Origin. ACS, Symposium Series No. 387, Am. Chem. Soc. Washington, D.C. USA, pp: 213.

Crombie, L., 1990. Recent Advances in the Chemistry of Insect Control II. Special Publication No. 79, Roy. Soc. Chem., Cambridge, U.K., pp: 296.

Echendu, T.N.C., 1991. Ginger, cashew and neem as surface protectants of cowpea against infestation and damage by *Callosobruchus maculatus* (Fab.) Trop. Sci., 31: 209-211.

IITA, 1974. Research Highlights, Ibadan, Nigeria, IITA.

IITA, 1987. Research Highlights, Ibadan, Nigeria, IITA.

IITA, 1988. Research Highlights, Ibadan, Nigeria, IITA.

Jackai, L.E.N., 1983. Efficacy of Insecticide Application at Different Times of the Day against the Legume Pod Borer, *Maruca testulalis* (Geyer) Lepidoptera: Pyralidae). Protec. Ecol., 5: 245-251.

Jackai, L.E.N. and S.R. Singh, 1988. Screening Techniques for host plant resistance to insect pests of cowpea. Trop. Grain Legume Bull., 35: 2-18.

Jackai, L.E.N., 1995. The legume pod Borer *Maruca testulalis* and its principal host plant, *Vigna unguiculata* (L.) Walp-use of selective insecticide sprays as an acid in the identification of useful levels of resistance. Crop Protec., 14: 299-306.

Lale, N.E.S., 1995. An overview of the use of plant products in the management of stored product coleoptera in the tropics. Post Harvest News and Inform., 6: 69N-75N.

Mordue, A.J. and A. Blackwell, 1993. Azadirachtin: An update. J. Insect Physiol., 39: 903-924.

Ofuya, T.I. and O.E. Fayape, 1999. Evaluation of cashew nut shell liquid and powder for the control of *Callosobruchus maculatus* (Fabricus) (Coleoptera: Bruchidae) Infesting Stored Seeds of Cowpea, *Vigna unguiculata* (L.) Walpers. Appl. Trop. Agric., 4: 72-77.

Ofuya, T.I., 1989. Effects of weeds on pre-flowering insect infestation and seed yield of cowpea (*Vigna unguiculata*) in a rainforest area of Nigeria. Experim. Agric., 25: 343-347.

Olotuah, O.F., 2003. Evaluation of Cashew Nut Shell Liquid (CNSL) for the control of *Podagrica* Beetles Infesting Okra, *Abelmoschus esculentus* (L.) Moench. Applied Trop. Agric., 8: 8-10.

Puntener, W., 1981. Manual for Field Trials in Plant Production. 2nd Edn. Ciba-Gergy Limited, Basle, Switzerland, 51: 205.