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Screening of germplasm of medium maturity group of pigeonpea against pod borer complex

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Abstract
Studies on screening of germplasm of medium maturity group of pigeonpea against pod borer complex were conducted during *Kharif* 2021-22 at Research cum Instructional Farm, IGKV, Raipur, (C.G.). Among all the tested germplasm, minimum pod damage by turn pod borer (*H. armigera*) and turn pod fly (*M. obtusa*) was observed in GJP-1915, whereas in case of spotted pod borer (*M. vitrata*) minimum pod damage was observed in GRG 622. The highest grain of pigeonpea was recorded in CG Arhar-2.

Keywords: Screening of germplasm, pigeonpea, experiment, germplasm, pod damage

Introduction
Pigeonpea [*Cajanus Cajan* (L.) Millsp.] is an important pulse crop grown worldwide because it is endowed with several unique characteristics with diversified uses for human needs. It is usually grown in semi-arid tropical and sub- tropical areas. Especially in Asia it is a major source of protein for humans (Pathade *et al.*, 2015; Shanower *et al.*, 1998) [9, 12]. It is also known as red gram, arhar and turn and second most grown pulse crop of India next to gram and is generally grown in *Kharif* season. Primarily grown as food crop but it is also used for forage, fodder, fuel and medicinal purpose. It is an essential pulse crop that thrives in poor soils and areas with inconsistent or insufficient moisture supply.

It is a perennial legume belonging to the family Fabaceae and has deep root system which helps it to withstand drought and also prevents soil erosion. It can be also grown as intercrop in combination with short duration crop like URD, Mung bean, soybean and cowpea. It produces a lot of biomass, which is mostly utilised as feed and it gives the earth a lot of nutrients and moisture (Shiying *et al.*, 2001) [13]. It is also utilised as green manure in some locations, providing up to 90 kg nitrogen per acre. According to the Food and Agriculture Organization (FAO), the global annual production of pigeonpea in 2019 was 5.6 Mt, with India producing 59% of it. India is the largest producer and also the largest consumer of pulses in the world. Pigeonpea yields have remained stagnant for the past 3 to 4 decades largely due to damage inflicted by insect pests. There are various causes for the low productivity of pigeonpea in the nation, but insect pest damage is one of the most significant (Mishra *et al.*, 2012) [8]. Nearly, two hundred fifty of insect species belonging to eight orders and sixty-one families have been found to attack on pigeonpea, of this only few are economically important as pests (Lal, 1978) [7] among which the pod – borers *viz*., pod borer (*Helicoverpa armigera* Hubner), turn plume moth (*Exelastis atmosa* Walshingham) and pod fly (*Melanagromyza obtusa* Malloch) are the most damaging pests, inflicting considerable damage to the reproductive parts of the plant and cause losses in grain yield ranging from 30- 100 % (Adgkar *et al.*, 1993) [1].

Yield of pigeonpea is not very impressive and there is still scope of improvement. Irrational use of pesticides against pod complex borer is burdensome for pocket of farmers and also not so effective. It has led to several problems like pest resurgence, pest resistance against pesticides, lethal effect on non-targeted organisms, soil infertility and disturbance in agro-ecosystem. Hence to avoid such problems regular monitoring of pest and application of pesticides at optimum dosage at economic threshold level is necessary.

To increase the productivity of pigeonpea it is essential to search for resistant or tolerant germplasm along with modern and integrated pest management techniques and usage of newer and safer insecticides which are effective against pod borer complex. Integration of all available resources and techniques will help to increase production of pigeonpea sustainably and will also increase farmer's income.

Material and Method

The experiment was conducted during *Kharif* season 2021-22 at Research cum Instructional Farm, IGKV, Raipur, (C.G.) by growing a total of twenty three mid early group (medium) advanced varieties of Pigeonpea in RBD design. In each plot there were two rows of 4 m^2 length with plant spacing of 90 x 60 cm^2. The observations were recorded as pod damage percent. Percent pods damaged due to different pod borers based on the nature of damage were separated from 100 randomly collected pods from each plot at the time of harvest.

Nature of damage

Helicoverpa armigera: Large round and regular holes on the pods.
Maruca vitrata: Irregular scrapping and holes on the pods.
Melanagromyza obtuse: Pin head size holes at the peripheral end of the pod.
The grain yield was recorded at the time of harvest. The percentage of pod damage and grain yield Kg/ ha was estimated with the help of following formula:

$$\text{Pod Damage (\%)} = \frac{\text{Number of damage pods}}{\text{Total Number of pods (Healthy + Damage)}} \times 100$$

$$\text{Grain yield(kg/ha)} = \frac{\text{Weight of grains in kg/plot}}{\text{Plot area in } m^2} \times 10{,}000$$

Statistical analysis

The data obtained were analysed statistically after using appropriate transformation. The larval population of pod borer complex data obtained was converted into square root transformation; by using the formula ($\sqrt{x} + 0.5$) the data on pod and grain damage was first recorded from the plants and then converted into percentage. The percentage data was processed under arcsine transformation Sin-1 ($\sqrt{x}/100$) before statistical analysis. This transformed data was then analysed by the method of analysis of variance as described by Gomez and 18 Gomez (1984) [5]. The "F" test was used at 5 percent level of significance. The following formulae were used for standard error, critical difference and coefficient of variance estimations:

$$C.D. = \sqrt{\frac{2EMSR}{R}} \times t\ (D.F.at\, 5\%)$$

Results and Discussion

Screening of germplasm of medium maturity group of pigeonpea against tur pod borer, *Helicoverpa armigera* (Hubner)

The incidence of insect pest was measured in terms of percent pod damage at the harvesting stage of the crop. Germplasm showed significantly difference with each other for percent pod damage by tur pod borer (*H. armigera*) which varied from 5.15 % to 11.33%. Among the all tested germplasm, minimum pod damage by *H. armigera* was observed in germplasm GJP-1915 with 5.15 % which was found at par with GRG 622, CG Arhar-2, RP-7, RP-8 with 5.65, 6.00, 6.20, 6.20 %, respectively, whereas the maximum pod damage was observed in Rajeev- lochan with 11.33%.

More or less our findings were similar with the findings of Rana *et al.* (2017) [10] who reported pod borer complex *H. armigera* and found that the germplasm ICP 6996 showed a minimum larval population, minimum pod damage, minimum grain damage, least pest susceptibility rating and gave maximum yield. The second least susceptible germplasm was ICP 7374, followed by ICP 7005, ICP 7406, ICP 7392, ICP 7404, ICP 7003, ICP 6994, ICP 7405, ICP 6999, ICP 7373, ICP 7391, ICP 7387, ICP 7393, Rajeevlochan, ICP 7398, ICP 7004, ICPL 87119, ICP 7379 and ICP 7409. Similarly, *et al.* (2019) [11] revealed that based on percent pod damage and grain damage five genotypes *viz.*, LRG 30, LRG 41, ICPL 87119, ICP 8863 and BSMR 853 were into grouped under resistant category and nine genotypes *viz.*, TDRG 33, Guliyal local, WRP 1, CO 6, LRG134, RVSA 9, SKNP 224, ICPL 4503 and WRG 79 under susceptible category against *H. armigera*.

Screening of germplasm of medium maturity group of pigeonpea against spotted pod borer, *Maruca vitrata* (Geyer)

The incidence of insect pest was measured in terms of percent pod damage at the harvesting stage of the crop. Germplasm were showed significantly difference with each other for percent pod damage which varied from 1.40 % to 10.53 %. Among the tested germplasm, minimum pod damage by *M. vitrata* was observed in germplasm GRG 622 with 1.40 % which was found at par with GJP 1915, AKTM 1637 with 1.45, 1.50 % pod damage, respectively. Whereas the maximum pod damage was observed in CG Arhar-2 with 10.53 % per cent.

The current findings were more or less similar to Chaitanya *et al.* (2012) [3] who observed the incidence of spotted borer *Maruca vitrata* in three cultivars *viz.*, LRG41, TRG 22 and TRG 38. Among the three cultivars, LRG-41 has recorded the highest population (17.3 larvae per plant) followed by the TRG-22 (14.4 larvae per plant) and the lowest pest population was recorded in the TRG-38 (9.9 larvae per plant).

Screening of germplasm of medium maturity group of pigeonpea against tur pod fly, *Melanagromyza obtusa* (Malloch)

At the harvesting stage of the crop, the incidence of insect pest was measured in terms of percent pod damage. Germplasm were showed significantly difference with each other for percent pod damage by tur pod fly (*M. obtusa*) which varied from 3.65 % to 13.33 %. Among the tested germplasm, minimum pod damage by *M. obtusa* was observed in germplasm GJP 1915 with 3.65 %, which was found at par with GRG 622, AKTM 1637, RP-3 with 3.90, 3.95, 12.41 % pod damage respectively, whereas the maximum pod damage was observed in Rajeev lochan with 13.33 % per cent.

More or less our findings were similar to Singh *et al.* (2017) [14] who reported against that the first incidence of pod fly was observed in the 4th standard week in all genotypes except IVT-509, AVT-607 and AVT-605 and the population persisted up to 12th standard week in all the genotypes. The mean populations of pod fly on different genotypes ranged from 0.61 pod fly maggots/ 10 pods in IVT-520 to 1.57 pod fly maggots / 10 pods in IVT-510. The percent pod damage due to pod fly significantly varied from 22.33 % in genotype IVT-520 to 46.67% in genotype IVT-510. The highest grain damage by pod fly was also seen in IVT-510 (20.96 %) while the lowest grain damage was observed in IVT-520 (10.67 %). Similarly, Akhauri *et al.* (2001) [2] also reported that susceptibility of pigeonpea genotypes against pod boring insect podfly (*Melanagromyza obtusa,* Malloch) on the basis of extent of pod damage showed that the genotypes ICPL-83015 and Pusa -6 were relatively less susceptible as against ICPL-151 which was found highly prone to the borer attack under the Agroclimatic of North Bihar.

Grain Yield

Among the all twenty- three screened germplasm, the highest grain yield of pigeonpea was recorded in CG Arhar-2 as 1987.50 kg/ha which was found at par with Chhattisgarh Arhar-1, Asha as 1665.28 kg/ha, 1636.11 kg/ha, respectively. Whereas, the lowest grain yield of pigeonpea was recorded in RP-8 as 488 kg/ha.

More or less our findings were similar with Gupta *et al.* (2018) [6] who reported that the highest yield was obtained in ICP 7398 during both years with 12.23 q/ha and 13.65 q/ha. But the germplasm RP3 recorded highest percent pod damage with 36.26 %, highest percent grain damage of 26.72 % and also lowest grain yield was obtained in both years with 2.50 q/ha and 1.59 q/ h. Similarly, Srivastava and Seghal (2005) [15] also reported that ICPL 151 give the highest yield among all entries. Singh *et al.* (2017) [14] The grain yield of different genotypes also differed significantly and ranged from 479 kg/ha in the genotype IVT-510 to 3314 kg/ha in IVT-520.

Table 1: Screening of medium maturity group germplasms (GP) against major insect pest of pigeonpea (*Kharif* 2021-22).

Treatment	Pod Damage (%)			Yield (Kg/ha)
	H. Armigera	***M. Vitrata***	***M. Obtusa***	
R-P-1	7.87(16.25)	9.13 (17.49)	11.33(19.62)	1,066.66
R-P-2	8.93 (17.35)	10.40(18.69)	12.00(20.23)	991.66
R-P-3	8.07(16.40)	8.87(17.27)	4.67 (12.41)^{c}	1,305.55
R-P-5	7.93 (16.32)	10.27(18.67)	9.23(17.58)	687.50
R-P-7	6.20 (14.30)^{c}	9.13(17.55)	10.73(18.96)	888.88
R-P-8	6.20 (14.30)^{c}	9.80(18.18)	11.27(19.59)	488.89
R-P-14	8.20 (16.53)	9.00(17.32)	13.27 (21.34)	883.22
R-P-15	8.60 (16.99)	7.67(15.97)	6.00(14.14)	1,293.05
R-P-17	6.90 (15.24)	9.2(17.64)	12.87 (20.98)	633.33
ICP – 6994	7.50 (15.88)	9.47 (17.85)	10.73 (19.07)	1,408.33
ICP – 6996	7.60 (15.98)	7.00 (15.31)	10.60 (18.95)	1,294.44
ICP – 7005	7.70 (16.13)	6.20(14.37)	10.67(19.00)	1,373.61
ICP – 7373	8.27 (16.69)	9.67(18.09)	8.85(17.03)	563.88
ICP – 7374	8.07 (16.47)	8.87 (17.31)	8.92(17.09)	866.66
ICP – 7379	7.73 (16.11)	8.93 (17.38)	8.07(16.48)	1,259.72
CG A-1 (LC)	7.93 (16.33)	10.33 (18.74)	12.40(20.52)	1,665.28^{a}
CG A-2	6.00 (14.16)^{b}	10.53 (18.91)	10.60(18.97)	1,987.50
ASHA (NC)	11.13 (19.47)	9.33 (17.73)	11.13 (19.43)	1,636.11^{b}
Rajeev Lochan	11.33 (19.63)	9.37(17.75)	13.33(21.40)	855.55
Rajeshwari	7.73 (16.13)	10.00(18.42)	10.47(18.82)	870.83
GRG 622	5.65(13.72)^{a}	1.40(6.76)	3.90(11.33)^{a}	1,265.10
AKTM 1637	7.95(16.19)	1.50(7.02)^{b}	3.95(11.38)^{b}	1,311.98
GJP 1915	5.15(13.07)	1.45(6.91)^{a}	3.65(10.95)	1,316.40
C.D.	2.13	2.36	3.01	379.64
S.E.M	0.74	0.82	1.047	132.09
C.V.	18.49	16.09	21.75	20.78

Conclusion

In terms of percent pod damage and grain production, the results of the germplasm screening trial revealed a considerable difference between the tested genotypes. In contrast to GRG622, which was shown to be least impacted by Maruca vitrata, the germplasm GJP 1915 was found to be least affected by Helicoverpa armigera and Melanagromyza obtusa. The maximum grain output in CG Arhar-2, followed by Chhattisgarh Arhar-1, and the lowest grain production in RP-8.

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