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Screening of pigeonpea germplasm against tur pod bug *Clavigralla gibbosa* Spinola at Pantnagar, Uttarakhand

Elluru Sireesha and Ruchira Tiwari

Abstract
The evaluation trials were conducted to screen thirty-three promising pigeonpea germplasm lines along with two check entries *i.e.,* PA421 (Check) and MN1 (Susceptible check) for their resistance/ tolerance against Tur Pod bug, *Clavigralla gibbosa* (Spinosa) during two *Kharif crop* seasons *i.e.,* 2021-22 and 2022-23 at the NEBCRC, GBPUA&T, Pantnagar. The Cumulative data on the overall mean population of pod bug was ranged from 2.20 bugs/ plant in PA659 to 5.57 bugs/ plant in PA727 as compared to 3.47 bugs/ plant in PA421 (check) and 5.87 bugs/ plant in MN1 (Susceptible check). The minimum mean pod bug population were recorded in the PA718 (2.47 bugs/ plant) after PA659, followed by PA674 (2.57 bugs/ plant) which is at par with genotypes PA733 (2.60 bugs/ plant). The lowest seed damage percent were recorded in the lines PA659 (2.83%), followed by PA718 (3.00%), PA674 (3.50%) which is at par with genotypes PA733 (3.67%) as compared to PA421 (5.17%) and MN1 (13.67%). Considering the minimum pod bug mean population and seed damage percentage, the four germplasm lines *i.e.,* PA659, PA718, PA674 and PA733 were found to be best.

Keywords: Pigeonpea, screening, pod bug and seed damage

Introduction

Cajanus cajan (L.) Millspaugh, commonly known as Pigeonpea, is a notable type of legume crop in India and ranks as the next most important crop after chickpea. (Nene *et al*., 1990) [6]. Around 90 percent of the total global area falls in India with corresponding 93 percent of global production (Anon, 2000) [1]. Under pulses, the total world acreage is about 93.18 million hectares with production of 89.82 million tonnes at 964 kg/ ha yields level. In India, an area of 49.10 lakh hectares is under arhar with a production of 40.35 lakh tonnes and productivity of 885 kg/ha (dpd.gov.in. 2021-2022). Apart from production, the crop is highly sensitive to attack by a broad range of insect pests both in the fields (at various stages of crop growth) and storage. The tur pod bug, scientifically known as *Clavigralla gibbosa* Spinola, has emerged as a serious menace to the quality produce pigeonpea grains, ranking closely after the pod borers Spotted pod borer *Maruca vitrata* (Geyer), Gram pod borer *Helicoverpa armigera* (Hubner), and redgram pod fly *Melanogromyza obtuse* (Malloch), all of which are insects that damage the pods of the pigeonpea plant.

Clavigralla gibbosa (Spinola) (Hemiptera: Coreidae), an insect pest that damages the pods of pigeonpea plants, has become a significant threat to the production of high-quality grains, ranking just after the pod borer in terms of its potential for causing damage. (Chakravarty *et al*., 2016) [2]. The pod bug adult females lay eggs in groups, mostly on the pod surface and on the ventral surface of leaves. The damaging stages are nymph and adults, where both suck the sap from tender seeds through puncturing on the pod wall. Pigeonpea seeds infected with pests, exhibit irregular, zig-zag patterns and develop dark patches, causing them to shrivel up. This can lead to the early shedding of pods, as well as the deformation of pods, and ultimately result in a significant decrease in grain yield. (Srujana and Keval, 2014) [10]. Furthermore, damaged seeds do not germinate properly and also are not suitable for human consumption (Shanower *et al*., 1999) [9]. The damage caused by the pod bug results in a decrease in grain yield production of approximately 25% - 40% percent. (Gopali *et al*., 2013) [3].

Pigeonpea farmers incur significant costs on inputs such as pesticides. Therefore, exploring available germplasms for sources of resistance against the pod borer complex for use in plant breeding is considered a viable option. Understanding the mechanism of resistance against the pest complex in the field and storage pests is also crucial for developing high-yielding and resistant pigeonpea varieties. Using resistant cultivars can significantly reduce the need for costly pest management measures, making it an important component of pest control alongside cultural, biological, and chemical methods. To identify sources of resistance and develop less susceptible cultivars against the Tur pod bug in pigeonpea, the present study was conducted with these perspectives in mind.

Material and Methods

A field trial was carried out to evaluate the performance of thirty-three (33) potentially superior pigeonpea germplasms (PA690, PA693, PA703, PA706, PA707, PA708, PA710, PA711, PA712, PA713, PA714, PA716, PA718, PA719, PA722, PA724, PA726, PA727, PA730, PA733, PA736, PA738, PA739, PA740, PA741, PA656, PA659, PA663, PA669, PA674) along with three check varieties PA421 (Check), PAU 881 (Zonal check), MN1 (Susceptible check) against the tur pod bug. The trial was conducted during the *kharif* seasons of 2021-22 and 2022-23 at the Crop Research Centre, Govind Ballabh Pant University of Agriculture and Technology (GBPUA&T), Pantnagar, Uttarakhand, India. The experimental design consisted of planting each germplasm in three rows of 4 m length, with a row-to-row spacing of 60cm and a plant-to-plant spacing of 45 cm, using a randomized block design that was replicated three times. Suggested agronomic practices were followed while growing the crop, except for the use of plant protection measures.

For making the record of tur pod bug population a total of five plants were randomly choosen from each line and each plot. The population of nymphs and adults of *C. gibbosa* on these plants were counted at weekly intervals and averaged separately for each line on a standard weekly basis. The sampling for assessing seed grain damage due to pod bug was done when the crop reached 80% maturity stage. For the seed grain damage assessment, five plants from the three rows in each unit were randomly selected, and all the pods from these plants were collected together. A total of hundred pods were hand-picked and observed for damage. Finally, the seed grain damage percentage was calculated.

The noted data were evaluated statistically using the Randomized Block Design and the pod bug population data subjected to square root transformation $\sqrt{x+1.0}$, whereas seed grain damage assessment data were converted using the arc sin transformation method.

$$\text{Percent Seed damage (\%)} = \frac{\text{Number of damaged grains}}{\text{Total number of seeds}} \times 100$$

Results and Discussions

Thirty-three pigeonpea germplasm were screened under unprotected conditions to study the pod bug damage assessment during two *kharif* seasons 2021-22 and 2022-23. The findings of the study and the appropriate discussions have been presented are as follows:

The initial sighting of the pod bug, *C. gibbosa*, was seen during the 44th week of the study, and persisted in all the germplasms until the 48th week (as shown in Table 1). Various peaks in the population of the pod bug were observed across different germplasms between the 47th and 48th weeks. Among the thirty-three pigeonpea germplasm, the mean population of pod bug was ranged from 2.20 bugs/ plant to 5.57 bugs/ plant as compared to 3.47 in PA4211 (Check) and 5.87 in MN1 (Susceptible check). The highest mean pod bug population were recorded in PA727 (5.57 bugs/ plant), followed by PA690 (5.43 bugs/ plant), PA722 (4.87 bugs/ plant) and the lowest mean pod bug population were recorded in PA659 (2.20 bugs/ plant), followed by PA718 (2.47 bugs/ plant), PA674 (2.57 bugs/ plant) which is at par with genotypes PA733(2.60 bugs/ plant) PA711 (2.63 bugs/ plant), PA656 (2.67 bugs/ plant) and PA730 (2.77 bugs/ plant).

The percent seed grain damage by the pod bug ranged from 2.83% to 10.67% as compared to 5.17% in PA421 (check) and 13.67% in MN1 (Susceptible check). The maximum percent seed damage was observed in PA727 (10.67%) followed by PA690 (9.50%), PA722 (9.33%), PA710 (9.00%) and the minimum percent seed damage were observed in the genotypes PA659 (2.83%) followed by PA718 (3.00%), PA674 (3.50%), PA733 (3.67%), PA711 (4.50%), PA656 (4.83%) and PA730 (5%).

The above results were supported by Pradyumn *et al.*, (2005) [7] reported among the fifteen pigeonpea genotypes, ICPL 84023 was highly preferred whereas the genotypes ICPL 87, ICPL 86012 and ICPL 84052 were the least preferred hosts by the pod bug, *C. gibbosa*. Khan *et al.* (2014) [5], screened twenty-four pigeonpea genotypes and among them ICPL 20036, ICP 10531, ICP 13212, ICPHaRL 4985-1 and ICPHaRL 4979-2 were identified as the most susceptible to pod bug. Shailesh *et al*. (2018) [8] screened the 16 genotypes and stated that the genotypes ICPL 87 (4.17), IPS 16 (2.78) and IPS 4 (3.62), and recorded lowest counts of pod bug *C. gibbosa*. Kavitha *et al*. (2018) [4] recorded the four entries (GR 28, ICP 49114, H 23, and SMR 1693158) were resistant to the pod bug complex out of 145 pigeon pea genotypes.

Table 1: Cumulative mean of Pigeonpea germplasm against Tur pod bug *Clavigralla gibbosa* during *kharif* crop seasons 2021-22 and 2022-23 at Pantnagar, Uttarakhand

S.No.	Germplasm	*Pod bug/ 5 plants					*Mean	**Seed damage (%)
		Standard week						
		44	45	46	47	48		
1	PA690	1.33 (1.50)	3.83 (2.20)	5.00 (2.45)	7.67 (2.93)	9.33 (3.20)	5.43 (2.46)	9.50 (17.65)
2	PA693	0.83 (1.31)	2.83 (1.96)	4.17 (2.26)	5.00 (2.44)	7.00 (2.83)	3.97 (2.16)	5.50 (13.48)
3	PA703	1.00 (1.37)	2.83 (1.96)	3.67 (2.15)	5.00 (2.44)	6.50 (2.73)	3.80 (2.13)	8.33 (16.54)
4	PA706	0.50 (1.21)	2.17 (1.76)	2.33 (1.82)	4.50 (2.34)	5.33 (2.51)	2.97 (1.93)	4.67 (12.33)
5	PA707	0.67 (1.26)	2.00 (1.73)	2.67 (1.91)	4.00 (2.23)	4.33 (2.31)	2.73 (1.89)	5.50 (13.29)
6	PA708	0.67 (1.28)	1.83 (1.66)	3.33 (2.08)	5.67 (2.57)	6.67 (2.76)	3.63 (2.07)	6.33 (14.30)
7	PA710	0.83	2.67	3.67	5.00	7.83	4.00	9.00

		(1.33)	(1.90)	(2.15)	(2.45)	(2.97)	(2.16)	(17.21)
8	PA711	0.50 (1.21)	1.33 (1.52)	2.00 (1.72)	4.00 (2.24)	5.33 (2.51)	2.63 (1.84)	4.50 (12.04)
9	PA712	0.17 (1.07)	1.50 (1.57)	2.17 (1.78)	5.67 (2.53)	5.00 (2.44)	2.90 (1.88)	5.67 (13.47)
10	PA713	0.67 (1.28)	2.17 (1.77)	2.83 (1.94)	3.83 (2.18)	5.67 (2.57)	3.03 (1.95)	6.33 (14.30)
11	PA714	1.00 (1.38)	3.50 (2.12)	4.50 (2.33)	5.33 (2.51)	6.17 (2.67)	4.10 (2.20)	7.67 (15.86)
12	PA716	0.33 (1.14)	1.50 (1.57)	3.17 (2.03)	4.17 (2.27)	5.00 (2.45)	2.83 (1.89)	5.83 (13.65)
13	PA718	0.50 (1.21)	1.00 (1.41)	2.67 (1.91)	3.00 (2.00)	5.17 (2.45)	2.47 (1.80)	3.00 (8.78)
14	PA719	1.00 (1.37)	2.67 (1.91)	4.50 (2.32)	5.50 (2.55)	6.17 (2.68)	3.97 (2.16)	8.00 (16.17)
15	PA722	1.17 (1.45)	3.33 (2.07)	4.67 (2.38)	6.33 (2.70)	8.83 (3.13)	4.87 (2.35)	9.33 (17.51)
16	PA724	1.00 (1.41)	2.83 (1.96)	3.83 (2.19)	4.50 (2.34)	5.50 (2.55)	3.53 (2.09)	4.33 (11.34)
17	PA726	0.83 (1.35)	2.50 (1.87)	3.33 (2.08)	4.33 (2.30)	5.50 (2.54)	3.30 (2.03)	5.33 (13.11)
18	PA727	1.50 (1.55)	3.67 (2.14)	4.50 (2.34)	8.17 (3.00)	10.00 (3.30)	5.57 (2.47)	10.67 (18.72)
19	PA730	0.50 (1.21)	1.00 (1.40)	3.17 (2.03)	4.00 (2.22)	5.17 (2.47)	2.77 (1.87)	5.00 (12.27)
20	PA733	0.33 (1.14)	1.50 (1.57)	2.67 (1.89)	3.67 (2.16)	4.83 (2.41)	2.60 (1.83)	3.67 (9.80)
21	PA736	0.33 (1.14)	1.67 (1.63)	4.67 (2.34)	5.83 (2.57)	7.67 (2.92)	4.03 (2.12)	4.17 (11.62)
22	PA738	1.00 (1.41)	2.00 (1.72)	3.50 (2.12)	5.33 (2.50)	6.67 (2.76)	3.70 (2.10)	4.50 (11.72)
23	PA739	0.67 (1.28)	1.50 (1.57)	3.17 (2.02)	4.83 (2.41)	5.17 (2.48)	3.07 (1.95)	5.17 (12.91)
24	PA740	1.33 (1.52)	3.17 (2.03)	4.67 (2.38)	5.17 (2.48)	5.83 (2.61)	4.03 (2.20)	7.17 (15.27)
25	PA741	1.00 (1.40)	3.00 (1.97)	4.67 (2.37)	5.50 (2.53)	7.00 (2.81)	4.23 (2.22)	6.83 (14.92)
26	PA421 (Check)	0.83 (1.33)	2.17 (1.78)	3.17 (2.04)	4.83 (2.40)	6.33 (2.69)	3.47 (2.05)	5.17 (12.46)
27	PAU 881 (Zonal Check)	1.83 (1.66)	4.17 (2.26)	4.50 (2.34)	8.67 (3.09)	10.33 (3.35)	5.90 (2.54)	11.33 (19.41)
28	MN1 (Suscp. Check)	2.33 (1.82)	4.17 (2.26)	4.50 (2.34)	7.67 (2.92)	10.67 (3.40)	5.87 (2.55)	13.67 (21.50)
29	PA656	0.17 (1.07)	1.67 (1.63)	2.83 (1.94)	4.00 (2.22)	4.67 (2.37)	2.67 (1.85)	4.83 (12.42)
30	PA659	0.00 (1.00)	1.17 (1.47)	2.33 (1.81)	3.17 (2.02)	4.33 (2.26)	2.20 (1.71)	2.83 (8.55)
31	PA663	0.67 (1.28)	1.67 (1.62)	2.83 (1.96)	4.50 (2.32)	6.50 (2.72)	3.23 (1.98)	4.17 (11.15)
32	PA669	0.33 (1.14)	2.00 (1.72)	2.33 (1.82)	3.83 (2.19)	5.67 (2.57)	2.83 (1.89)	4.00 (10.75)
33	PA674	0.50 (1.21)	1.83 (1.66)	2.00 (1.71)	4.00 (2.24)	4.50 (2.34)	2.57 (1.83)	3.50 (9.59)
SE(m)±		0.097	0.077	0.069	0.047	0.055	0.069	0.541
CD at 5%		0.274	0.218	0.195	0.132	0.156	0.195	1.527

*Figures in the parentheses are square root transformed values with adding factor √x+1.0 transformed values
**Figures in the parentheses are angular transformed values

Conclusion

The study suggests that the level of pest infestation in pigeonpea can be effectively controlled by host plant resistance, and screening is a reliable method for identifying resistant genotypes. The *Clavigralla gibbosa* Spinola, an insect pest of pigeonpea in this region commonly known as the pod bug where its infestation level increases as the crop matures. In the case of pulses, actual damage to the economic produce occurs after flowering. Out of the thirty-three-germplasm evaluated, PA727, PA690, PA722, and PA710 were found to be the most resistant to pod bug damage and should be promoted.

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