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Studies on the Influence of Insecticide Spraying Regimes and Cultivars on Insect Pests and Grain Yield of Cowpea in the Semi Arid Zone of Nigeria

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ABSTRACT

Field experiments were carried out during 2010 and 2011 cropping seasons at the Teaching and Research farm of the Department of Crop Protection, Faculty of Agriculture, University of Maiduguri the aim is to evaluate the influence of insecticide spraying regime and variety on the infestation of cowpea varieties by pod sucking bugs in the semi arid zone of Nigeria. The experiment was laid out in a randomized complete block design in a split plot with four varieties CIT 89 KD – 288, IT 90K – 277 – 2, Borno brown and Banjaram as main plots and four insecticide spray regimes (one each at flower buds, full flowering, early podding and pod filling stages) as subplots all replicated three times. Data were collected on insect pest count, pods/ plant, undamaged pods/ plant, damaged pods/ plant, normal seeds/ pod, 100 seed weight and grain yield. Result showed that varietal resistance and spraying regimes had significant effects on insect pest populations and yield parameters of improved cowpea varieties (IT 89KD – 288 and IT 90K – 2772- 2). Significantly reduced insect pest populations, pod damaged while increasing the number of pods/ plant, undamaged pods/plant, normal seed per pod, seed weight and grain yields. Compared to the local cowpea varieties (Borno brown and Banjaram) four applications of insecticide once each at flower buds, flowering, early podding and pod filling stages significantly reduced pod and seed damage, insect populations resulting in substantial increase in grain yield of cowpea compared to one application. Combined effect of variety and spray regime showed that all the varieties sprayed four times had significantly lower insect pests populations, damaged pods, undamaged pods, normal seeds, seed weight and grain yield. This study therefore indicates that varietal resistance and four spray regimes provided adequate protection for cowpea thus reducing cowpea losses on the field.

Keywords: Cowpea, Variety, Spray Regime, Insecticide, Yield, Pod-Sucking Bugs

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp) is an important grain legume throughout the tropics and sub-tropics. It is a versatile crop grown between 35 N to 30 S of the equator covering Africa, Asia, Oceania middle East, Southern Europe, southern and central America (Singh *et al.*, 1997). Cowpea is Vulnerable to

insect pests during all stages of growth; however, damage is especially severe during the reproductive phase of the crop (Jackai *et al.*, 1992, Alghali, 1992, Amatobi, 1994, Sharah and Ali, 2008, Dugje *et al.*, 2009, Egho, 2010). Several species of pod-sucking bugs (PSBs) such as *Anoplocnemis curvipes*, *Riptortus dentipes, Clavigralla* spp. and the legume pod borer (LPB) *Maruca vitrata* are among the most commonly occurring and economically important insect pests of cowpea in Nigeria (Alghli, 1992, Degri and Chaudhary, 1998a onyibe *et al.*, 2006, Degri *et al.*, 2012). Pod sucking bugs are prevalent in the semi – arid zone of north eastern Nigeria during the main cowpea cropping season (August – November). Both adults and nymphs of these pod-sucking bugs suck the sap from the young pods and developing seeds, causing serious premature drying, abscission of pods, seed abortion and the legume pod borer which attacks the flower buds, flower and pods causes premature flower buds, flower and pod abortion, seed damage and serious grain yield losses (Degri and Chaudhary, 1998b, Sastawa and Odo, 1999, Degri, 2011). Estimated grain yield losses from infestation by PSBs and LPB are 60 – 90% (Jackai *et al.*, 1992).

In Nigeria, cowpea growers do generally use a number of synthetic insecticides often with serious environmental and human consequences. The use of varieties that are resistant to attack by insect pests and the carefully timed and managed application of insecticides to coincide with stages in crop penology where pest pressure is high are some of the most promising alternative control measures since they are economically and environmentally safe (Alghali, 1992, Kyamanyawa, 1996, Sharah and Ali, 2008, Dzemo *et al.*, 2010, Egho, 2010). Insecticide application schedules or calendar and monitoring used complementarily with other insect pests control options like the use of resistant varieties and good agricultural practices (GAP) minimizes environmental hazards, reduces cost and the effect of spray frequencies and intensity (Alghali, 1992, Ajeigbe and Singh, 2006, Ahmed *et al.*, 2009). In the semi – arid zone of Nigeria, no sufficient literature on spray regimes available for the arid grassland agro ecological zone where subsistence and poor resource famers grow different varieties of cowpea. Baseline studies are important to make decision for cowpea pest management in the semi arid zone of Nigeria. It is for this reason therefore that this study is aim to determine the minimal time and frequency of this insecticide application and the right variety that can sustainably and substantially reduce cowpea insect pest infestations which specialized in feeding on cowpea pods and increase grain yield production in the study area.

Materials and Methods

Field experiments were carried out 2010 and 2011 cropping seasons at the Teaching and Research farm of the Department of Crop Protection, University of Maiduguri situated at the dry Sudan savanna zone (Latitude 11 51'N and Longitude 13^0 05'E, with 560mm mean rainfall) of North eastern Nigeria. The aim of the study was to evaluate the influence of four cultivars and synthetic insecticide applications on coreid bugs damages and grain yields. The experimental land was cleared, ploughed, harrowed and ridged manually using a hand hoe. The experimental field was laid out in a randomized complete block design in a split – plot with four varieties as main plots and four applications of the insecticide as subplots all replicated three times. The net plot size measured 4.0 m x 3.0 m (12.0 m^2) spaced at 1.5 m in between plots with an alley of 2.0 m apart.

Four cowpea varieties namely IT89KD – 288, IT90K277 – 2, Borno Brown and Banjaram with different characteristics (Table I) were obtained from Borno state Agricultural Development Program (BOSADP) and Fastac R415 EC (a combination of cypermethrin 15 g/l + dimethoate 400 g/l) with four years shelve life was obtained from on accredited agrochemical dealer in Monday market, Maiduguri and used for the study.

Table 1: Characteristics of Varieties Used in the Study and Their Source

Variety	Source	Growth Habit	Maturity	Seed Coat	Seed Size
IT 89KD - 288	IITA	Erect	Early	white	Large
IT 90K – 277 -2	IITA	Erect	Early	white	Small
Borno Brown	BOSADP	Semi - erect	Medium	Red	Medium
Banjaram	BOSADP	Semi erect	Medium	Red	Medium

All the cowpea varieties seeds were dressed with Apron star 40DS at one sachet to 2 kg of seeds to enhance good seed germination and protect the seedlings from fungal infection and seedling pests as soon after emergence. The seeds were sown two seeds per hole at 50 cm x 20 cm (erect) and 75 cm x 20 cm (semi - erect) spacing, 2:00cm – 4.0 cm sowing depth. The application of the insecticide was done at 200 g ai/ha at the interval of one week beginning from flower bud formation till physiological maturity. Spray regime one received one application at flower bud initiation (35 days after planting DAP); Spray regime two received two applications at 35 DAP and at full flowering stage (42DAP); Spray regime three received three applications at 35 DAP 42 DAP and podding stage (49DAP) and spray regime four received four applications at 35 DAP, 42 DAP, 49DAP and at pod filling stage (54 DAP).

Insect pest population count were done by using direct count method of the conspicuous nymphs and adults of the pod-sucking bugs and conspicuous holes of the legume pod borer from commencement of flowers bud formation till pod physiological maturity early in the morning (6:00 – 8:00am) on five randomly selected plants per plot and tagged.

The number of pods per plant was obtained at maturity. The number of normal (undamaged) pods per plant and number of damaged pods per plant were obtained from the total number of pods harvested from the randomly selected and tagged plants. Undamaged (normal) pods are pods without shriveled, empty or damaged seeds.

Normal seeds per pod were obtained from the harvested pods of each plot. The normal seeds per pod (seeds without damaged or wrinkled or eaten by insect) average were recorded. One hundred seed weight were obtained from the harvested pods of each plot and weighed using Metler balance (PC. 2000 Model, Wiley Co Sussex England) to obtain the average weight per plot.

Statistical Analysis

Data obtained were subjected to analysis of Variance (ANOVA) using statistics version 8.0 and the means were compared using least significant difference (LSD) at 5% level of probability.

Results and Discussion

Pod-sucking Bugs Population on Cowpea Varieties Under Different Spray Regime

The results presented in table 2 on pod-sucking bugs showed that there were two groups in which the means are not significantly different from one another. Improved cowpea varieties (IT 80KD – 288 and IT 90K – 277 - 2) had significantly lower insect pests count than the local cowpea varieties (Borno Brown and Banjaram). Lower insect pests on plots with improved varieties indicates that they resistant to the pests than the local cowpea varieties (Jackai and Singh, 1993, Kamara *et al*, 2007). It also implies that the improved varieties have some chemical constituents that repelled and deterred the pod-sucking bugs from feeding on them than the pests (Ojehomon 1986, Jackai and Singh, 1983, Jackai *et al.,* 2001). Four spray regimes significantly higher insect pests' populations. This implied that four applications of the insecticide provided significantly adequate protection for cowpea flowering and podding insect pest than one spray. This corroborates with the findings of Amatobi (1994) who reported that more than 70% of total loss in yield attributable to

insect pest as a result of damage during flowering and podding stages. In the northern Sudan and particularly the dry northern Sudan savanna zone of Nigeria, the pre flowering insects (aphids, leaf beetles, whiteflies, leafhoppers) are rarely a problem. The four spray regimes could be considered adequate for the production of early maturing varieties such as IT 89 KD – 288 and IT 90K – 277 – 2). A long or medium duration varieties like Borno Brown and Banjaram may require more spraying regimes because of their indeterminate habit (Jackai, 1981, Jackai *et al.*, 1989).

Table 2: Pod-sucking Bugs and Legume Pod Borer Population Counts on Cowpea Varieties Under Different Spray Regime

Variety	**Mv**	**Ac**	**Rd**	**Ct**
IT 89KD – 288	1.25	1.75	1.58	1.17
IT 90K-277-2	1.33	1.67	1.75	1.50
Borno Brown	2.67	2.42	2.50	2.42
Banjaram	2.33	2.25	2.33	1.75
SE ±	0.33	0.34	0.34	0.28
LSD (5%)	0.69	0.69	0.69	0.58
Spray Regime				
1 spray	3.25	3.17	3.42	2.50
2 sprays	2.25	2.33	2.50	2.33
3 sprays	1.58	1.83	1.92	1.50
4 sprays	0.50	0.75	0.33	0.50
SE ±	0.68	0.69	0.69	0.57
LSD (5%)	1.38	1.39	1.39	1.15
VXS	*	*	*	*

*** Significant**

The combined effects of variety and spray regime showed that all the varieties sprayed four times had reduced the insect pests' populations' more than one application. This indicates that insecticide spraying regimes had influence on the insect pests, hence the lower insect pest populations under plots that received four applications (Kamara *et al.*, 2007, Egho, 2010, Dzemo *et al.*, 2010).

Effects of Insecticide Applications on Yield Parameters of Cowpea Varieties
Results on number of pods per plant, number of normal (undamaged) pods per plant, normal seeds per pod, seed weight and grain yield presented in (Table 3,4,5,6,7,and 8) respectively. The results showed that there were significantly

higher number of pods per plant (Table 3), undamaged pods per plant (table 4), normal seeds per pod (Table 8), seed weight (Table 7) and grain yield (Table 8) under cowpea variety IT 89KD – 288 than cowpea variety Borno Brown. The number of damaged pods per plant were significantly higher in Borno Brown but higher in IT 89KD – 288 variety (Table 5). The highest number of pods, undamaged pods, normal seeds, seed weight and grain yield recorded on IT89KD – 288 and IT90K – 277 – 2 varieties could be due to adequate protection achieved by using these varieties.

Table 3: Effects of Insecticide Spray Regime on Number of Pods Per Plant of Cowpea Varieties

Variety	**No of Pods/ Plant**
IT 89KD – 288	21.00
IT90K-277-2	14.50
Borno Brown	13.75
Banjaram	14.75
SE ±	0.59
LSD (5%)	1.22
Spray Regime	
1Spray	11.92
2 Sprays	14.83
3 sprays	16,75
4 sprays	20.50
SE ±	0.59
LSD (5%)	1.22
VXS	*

*** Significant**

This indicates that the varieties were able to compensate or re-flush after the attack of the pests quicker than the local cowpea varieties. The damage inflicted on the cowpea plant is known to stimulate compensatory flowering and pod production in the early flowering and podding varieties (IT 89KD – 288 and IT90K – 277 - 2) than the late flowering and podding varieties (Borno Brown and Banjaram) (Jackai *et al*., 1989) hence the highest yield parameters.

Table 4: Effects of Insecticide Spray Regimes on Number of Normal Pods Per Plant of Cowpea Varieties

Variety/ Treatment	No. of Normal pods/plant
IT 89KD – 288	21.92
IT 90K-277-2	16.58
Borno Brown	15.50
Banjaram	14.17
SE ±	0.53
LSD (5%)	1.08
Spray Regime	
1 Spray	8.92
2 Sprays	13.17
3 Sprays	21.67
4 Sprays	24.42
SE ±	0.53
LSD (5%)	1.08
VXS	*

Table 5: Effects of Insecticide Spray Regimes on Number of Damaged Pods Per Plant of Cowpea Varieties

Variety/Treatment	Number of Damaged Pods/Plant
IT89KD-288	3.83
IT90K-277-2	5.75
Borno Brown	9.17
Banjaram	6.08
SE ±	0.40
LSD	0.82
Spray Regime	
1 Spray	9.50
2 Sprays	8.33
3 Sprays	4.42
4 Sprays	2.58
SE±	0.42
LSD	0.82
V×S	*

The highest number of damaged pods per planet on Borno Brown and Banjaram varieties could be due to their inability to resist or re-flush or re-grow after being inflicted by the insect pests at flower and pod stages (Asiwe, 2009). Four

applications of the insecticide significantly gave the highest number of pods per plant, undamaged pods, normal seeds, seed weight and grain yield but lowest number of damaged pods per plant.

Table 6: Effects of Insecticide Spray Regimes on Number of Normal Seeds/ Pods of Cowpea Varieties

Variety/Treatment	**Number of Normal Seeds/Pod**
IT89KD-288	10.83
IT90K-277-2	10.75
Borno Brown	8.42
Banjaram	7.75
SE ±	0.53
LSD	1.08
Spray Regime	
1Spray	6.58
2 Sprays	9.58
3 Sprays	10.17
4 Sprays	11.42
SE±	0.53
LSD	1.08
V×S	*

Table 7: Effects of Insecticide Spray Regimes on 100 Seed Weight of Cowpea Varieties

Variety/Treatment	**100 Seeds Weight/ Plot (g)**
IT89KD-288	10.79
IT90K-277-2	10.77
Borno Brown	7.69
Banjaram	7.45
SE +_	0.19
LSD	0.39
Spray Regime	
1 Spray	7.53
2 Sprays	8.11
3 Sprays	9.57
4 Sprays	11.47
SE±	0.19
LSD	0.39
V×S	*

Table 8: Effects of Insecticide Spray Regimes on Grain Yield of Cowpea Varieties

Variety/Treatment	**Grain Yield (kg/ha)**
IT89KD-288	1265.90
IT90K-277-2	894.80
Borno Brown	828.20
Banjaram	731.10
SE ±	32.51
LSD	66.22
Spray Regime	
1Spray	652.40
2 Sprays	769.20
3 Sprays	1049.20
4 Sprays	1249.30
SE±	32.51
LSD	66.22
V×S	*

Based on the insecticide recommendation for arid zone (Singh *et al.*, 1999, Onyibe *et al.*, 2006, Dugje *et al.*, 2009) four applications of insecticide provide adequate protection for cowpea variety IT 89KD – 288, hence the significantly highest number of pods, undamaged pods, normal seed, seed weight and grain yield but lowest number of damaged pods. Four applications of insecticides at flower bud, full flowering, early podding and pod filling stages adequately protected the cowpea from being damaged and ensures optimal flower, pod and seed protection (Dzemo *et al.,* 2010, Egho, 2010, Degri *et al.,* 2012).

Conclusion

Results from this study showed that among the cowpea varieties used, IT 89 KD -288 appear to be the most reliable and four applications of insecticide Fastac R415 EC Provided adequate protection for cowpea varieties. The combining effects of varietal resistance and insecticide applications were considered adequate for the production of an early duration variety in the semi –arid zone of Nigeria. Due to short rainy season (two months with a mean rainfall of 560mm) in the semi – arid of Nigeria, drought and pest resistant varieties should be combined with minimum use of insecticides. It is very important to determine which of the available insecticides, the most effective, economical, less toxic and intervals the spray should be carried out to achieve the best result. Insect pest species specialized in feeding at flowering and podding

stages, plans to control such insect can be achieved with minimum waste and hazards.

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