CROP LOSSES DUE TO INSECT PESTS

SPECIAL ISSUE Indian J. Ent. 1983 VOLUME-II

Published by:

THE ENTOMOLOGICAL SOCIETY OF INDIA
Hyderabad Branch

REVIEW OF CROP LOSSES CAUSED BY INSECT PESTS IN PIGEONPEA* INTERNATIONALLY AND IN INDIA

S. S. Lateef and W. Reed**

A review of the pests and pest caused losses in pigeonpea (*Cajanus cajan* L. Millsp.) grown in different parts of the World is given. At Patancheru (Andhra Pradesh, India[1] pest damage assessments on some pigeonpea cultivars during 1975-77 showed that about 80% of the pigeonpea flowers were shed without setting pods and up to 32% of the shea flowers were found to he attacked by Insects. The relationship of the plants growth habit and the maturity period of the crop to the attack and damage by various pests is explained. A summary of pest damage recorded during extensive surveys of farmers' fields in India during 1975-81 is furnished.

Pigeonpea *(Cajanus cajan* (L.) Millsp.) is grown commercially in the Indian sub-continent. East Africa, some parts of South and Central America and the Caribbean.

The latest available crop statistics (Parpia 1981) showed a world annual pigeonpaa production of 2017 thousand tonnes from 2,951 thousand hectares-India produces about 90% of the world's recorded production and Kenya is the second largest pigeonpea producer.

Insect pests attacking the pigeonpea crop

Several insects have been recorded as pests on pigeonpea in India (Reddy 1973; Yadav *et.al.* 1974; Saxena, 1974; 1978; Davies & Lateef, 1975; 1978; and Singh &. Singh, 1878), but only a few causa economic loss and are common over large areas and so can be regarded as major pests.

Pest group	Scientific name	Common name
Seedling pests and defoliators	*phyllabius* sp.	Leaf. weevils
	Ophiomyis centrosematis	Stemfly
	Megachile spp.	Leaf cutter bees
	Caloptllia soyella	Leaf roller
	Cydia (Eucosma) critica	Leaf tier
	Amsacta albistriga	Haity caterpiller
	Dlachrysia (Plusia) orichaicea	Semilooper
	Colemanis sphenerioides	Daccan wingless grasshopper
Buf/flower pests	*Ceuthorrhynchus asperulus**	Bud weevil
	*Mylabris pustulata**	Fiowef beetle
	Euproctis subnotata	Hairy caterpillar
	*Lampides boeticus**	Blue butterflies
	Catochrysops strabo	Blue butterflies
	*Haliothis armigera**	Trup Pop borer
	Exelastis stomosa	Pluma moth
	Campylomma livida	Bugs

ests group	Scientific name	Common name
	Creontiades pallidus	Bugs
	Megalurothrips usitatus	Flower thrips
	Taeniothrips nigricornis	Flower thrips
Lepidopteran pod borers	*Heliothis armigera**	Tur pod borer
	Exelastis atomosa	Plume moth
	*Maruca testulalis**	Pod borer
	*Etiella zinckenelia**	Pod borer
	Adisura atkinsoni	Pod borer
	A. marginalis	Pod borer
Lepidopteron pod borers	*Cydia (Eucosma) critics**	Last tier
	Lampides boeticus	Blue butterfly
	Catochrysops strata	Blue butterfly
	Sphenarchas anisodactylus	Bean pinme moth
Diptoran seed borer	*Melanagromyza obtusa**	Podfly
Coleopteran pod and seed borers	*Apion benignum*	Seed weevil
	*Callosobruchus chinenses**	Bruchids
	*C. maculatus**	Bruchids
	*C theobromae**	Bruchids
Hymenopteran pod borers	*Tanaostigmodes* sp.*	Phytophagus chilcid
Homipteran pests	*Clavigralla gibbosa**	Tur Pod bug
	C. scutellaris	Ter pod bug
	Nezars viriduais	Slink bug
	Dolicoris Indicus	Stink bug
	Anoplocnemis spp.	Bugs
	Oxyrhachis tarandus	Cow bug
	Otinotus sp.	Cow bug
	Oxycarenus sp.	Dusky cotton bug
	Aphis craccivora	Aphids
	Amrasca sps	Leaf hoppers
	Cicerella spectra	Leaf hoppers

Many reports are available from other countries on the pest complex of pigeonpea, but little information is available on the extent of damage and on yield losses. Hozarika & Abdus (1961) from Bangladesh; Korytkowski & Torres (1966) from pern; Materu (1970) from Tanzania; Kohler & Rachie (1971) from Uganda; Laurence (1971) from Trinidad and Okeyo-owuor (1978) from Kenya, have reported the most common pests on this crop in their countries.

Insect pest damage to pigeonpea

Pigeonpea seedlings are attacked by several insect pests, but few plants are killed and the damage does not seriously affect the later plant growth-

Studies at ICRISAT by sheldrake and Narayanan (1977) showed the removal of 50 to 75% of the leaves throughout the reproductive phase resulted in only slight and statistically insignificant reduction in seed yield.

Pigeonpea has also been reported to produce an over abundance of buds and flowers, and about 80% of these are shed (Narayanan and sheldrake, 1975). To determine the role played by pests in flower and pod shedding on this crop, insect pest damage was recorded in the shed flowers and pods from six cultivars which were grown on deep black soil (vertisol) and *on* shallow red soil (alfisol) at ICRISAT centre. The majority of the shed flowers had no detectable pest damage so insects probably played only a small role in the flower shedding. However, more than half of the shed pods, particularly from the vertisol, were damaged by pests, so insects may be of importance in determining pod shedding.

Sheldrake *et al.* (1979) also showed that removal of early flowers from pigeonpea plants had little or no effect on final grain yield. This ability of pigeonpea plants to compensate for early flower loss complicates the pest loss assessments in pigeonpea. However, some methods were used to assess yield loss due to pod borers in pigeonpea (Lateef, 1977).

The determinate/clustering types* particularly of the early and mid maturity groups suffered most from lepidopteran borer attack. The indeterminate, mid and late maturing cultivars had more podfly incidence (Lateef & Reed, 1980).

Crop losses in pigeonpea due to insects

Crop loss assessment is viewed as a prerequisite for pest management and suitable techniques have been evoloved for the estimation of losses caused by various pests on several crops (Chiarappa 1971; Pinstrup-Anderson et al. 1976).

In India there are scattered reports that refer to crop loss assessments on pigeonpea in different areas. For example Argikar and Thobbi (1957) reprted 0.3% to 19.6% pod loss due to *Exelastis atomosa* in Maharashtra. Gangrade

(1963, 1964) recorded 27% to 100% pod damage and 11 % to 87% seed loss due to podfly in five pigeonpea cultivars in Madhya Pradesh. In the same state, Odak *et. al*. (1967) recorded that the podfly, *Melanagromyza obtusa* caused pod damage ranging from 34% to 64% in four cultivars and that the actual seed damage ranged from 13.5% to 33.2%. The damage by *H. armigera* and *E. atomosa was* considerably lower Srivastava *et.al.* (1971) reported from Kanpur that podfly damage in the pods of various cultivars ranged from 8% to 29%.

Bindra and Jakhmola (1967) reported a high' correlation (r= +0.97) between podfly incidence and seed damage in pigeonpea in Madhya Pradesh. They further reported that the podfly damage to seeds ranged from 6% to 10% by weight and that other pests, including *H.armigera,* caused only 1% to 4% loss. However, Davies and Lateef (1978) reported 5% to 85% pod damage in cultivars of various maturities by lepidopteran pests, of which *H.armigera* was the most important in Andhra Pradesh. They also reported that podfly damage was severe in the in the late maturing cultivars with a maximum of 44% pod damage. According to Lateef and Reed (1980), the incidence *of H.armigera* was greater on determinate/clustering types than on the indeterminate ones.

These reports and others emphasise that threre is a wide range of losses due to a number of pests on pigeonpea in India and that the losses vary according to location, year and cultivar tested.

In Africa there are relatively few published reports of crop loss assessment in pigeonpea. In Tanzania, Mataru (1970) recorded that more than 50% of pigeonpea seeds were disfigured and unmarketable because of pod bug attack. In Uganda, Koehler and Rachie (1971) recorded *5%* seed damage by *Heliothis armigera,* Okeyo-Owuor (1978) assessed pest caused crop loss in pigeonpeas in Kenya using data from pesticide trials. He found 13% seed loss due to lepido-piteran borers and 11% seed loss due to the podfly, *Melanagromyza* sp.

Avoidable loss estimation

AICPIP-ICAR have encouraged entomologists to conduct comparisoins of large (50 to 165m^2) unreplicated plots to demonstrate the benefits of pest control technology for several years at many centers. AICPIP entomologists have also conducted many small plot (10-25m^2) replicated trials of different pesticides. Recent data from such trials have been summarised (AICPIP-ICAR. 1978 ; Saxena, 1979 and Sachan 1982). It can be seen that there were large ranges of avoidable losses, both between and within locations. Such differences emphasise the problem of producing estimates of crop loss that are applicable to more than one area and season.

Surveys of Pest Damage in India

An alternative means of assessing pest caused loss is to survey the pest caused damage on pigeonpea in farmers' fields and then to estimate the tosses that are likely to be associated with such levels of damage. The AICPIP entomologists have been encouraged to conduct such surveys in the farmers' fields in the vicinity of their research stations and data from these surveys are presented in the AICPIP reports. In addition ICRISAT entomologists decided to embark on sample surveys of farmers' fields across the major pigeonpea growing areas of India. These surveys were carried out in cooperation with entomologists of the national program.

The surveys were conducted by travelling along roads, visiting farmers' fields, chosen randomly, after every 20 to 30 km. Each farmer was asked a series of questions relating to the crop and they usually perimitted us to collect a random sample of 400 to 600 pods from their fields. Theses samples were brought back to our Center, where the damage caused by the different pests was analysed. Our surveys were conducted at the time when pigonpeas were close to maturity so the damage levels were recorded in the pods that were retained on the plants at that time. We considered this to be the most useful stage for sampling. Earlier damage that resuted in a loss of pods could not be estimated in such samples, but some of that damage may have been compensated for by later growth. However, we know that the percentage pod damage that we record is likely to seriously underestimate pests caused loss in many cases.

Such surveys suffer from many inadequacies but, in the absence of much more comprehensive (and costly) survey data, they have provided us with some quantitative data of the damage caused by the different groups of pests to this crop over the major pigeonpea growing areas of India end across differing seasons.

Table 1 shows detailed assessment- of pest damage recorded from pod samples collected from a total of 98 fields, over 19 districts of Andhra Pradesh. The total seed losses were also estimated in these samples (Lateef, 1677). It can be seen that the damage was very variable ranging from 19 to71% in pods and seed losses ranged from 20 to 72% The incidence of lepidopteran borer mainly *H.armigera* was generally high but podfly damage was relatively low in most of the samples.

An overall summary of the pest damage recorded in pod samples collected from 1297 farmers fields across the major pigeonpea growing areas of India is presented in Table 2. Here it can be seen that lepidopteran borer damage was

relatively severe in the north-west zone where early maturing pigeopeas that mature before the winter are commonly grown In the northern zone, where most pigeonpea crops mature after the winter, the borer damage was relatively low but podfly caused extensive damage. In central India, where mid-and late maturing cultivars are generally grown, both borer and podfly caused major damage to the crop. In southern India, *H.armigera* has caused massive losses on pigeonpea in many areas in most years.

These survey data of percentage pod damage cannot be precisely translated to yield losses for we do not know how many pods would have been held on the plants if pests had not caused losses of flowers and young pods. However, they can be used to estimate minimum losses. Most pods attacked by lepidopteran borers give little or no useful yield but those attacked by podfly generally lose only one or two seeds.

CONCLUSIONS

The data available indicate that losses to pests are generally large, often exceeding 50% particularly in southern India, but that they appear to be very variable. Given such variability we can only hope to determine losses and subsequently, economic thresholds, for a particular cultivar, agronomic package, area and season-

In addition to pesticide use and pest damage surveys there is a third method of pest caused loss assessement that may be of use. This is by surveying the pest populations and relating data to the losses that such populations are known to cause.

The available data indicate that although there are many pests that can and do attack this crop, the major losses are caused by pod borer, *H.armigera* in southern India and podfly, *M.obtusa* in northern India. It might be worthwhile to concentrate research upon these two pests, to determine the levels of their populations that cause economic levels of loss, and to attempt to determine the factors involved In the build up of those populations. It would be particularly useful if we could build up a sufficient understanding of the factors involved in the determination of the pest populations that would allow us to predict damaging populations, in time and space, and so enable us to plan adequate pest management In the farmers' fields.

REFERENCES

Aicpip-ICAR (1978). Division of Genetics, lARI, New Delhi, 263 pp.

Argikar, C.P. and Thobbi, V.V. (1957). Poona agric. Coll. Mag. *48:* 25-26.

Bindra, O.S. and Jakhmola, S.S. (1979). Indian. agric. Sci. 27: 177-18S.

Chirappa, L. (ed.) (1971). FAO Manual on the evaluation and prevention of losses by pests, diseases and weeds, U.N., FAO, Rome.

Davies, J.C. and Lateef, S.S. (1975). Pages 313-331 *in* proceedings, International Workshop on Grain Legumes, ICRISAT 13-16 Januaryl975, Hyderabad. India.

Davies J.C. and Lateef, S.S. (1978). Pests of grain legumes: Ecology and Control, ed. S.R. Singh. London: Academic Press. P 25 to 31.

Gangrade, G.A. (1963). Indian J. agric. Sci. *33* (1), 17-20.

Gangrade, G.A. (1964). Indian J. Ent., *26.* 364-365.

Hazarika, S.H. and ABDUS, S. (1951). Scientist (Pak.) 4/18-20.

ICRISAT (1982). ICRISAT annual report-1980-81.

Koehler, C.S. and Rachie, K.O. (1971). E. Afr. agric. for J. *36* (3) : 296 297.

Korytkowski, C. and Torres, M. (1966). Rev. Peruara Entomol. *9* : 3-9.

Lateef, S.S. (1977). Chemicalisation of plant production in the tropics and sub-tropics. Vol. 3. Leipzig GDR-KMU.

Lateef, S.S. and Reed, W. (1980). Proceedings International Workshop on Pigeonpeas, 15-19 Dec 1980, ICRISAT.

Laurence, G.A. (1971). J. Agric. Soc. Trin. 71 (4) i 501-504.

Materu, M.E.A. (1970). E.A. Agri. for J. *35* (4) 429-435.

Narayanan, N. and Sheldrake, A.R. (1975). ICRISAT PUISe Physiology ann report 1974-75.

Odak, S C, Deshpande, S.V., and Dhamdhare, S.V. (1967). J. Agric. Coll., Gwalior, 8:1-3.

Okevo-Owuor, J.B. (1978). M.Sc (Agr. Ent.) thesis, Univ. of Nairobi, Kenya, 150 pp.

Parpia, H.A B. (1981). International Workshop on pigeonpea Vol. 1: 15-19 December 1980.

Pinsturp Andersen, (1976). Pans, 22: 359-365.

Reddy, K.V.S. (1973). Ph.D. thiesis, Univ. of Agril. Sciences, Bangalore, India 132 pp.

Sachan, J.N. (1982). 1981-82 Entomology. Kharif workshop report, April 20-23, Jabalpur, Project Directorate (Pulses), Kanpur, 65 pp.

Saxena, H.P. (1974). Ent. News, 4:21

Saxena H.P. (1978). Pests of grain legumes: Ecology and control, ed. S.B. Singh, London : Academic Press.

Saxena, H.P. (1979). AICPIP-ICAR-data sheets and summarised results of entomology trials conducted during Kharif 1978-79. Division of Entomology lARL. New Delhi, 88 pp.

Sheldrake, A. R. and Narayanan, N. (1977). Pulse Physiol. Ann. Rap. 1976-77 part-1-pigaonpea, ICRISAT,

Sheldrake, A.R., Narayanan, A, and Venkataratnam, N. (1979). Ann. appl. Biol. 19, 383-390.

Singh, R.N. and Singh, K.M. (1978). Indian J. Ent. 40 (1): 1-6.

Srivastava, A.S., Katiyar, S.S.L., and Srivastava, K.M. (1971). Labdev. J. of Science & technology, 9-8 (1): 71-73.

Yadav, H.S., Gangrade, G.A., and Jakhmola, S.S. (1974). Indian J. agric. Sci. 44(8): 555-556.

Table : 1 Assessment of pod damage and seed loss in various districts of Andhra Pradesh, India (pod samples) collected from farmers' fields (Dec 26, 1975 to Jan 13, 1976).

Districts in A.P.	No. Samples assessed	Insect damage to pods and seeds - mean (%) *** Borer pods	Borer Seeds	Podfly Pods	Podfly Seeds	Other pests* Pods	Other pests* Seeds	Illinformed : Pods	Illinformed : Seeds	Totol Pod damaged**	Total seeds damaged
Adilabad	5	33.2	16.0	4.6	3.8	1.6	1.9	8.4	37.8	30.1	
Nizamabad	2	18.2	8 6	14.6	12 9	1 2	1.0	12.5	32.8	35.0	
Karimnagar	4	39.0	23.8	8.5	4 6	1.5	1.2	4.0	45.6	33.6	
Warangal	7	53.4	28.1	8.8	5.6	7.1	5.2	3.1	60.1	42.0	
Medak	10	58.5	34.0	5.4	5.5	0.8	1.6	6.9	61.9	48.0	
Ranga Reddy	8	39.7	22.8	8.6	6.3	2.2	1.8	7.6	48.0	38.5	
Nalgonda	12	48.9	25.3	6.6	6.5	2.2	2.0	15.2	57.0	49.0	
Khammam	3	40.8	14.4	2 3	0.4	1.2	1.1	12.2	41.8	28.1	
Mahboobnagar	7	24.4	11.1	4.2	2 3	1.3	0.9	5.8	28.2	20.1	
Kurnool	3	67.9	47.7	3.2	2.2	2.1	2.2	8.3	71.4	60.4	
Anantapur	6	55.4	37.9	3.0	2 8	1.5	2.8	7.5	59.1	51.0	
Cuddapah	5	35.5	20.1	5.4	5.1	1.7	0 9	35.2	42.0	61.3	
Prakasam	4	43.6	24.7	1.3	1.4	0.1	0.1	40.8	44.8	72.0	
Guntur	6	50.0	31.2	3.4	3.8	1.7	1.3	27.7	53.8	64.0	
Krishna	3	22.7	10.7	1.1	0.4	1.6	2.0	14.6	23.5	27.7	
West Godavari	5	17.4	9.3	1.3	1.0	1.2	1.0	13.2	18.7	24,5	
East Godavari	4	37.3	14.7	1.9	0.9	3.7	4.6	13.3	38.8	33.5	
Visakhapatnam	3	17.1	13.5	3.8	2.5	21.3	17.5	8.9	20.4	42.4	
Srikakulam	1	20.8	4.6	1.9	0.7	49.8	37.0	9.0	54.7	51.3	
Means		41.6	23.2	5.1	4.1	3.1	2.8	12.9	46.8	43.2	

* Other pests include bruchids *(Callosobruchus spp.)* and hymenopteran pest *(Tanaostigmodes sp.)*

** III formed seeds - resulted from bug damage and Physiological disorders.

*** As some pods had damage caused by more than one pest, the total pod damage is less than the total of the pods damaged by individual pests.

Table 2 Insect pests damage to pigeonpea pods in various zones in India recorded during sample surveys from 1975 to 1981.

Zones		Percent pod damage				
		Borer	Podfly	Bruchid	Hymn.	Total
1	*North - West Zone.* Punjab, Haryana, Delhi (early maturing pigeon pea) (n=49)	29.7	14.5	0.05	0.03	44.0
II	*North Zone* Above 23°N (Late maturing pigeonpea) (n=359)	13.2	20.8	0.2	0.5	33.S
III	*Central Zone* 20° - 23°N (Mid and late maturing p. pea) (n=446)	24.3	22.3	2.2	1.6	48.0
IV	*South Zone* Below 20°N (Early and mid maturing pigeonpea) (n=443)	36.4	11.1	6.7	2.2	49.9

n%no of samples analysed for past damage