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Effect of Intra-Row Spacing of Cowpea on Pod-Sucking Bug Population and Damage in Ibadan, Nigeria

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ABSTRACT

The effect of different intra-row spacings of cowpea on the pod-sucking bugs (*Clavigralla tomentosicollis* Stal., *Riptortus dentipes* Fab., *Anoplocnemis curvipes* Fab. and *Mirperus jaculus* Wstw.) were studied using 15, 30, 45 and 60 cm spacing. Results showed that the bug populations as well as cowpea seed yield were significantly lower ($P < 0.05$) in 15 cm plot than at any other spacing but seed yield was significantly higher ($P < 0.05$) in 30 cm spacing plot than in other treatment plots. There were also negative and highly significant correlations between the total bug population and yield per plant ($r^2 = 0.82$; $r^2 = 0.91$; late and early seasons respectively).

INTRODUCTION

The cowpea plant is widely grown in both savannah and forest zones of Nigeria (Rachie and Roberts, 1974). It is a cheap principal source of protein and also contains useful vitamins (Oyenuga, 1967; Ogunmodede and Oyenuga, 1969). Cowpea leaves are utilised as vegetable for human consumption and the grains as food to supplement animal protein. A notable feature of cowpea crop is its susceptibility to damage by insect pests. Golding (1946) and Singh (1977) described numerous insect pests infesting the crop during all stages of growth and development. Some of the important pod-sucking bugs of cowpea are *Clavigralla tomentosicollis*, *Riptortus dentipes*, *Anoplocnemis curvipes*, *Mirperus jaculus*, and *Nezara viridula* (Singh and Jackai 1985).

The control of pod sucking bugs in cowpea has been centred primarily on the use of insecticides (Jackai *et al.*, 1985; IITA, 1986). However, there are evidences that pod- sucking bugs are not easy to control by insecticides.

The concern for the environment and the fact that cowpea is cultivated in tropical Africa by small-scale farmers who rarely use pesticides, has necessitated a shift toward integrated pest management (Ofuya, 1987). The problems associated with chemical control of insects coupled with inadequate supply and high cost of insecticides call for an extensive research into alternative control methods that are safe, affordable and reliable.

Host plant resistance combined with carefully timed minimum insecticide application (that will not disrupt the natural enemy balance) and appropriate cultural practices have been suggested as the most practical integrated control methods for the various cowpea pests (Jackai and Singh, 1983). Plant products that reduce pod –sucking bug population have been listed (Don Pedro, 1985; Lambert *et al*, 1985). The major parasitoids and predators which contribute to the population regulation of the pod-sucking bugs in the field have been identified (Olaifa, 1977; Usua and Singh, 1978) as well as other cultural methods that could reduce the population of pod sucking bugs (PSB), (IITA, 1984, Jackai *et al*., 1985).

Observations and experiments indicate that plant density may influence the incidence of certain pests in some crops. For example, the reduction of the population of *Ootheca mutablis* observed in closely spaced cowpea compared with widely spaced cowpea (Booker, 1965); the infestation and cutting by the wheat stem sawfly, *Cephus cinctus*, which decreased as row spacing became less (Luginbill and McNeal, 1958) and the reduction in the population of *Aphis craccivora* observed on closely spaced groundnut (Booker, 1963 and A' Brook, 1968) are a few cases in point.

The objective of the present work was therefore to assess the effect of different planting distances on host plant-insect interaction.

MATERIALS AND METHODS

The study was carried out in the Teaching and Research Farm of the Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria. "Ife Brown", an improved, local, determinate, semi - erect cowpea variety of medium maturity, which is highly susceptible to pod – sucking bug (PSB) damage was used. The experiment was carried out in the early season (April – July) and late season (August - November) in a randomised complete block design with four replicates. The plot size was 5 x 5 m with a clear border of 4 m between plots to minimise cross infestation. The treatments were different intra-row spacings of 15, 30, 45 and 60 cm. A constant inter-row spacing of 60 cm was maintained for all the treatments making a total of 9 rows per plot. The cowpea seeds were planted at the rate of 2 seeds per hill and at 14 days after planting (DAP), the plants were thinned to one per stand.

Weeding was done every 2 weeks and deltamethrin at 25g.a.i/ha was applied at 15, 25 and 35 DAP against the leaf and flower pests of cowpea when the pests started appearing in the field.

Assessment of the number and species of the PSB started at the budding stage (48 DAP). Only the populations of the adults were estimated by visual counting on ten randomly selected plants in the middle row of each plot. This was done by gently examining the selected plants and by carefully turning the leaves and pods for the correct assessment of all the PSB present on each of the cowpea plants. Sampling was done at weekly intervals for 4 weeks till pod maturity (75 DAP) between 7.30 a.m. and 9.30 a.m. when the insects were relatively less active and would not readily take to flight when slightly disturbed. The data generated were subjected to Analysis of variance (ANOVA) and when there was a significant difference ($P < 0.05$) between means. Least Significant Difference ($LSD_{0.05}$) was used to separate the means. Data on insect counts were transformed using $\sqrt{(x+1)}$ while those in percentages were transformed using arcsine $\sqrt{(x)}$ before analyses.

At maturity, all the pods were harvested and properly dried to moisture content of 12%. Damaged and undamaged seeds and pods were sorted out for each of the treatments. A pod was considered damaged when it had one or more constrictions along its length showing seed failure due to the bug attack or when it was shrivelled. Damaged seeds included aborted, wrinkled or shrivelled seeds or seeds showing necrosis and/or feeding lesions. Pods damaged by PSB when opened contained damaged seeds with darkly stained "feeding lesions" compared with physiologically aborted wrinkled or shrivelled seeds.

Evaluation of damage by the PSB was based on 200 pod-samples per replicate. For seed damage, 1000 seeds were selected randomly per plot and sorted into damaged and undamaged groups. The data on yields were also subjected to ANOVA and where there were significant differences, the means were separated using $LSD_{0.05}$.

RESULTS

The effect of intra-row spacing on the PSB population was determined separately in the early and late cropping seasons and the results are shown in Table 1. The population of *Clavigralla* was significantly higher ($P < 0.05$) at 15 cm compared with other spacings (30, 45 and 60 cm), which were themselves not significantly different from one another ($P < 0.05$). *Riptortus, Anoplocnemis,* and *Mirperus* spp. did not respond to differences in spacing and plant densities.

Table 1. The effect of four different intra-row spacing on the mean population of the pod-sucking bugs.

Pod Sucking bug	Planting distance (cm) 15 (231.2)[1]	30 (115.6)	45 (81.6)	60 (61.2)	$LSD_{(0.05)}$
Early season					
Clavigralla spp.	20.3	14.3	14.8	14.0	4.8
Riptortus spp.	5.3	2.9	2.6	3.2	1.0
Anoplocnemis spp.	7.5	3.8	2.6	3.1	3.6
Mirperus spp.	0.0	0.0	0.0	0.0	0.0
Late season					
Clavigralla spp.	37.7	30.3	27.7	28.5	5.2
Riptortus spp.	5.3	4.8	4.5	5.1	1.6
Anoplocnemis spp.	1.3	1.1	1.8	1.8	0.8
Mirperus spp.	1.5	1.6	1.3	1.8	0.8

[1] Corresponding plant density/ha at each spacing (X^1000).

Table 2 shows that pod and seed damage decreased with increase in intra-row spacing. Though the percentage of pods and seeds damaged in 30, 45 and 60cm were not significantly different ($P < 0.05$) from one another they were, however, significantly lower ($P < 0.05$) than that of 15 cm plots.

The number of pods/plant and seeds/pod in 15cm plot were significantly lower than that of other plots ($P < 0.05$) (Table 3). However, there was no significant difference between the seed weight in all the plots. The yields from 15 and 30 cm spacing-plots were significantly higher than those from 45 cm and 60 cm spacing which themselves were not significantly different from each other ($P < 0.05$) irrespective of planting seasons. The results also showed that yield per plant was generally higher in the late cropping season than in the early cropping season (Table 3). Yield per plant, in order of magnitude at different planting distances was 60 cm > 45 cm > 30 cm > 15 cm. The yield per plant obtained from cowpea plot of highest density (15 cm spacing) was at least half of that obtained in other plots (Table 3). The correlation between the total bug population and yield per plant was negative and highly significant at $P<0.05$ (r^2 = 0.82 and 0.91 for early and late seasons respectively).

Table 2: The effect of different intra-row spacings on percentage pod and seed damage.

Spacing (cm)	Plant density/ha (X '000)	Early season		Late season	
		Pod Damage[1]	Seed damage[2]	Pod damage	Seed damage
15	231.2	69.0	80.0	72.0	74.1
30	115.6	63.0	72.0	59.0	63.7
45	81.6	61.0	71.0	62.0	61.3
60	61.2	61.0	71.0	60.0	63.1
$LSD_{(0.05)}$	25.4	4.6	4.1	0.5	6.4

Data on percentage were transformed using arcsine before analysis
[1] Based on 200 pods per treatment
[2] Based on 1000 seeds per treatment

Table 3. The effect of four different intra-row spacings on cowpea yield in the early and late cropping seasons.

Yield and yield components	Planting distance (cm)				
	15 (231.2)[1]	30 (115.6)	45 (81.6)	60 (61.2)	$LSD_{(0.05)}$
Early season					
Mean no of pods/plant	9.9	11.2	11.4	11.4	1.1
Mean no of seeds/pod	8.9	10.8	10.9	10.9	0.9
Mean 100 seed weight (g)	15.3	15.3	15.3	15.3	0.1
Yield (plant $^{-1}$) (g)	2.5	5.1	5.4	5.7	2.7
Yield (ha $^{-1}$) (kg)	280.3	284.4	200.1	156.2	45.3
Late season					
Mean no of pods/plant	8.6	11.8	11.8	11.7	2.5
Mean no of seeds/pod	8.7	10.6	11.1	10.7	0.9
Mean 100 seed weight (g)	15.2	15.2	15.2	15.2	0.2
Yield (plant $^{-1}$) (g)	3.4	7.6	7.9	9.1	1.0
Yield (ha $^{-1}$) (kg)	370.0	421.0	291.4	249.6	42.4

[1] Corresponding plant density / ha at each spacing (X '000)

DISCUSSION

The results of the present study show that close spacing of cowpea increases the danger of damage by the PSB. This may be usefully exploited for the control of the pest, but perhaps more meaningfully, in relation to optimisation of yield in the crop. Yield was highest in the 15cm and 30cm plots compared with 45cm and 60cm plots. Spacing undoubtedly affects the yield of cowpea in the forest zone of Nigeria. Wide spacing can lead to a significant reduction in yield (Ezedinma, 1974). Similarly, a high plant population (close spacing) may depress yield (Remison, 1980) or have no yield advantage (Kayode and Odulaja, 1985) as confirmed in the present study. Whatever the density is at which yield is optimised, it is clearly disadvantageous to increase density still further as this is likely to lead to greater damage by the PSB. Some other workers have also observed increased incidence of insect pests and diseases in the cowpeas planted at high densities (Evans 1954, Booker, 1963 and 1965, Nangju, 1976; Remison and Okunariwo, 1979 and Ofuya, 1987). From these and other reports, it would then appear therefore that the role of spacing or plant density in insect control depends on the crop, type of insects and other factors that have not really been studied.

The susceptibility of cowpea cultivars to damage by PSB has been partly explained by the amount of foliar cover that offered shelter to the adult PSB. *C. tomentosicollis* and *N. viridula* lay their eggs on the under surfaces of leaves thereby protecting the eggs from sunlight (Egwuatu and Taylor, 1977; Singh and Rachie, 1985).

The thick foliage resulting from the closeness of the plants shelter the pests and encourage reproductive activities and thereby attract more of the pests to this microenvironment. Ofuya (1987) reported that cultivars which are strongly vegetative with overlapping foliage suffer greater damage by *Cydia ptychora* than non-vigorous types. The foliar cover is thus dependent on two factors: the growth habit and population of plants. Climatic factors also affect the foliar cover. For instance, in the forest zone where wet season cowpeas tend to grow more vegetatively, more PSB are therefore attracted to the crop and more damage is done.

Spacing at 30 cm appears to reduce foliar overlap and therefore reduce PSB population is therefore most appropriate in controlling PSB in cowpea. It is also an invaluable input to the integrated pest management of PSB in cowpea.

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