

## Original Research Article

# Estimation of yield losses caused by insect pests on pigeonpea (*Cajanus cajan* (L.) Millsp.)

Comment [D1]: Pigeon pea

### ABSTRACT

Field experiment was carried out to estimate the yield losses in pigeonpea crop due to insect pests during *kharif* 2018-19, 2019-20 and 2020-21 at College of Agriculture, Navsari Agricultural University, Bharuch (Gujarat). Results revealed that avoidable yield loss due to insect pests in pigeonpea was recorded up to 38.48% when no plant protection measures are taken. Amongst different insect pests, the maximum damage was recorded due to pod borer, *Helicoverpa armigera* (34.90%) followed by pod sucking bugs, *Clavigralla gibbosa* (29.75%) and pod fly, *Melanogromyza obtusa* (23.64%). Pod damage due to spotted pod borer, *Maruca vitrata* and tur plume moth, *Exelastis atomosa* was recorded up to 14.09% and 5.60%, respectively.

Comment [D2]: Pigeon pea

**Keywords:** yield loss, *Helicoverpa armigera*, *Melanogromyza obtusa*, *Clavigralla gibbosa*, pigeonpea

### 1. INTRODUCTION

Pigeonpea (*Cajanus cajan* (L.) Millspaugh) is one of the major pulse crops of the tropics and subtropics. It is the second most important pulse crop of India, after chickpea. Pigeonpea is an important pulse crop of dry land agriculture because of its ability to produce economic yield under limited moisture condition. In India, the area grown under pigeonpea is 47.24 lakh ha with a production of 43.16 lakh tonnes and a productivity of 914 kg/ha. In Gujarat, pigeonpea is grown under 2.41 lakh ha with an annual production of 2.86 lakh tonnes leading to a productivity of 1186 kg/ha (Anon., 2021) [1]. Pigeonpea is grown throughout the country except the hilly regions where winter temperature is very low. The major pigeonpea growing states are Maharashtra, Uttar Pradesh, Karnataka, Gujarat and Andhra Pradesh that altogether account for more than 87 per cent area and 83 per cent of the production (Anon., 2015) [2]. A large number of insect pests (more than 300 species) are noticed to attack pigeonpea (Prasad and Singh, 2004) [3]. Insects that attack the reproductive structures of plant cause the maximum yield losses (Rangaiah and Sehgal, 1984) [4]. The most economical pests those attack at flowering and podding stage are pod borer, *Helicoverpa armigera* (Hubner) Hardwick; blue butterflies, *Lampides boeticus* L. and *Catochrysops strabo* (Fabricius); plume moth, *Exelastis atomosa* (Walsingham) and pod fly, *Melanogromyza obtusa* Malloch (Reed *et al.*, 1989) [5]. Pod borers cause huge annual losses and damage to pods due to the borer complex was reported to be 20 to 72 per cent (Lateef and Reed, 1983) [6]. Hence, considering the economical importance of the crop, the present investigation was undertaken to know the impact of pests on yield loss in pigeonpea.

## 2. MATERIAL AND METHODS

Field experiment was carried out during *khariif* 2018-19, 2019-20 and 2020-21 at College farm, College of Agriculture, Navsari Agricultural University, Bharuch (Gujarat) to know the yield loss cause by insect pests of pigeonpea crop. Experimental area was divided in to two plots *i.e.* protected and unprotected plot by following two sample 't' test method with a plot size of 20 m x 20 m and plant spacing of 90 cm x 20 cm. Variety "*Vaishali*" of pigeonpea crop was selected for study. All the agronomic practices were followed as per recommendation with a fertilizer dose of 20-40-0 NPK kg/ha. One set of plots were kept as protected and provided complete protection by spraying imidacloprid 17.8 SL @ 0.005% at 30 days after sowing and chlorantraniliprole 18.5 SC @ 0.006 % at 50% flowering stage and flubendiamide 39.35 SC @ 0.0096% at 50% pod setting stage. Another set of plots termed unprotected were kept untreated and exposed to natural infestation by insect pests. For recording observations, 20 plants were selected randomly from both sets of plots and yield attributing characters such as plant height, number of pods/plant, numbers of seeds/pod and grain yield (kg/ha) were recorded. The observations on yield was recorded from 20 plots (size 1m x 1.8m) having 10 plants in each plot and were converted on hectare basis. The pod damage and grain damage due to insect pests were recorded by following below mentioned standard methodology.

### 1. Pod borer (*Helicoverpa armigera*) :

Number of damaged and healthy pods were recorded and per cent pod borer infestation was worked out. Number of pods damaged due to *Helicoverpa* larva was ascertained by clean big hole on pod.

### 2. Tur plume moth (*Exelastis atomosa*):

Per cent tur plume moth larva infestation was calculated by counting healthy and damaged pods due to tur plume moth larva. Pods damaged due to tur plume moth larva were ascertained by presence of small dirty hole between two grain on pod.

### 3. Spotted pod borer (*Maruca vitrata*)

Per cent damage due to *Maruca* infestation was calculated by counting number of healthy and damaged pods. *Maruca* larva damage was ascertained by presence of webbed and frass materials on pods.

### 4. Pod Sucking Bug (*Clavigralla gibbosa*):

Per cent pod damage by pod sucking bug was calculated on the basis of counting healthy and damaged pods due to pod sucking bug.

### 5. Pod fly (*Melanogromyza obtusa*):

Per cent pod fly infestation was worked out by counting numbers of healthy and damaged grain from 100 pods. Pod fly damage was detected by presence of maggot or pupa tunneled grain by splitting the pods.

Data were subjected to two sample 't' test and analysed by using ICAR, Web Agri Stat Package (WASP). The loss in yield due to insect pests in pigeonpea was worked out by using following equation given by Le Clerg (1971) [7].

$$\text{Loss in yield (\%)} = \frac{X_1 - X_2}{X_1} \times 100$$

Where,  $X_1$  = Yield in treated (Protected) plot  
 Yield in untreated (Unprotected) plot  $X_2$  =

### 3. RESULTS AND DISCUSSION

#### 2018-19

During year 2018-19, mean plant height (cm) and mean no. of pods/plant were 1.04 times and 1.48 times higher in protected plot than unprotected plot (Table-1). However, no significant difference was observed in mean number of seeds/pod between protected and unprotected plot. The per cent pod damage due to pod borer, tur plume moth, pod sucking bug, spotted pod borer and per cent grain damage due to pod fly was 31.89%, 6.78%, 35.99%, 14.76% and 23.02%, respectively in unprotected plot which was 3.39, 4.74, 9.78, 4.12 and 3.71 times higher than protected plot, respectively. The mean grain yield (kg/ha) in protected plot was recorded 1058.32 which was 1.68 times greater than yield in unprotected plot (630.55). The avoidable yield loss due to insect pest in pigeonpea was recorded 40.41 per cent.

#### 2019-20

Mean plant height (cm) and mean no. of pods/plant were 1.07 times and 1.36 times higher in protected plot than unprotected plot (Table-1). However, no significant difference was observed in mean number of seeds/pod between protected and unprotected plot. The per cent pod damage due to pod borer, tur plume moth, pod sucking bug, spotted pod borer and per cent grain damage due to pod fly was 36.06%, 5.25%, 27.80%, 15.07% and 22.60%, respectively in unprotected plot which was 3.15, 4.82, 6.03, 6.18 and 4.20 times higher than protected plot, respectively. The mean grain yield (kg/ha) in protected plot was recorded 1103.36 which was 1.57 times greater than yield in unprotected plot (703.27). The avoidable yield loss due to insect pest in pigeonpea was recorded 36.26 per cent during 2019-20.

#### 2020-21

Mean plant height (cm) and mean no. of pods/plant were 1.06 times and 1.14 times higher in protected plot than unprotected plot (Table-1). However, no significant difference was observed in mean number of seeds/pod between protected and unprotected plot. The per cent pod damage due to pod borer, tur plume moth, pod sucking bug, spotted pod borer and per cent grain damage due to pod fly was 36.76%, 4.77%, 25.49%, 12.46% and 25.31%, respectively in unprotected plot which was 3.08, 2.66, 3.07, 3.65 and 4.86 times higher than protected plot, respectively. The mean grain yield (kg/ha) in protected plot was recorded 1114.80 which was 1.64 times greater than yield in unprotected plot (681.65). The avoidable yield loss due to insect pest in pigeonpea was recorded 38.85 per cent during 2020-21.

#### Pooled

The pooled results of three years (Table -1) showed that mean plant height (cm) and mean no. of pods/plant were 1.06 times and 1.30 times higher in protected plot than unprotected plot. However, no significant difference was observed in mean number of seeds/pod between protected and unprotected plot. The per cent pod damage due to pod borer, tur plume moth, pod sucking bug, spotted pod borer and per cent grain damage due to pod fly was 34.9%, 5.6%, 29.75%, 14.09% and 23.64%, respectively in unprotected plot which was 3.20, 3.92, 5.39, 4.49 and 4.22 times higher than protected plot, respectively. The mean grain yield (kg/ha) in protected plot was recorded 1092.20 which was 1.63 times higher than yield in unprotected plot (671.82). The avoidable yield loss due to insect pest in pigeonpea was recorded 38.48 per cent.

Present findings regarding pod damage due to pod borer, *H. armigera* are in agreements with the findings of Patel and Patel (1990) [8] who reported that the pod damage due to *H. armigera* was up to 39.20% in BDN-2 variety of pigeonpea and Lateef and Reed (1983) [6] also reported pod damage due to the borer complex up to 20 to 72%. However, Sahoo and Senapati, 2000 [9] reported the yield loss up to 27.77% due to pod borer complex in pigeonpea. Present findings of damage due to pod fly and pod bug are more or less in agreement with reports of Kumar *et al.* (2016) [10] who reported higher pod damage in pigeonpea due to pod fly, pod bug, and lepidopteron pod borer in the range of 26.66 to 43.0%, 16.0 to 19.0% and 4.0 to 7.66%, respectively. Pandey *et al.*, 2011 [11] reported the grain damage caused due to pod fly varied from 20 to 80% in Uttar Pradesh which was in complete agreement with present investigation. However, Adgokar *et al.* (1993) [12] reported 70-80% damage due to pod fly in pigeonpea whereas, Khan *et al.* (2014) [13] reported that 21.00 to 38.50% pod and 12.29 to 19.87% seed damaged by pod fly and 5.50 to 12.50 % pod damage by pod borers. Sandip Patra *et al.*, 2016 [14] reported pod damage 8.75 and 6.25% by *Helicoverpa armigera* and 44.94 and 17.75% by *Melanagromyza obtusa* during first and second seasons, respectively. Mean pod damage caused by *H. armigera*, and *M. obtusa* were found to be 7.50 and 31.35%, respectively. Results revealed that pod boring insects (*H. armigera*, *L. boeticus*, *A. clavipes* and *M. obtusa*) caused major crop losses to pigeonpea.

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Table: 1 Comparative yield losses due to insect pests on pigeonpea (2018-19,2019-20,2020-21 & pooled)													
Sr no.	Parameter	2018-19			2019-20			2020-21			Pooled (2018-2020)		
		Protected (X <sub>1</sub> )	Unprotected (X <sub>2</sub> )	T- Cal	Protected (X <sub>1</sub> )	Unprotected (X <sub>2</sub> )	T- Cal	Protected (X <sub>1</sub> )	Unprotected (X <sub>2</sub> )	T- Cal	Protected (X <sub>1</sub> )	Unprotected (X <sub>2</sub> )	T- Cal
1	Mean plant height(cm)	169.55	163.55	2.67*	170.25	158.70	5.19*	171.50	161.20	4.45*	170.43	161.15	7.069*
2	Mean number of pods/plant	155.60	105.00	7.04*	164.25	120.65	6.07*	186.20	162.65	2.88*	168.68	129.43	7.042*
3	Mean number of seeds/pod	4.20	4.05	1.02	4.30	4.25	0.34	4.35	4.30	0.33	4.28	4.20	0.97
4	Mean per cent pod damage due to pod borer	9.40	31.89	8.38*	11.44	36.06	7.88*	11.95	36.76	9.64*	10.92	34.90	14.78*
5	Mean per cent pod damage due to tur plume moth	1.43	6.78	5.38*	1.09	5.25	5.92*	1.79	4.77	2.59*	1.43	5.60	7.42*
6	Mean per cent pod damage due to pod sucking bug	3.68	35.99	9.83*	4.61	27.80	7.95*	8.29	25.49	6.83*	5.52	29.75	13.61*
7	Mean per cent pod damage due to spotted pod borer	3.58	14.76	7.73*	2.44	15.07	9.56*	3.41	12.46	6.96*	3.14	14.09	13.91*
8	Mean per cent grain damage due to pod fly	6.20	23.02	10.43*	5.38	22.60	9.11*	5.21	25.31	10.28*	5.60	23.64	17.21*
9	Mean grain yield(kg/ha)	1058.32	630.55	14.61*	1103.36	703.27	13.24*	1114.80	681.65	10.38*	1092.2	671.82	20.95*
10	Mean Yield loss (%)	<b>40.41</b>			<b>36.26</b>			<b>38.85</b>			<b>38.48</b>		

\*The t-value significant at P = 0.05 (2.024)

#### 4. CONCLUSION

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Comment [D3]: This is not a conclusion

#### REFERENCES

1. Anonymous. Crop wise area, production and productivity of pulses from 2010-11 to 2020-21. Report published by Directorate of Pulses Development, Government of India, Bhopal. 2021;p.8.
2. Anonymous. Expert Committee Report on Pulses, Technology Mission on Oilseeds and Pulses, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi. 2015;p.126.
3. Prasad D and Singh A. Advances in Plant Protection Sciences. Akansha Publishing House, New Delhi; 2004 p. 421.
4. Rangaiah PV and Sehgal VK. Insects on T-21 pigeonpea and losses caused by them at Pantnagar, Northern India. International Pigeonpea Newsletter. 1984;3: 40-43.
5. Reed W, Lateef SS, Sithanathan S and Pawar CS. (1989) Pigeonpea and chickpea Insect Identification Handbook. Information Bulletin no. 26. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, India. 1989;p. 120.
6. Lateef SS and Reed W. Review of crop losses caused by insect pests of the pigeonpea internationally and in India. Indian J Entomol.1983;2: 284-291.
7. Le Clerg EL. Field experiments for assessment of crop losses. In crop loss assessment method FAO manual on the evaluation and prevention of losses by pests-diseases and weeds. Rome; FAO Edited by Chirappa, L; 1971.
8. Patel PS and Patel JR. Screening of pigeonpea germplasm to pod-borers and pod fly. Legume Res. 1990;13(2): 91-94.
9. Sahoo BK and Senapati B. Determination of economic thresholds for pod borer complex in pigeonpea. Indian J Plant Prot. 2000;28: 176-179.
10. Kumar R, Keval RM and Yadav A. Determination of damage caused by major insect pest in long duration pigeonpea genotypes. Res in Environ Life Sci. 2016;9(5): 526-527.
11. Pandey V, Srivastava CP, Triyugi N and Raha P. Chemical traits of pigeonpea (*Cajanus cajan*) pod wall affecting pod fly (*Melanagromyza obtusa*) damage. Indian J Agric Sci. 2011;81(11): 1059-1062.

12. Adgokar RT, Satpute US, Temprde AM and Mahokar AP. Extent of avoidable incidence and losses due to pod borer complex in promising of cultivars of pigeonpea *Cajanus cajan* (L.). *Pestology*. 1993;17:10-12.
13. Khan M, Srivastava CP and Sitanshu. Screening of some promising pigeonpea genotypes against major insect pests. *The Ecoscan*. 2014;VI (Spl): 313-316.
14. Sandip Patra, Firake DM, Azad Thakur NS and Roy A. Insect pest complex and crop losses in pigeonpea in medium altitude hill of Meghalaya. *The Bioscan*. 2016;11(1):297-300.

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