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Screening of germplasm of mungbean against pod borer complex

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Abstract
The present investigation was conducted at the Research cum Instructional farm of the Indira Gandhi Krishi Vishwavidyalaya in Raipur (C.G.), during *Kharif* 2021–2022. In studies on screening of germplasm of mungbean against pod borer complex, the minimum pod damage infestation *by H. armigera* and *M. vitrata* were observed in germplasm OBGG 109 and BM-4, respectively. The highest grain yield of mungbean was recorded in KM 2241.

Keywords: Screening, mungbean, pod borer, spotted pod borer

Introduction
Mungbean is the third most important pulse crop farmed in India among the major pulse crop accounting for roughly 16% of the country's total pulse area. The pulse crop *Vigna radiata* (L.) Wilczek (Family: Leguminosae, Sub-family: Papilionaceae), also known as green gram (Synonyms: Golden bean or mung bean or moong bean), has been grown since antiquity. It is a tiny green circular shaped bean widely cultivated throughout Asia, including India, Pakistan, Bangladesh, Sri Lanka, Thailand, Laos, Cambodia, Vietnam, Indonesia, Malaysia, and the Republic of Formosa. Mungbean is a native of India and Central Asia, according to Vavilov (1926). It is a great source of high-quality protein that's easy to digest. It has a protein content of roughly 25%, which is almost three times that of grains. It meets the protein needs of the country's vegetarian population. Green gram has a nutritional content of 334 calories per 100 grams, crude protein (percentage) 24, fat (percentage) 1.3, carbohydrate (percentage) 56.6, calcium (mg/100 g) 140, phosphorus (mg/100 g) 280, iron (mg/100 g) 8.4, vitamin (mg/100 g), B1 0.47, B2 0.39, and niacin 2.0 (Baldev *et al*., 2000) [1]. It is planted on around 4.5 million hectares, yielding 2.5 million tonnes with a productivity of 548 kg/ha and accounting for 10% of total pulse production. Green gram output is expected to reach 2.64 million tonnes in 2020-21, according to the Government of India's third advance projections. Green gram consumption was 22.5 lakh tonnes in the marketing year 2020-21, compared to production of 21.42 lakh tonnes, with the remaining demand-supply gap filled by importing roughly 1.08 lakh tonnes and opening inventories of 2.10 lakh tonnes (Green gram outlook report, AMIC, 2021). Mungbean is preyed upon by a variety of insect pests. Insect pests that attack the mungbean plant can be categorised based on how they arrive in the field, which is linked to the phenology of the plant. Stem feeders, foliage feeders, pod feeders, and storage pests are the four types. This classification is useful for determining the economic importance of pests, particularly their impact on seed yield, as well as developing control strategies. Different insect pests attack mungbean, but sucking insect pests (aphids, jassids, leaf hoppers, and whiteflies) are the most common (Islam *et al*., 2008) [7]. Though many options are available for the management of these insect pests, farmers in India mostly use synthetic chemicals because of their quick effect with or without knowing the ill effects of these chemicals. However, farmer education for the safe and timely use of the insecticides is very important. Host plant resistance is recognised as an important component of integrated pest control since it is a low-cost, realistic, long-term strategy for sustaining lower whitefly populations and decreasing crop losses (Bellotti and Arias, 2001) [3]. Host plant resistance, according to Dowell (1990) [4], is the best long-term solution for controlling whiteflies.

Materials and Methods
The field experiment was conducted during *Kharif* season of 2021-2022, at the Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.).

Total mungbean germplasm used were seventy-six, sown in RBD design with 2 replications. The observations were recorded as (i) pod damage (%): Pods damaged due to different pod borers based on the nature of damage of *Helicoverpa armigera* cause large round and regular holes on the pods, while *Maruca vitrata* makes irregular scrapping and holes on the mungbean pods was separated from 100 randomly collected pods at the time of harvest. (ii) Yield parameters: Grain yield will be recorded at the time of harvest. Afterward, the total number of pods and the number of damaged pods by pod borers on each demarcated plant were counted and converted into percentages. The percentage of pod damaged and grain yield Kg/ha were 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 (√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 (√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

(A) Screening of germplasm of mungbean against gram pod borer, *Helicoverpa armigera* (Hubner): The incidence of insect pest was assessed in the percentage pod damage at the harvesting stage of the crop. Germplasm differed significantly in terms of percent pod damage, which ranged from 0.5 to 10.5 percent. Among the tested germplasm, the minimum pod damage by *H. armigera* was observed in germplasm OBGG 109 with 0.5 percent, which was found at par with LGG 460 and PM 1711 with 1.00 percent and IPM 1603-3, IPM 20-1, MH 1830, ML 2506, ML 818, SML 2015 with 1.5 percent pod damage respectively, whereas the maximum pod damage was observed in germplasm BCM 20-9 with 10.5 percent pod damage. Our findings are similar with the findings of Yadav *et al.* (2021) [12], who estimated the minimal percentages of pod infestations by *H. armigera* in the four genotypes KU-99-05, Azad Urd-1, Shekhar-2, and PU-6 to be 5.83, 6.17, 8.50, and 9.83 percent, respectively. Similar to this, Banu *et al.* (2007) [2] tested fifteen germplasm lines for resistance to *H. armigera* and discovered that ICPL -13201 had the lowest pod damage (25%) and greatest yield (60.35g/plant), followed by ICPL-13028 (28%) and ICPL-11964(29%).

(B) Screening of germplasm of mungbean against spotted pod borer, *Maruca vitrata* (Geyer): The insect pest incidence was observed in terms of percent of pod damage at the harvesting stage of the crop. The germplasm showed significant differences with each other for percent pod damage, which varied from 1.00% to 14.00%. Among the tested germplasm, the minimum pod damage by M. vitrata was observed in germplasm BM-4 with 1.00 percent, which was found at par with ML 2500 at 1.00 percent pod damage, MH 1142 with 2.5 percent pod damage, BCM 18-1, IPM 1604-1, IPMD 1603-7, Kopergoan at 2.5 percent pod damage, respectively. Whereas the maximum pod damage was observed in OBGG 104 with 14.00 percent. More or less the present findings are also agreement with the findings of Singh and Singh (2014) [9] who tested the 30 mungbean genotypes against *Maruca vitrata*, in which RVSm-11-92 had the least pod damage, followed by PM-306-6, IEM 2K-15 4, MH-805, BM-4, DGGS-4, and BM-2002-2. Similarly, Sandhya Rani *et al*. (2014) [8] found the preference of *M. vitrata* in five genotypes, where KM-9-128, KM-9-136, RMG-492, LGG-527, and LGG-538 were found to be tolerant, while the susceptibility of the other twenty-one genotypes ranged from 12.59 percent (MGG-332) to 20.0 percent (IPM-02-03 and LGG-522) and thirteen genotypes were highly susceptible ranging from 43.25 percent (KM-8-662). The others were extremely vulnerable, with a range of 20.21 percent (UPM-99-3) to 40.0 percent (KM-2241). Srivastava and Singh (2017) [10] also found that, KM 2348 had the highest proportion of pod damage by *M. vitrata*, followed by BM 2012-9 (16.51%), AKM 12-17 (16.40%), PM 4 (15.06%) and IPM 312-20 (15.06%). Based on percent pod damage and the Pest Susceptibility Rating (PSR) score, VGG 10-008 was shown to be the genotype that was least susceptible to the spotted pod borer.

Table 1: Percent pod damage by pod borer complex and grain yield in different germplasm of mungbean (Kharif 2021-22)

S.no	Germplasm	Pod Damage (%)		Grain Yield (Kg/ha)
		H. armigera	***M. vitrata***	
1	AKM 12-28	6(14.12)	6(14.17)	806.67
2	AKM 8802	4.5(12.07)	4.5(12.22)	946.67
3	AKM 4	8.5(16.88)	3(9.83)	1110.00
4	BCM 18-1	8(16.39)	2.5(9.04)c	1016.67
5	BCM 18-2	4.5(12.22)	10.5(18.85)	1133.34
6	BCM 20-9	10.5(18.85)	4(10.53)	996.67
7	BM 2019-10	7(15.29)	9.5(17.93)	1036.67
8	BM-4	4(11.44)	1(4.06)	910.00
9	COGG 18-17	2.5(9.04)	7.5(15.81)	1000.00
10	COGG 912	3(9.83)	5.5(12.78)	1120.00
11	Daftri Vikas	6.5(14.67)	8(16.3)	1140.00

12	GJM 1701	12(20.24)	11(19.34)	1006.67
13	IPM 13-6	4(11.44)	2.5(9.04)[c]	970.00
14	IPM 1603-3	1.5(6.93)[b]	12(20.19)	1093.33
15	IPM 1604-1	3.5(10.75)	13(21.07)	730.00
16	IPM 20-1	1.5(6.93)[b]	13.5(21.51)	1043.34
17	IPM 20-2	4.5(12.22)	8.5(16.93)	890.00
18	IPM 2-14	3.5(10.52)	3.5(10.75)	973.34
19	IPM 2-3	2.5(9.04)	5.5(13.43)	1230.00
20	IPM 2K-14-9	2.5(9.04)	10.5(18.85)	1043.33
21	IPM 410-3	2.5(8.63)	6(14.12)	970.00
22	IPM 512-1	3.5(10.75)	7.5(15.81)	1133.34
23	IPMD 1603-7	6(13.97)	2.5(9.04)[c]	1170.00
24	JLPM 702-1	5(12.85)	5.5(13.43)	1016.67
25	K 851	3.5(10.75)	7(15.18)	1126.67
26	KM 2241	3(9.83)	6(14.12)	1343.34
27	KM 2419	2(7.85)	4.5(12.22)	1180.00
28	KM 2421	3.5(10.52)	12.5(20.60)	1193.33
29	Kopergoan	5(12.85)	2.5(9.04)[c]	1036.67
30	LGG 450	3(9.83)	9(17.42)	1016.67
31	LGG 460	1(5.73)[a]	4(11.44)	1133.33
32	LGG 610	2.5(8.63)	4(11.53)	1000.00
33	MH 1830	1.5(6.93)[b]	10(18.40)	916.67
34	MH 1142	3.5(10.52)	2.5(8.63)[b]	1260.00
35	MH 1468	2.5(9.04)	6(14.12)	956.67
36	MH 1772	3.5(10.75)	5.5(13.43)	1246.67
37	MH 1857	6(14.12)	4.5(12.22)	886.67
38	MH 2-15	4(11.44)	3.5(10.52)	866.67
39	MHBC 20-2	2.5(9.04)	4(11.44)	1236.67
40	MI 181-1	3(9.83)	8(16.3)	1110.00
41	MI 750-1	2(8.12)	7.5(15.87)	1170.00
42	MI 98-64	3(9.83)	7(15.29)	1140.00
43	ML 2500	2.5(9.04)	1(5.73)[a]	1066.67
44	ML 2506	1.5(6.93)[b]	5(12.91)	1193.34
45	ML 818	1.5(6.93)[b]	4.5(12.07)	1070.00
46	NVL 1143	3(9.83)	7(15.18)	1010.00
47	OBGG 104	2.5(9.04)	14(21.91)	1006.67
48	OBGG 105	3(9.83)	9(17.02)	1096.67
49	OBGG 109	0.5(2.86)	3.5(10.75)	980.00
50	OUM 11-5	3.5(10.75)	9.5(17.79)	1070.00
51	Palamapur 93	3(9.83)	10.5(18.77)	1106.67
52	PM 1711	1(5.73)[a]	13.5(21.51)	1020.00
53	PM 1723	5(12.91)	11(19.28)	1093.34
54	PM 4	4(11.44)	7.5(15.81)	1143.34
55	PM 6	2(8.12)	7.5(15.87)	1073.34
56	Pusa 0672	5(12.91)	5.5(13.19)	1080.00
57	Pusa 1371	4.5(12.22)	7.5(15.81)	833.34
58	Pusa BM 9	5.5(13.43)	4(11.44)	950.00
59	Pusa M 2071	4.5(12.22)	4(11.53)	913.33
60	Pusa M 2171	6(13.97)	6.5(14.49)	1033.34
61	Pusa M 2172	5(12.85)	4.5(12.07)	1220.00
62	RM 03-71	6(13.97)	7(15.29)	1066.67
63	RMG 1132	4(11.44)	6(14.12)	1086.67
64	RMG 1139	2(8.12)	6(14.17)	1146.67
65	RMG 1166	4(11.44)	5(11.59)	1166.67
66	RVSM 18-1	5(12.85)	3.5(10.52)	1076.67
67	SKNM 1705	5.5(13.54)	5.5(13.54)	1210.00
68	SKNM 1904	4(11.44)	5.5(13.43)	1030.00
69	SML 1839	3(9.97)	7(14.98)	1246.67
70	SML 2015	1.5(6.93)[b]	6.5(14.67)	1036.67
71	T-44	3(9.83)	9(17.34)	1106.67
72	VBN 4	4.5(12.07)	4.5(12.07)	1046.67
73	VGG 17-049	2(7.85)	5.5(13.19)	1070.00
74	VGG 17-106	5.5(13.54)	6(13.97)	1123.34
75	VGG 18-021	3(9.83)	3(9.97)	1130.00
76	Pusa Vishal	3.5(10.75)	7(15.18)	1110.00
CD at 5%		4.214	5.579	208.211
S.E(m)		1.493	1.976	73.757

Figure in parenthesis () are angular transformed value

Grain Yield

The grain yield of various mungbean genotypes ranged from 730.00 kg/ha to 1343.34 kg/ha. The genotype KM 2241 was produced the highest grain yield as 1343.34 kg/ha, followed by genotype MH 1142 as 1260.00 kg/ha. Whereas genotype IPM 1604-1 was produced the lowest grain yield as 730.00 kg/ha, followed by genotype IPM 20-2 as 890.00kg/ha. More or less the present findings are also agreement with the findings of Srivastava and Singh (2017) [10] who discovered that the lowest grain yield was recorded from KM 2348 (416 kg/ha), as compared to check cultivar, HUM-12 (590 kg/ha), and that the maximum grain yield was recorded from VGG 10-008 (819 kg/ha), which was substantially different from other genotypes. Singh and Singh (2014) [14] also observed that AKM-4 had the highest yield, which was then followed by KM-2293, AKM-09-2, IPM-3066, and ML-1628.

Conclusion

On numerous metrics such as percent pod damage and grain yield, the germplasm screening trail revealed considerable differences among examined germplasm. The least pod damage impact on the germplasms OBGG 109 and BM-4 was caused by *Helicoverpa armigera* and *Maruca vitrata*, respectively. The germplasm KM 2241 produced the highest grain yield, whereas the germplasm IPM 1604-1 produced the lowest grain yield.

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