Table 1. Mean percentage of pod damaged by pod borer and podfly in the main pigeonpea-growing districts of Nepal, 1994/95.

	Siraha	Dhanusha	Mahottari	Sarahi	Rautahat	Banke	Bardiya
Pod borer damage (%)	22.6 (16–28)	65.4 (24–70)	60.0 (22–65)	19.5 (12–25)	23.3 (19–27)	67.0 (41–73)	62.3 (35–74)
Podfly damage (%)	61.9 (19–69)	63.5 (23–72)	51.5 (11–61)	58.3 (13–70)	56.2 (23–63)	63.1 (31–72)	69.0 (53–75)

Values are the mean of 5 samples.
Values in parantheses are the damage range.

the third most important legume crop of Nepal but its extent and productivity are very low. The reasons include insect pests and diseases, cultivation on marginal land, and poor management.

Though pigeonpea has been cultivated for a long time in Nepal, no systematic information is available on the insect pests associated with this crop. In 1994/95 a survey was conducted to identify the major insect pests of pigeonpea in the main pigeonpea-growing districts of the country: Siraha, Dhanusha, Mahottari, Sarlahi, Banke, and Bardiya. The pigeonpea crop was examined at the vegetative and flowering stages, and at maturity. Short-duration varieties in Siraha, Dhanusha, Mahottari, Sarlahi, and Rautahat, long-duration varieties in Banke, and Bardiya districts were observed.

The survey revealed that the podfly (*Melanagromyza obtusa*) and pod borer (*Helicoverpa armigera*) were the most destructive insects of pigeonpea. Podfly damage was highest in Bardiya, while pod borer damage was the greatest in Banke. Relatively low infestations of pod borer were observed in Sarlahi. The pod borer, *Etiella zinckenella* (TR), was observed in Siraha, Sarlahi, and Dhanusha and the pod borers, *Lampides boeticus*, and *Exelastis atomosa* were observed in Banke and Bardia.

The blister beetle (*Mylabris pustulata*) was noticed at Sugarcane Research Station, Jitpur, (Bara) and Lalpur, (Siraha) on short-duration pigeonpea. Leaf webbers were observed in nearly all districts surveyed. Jassid (*Empoasca* spp) was a serious pest at Lalbandi (Sarlahi), Lalpur (Siraha), and Dhalkebar (Dhanusha). The important pod-sucking bugs, *Clavigralla gibbosa, Riptortus* spp and *Nezara viridula*, were observed in all the districts surveyed.

Other insect pests of minor importance observed during this survey include: cowbugs (*Otinotus* spp and *oxyrachia* spp), termites (*Odontotermes* spp and *Microtermes* spp), grasshhoppers (*Colemania* spp, *Catantops* spp and *Cyrtacanthacris* spp) pod weevil (*Apion benignum*), and leaf-damaging weevil (*Myllocerus undecimpustulatus* Faust).

This survey has indicated that podfly and pod borer are the most destructive pests of pigeonpea. To increase both quality of seed and quantity of yield, management of these pests is needed in Nepal.

Maruca testulalis Damage in Determinate and Indeterminate Lines of Pigeonpea in Sri Lanka

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In Sri Lanka the natural incidence of *Maruca testulalis* in short-duration pigeonpeas is extremely high because their peak flowering period coincides with peak pest activity. It has been reported that of the pod borer larvae causing damage, 84% is due to *M. testulalis* (Dharamsena et al. 1992). The regular and high incidence of *M. testulalis* offers an excellent opportunity to screen pigeonpea germplasm against this pest. Therefore, in 1990, 271 short-duration lines were screened for *M. testulalis* damage at Field Crops Research and Development Institute, Maha Illuppallama. This paper compares *M. testulalis* damage in determinate (DT) and indeterminate (IDT) pigeonpea plant types.

The *M. testulalis* screening nursery was established in a 0.5-ha block under insecticide-free conditions. To attract the pest, and to have a uniform level of infestation, ICPL 87, a highly susceptible short-duration determinate cultivar was used as an infector in every tenth row. In addition, five rows of this variety were also sown around the testing block.

Table 1. Frequency distribution of determinate and indeterminate pigeonpea lines for *Maruca testulalis* damage score, Maha Illuppallama, Sri Lanka rainy season 1990/91.

Score	Damage (%)	Determine lines		Indeterminate lines		Total	
		No.	%	No.	%	No.	%
1	0	0	0.0	0	0.0	0	0.0
2	1–10	0	0.0	0	0.0	0	0.0
3	10–25	4	2.6	12	10.1	16	5.9
4	25–40	4	2.6	23	19.3	27	10.0
5	40–50	14	9.2	32	26.9	46	17.0
6	50–65	13	8.6	22	18.5	35	12.9
7	65–75	56	36.9	29	24.4	85	31.4
8	75–90	43	28.3	1	0.8	44	16.2
9	100	18	11.8	0	0.0	18	6.6
Total		152	100.0	119	100.0	271	100.0

Advanced breeding lines and varieties obtained from ICRISAT Asia Center, and from three Indian national agricultural research programs were screened. These included 152 DT and 119 IDT lines. The infector rows and the test materials were sown on 11 Oct 1990. Each accession was sown in an unreplicated single row plot 4-m long. Interrow spacing was 60 cm, and intrarow spacing was 20 cm. The nursery was kept weed free using one preemergence herbicide followed by two hand weedings. The crop was maintained under rainfed conditions. The rainfall during the cropping season was well distributed resulting in excellent plant stand and canopy development. No disease was recorded in any line. The infector cultivar attracted *M. testulalis* in large numbers resulting in extremely high pest build-up within about 75–80 days after sowing (DAS). The lines were scored for *M. testulalis* damage 92 DAS when all the lines were at flowering/early podding stage.

A nine-point visual assessment scale (Table 1) was used to discriminate pigeonpea lines on the basis of damage caused by *M. testulalis* to the flowers and pods. The lines were also visually scored between 145–155 DAS for their ability to produce a second flush of pods. This trait was considered as recovery from *M. testulalis* damage. A five-point scale was used for the assessment with 1 being the best with a reasonably good number of pods on the plants. Lines with no pod were scored 5.

Each row of ICPL 87 scored either 8 or 9. The score for *M. testulalis* damage in the test lines was between 3 and 9, and none of the lines was found to have less than 10% damage. The average score of DT lines was 7. 09 and that of IDT lines was 5.29. There was a large variation for damage within each growth type. The frequency distribution and percentage of DT and IDT lines falling into different score classes are summarized in Table 1. Only four DT lines scored 3 while 12 IDT lines secured this rating. Eighteen DT lines were completely damaged while none of the IDT lines showed complete damage. Seventy-seven (56.3%) IDT lines showed <50% damage while 130 (85%) DT lines had >50% damage.

Days to 50% flowering in DT lines was 54–84 and was not related (r = 0.09) with *M. testulalis* damage score. Days to 50% flowering in IDT 60–87 days, and showed a significant negative correlation (r = –0. 43**) with *M. testulalis* damage score indicating that the early-flowering lines suffered more damage than late-flowering lines. Evaluation of these lines for yield under protected conditions during the main rainy seasons and the short rainy seasons revealed that all these lines can yield 1.5–2.0 t ha^{-1}.

In general, *M. testulalis* damage caused serious flower drop in both DT and IDT types. Sufficient soil moisture levels in Jan helped to produce a second flush of flowers and pods. Only three (1.97%) DT lines showed average recovery; there was no recovery from the damage in 136 lines (Table 2). In contrast, 34 (28.57%) of the 119 IDT lines tested were found to be promising with a score of 3 and less. Excellent recovery was recorded in ICPL 88034, ICPL 87113, and MPG 679. There was no recovery from the damage in ICPL 87 rows.

In short-duration group both DT and IDT varieties are popular. Gupta et al. (1991) reported similar levels of pod damage from *Helicoverpa armigera* in DT and IDT varieties under nonsprayed conditions. However, most growers and researchers believe that DT types are more susceptible to insect pests. Under nonprotected conditions, yield losses are higher in the DT types.

Table 2. Frequency distribution for recovery from *Maruca testulalis* of determinate and indeterminate pigeonpea lines damage, Maha Illuppallama, Sri Lanka, rainy season 1990/91.

	Determinate lines		Indeterminate lines		Total	
Score	No.	%	No.	%	No.	%
1	-	-	3	2.52	3	1.10
2	-	-	4	3.36	4	1.48
3	3	1.97	27	22.69	30	11.07
4	13	8.55	38	31.93	51	18.82
5	136	89.47	47	39.50	183	67.53
Total	152	100.00	119	100.00	271	100.00

The present study provides preliminary but useful information about the extent of *M. testulalis* damage in DT and IDT pigeonpea lines. Since DT types have clustered inflorescences, they appear to be more prone to *M. testulalis* damage than the IDT types which have long fruiting branches and loose inflorescences. Lateef and Reed (1981) also suggested that the DT types suffer more flower and/or young pod damage by *M. testulalis*. The variations observed within each plant type indicates that there is a scope for selecting promising genotypes.

However, more experiments are needed to confirm these results. The ability of plants to recover from the pest damage is important from the point of view of yield stability. The expression of this trait is complex and could be influenced by soil moisture content, plant age, and the inherent physiological capacity of the plant to produce flower buds in the second flush. No relationship was observed between the *M. testulalis* damage and recovery scores. This suggests that in breeding programs aimed at developing resistant lines, the two traits should be handled very carefully and attempts should be made to combine these characters.

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A Survey of Pigeonpea Pests in Sri Lanka

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Biotic constraints, particularly insect pests, are of great concern to pigeonpea farmers in Sri Lanka. There are reports of insect damage in farmers' fields. Therefore during the rainy, or maha season, 1995, insect pests and damage were surveyed in six districts of Sri Lanka. Except for Ratnapura, the locations covered in the survey are in the dry or intermediate rainfall zones of Sri Lanka, where pigeonpea production is concentrated. The survey was conducted between Jan–Mar 1995 and included pigeonpea growing in farmers' fields and on research stations. The pigeonpea varieties grown in these areas included ICPL 2, ICPL 87, ICPL 89008, and MPG 537.

A total of 44 fields were visited. At each location insect counts were taken on 20 plants, and the crop was visually scored for flower and pod damage. Pod damage assessment was undertaken at crop maturity by collecting all pods from three randomly selected plants in three districts. The insects observed in this survey were *Maruca testulalis*, *Helicoverpa armigera*, *Exelastis* sp *Lampides* sp, *Melanagromyza obtusa*, and *Mylabris* sp Jewel beetles (*Sphenoptera* sp) were also found damaging pigeonpea stems at few locations.

In Polonnaruwa district, *Maruca* populations were high in both ICPL 87 (3.1 larvae plant^{-1}) and MPG 537 (3.6 larvae plant^{-1}). The larval populations were similar in farmer- and researcher-managed plots. At the Seed Production Farm at Aluttarama in Polonnaruwa district, slightly lower *Maruca* infestation (2.15 larvae plant^{-1})