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# Screening of pigeonpea germplasms against the pod borer complex over a period of two years under field conditions

**Shimla Gupta, Navneet Rana and Jaikishan Bhagat**

**Abstract**
Field investigations were conducted during *kharif* 2016-17 and 2017-18 at the experimental field of Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh to the screening of Screening of twenty five pigeonpea germplasm against the pod borer complex viz. *M., vitrata, H. armigera, Exelastis atomosa* and *M. obtusa,* under field conditions in which recorded lowest larval population in ICP 7398 with 3.73, 3.38, 4.05 and 2.57 larvae per plant, respectively, but it was highest in RP3 with 9.93, 6.69 and 6.84 larvae per plant of *M. vitrata, H. armigera and M. obtusa* respectively, whereas in case of *E. atomosa* it was highest in RP8 with 8.14 larvae per plant. However, overall in pod borer complex minimum pod damage and minimum grain damage of borer complex was found in ICP 7398 with 18.73 percent and 10.25 percent, respectively and also highest yield was obtained in ICP 7398 during both years with 12.23 and 13.65q/ ha. But the germplasm RP3 recorded highest percent pod damage with 36.26 percent, highest percent grain damage of 26.72 percent and also lowest grain yield was obtained in both years with 2.50 and 1.59q/ ha.

**Keywords:** pigeonpea, pod borer complex, germplasms, field conditions

## Introduction
Pigeonpea (*Cajanus cajan* L.) is most important legume crop of India. Pigeonpea s one of the sources of animal feed and fire wood and carbohydrates and protein are found with 67% and 22% in pigeonpea seeds [3].

Pigeonpea is the second important pulse crop of India after chickpea and India is the largest producer and consumer of pulses in the world. It has 33 percent of the world area and 25 percent share in global production [9]. India has the total production and productivity in pigeonpea of 2.65 mt and 741 kg/ha, respectively [2]. In Chhattisgarh state pigeonpea acreage stands 64.4 thousand hectare with a total production and productivity of 29.5 thousand tonnes and 458 kg/ha, respectively [1].

Yield levels of this crop are not very encouraging. Among the factors responsible for low yield, the damage caused by insect pests is one of the major factors in pigeonpea. Pod borer complex is a major problem in production which are inflicting 80 to 90 percent of loss [5]. Among these only few are economically important for pigeonpea as pests *viz.*, spotted pod borer, *Maruca vitrata* (Geyer), pod borer, *Helicoverpa armigera* (Hubner) plume moth, *Exelastis atomosa* (Walsh), and pod fly, *Melanagromyza obtusa* (Mall) collectively referred as "pod borer complex" [6]. Pigeonpea farmers have to spend much on input like pesticides; it was considered viable to search the available germplasms for sources of resistance against pod borer complex for use in plant breeding. Screening of more than 14,000 pigeonpea accessions against *H. armigera* has revealed low to moderate levels of resistance to this pests [7].

## Materials and Methods
The treatments comprised of twenty five germplasms of pigeonpea during 2016-17 and 2017-18 against pod borer complex. The experiment was conducted in Randomized Block Design (RBD) and replicated three times without any plant protection measure.

## Observations recorded
During crop growing period, the number of larvae per plant of pod borer complex *viz. Helicoverpa armigera, Maruca vitrata* and *Exelastis atomosa* were recorded on randomly selected five plants but in case of *Melanagromyza obtusa* the number of maggots per ten randomly selected pods per plant were recorded at fifteen days interval. The total number of damaged pods by pod borer complex of pigeonpea, on five random plants from each plot were selected at the time of maturity. Afterwards, the total number of pods and number of damaged

pods by pod borer complex on each demarcated plant was counted and converted into percent damage.

Percentage of pod damage and grain damage were recorded with the help of following formula:

$$\text{Pod damage (\%)} = \frac{\text{Number of damaged pods}}{\text{Total number of pods(healthy + damaged)}} \times 100$$

$$\text{Grain damage (\% )} = \frac{\text{Number of damaged grains}}{\text{Total number of grains(healthy + damaged)}} \times 100$$

**Results and Discussion**

**Larval population, pod damage, and grain damage of *Maruca vitrata, Helicoverpa armigera, Exelastis atomosa* and *Melanagromyza obtusa* against different germplasms in pigeonpea crop during *Kharif* 2016-17 and 2017-18.**

**Larval population**

During *Kharif* 2016-17 and 2017- 18, the larval population of *M. vitrata* per plant was showed significant differences among the tested germplasms which varied from 3.73 to 9.93 larvae per plant. Minimum larval population was observed in germplasm ICP 7398 with 3.73 larvae per plant which was found at par with ICP 7406 with 3.80 larvae per plant followed by ICP 7004, ICP7392,, ICP7003, ICP 7005, RP 1, RP 2, RP 6, Rajeevlochan, ICP 6994, ICP 7393, ICP 7391, ICP 6999, ICP 7404, ICP 7405, ICP 7373, ICP 7374, RP 7, ICPP 7387, ICP 6996, ICP 7379, RP 8, RP 5 with 4.30, 4.47, 4.83, 4.90, 4.97, 5.14, 5.14, 5.43, 5.50, 5.60, 5.70, 5.73, 5.87, 5.94, 6.00, 6.00, 6.30, 6.30, 6.70, 6.97, 7.37 and 8.70 larvae per plant, respectively, whereas highest larval population was observed in germplasm RP 3 with 9.93 larvae per plant (Table 1). Data recorded for *H. armigera* larvae, the number of larval population per plant showed significant differences among the tested 25 germplasms which varied from 3.38 to 6.69 larvae per plant. Minimum larval population was observed in germplasm ICP 7398 with 3.38 larvae per plant which was found at par with ICP 7003 and ICP 7406 with 3.40 and 3.50 larvae per plant followed by, RP 6, ICP 7373, ICP 7004, ICP 7005, Rajeevlochan, ICP7374, ICP 7379, ICP 7393, ICP 7387, ICP 6999, ICP 7404, RP 1, ICP 7391, ICP 6996, ICP 7405, RP 7, ICP 6994 ICP7392, RP 2, RP 5 and RP 8 with 3.62, 3.62, 3.63, 3.73, 3.76, 3.99, 4.03, 4.11, 4.32, 4.36, 4.45, 4.46, 4.50, 4.62, 4.62, 4.65, 4.68, 4.81, 5.03, 5.59 and 5.98 respectively, whereas highest larval population was observed in germplasm RP 3 with 6.69 larvae per plant. During this period the average maximum number of larvae was recorded at pod formation to pod maturity stage of crop (Table 1). Data recorded for *E. atomosa* larval population per plant showed significant differences among the tested germplasms which varied from 4.05 to 8.14 larvae per plant (Table 4.4). Minimum larval population was observed in germplasm ICP 7398 with 4.05 larvae per plant followed by ICP 7406, ICP 7004, ICP 7003, Rajeevlochan, ICP 7404, RP 1, ICP 7005, RP 6, ICP 7392, ICP 7373, ICP 7393, ICP 7374, ICP 6999, RP 2, ICP 7405, ICP 7391, ICP 7387, ICP 6996, ICP 7379, ICP 6994, RP 7, RP 5, RP 3 and with 5.30, 5.60, 5.60, 5.70, 5.73, 5.83, 5.88, 5.93, 6.07, 6.07, 6.40, 6.40, 6.54, 6.64, 6.74, 6.80, 7.07, 7.07, 7.24, 7.60, 7.60, 7.71 and 8.10 larvae per plant, respectively, whereas highest larval population was observed in germplasm RP 8 with 8.14 larvae per plant. Data recorded for *M. obtuse* larvae, the number of larval population per plant showed significant differences among the tested 25 germplasms which varied from 2.57 to 6.84 larvae per plant. Minimum larval population was observed in germplasm ICP 7398 with 2.57 larvae per plant which was found at par with ICP 7003 and ICP 7406 with 2.67 and 2.97 larvae per plant followed by, ICP 6999, RP 6, ICP7374, ICP 7373, ICP 7005, ICP7392, Rajeevlochan, RP 1, ICP 7405, ICP 7393, ICP 7387, ICP 7379, ICP 7404, ICP 7391, ICP 7004, ICP 6996, ICP 6994, RP 7, RP 2, RP 8 and RP 5 with 3.13, 3.20, 3.24, 3.30, 3.37, 3.54, 3.63, 3.71, 3.80, 3.84, 4.00, 4.00, 4.04, 4.14, 4.33, 4.47, 4.67, 5.04, 5.12, 5.53 and 6.34 respectively, whereas highest larval population was observed in germplasm RP 3 with 6.84 larvae per plant.

**Table 1:** Average larval population of pod borer complex in pigeonpea during 2016-17 and 2017-18

| S. no | Germplasm | Larval population / plant | | | |
|---|---|---|---|---|---|
| | | ***M. vitrata*** | ***H. armigera*** | ***E. atomosa*** | ***M. obtusa*** |
| 1 | RP1 | 4.97 *(2.32)* | 4.46 *(2.21)* | 5.83 *(2.51)* | 3.71 *(2.04)* |
| 2 | RP2 | 5.14 *(2.35)* | 5.03 *(2.33)* | 6.64 *(2.66)* | 5.12 *(2.36)* |
| 3 | RP3 | 9.93 *(3.22)* | 6.69 *(2.66)* | 8.10 *(2.92)* | 6.84 *(2.70)* |
| 4 | RP5 | 8.70 *(3.02)* | 5.59 *(2.45)* | 7.71 *(2.86)* | 6.34 *(2.60)* |
| 5 | RP6 | 5.14 *(2.35)* | 3.62 *(2.01)* | 5.93 *(2.53)* | 3.20 *(1.91)* |
| 6 | RP7 | 6.30 *(2.59)* | 4.65 *(2.25)* | 7.60 *(2.84)* | 5.04 *(2.34)* |
| 7 | RP8 | 7.37 *(2.79)* | 5.98 *(2.52)* | 8.14 *(2.93)* | 5.53 *(2.44)* |
| 8 | Rajeevlochan | 5.43 *(2.42)* | 3.76 *(2.05)* | 5.70 *(2.48)* | 3.63 *(2.02)* |
| 9 | ICP 6994 | 5.50 *(2.43)* | 4.68 *(2.26)* | 7.60 *(2.84)* | 4.67 *(2.26)* |
| 10 | ICP 6996 | 6.70 *(2.67)* | 4.62 *(2.25)* | 7.07 *(2.73)* | 4.47 *(2.22)* |
| 11 | ICP 6999 | 5.73 *(2.47)* | 4.36 *(2.19)* | 6.54 *(2.64)* | 3.13 *(1.89)* |
| 12 | ICP 7003 | 4.83 *(2.30)* | 3.40 *(1.96)* | 5.60 *(2.46)* | 2.67 *(1.75)* |
| 13 | ICP 7004 | 4.30 *(2.15)* | 3.63 *(2.01)* | 5.60 *(2.46)* | 4.33 *(2.19)* |
| 14 | ICP 7005 | 4.90 *(2.30)* | 3.73 *(2.04)* | 5.88 *(2.52)* | 3.37 *(1.95)* |
| 15 | ICP 7373 | 6.00 *(2.54)* | 3.62*(2.01)* | 6.07 *(2.55)* | 3.30 *(1.94)* |
| 16 | ICP 7374 | 6.00 *(2.54)* | 3.99 *(2.10)* | 6.4 *(2.61)* | 3.24 *(1.92)* |
| 17 | ICP 7379 | 6.97 *(2.71)* | 4.03 *(2.11)* | 7.24 *(2.77)* | 4.00 *(2.11)* |
| 18 | ICP 7387 | 6.30 *(2.59)* | 4.32 *(2.18)* | 7.07 *(2.75)* | 4.00 *(2.11)* |
| 19 | ICP 7391 | 5.70 *(2.47)* | 4.50 *(2.22)* | 6.80 *(2.69)* | 4.14 *(2.14)* |
| 20 | ICP 7392 | 4.47 *(2.19)* | 4.81 *(2.08)* | 6.07 (2.55) | 3.54 *(2.00)* |
| 21 | ICP7393 | 5.60 *(2.45)* | 4.11 *(2.13)* | 6.40 *(2.62)* | 3.84 *(2.07)* |

| | | | | | |
|---|---|---|---|---|---|
| 22 | ICP 7398 | 3.73 (2.03) | 3.38 (1.95) | 4.05 (2.12) | 2.57 (1.73) |
| 23 | ICP 7404 | 5.87 (2.51) | 4.45 (2.21) | 5.73 (2.48) | 4.04 (2.12) |
| 24 | ICP 7405 | 5.94 (2.52) | 4.62 (2.25) | 6.74 (2.68) | 3.80 (2.06) |
| 25 | ICP 7406 | 3.80 (2.05) | 3.50 (1.98) | 5.30 (2.40) | 2.97 (1.85) |
| CD at 5% | | *37.5* | *0.35* | *0.39* | *0.45* |

* Figures in parentheses are square root transformed values.

**Pod damage**

The incidence of pod borer complex was observed in terms of pod damage at harvest, the tested germplasms showed significant differences with each other for percent pod damage which varied from 18.73 percent to 36.26 percent (Table 2). Minimum pod damage was observed in ICP 7398 percent with 18.73 which was at par with ICP 7373, ICP 7003 and ICP 7406 with 20.07, 20.08 and 20.89 percent, respectively, followed by ICP 7005, ICP 7004, Rajeevlochan, ICP 7404, ICP 7374, ICP 7379, ICP 7392, ICP 7393, RP 1, RP 6, ICP 6999ICP 7405, ICP 7391, ICP 7387, ICP 6996, ICP 6994, RP 2, RP 7, RP 5 and RP 8 with 23.14, 23.67, 24.15, 25.57, 25.73, 26.10, 26.73, 27.23, 27.58, 27.89, 28.14. 28.65, 29.10, 29.55, 30.70, 31.63, 33.30, 33.32, 33.36 and 33.83 percent pod damage, respectively, whereas maximum pod damage was observed in germplasm RP 3 with 36.26 percent.

**Grain damage**

The incidence of grain damage by pod borer complex (Table 2). Minimum grain damage was recorded in germplasm ICP 7398 with 10.25 percent which was at par with ICP 7003 (10.72 percent) followed by ICP 7406,ICP 7373, ICP 7005, ICP 7004, RP 6, Rajeevlochan, ICP 7374, ICP 7404, ICP 7392, ICP 6999, ICP 7393, RP 1, ICP 7405, ICP 6994, ICP 7391, ICP 7387, ICP 6996, ICP 7379, RP 8, RP 2, RP 7 and RP 5 with 11.97, 12.58, 13.74, 14.27, 14.37, 15.74, 15.75, 16.22, 17.38, 17.84, 19.19, 19.44, 20.39, 20.45, 20.81, 21.39, 21.88, 21.97, 22.48, 22.80, 24.48 and 25.35 percent grain damage respectively. Maximum grain damaged was observed in germplasm RP 3 with 26.72 percent grain damage.

**Table 2:** Average percent pod damage and grain damage of pigeonpea germplasms for pod borer complex during 2016-17 and 2017-18.

| S. No | Germplasms | Percent pod damage / plant | Percent grain damage / plant |
|---|---|---|---|
| 1. | RP1 | 27.58 (31.68) | 19.44 (26.15) |
| 2. | RP2 | 33.30 (35.22) | 22.80 (28.55) |
| 3. | RP3 | 36.26 (37.03) | 26.72 (31.13) |
| 4. | RP5 | 33.36 (35.28) | 25.35 (30.23) |
| 5. | RP6 | 27.89 (31.58) | 14.37 (22.22) |
| 6. | RP7 | 33.32 (35.32) | 24.48 (29.66) |
| 7. | RP8 | 33.83 (35.54) | 22.48 (28.31) |
| 8. | Rajeevlochan | 24.15 (29.37) | 15.74 (23.32) |
| 9. | ICP 6994 | 31.63 (34.18) | 20.45 (26.88) |
| 10. | ICP 6996 | 30.70 (33.65) | 21.88 (27.88) |
| 11. | ICP 6999 | 28.14 (31.78) | 17.84 (24.96) |
| 12. | ICP 7003 | 20.08 (26.19) | 10.72 (19.04) |
| 13. | ICP 7004 | 23.67 (29.05) | 14.27 (22.11) |
| 14. | ICP 7005 | 23.14 (28.63) | 13.74 (21.73) |
| 15. | ICP 7373 | 20.07 (26.26) | 12.58 (20.71) |
| 16. | ICP 7374 | 25.73 (30.45) | 15.75 (23.33) |
| 17. | ICP 7379 | 26.10 (30.69) | 21.97 (27.94) |
| 18. | ICP 7387 | 29.55 (32.93) | 21.39 (27.56) |
| 19. | ICP 7391 | 29.10 (32.63) | 20.81 (27.15) |
| 20. | ICP 7392 | 26.73 (31.12) | 17.38 (24.62) |
| 21. | ICP7393 | 27.23 (31.44) | 19.19 (25.96) |
| 22. | ICP 7398 | 18.73 (25.26) | 10.25 (18.58) |
| 23. | ICP 7404 | 25.57 (30.35) | 16.22 (23.73) |
| 24. | ICP 7405 | 28.65 (32.30) | 20.39 (23.87) |
| 25. | ICP 7406 | 20.89 (26.84) | 11.97 (20.19) |
| CD at 5% | | *4.15* | *5.26* |

Note: Figures in parentheses are arc sin transformed values

**Grain yield**

During *Kharif* 2016-17, significant differences were seen in the grain yield among the tested germplasms. Highest grain yield of 12.23 q/ ha was obtained from ICP 7398 which was found at par with ICP 7003, ICP 7406, ICP 7004, ICP 7373, RP 6, ICP 7005, Rajeevlochan, ICP 7392, ICP 7374, ICP 7393, ICP 7404, RP 1, ICP 6999, ICP 7387, ICP 7405, ICP 7391, ICP 6996 and ICP 7379 with 12.18, 11.71, 11.28, 11.11, 10.98, 10.86, 10.82, 10.77, 10.63, 10.57, 10.39, 10.29, 9.88, 9.87, 9.44, 9.14, 8.94and 8.86 q/ ha followed by ICP 6994, RP 7, RP 2, RP 5 and RP 8 with 7.93, 6.29, 5.79, 5.77and 5.57 q/ ha respectively, whereas minimum grain yield of 2.50 q/ ha was obtained from RP 3 (Table 3). However, during *Kharif* 2017-18, among the tested germplasms, highest grain yield of 13.65 q/ ha was obtained from ICP 7398 which was found at par with ICP 7003, ICP 7406, ICP 7004, ICP 7373, RP 6, ICP 7005, Rajeevlochan, ICP 7392, ICP 7374, ICP 7393, ICP 7404, RP 1, ICP 6999, ICP 7387, ICP 7405, ICP 7391 and ICP 7379 with 13.55, 13.24, 12.82, 12.79, 12.30, 12.27, 12.06, 11.95, 11.76, 11.69, 11.61, 11.18, 11.06,

10.93, 10.36, 10.33 and 10.10 q/ ha followed by ICP 6996, ICP 6994, RP 7, RP 2, RP 5 and RP 8 with 9.16, 8.29, 8.23, 7.72, 7.01 and 5.92 q/ ha respectively. Minimum grain yield of 1.59 q/ ha was obtained from RP 3 (Table 3).

**Table 3:** Grain yield in different germplasm of pigeonpea during 2016-17 and 2017-18

| S. No. | Germplasm | Yield (q/ ha.) in 2016-17 | Yield (q/ ha.) in 2017-18 |
|---|---|---|---|
| 1 | RP1 | 10.29 | 11.18 |
| 2 | RP2 | 5.79 | 7.72 |
| 3 | RP3 | 2.50 | 1.59 |
| 4 | RP5 | 5.77 | 7.01 |
| 5 | RP6 | 10.98 | 12.30 |
| 6 | RP7 | 6.29 | 8.23 |
| 7 | RP8 | 5.57 | 5.92 |
| 8 | Rajeevlochan | 10.82 | 12.06 |
| 9 | ICP 6994 | 7.93 | 8.29 |
| 10 | ICP 6996 | 8.86 | 9.16 |
| 11 | ICP 6999 | 9.88 | 11.06 |
| 12 | ICP 7003 | 12.18 | 13.55 |
| 13 | ICP 7004 | 11.28 | 12.82 |
| 14 | ICP 7005 | 10.86 | 12.27 |
| 15 | ICP 7373 | 11.11 | 12.79 |
| 16 | ICP 7374 | 10.63 | 11.76 |
| 17 | ICP 7379 | 8.94 | 10.10 |
| 18 | ICP 7387 | 9.87 | 10.93 |
| 19 | ICP 7391 | 9.14 | 10.33 |
| 20 | ICP 7392 | 10.77 | 11.95 |
| 21 | ICP7393 | 10.57 | 11.69 |
| 22 | ICP 7398 | 12.23 | 13.65 |
| 23 | ICP 7404 | 10.39 | 11.61 |
| 24 | ICP 7405 | 9.44 | 10.36 |
| 25 | ICP 7406 | 11.71 | 13.24 |
| CD at 5% | | 3.99 | 4.60 |

Overall larval population, percent pod damage, percent grain damage and grain yield of Pigeonpea germplasms against pod borer complex viz., *Maruca vitrata*, *Helicoverpa armigera*, *Exelastis atomosa* and *Melanagromyza obtusa*, based on two years study it was revealed that the germplasm ICP 7398 and ICP 7003 showed minimum larval population, minimum pod damage, minimum grain damage and gave maximum yield. This may be either due to the germplasm inheritance character of producing higher yield against pod borer complex or due to the capacity to tolerate damage, without showing any reduction in yield. Germplasm in their increasing order of pod borer complex susceptibility over ICP 6996 were 6999, ICP 7391, Rajeevlochan, ICP 7374, ICPL 89117, ICP 7004, ICP 7005, ICP 6994, ICP 7405, ICP 7393, ICP 7379, ICP 7003, ICP 7398, ICP 7373 ICP 7387, ICP 7404, ICP 7406, ICP 7492 and ICP 7409 [4]. The present finding is in agreement with the extent of pod damage due to lepidopterous pod borers (LPBs) *viz*. Gram pod borer (*H. armigera*), legume pod borer (*M. vitrata*), plume moth (*E. atomosa*) and pod fly (*M. obtusa)* under insecticide-free conditions in which the extent of pod damage inflicted by LPBs and pod fly varied from 1.00 to 6.30% and 15.10 to 33.10% [8].

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