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RELATIVE INFESTATION AND DAMAGE OF SOME PIGEONPEA CULTIVARS BY LEPIDOPTERAN POD BORERS IN UGANDA

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ABSTRACT

Infestation and damage of some pigeonpea (*Cajanus cajan* [L.] Millsp.) cultivars by lepidopteran pod borers were evaluated over two cropping seasons during 1991 at the Makerere University Agricultural Research Institute, Kabanyolo. Significant ($P \leq 0.05$) cultivar differences were recorded in borer incidence and pod damage. Apio, the local cultivar, showed the highest infestation by *Helicoverpa armigera* (Hubner). ICPL 87104 had the greatest infestation by *Maruca testulalis* (Geyer), although in the second season it was not significantly higher than the rest. *Etiella zinckenella* (Treitschke) occurred in very low numbers, and cultivar differences were not significant ($P > 0.05$). Indexing larval counts to number of pods per plant showed that infestation pressure by both *H. armigera* and *M. testulalis* was not as different among cultivars as larval counts suggested. Pod damage was greatest on ICPL 87 and lowest on ICPL 87104.

Key Words: **Pigeonpea, pod borers, Uganda**

RÉSUMÉ

L'infestation et le dégâts sui quelques cultivars de pois d'Angole (*Cajanus cajan* (L.) Millsp.) dus aux lepidoptères foreurs des fousses ont été évalués durant deux saisons de culture en 1991, à Kabanyolo, à l'Institut de Recherche Agricole de l'Université de Makerere. Des differences significatives ($P \leq 0,05$) ont été en registrées entre les variétés quant à l'incidence des foleurs et aux dégâts sur les fousses. Lé cultivar local, Apio a enregistré la plus forte infestation due à *Helicoverpa armigera* (Hubner). Le cultivar ICPL 87104 a enregistré la plus forte infestations due à *Maruca testulalis* (Geyer) même si durant la seconde saison, elle n'etait pas significativement differente des autres. *Etiella zinckenella* (Treitschke) a été observée en faible nombre et la difference entre les cultivars n'est pas significative ($P > 0,05$). La relation entre le nombre de larves et le nombre de fousses par plante a dé montré pue la plession d'infestation due à *H. armigera* et *M. testulalis* n'est pas sussi différente entre les cultivars comme le comptage des larves le laisse ressortir. Les dégâts sur les fousses ont été plus élevés sur ICPL 87 et plus bas sur ICPL 87104.

Mots Clés: **Pois d'Angole, foreurs des gousses, Ouganda**

INTRODUCTION

Pigeonpea (*Cajanus cajan* [L.] Millsp.) is one of the major grain legume crops of the tropics and sub-tropics (Nene and Sheila, 1990). In Uganda, it is mostly grown in the drier north, where over 80% of the crop is cultivated (Acland, 1986). The most important constraints to the production of pigeonpea are the occurrence of foliar diseases, and damage by pests (Nawale and Jadhar, 1983). In East Africa, over 50 pest species have been recorded feeding on various parts of the crop (Le Pelleg, 1959). Although pest attack begins at the vegetative stage, the complex of insects feeding on pods cause the greatest damage (Chhabra *et al.*, 1981; Lal and Yadava, 1987). Among these are the lepidopteran pod borers, *Helicoverpa armigera* (Hubner) (American bollworm) (Bhosale and Nawale, 1983; Kabaria *et al.*, 1988; Tirumala *et al.*, 1986), *Maruca testulalis* (Geyer) (cowpea pod borer) (Sinha *et al.*, 1979), *Etiella zinckenella* (Treitschke) (legume pod borer) (Armstrong, 1991) and *Exelastis atomosa* (W.) (plume moth) (Odak *et al.*, 1976).

Of the numerous pod borer species, *H. armigera* and *M. testulalis* are probably the most important pests of the crop, although their status may vary from one region to another. In India, for instance, *H. armigera* was reported as causing the greatest damage in Bharuch District, Gujarat (Kabaria *et al.*, 1988), in Andhra Pradesh (Tirumala *et al.*, 1986) and in Maharashtra (Bhosale and Nawale, 1983), while Yadava *et al.* (1988) reported that in Uttar Pradesh it was second in importance after the podfly, *Melanagromyza obtusa* (Malloch). The cowpea pod borer has also been reported as an important pest in some regions of India, such as Bihar (Sinha *et al.*, 1979) and Orissa (Patnaik *et al.*, 1986), particularly on early maturing varieties (Sinha *et al.*, 1979; Yadava *et al.*, 1988). Another lepidopteran pod borer considered important on pigeonpea is *E. zinckenella*. In Puerto Rico, together with *Heliothis virescens* (Fabricius), it accounts for about 50% loss in crop yield (Armstrong, 1991).

Although pests are known to cause substantial yield losses, most of the farmers in the main pigeonpea growing regions are subsistence producers who do not apply insecticides, mainly because of resource limitation and the low economic value of the crop (Lateef and Reed, 1981; Reed *et al.*, 1981). Under these circumstances, the use of resistant cultivars offers one of the best options for pest management on the crop. In the present study, therefore, investigation was carried out on the relative infestation and damage of some pigeonpea cultivars by lepidopteran pod borers in Uganda.

MATERIALS AND METHODS

The study was carried out at the Makerere University Agricultural Research Institute, Kabanyolo (MUARIK), during the long (LR) and short rainy (SR) seasons of 1991. The station is located about 19 km north-east of Kampala, at latitude 0° 28'N and longitude 32° 37'E. In the long rains (March–June), six short-duration cultivars, namely ICPL's 85010, 87, 87104, 151, 88001 and 87111, and seven medium-duration cultivars, ICP's 13200, 11377, 11984, 11429, 12748 and 12075, obtained from the International Crops Research Institute for the Semi Arid Tropics (ICRISAT) and Apio (a local check) were grown. In the following season (October–December), the cultivars ICPL 151, ICPL 88001, and ICP's 11377, 11429 and 12748 were discarded owing to their high susceptibility to *Phytophthora drechsleri* and *Fusarium udum*. Data for these cultivars were therefore excluded from the analyses.

The crops were grown in randomised complete blocks, with four replications. Plots measured 2.4 m by 5 m, and there were five rows per plot. Inter- and intra-row spacings were 60 cm and 30 cm, respectively. Planting dates were March 29 and October 11 in the long and short rains, respectively. Three to five seeds were planted per hole, and the plants thinned to one seedling per hill three weeks after germination. Plots were maintained by regular hand-weeding.

Ten plants, randomly selected from the second and fourth rows of each plot were examined. Infestation by *H. armigera* and *M. testulalis* was determined by counting the number of larvae on sample plants at peak incidence, 3 and 5 weeks after anthesis for short- and medium-duration cultivars, respectively.

Incidence of the legume pod borer, *E. zinckenella*, was assessed from the sample rows mentioned above at crop maturity, as this pest attacks pigeonpea late in the season (Reed *et al.*, 1989; Badaya *et al.*, 1990). Each of ten plants was

TABLE 1. Infestation (number of larvae plant^{-1}) of eight (short-, SD, and medium-duration, MD) pigeonpea cultivars by lepidopteran pod borers at Kabanyolo, Uganda, 1991.

Pod borer species	Pigeonpea cultivar	Maturity group	Cropping season: Long rains Actual	Long rains Indexed[a]	Short rains Actual	Short rains Indexed
Helicoverpa armigera						
	ICPL 85010	SD	0.1(0.031)d[c]	0.00b[b]	0.5(0.119)b	0.01a
	ICPL 87	"	1.6(0.374)cd	0.11ab	5.0(0.663)ab	0.08a
	ICPL 87104	"	0.4(0.138)d	0.01b	0.3(0.075)b	0.01a
	ICPL 87111	"	1.0(0.291)cd	0.02b	2.8(0.369)ab	0.03a
	ICP 11984	MD	3.2(0.568)bc	0.05b	4.0(0.600)ab	0.04a
	ICP 12075	"	7.1(0.832)ab	0.20a	6.3(0.619)ab	0.09a
	ICP 13200	"	1.5(0.366)cd	0.03b	1.5(0.325)ab	0.03a
	Apio (Local)	"	11.3(1.081)a	0.11ab	10.0(0.942)a	0.09a
Maruca testulalis						
	ICPL 85010	SD	0.7(0.203)bc	0.05b	0.0(0.000)a	0.00a
	ICPL 87	"	2.2(0.437)ab	0.11ab	0.5(0.119)a	0.01a
	ICPL 87104	"	3.8(0.674)a	0.13a	0.5(0.119ab	0.01a
	ICPL 87111	"	0.5(0.148)bc	0.01b	0.3(0.075)a	0.00a
	ICP 11984	MD	0.0(0.000)c	0.01b	0.0(0.000)a	0.00a
	ICP 12075	"	0.4(0.142)bc	0.01b	0.0(0.000)a	0.00a
	ICP 13200	"	0.3(0.125)bc	0.01b	0.0(0.000)a	0.00a
	Apio (Local)	"	0.8(0.195)bc	0.01b	0.0(0.000)a	0.00a
Etiella zinckenella						
	ICPL 85010	SD	0.3(0.075)a	0.02a	1.0(0.226)a	0.02a
	ICPL 87	"	0.3(0.075)a	0.01a	0.5(0.119)a	0.01a
	ICPL 87104	"	1.5(0.270)a	0.04a	0.3(0.075)a	0.01a
	ICPL 87111	"	2.8(0.489)a	0.03a	0.0(0.000)a	0.00a
	ICP 11984	MD	2.0(0.413)a	0.03a	0.5(0.119)a	0.01a
	ICP 12075	"	1.0(0.270)a	0.02a	0.3(0.075)a	0.00a
	ICP 13200	"	3.0(0.445)a	0.05a	0.5(0.119)a	0.01a
	Apio (Local)	"	0.5(0.151)a	0.00a	0.0(0.000)a	0.00a

[a]Pod-indexed infestation calculated as the ratio of number of larvae/plant to mean number of pods/plant.

[b]For each borer species in a given column, means followed by the same letter are not significantly different at $P \leq 0.05$ (Tukey's Procedure).

[c]Figures in parentheses are log-transformed values (transformation done to adjust variances).

harvested separately, and all pods opened and the larvae found counted.

Data for larval counts were subjected to logarithmic transformation before analysis to adjust variances. Larval counts were also converted into indices of infestation (infestation pressure) by calculating the ratio of number of pests per plant to mean number of pods per plant. Incidence of damage was assessed as the proportion of pods with borer feeding holes (Kabaria *et al.*, 1988; Badaya *et al.*, 1990). Data were subjected to Analysis of Variance (ANOVA) with the linear additive model, and means compared using Tukey's Procedure.

RESULTS

Infestation by pod borers. The bollworm, *H. armigera*, was the most abundant pod borer, followed by *M. testulalis* and *E. zinckenella* (Table

1). None of the cultivars was free from attack by the American bollworm. Some cultivars, however, were not infested by *Maruca* and *E. zinckenella*, particularly during the short rains. Generally, higher numbers of *H. armigera* larvae were recorded on medium-duration than on short-duration cultivars. *M. testulalis* populations, on the other hand, were higher on SD than on MD cultivars. There were no consistent differences between SD and MD cultivars in infestation by the legume pod borer. While populations of the bollworm were slightly higher in the short rains than in the long rains, infestation by both cowpea and legume pod borers were higher in the long rains than in the short rains. The highest infestation recorded for *H. armigera* in the long rains was 11 larvae plant^{-1}, on the local cultivar, Apio. ICP 12075 also had a high population of this pest (7.1 larvae plant^{-1}) (Table 1). Another cultivar which had a high population of bollworms was ICP 11984, with 3.2 larvae plant^{-1}. Pod-indexing of the infestation revealed that ICP 12075 had the highest infestation pressure, followed by Apio and ICPL 87.

In the short rains, the cultivar Apio again had the highest infestation, but this was not significantly higher than those of other cultivars except ICPL's 85010 and 87104 (Table 1). Apio, ICP 12075 and ICPL 87 had the highest infestation indices, but differences among cultivars were not significant.

Incidence of the cowpea pod borer, *M. testulalis*, did not follow the same pattern as for the bollworm. ICPL 87104 supported the highest number of larvae (3.8 larvae plant^{-1}). ICPL 87 also had a high infestation (2.2 larvae plant^{-1}), and was not significantly lower than that on ICPL 87104. During this season, no *M. testulalis* larvae were found on ICP 11984. Expressed as pod index, ICPL 87104 had the highest infestation pressure, followed by ICPL 87. The indices of these two cultivars were not significantly different (Table 1).

In the short rains, ICPL's 87 and 87104 were again the most infested cultivars, although the larval populations were not significantly higher than the rest. No Maruca pod borers were found on MD cultivars. In terms of the pod index, ICPL's 87 and 87104 were still the most heavily infested. Cultivar differences were not significant.

E. zinckenella populations on the crop were generally low, particularly during the short rains. During the long rains, cultivars with high infestations included ICP 13200 (3.0 larvae plant^{-1}), ICPL 87111 (2.8 plant^{-1}), ICP 11984 (2.0 plant^{-1}) and ICPL 87104 (1.5/plant^{-1}). Cultivar differences were, however, not significant. Using pod-indexing altered cultivar ranking for infestation. ICPL 87111, for instance, had a higher actual infestation than ICPL 87104, but the latter had a higher indexed infestation. The relative pigeonpea infestation by *E. zinckenella* changed in the short rains. ICPL 85010, among the least infested cultivars in the long rains, supported the highest numbers of *E. zinckenella* larvae during the short rainy season. Cultivars did not differ significantly in infestation, even after indexing.

TABLE 2. Percentage of pods with feeding holes of lepidopteran pod borers for eight pigeonpea cultivars at Kabanyolo, Uganda, 1991.

Cultivar	Maturity group	Cropping season	
		Long rains	Short rains
ICPL 87	SD	35.7 ± 6.6a[a]	24.9 ± 4.7a
ICPL 85010	SD	19.1 ± 3.9ab	5.8 ± 0.7bc
ICPL 87104	SD	16.1 ± 0.9b	3.3 ± 0.3bc
ICPL 87111	SD	18.8 ± 2.8ab	12.6 ± 1.8b
ICP 11984	MD	17.4 ± 3.2b	4.9 ± 1.6bc
ICP 12075	MD	19.3 ± 4.0ab	9.1 ± 0.6bc
ICP 13200	MD	18.1 ± 2.1b	2.0 ± 0.6c
Apio (Local)	MD	19.12 ± 0.4ab	12.5 ± 0.4b

[a]For each season, means followed by the same letter are not significantly different at $P \leq 0.05$ (Tukey's Procedure).

Pod damage. Pod damage varied significantly among cultivars, particularly in the short rainy season, and was generally higher on short-duration than on medium-duration cultivars (Table 2). Damage levels in the short rains ranged from 2% to 24.9% of pods with feeding holes, compared to a variation of 16.1 to 35.7% in the long rains. In the first rains, ICPL 87 had the highest pod damage level (Table 2). Damage levels on the other cultivars were not significantly different.

In the second season, cultivar ICPL 87 again had the highest pod damage level, being significantly higher than those on all other cultivars. ICPL 87111 and Apio also had high proportions of eaten pods (12.6 and 12.5%, respectively), which were not significantly higher than for the other cultivars except ICP 13200. All other cultivars suffered less than 10% pod damage. A particularly low level of pod damage (2%) was recorded on ICP 13200.

DISCUSSION

On the whole, pod borer infestations were higher in the long rains than in the short rains. The more luxurient plant growth in the heavier long rains probably favoured build-up of populations of these pests. Pod damage followed a similar pattern. The high variability of pod damage among cultivars in the short rains is probably due to the low occurrence of the cowpea and legume pod borers, this implying that damage observed was mainly due to the bollworm. *H. armigera* was the most abundant lepidopteran pod borer. Similar results have been reported from India (Bhosale and Nawale, 1983; Tirumala *et al.*,1986; Kabaria *et al.*, 1988). While in the present study *Maruca* was second to *H. armigera* in abundance, in Orissa (India), *Maruca* pod borer was more important (Patnaik *et al.*, 1986).

Short-duration cultivars were generally more infested by *Maruca* pod borer than medium-duration cultivars. This is similar to earlier observations from Bihar, India (Sinha *et al.*, 1979). Since SD and MD cultivars generally had heavier infestations (both actual and pod-indexed) by *Maruca* pod borer and bollworm, respectively, and yet the former maturity group suffered higher pod damage, then *M. testulalis* is probably more important than actual larval numbers suggest.

Pod damage ranged from 2.0 to 35.7%. These damage levels were high compared to results obtained in Orissa, India, where various pod borers, including *Maruca*, American bollworm and plume moth, were reported to cause 8.2 to 15.9% pod damage (Patnaik *et al.*, 1986). However, figures obtained in the present study were lower than those obtained in other locations. At Rahuri, India, for instance, pod damage by *Helicoverpa* alone varied from 9.7 to 43.1% (Bhosale and Nawale, 1983). Armstrong (1991) recorded 19 to 57% pod damage by *H. virescens* and *E. zinckenella* in Puerto Rico.

Since the pod index takes into consideration resources available to insects for shelter, feeding and oviposition, it is probably a more realistic measure, particularly in relationships of infestation and damage. The observation that high pod indices do not necessarily imply high damage levels reflects differences in cultivar susceptibility to pests.

Cultivars with high infestation pressures (ratio of number of larvae per plant to mean number of pods per plant) did not necessarily have high pod damage levels. This may be attributed to some antibiotic factors, whereby high numbers of larvae per given space fed less. Cultivar ICP 12075, for instance, had high infestation indices both in the short and long rains, but low damage levels.

Another possible explanation for poor correlation between infestation pressure and damage could be differential shedding of damaged pods. Cultivars which shed more of their damaged pods may have low percentages of damaged pods. Cultivar ICP 12075 actually had a tendency to shed large numbers of pods, which were probably damaged.

From pod damage, it is apparent that cultivar ICPL 87 had the highest susceptibility to pod borers. This observation is supported by larval counts. Differences in ranking of the cultivars for borer infestation suggest that resistance/ susceptibility factors to these pests are different. This area requires further research.

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