Entomology

Insect Pest Incidence in Seed Pods of Pigeonpea Genotypes in On-farm Trials in Southern Malawi

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Pigeonpea (*Cajanus cajan* (L) Millsp.) is an important food and cash crop in Malawi. It is mostly grown in southern Malawi where it is consumed as green pea or dry grain, and exported as whole grain or *dhal* (Soko et al. 1994). Insect pests have been cited as one of the major biotic factors limiting pigeonpea production in Malawi (Reed 1987, Sithanantham and Reddy 1990). The economically important insect pest groups are the pod-sucking Hemiptera (dominated by *Clavigrella* spp.), pod-boring Lepidoptera (mainly *Helicoverpa armigera* Hübner, *Maruca vitrata* Geyer, and *Etiella zinckenella* Treitschke), and seed-boring Diptera (the pod fly, *Melanagromyza chalcosoma* Spencer).

Surveys conducted on farmers' fields in Malawi during 1995 and 1996 (Minja 1997) indicated that 15% of pigeonpea seed was damaged by insect pests. Pod-sucking bugs damaged 9.5% (60% of the total seed damage) of seeds in 1995 and 11.4% (75% of the total seed damage) of seeds in 1996. Pod borers damaged 6.0% and 3.6% of seeds, accounting for 38% and 24% of the total seed damage, respectively for the two seasons. Pod fly incidence was very low in both seasons, damaging <2% of seeds. The present studies were conducted in southern Malawi between July and September 1999 in a partnership between the Farming Systems Integrated Pest Management Project (FSIPMP), CABI Bioscience Global Project on legume pod borers and their natural enemies, and ICRISAT to enable farmers to evaluate the performance of improved high yielding medium- and long-duration pigeonpea genotypes in different cropping systems.

In 1999, pod-pest surveys were conducted within the Blantyre Shire Highlands Rural Development Project (RDP) Area, at on-farm trial sites in Nansadi and Mangunda sections of Matapwata Extension Planning Area (EPA) and Lirangwe section of Chiradzulu North (Mombezi) EPA. In this article only the results of the surveys in Mangunda section are reported, with brief comments from other parts of the RDP because trapping and trap security were most assured in Mangunda than in other sections.

The on-farm trials were designed by the FSIPM Project's agronomist and comprised of three main plots in each of the four farmers' fields. Two of the main plots had three sub-plots each planted with three long-duration genotypes (ICP 9145, ICEAP 00040, and ICEAP 00053). In one of the main plots, the pigeonpea was intercropped with maize. In the second main plot, pigeonpea was grown as a sole crop. In the third plot, four medium-duration genotypes (Chilinga, ICEAP 00068, ICEAP 00073, and ICP 6927) were grown on 4 subplots intercropped with maize.

At crop maturity, samples of 25 pigeonpea pods were randomly drawn from five plants in each subplot. The samples were examined in the laboratory for pest incidence and damage levels due to each pest group. Pods and seeds that were damaged by each pest group were expressed as proportions of the total number of pods/seeds per sample. In addition to pigeonpea, large numbers of pods from *Crotalaria ochroleuca*, *Tephrosia vogelii*, *Dolichos*, and other plant hosts were also collected and examined. Sampled borer larvae, pupae, or parasitoids were sorted out and reared for further identification.

Since pod and seed damage were expressed as proportions computed from numbers damaged by various pests, they were analyzed through logistic regression procedures (Collett 1991). All analyses were carried out taking into account the data structure as specified by the trial design, e.g., allowing for variation between farmers in all cases and nested data structure in the medium- and long-duration pigeonpea genotypes at Mangunda (Abeyasekera 2000).

The results are presented in terms of predicted percentages of seeds and/or pods showing damage. The results are also presented in the form of odds ratios, i.e.,

Table 1. Predicted % pod/seed damage and odds ratios of damage for medium-duration genotypes at Mangunda.

Genotype	Pods with external damage	Seed damage			Overall damage
		Borers	Sucking bugs	Pod fly	
Chilinga	7.0	2.0	39.0	0.4	41.4
ICEAP 00068	36.7	7.3	38.1	1.4	46.8
ICEAP 00073	14.0	2.3	45.0	1.2	48.5
ICP 6927	35.0	7.2	52.5	2.4	62.1
Sig. Prob.	<0.001	0.060	0.321	0.333	0.168
Odds ratios compared to Chilinga					
ICEAP 00068	7.79	3.80	0.96	3.34	1.25
ICEAP 00073	2.17	1.12	1.28	2.84	1.32
ICP 6927	7.22	3.73	1.74	6.11	2.30

the odds of damage to one genotype relative to the odds of damage to another genotype. The odds of damage for a particular genotype are defined as:

$$\frac{\text{Probability of damage}}{\text{Probability of no damage}} = \frac{\text{Probability of damage}}{1 - \text{Probability of damage}}$$

Two genotypes can be compared by looking at the ratio of their odds. For example, the odds of damage to ICP 6927 relative to Chilinga would be defined in terms of odds ratio as:

$$\frac{P_1/(1-P_1)}{P_2/(1-P_2)}$$

where P_1 = probability of damage for ICP 6927 and P_2 = probability of damage for Chilinga.

The results from analysing the proportion of seeds/pods damaged among medium-duration genotypes indicate that pod-sucking bugs are a major problem for all genotypes (Table 1). There were some indications that Chilinga and ICEAP 00073 showed less damage to borers compared to ICEAP 00068 and ICP 6927. The odds of damage relative to Chilinga indicated that ICEAP 00068 had nearly 8 times higher odds of external damage to pods compared to Chilinga. The results on the long-duration genotypes showed that pod-sucking bugs are also a major constraint later in the season (Table 2). ICP 9145 showed less pest damage in intercrops compared to sole crops but the differences were not significant. With respect to overall damage and damage by pod-sucking bugs, the ICEAP genotypes showed slightly worse odds of damage compared to ICP 9145. The odds of damage were significantly different ($p<0.001$) between the locations, with higher values for the humid and cool sites (Matapwata) compared to the warm and semi-humid sites (Mombezi).

Determination of pod borers collected from different host plants revealed two species that were previously not identified although they are common on pigeonpea in the region. They have now been identified (by A. Polaszek, CABI) as a noctuid *Pardasena virgulana* that was occasionally parasitized by *Cotesia* sp., and a tortricid *Leguminivora ptychora*. *L. ptychora*, and *E. zinckenella* were also collected from *Tephrosia* pods. Within pods of both pigeonpea and *Crotalaria* a large species of chalcidoid wasp, *Eurytoma* sp. was abundant. *Eurytoma* species have varied biologies, being parasitoids, hyper-parasitoids, and herbivores. Parasitism of *Lampides boeticus* by *Neotypus intermedius* (Ichneumonidae) was high particularly on *Crotalaria*; *M. vitrata* parasitization by *Braunsia* sp. (Braconidae) was also greater on *Crotalaria* than on pigeonpea.

The predicted levels of damage by pod borer and pod fly are consistent with farmer field survey results for Malawi during 1995 and 1996 (Minja 1997). The predictions for damage by sucking bugs, however, seem to be much higher than the 4–17% levels that accounted for 70% of total seed damage in the previous surveys. The higher susceptibility of ICP 6927 to pest damage compared to other medium-duration genotypes had also been observed from trials in Kenya. Similar variations in damage by pod borers and pod fly on pigeonpea in different locations have been reported from other countries in the region (Minja 1997). These variations are believed to be due to different levels of pest populations at different locations, possibly mediated by climatic and soil differences.

Given the evident seriousness of pigeonpea seed yield losses to pod pests in southern Malawi, immediate efforts should be made to assess the performance of elite pigeonpea genotypes against pod pests in different cropping systems

Table 2. Predicted % pod/seed damage and odds ratios of damage for long-duration genotypes at Mangunda.

Cropping pattern	Genotype	Pods with external damage	Seed damage		
			Borers	Sucking bugs	Overall damage
Intercrop	ICP 9145	12.8	5.3	37.6	42.9
	ICEAP 00040	20.0	7.1	48.9	56.0
	ICEAP 00053	32.8	10.8	44.5	55.3
	Sig. prob.	0.071	0.207	0.217	0.11
	Odds ratios compared to ICP 9145				
	ICEAP 00040	1.70	1.36	1.59	1.69
	ICEAP 00053	3.33	2.16	1.33	1.72
	ICP 9145	31.2	10.4	45.2	55.6
Sole crop	ICEAP 00040	15.2	5.1	53.5	58.6
	ICEAP 00053	25.6	9.4	54.4	63.8
	Sig. prob.	0.355	0.485	0.453	0.69
	Odds ratios compared to ICP 9145				
	ICEAP 00040	0.40	0.47	1.39	1.07
	ICEAP 00053	0.76	0.89	1.45	1.34
	Sig. prob. for cropping pattern	0.757	0.831	0.344	0.37

in other locations in the region. On-farm trials offer the best platform both to conduct such quantitative pest management assessments and to test any candidate pest management strategies.

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