Original Research Article

Field screening of black gram genotypes for resistance against the spotted pod borer, *Maruca vitrata* (Fabricius) under southern Telangana conditions, India

ABSTRACT

Black gram (*Vigna mungo* L. Hepper) is India's third most important pulse crop. Throughout its growth, the crop is vulnerable to various insect pests from sowing to harvest and during post-harvest. In Telangana, farmers are experiencing significant yield losses due to lepidopteran pests that feed on flowers and pods, particularly the spotted pod borer. Larvae feed continuously within webbed masses of flowers and pods. The present investigation was conducted during *Rabi*, 2023 at the Student Farm, College of Agriculture, Rajendranagar, Hyderabad, to identify resistant black gram genotypes against spotted pod borer. A total of 28 black gram genotypes were screened under field conditions for spotted pod borer resistance, resulting in the identification of two resistant genotypes with a rating of 3, ten moderately resistant with a rating of 4, ten moderately susceptible with a rating of 7 and five susceptible with a rating of 8, based on a pest resistance per cent. The results also revealed that the genotypes GBG-1 and PU-31 showed the lowest mean number of larvae per plant (2.21 and 2.31, respectively) and lowest pod damage per cent (3.98 and 4.07 %, respectively) and were categorized as resistant (R).

Keywords: Black gram genotypes; Field screening; Pest susceptibility per cent; Spotted pod borer.

1. INTRODUCTION

Black gram (*Vigna mungo* L. Hepper), also known as urd bean, mung bean, mash, mashkalai or black matpe, is India's third most important pulse crop. It belongs to the Leguminosae family and Papilionaceae subfamily. Black gram is a short-duration, drought-tolerant and self-pollinating crop (Gupta and Gopala Krishna, 2009). It provides high nutritional value, containing 24 % protein, 3.2 % minerals and 59.6 % carbohydrates. A 100-gram serving of split dal offers 154 mg of calcium, 9.1 mg of iron and 38 mg of β-carotene (Nene, 2006). Currently, India's black gram cultivation spans 3.211 million hectares, producing 2.055 million tonnes with a productivity of 640 kg per hectare (Indiastat, Second Advance Estimates, 2023-2024). During the *Kharif* and *Rabi* seasons, the respective area, production, and productivity are 2.619 and 0.592 million hectares, 1.55 and 0.505 million tonnes and 592 and 853 kg per hectare (Indiastat, Second Advance Estimates, 2023-2024). Major black gram-producing states include Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Telangana and West Bengal. Biotic and abiotic factors impact black gram productivity, with insect pests and diseases causing substantial losses. Each year, approximately 2.0 to 2.4 million tonnes of pulses, valued at around Rs. 6000 crores, are lost due to insect pest damage (Reddy, 2009). In India, about 60 insect species are known to affect black gram at different growth stages (Lal and Sachan, 1987). Farmers are facing considerable yield losses from lepidopteran pests, especially the spotted pod borer, which targets flowers and pods. The larvae feed persistently within clusters of webbed flowers and pods, leading to substantial damage (Rachappa et al. 2015). Yield losses due to this pest generally range from 20 % to 88 % and can reach up to 100 % in certain areas (Jayashinge et al. 2015). Black gram farmers commonly use various insecticides to manage pest populations. The excessive use of pesticides can lead to phytotoxicity and the destruction of beneficial organisms, including predators, parasitoids, microorganisms and pollinators (Luckman and Metcalf, 1978; Hussain, 1984). Under these circumstances, it is essential to explore eco-friendly alternative pest management methods which include screening of genotypes. Resistant varieties are particularly valuable in situations where yield is highly variable due to unpredictable weather or pest damage. Thus, black gram is ideally suited for exploiting the resistance phenomenon to control spotted pod borer. Therefore, keeping these views in mind, the present study was conducted to identify the resistant cultivars that are less susceptible to spotted pod borer in black gram.

2. MATERIALS AND METHODS

The experiment was carried out at Student farm, College of Agriculture, Rajendranagar, Hyderabad, Telangana, to screen black gram genotypes against spotted pod borer. The experimental site is located at 17° 32’ North latitude and 78° 42’ East longitude, with an average altitude of 542.3 meters above mean sea level. The field trial was laid in Randomized Block Design with 28 genotypes including susceptible check in three replications. Each entry was sown in two rows of 4 meters length and a spacing of 30 cm between rows and 10 cm between plants duly following the recommended agronomic practices except for plant protection measures as per Professor Jayashankar Telangana Agricultural University, Telangana Vyavasayam Diksoochi, 2022. One row of susceptible check (MBG-207) was interplanted as infestation rows for every two rows of each entry to maintain pest load.

Methodology: The incidence of spotted pod borer was monitored at weekly intervals standard week wise by counting the number of larvae on five randomly selected plants from each genotype per replication, starting from the first appearance of the pest to the pod maturing stage. At harvest, the percentage of pod damage caused by spotted pod borer was determined by randomly selecting 100 pods per genotype. The total number of pods and the number of damaged pods on randomly selected plants were counted and converted into a percentage using the following formula.

$$\text{Per cent pod damage} = \frac{\text{Total number of damaged pods}}{\text{Total number of examined pods}} \times 100$$

The resistance per cent of various cultivars to pod borers was assessed based on the percentage of pod damage at crop maturity.

$$\text{Pest resistance per cent} = \frac{\text{\% PD in check cultivar - \% PD in test cultivar}}{\text{\% PD in check cultivar}} \times 100$$

Where, PD = Pod damage by pod borer

The pest resistance rating was calculated based on the damage in the susceptible check entry and then converted into a Pest resistance Index/Rating, ranging from 1 to 9, using the standard scale recommended by Lateef (1985) (Table 1).

Table 1. Pest Susceptibility Rating/Index (Standard scale)

PRP	PRR	Category of resistance
100	1	Immune
75 to 99	2	Highly Resistant
50 to 75	3	Resistant
25 to 50	4	Moderately Resistant
10 to 25	5	Tolerant
(-10) to (10)	6	Equal to check
(-25) to (-10)	7	Moderately Susceptible
(-50) to (-25)	8	Susceptible
Less than -50	9	Highly Susceptible

PRP - Pest Resistance Per cent, PRR - Pest Resistance Rating

Statistical analysis: The mean spotted pod borer populations were normalized using square root transformation, while percentage pod damage was transformed to arcsine values. These transformed values were then subjected to DMRT (Duncan Multiple Range Test) to determine the level of significance.

3. RESULTS AND DISCUSSION

A total of twenty-eight black gram genotypes along with one susceptible check were screened against spotted pod borer, *M. vitrata* under field conditions. The results on relative resistance of black gram genotypes against spotted pod borer revealed that none of the genotypes was found completely free from the spotted pod borer attack however, some genotypes *viz.*, GBG-1 and PU-31 showed resistance whereas, TBG-104, MBG-1110, MBG-1123, MBG-1133, MBG-1247, MBG-1248, MBG-1238, MBG-1245, MBG-1134 and MBG-1171 showed moderately resistance when computed under Pest Resistance Rating (PRR).

The pooled data revealed that the mean larval population of spotted pod borer per plant varied significantly and was ranged from 2.21 to 5.51 larvae per plant (Table 2). However, lowest larval population of spotted pod borer per plant was noticed in entries GBG-1 (2.21 larvae/plant) and PU-31 (2.31 larvae/plant). The results are in accordance with Manoj and Singh (2018) who reported that the highest larval population of spotted pod borer was observed in susceptible black gram genotypes *viz.*, CO5, VBN 4 and Azad 4, the least population was observed in resistant genotypes, IPU 94-1 and IPU 7-3.

The incidence of spotted pod borer was recorded in terms of pod damage at harvest during *Rabi* 2023. The pod damage in tested genotypes varied significantly and ranged from 3.98 to 10.55 per cent. Among 28 genotypes including susceptible check were screened for resistance or tolerance to spotted pod borer, based on the per cent pod damage, two genotypes *viz.*, GBG-1 and PU-31 were grouped under the resistant (R) category with PRR rating 3.0, ten genotypes *viz.*, TBG-104, MBG- 1110, MBG-1123, MBG-1133, MBG-1247, MBG- 1248, MBG-1238, MBG-1245, MBG-1134 and MBG-1171 were in the category of moderately resistant (MR) with rating 4.0, Ten genotypes *viz.*, MBG-1167, MBG-1155, MBG-1194, MBG-1183, MBG-1237, MBG- 1179, MBG-1206, MBG- 1230, MBG- 1214 and MBG- 1220 were grouped as moderately susceptible (MS) with rating 7.0 and remaining five genotypes *viz.*, MBG-1240, MBG- 1226, MBG-1221, MBG-1241 and MBG-1242 were in the category of susceptible (S) with rating 8.0 (Table 3).

Based on the per cent pod damage, the genotypes were given the Pest Resistance Rating (PRR) scale of (1-9). From the table 2, it is evident that out of 28 genotypes, two genotypes, GBG-1 and PU-31 has pest resistance rating of 3 with 3.98 and 4.07 per cent pod damage, ten genotypes *viz.*, TBG-104, MBG- 1110, MBG-1123, MBG-1133, MBG-1247, MBG- 1248, MBG-1238, MBG-1245, MBG-1134 and MBG-1171 has PSR of 4 (4.61 – 6.01 %), ten genotypes *viz.*, MBG-1167, MBG-1155, MBG-1194, MBG-1183, MBG-1237, MBG- 1179, MBG-1206, MBG- 1230, MBG- 1214 and MBG- 1220 has PSR of 7 (10.03 – 10.31 %), five genotypes *viz* MBG-207, MBG-1240, MBG- 1226, MBG-1221, MBG-1241 and MBG-1242 has PSR rating of 8 (10.41 – 10.55 %). Manoj and Singh (2018) evaluated twenty black gram genotypes against spotted pod borer and reported that IPU 94-1, IPU 7-3 and IPU 2-43 are highly resistant recording least pod damage as compared to susceptible genotypes, VBN4 and CO 5. Naik and Mallapur (2019) reported that among fifteen black gram genotypes, the maximum pod damage done by spotted pod borer was found in RUG-10 (32.85 %) and significantly least pod damage was noticed in LBG-685 (8.25 %). Similarly, Pavitradevi and Muthukumaran (2021) reported that among 100 black gram accessions, six accessions were categorized under resistant with no pod damage thirteen accessions were grouped under moderately resistant, twenty-five accessions were categorized under tolerant, fifty- four accessions were classified as moderately susceptible and two were grouped under highly susceptible against spotted pod borer.

Table 2. Larval population, per cent pod damage and Pest Resistance Rating (PRR) of black gram genotypes for spotted pod borer

S. No.	Genotype	Mean no. of larvae/plant*	Per cent pod damage (%)**	Pest resistance Per cent	PRR	Category/ host reaction
1	GBG-1	2.21 (1.79)	3.98 (11.51)	51.75	3	R
2	TBG-104	2.69 (1.92)	4.61 (12.40)	44.12	4	MR

3	MBG-1110	2.70 (1.92)	4.68 (12.50)	43.27	4	MR
4	MBG-1123	2.81 (1.95)	4.71 (12.53)	42.90	4	MR
5	MBG-1133	2.90 (1.97)	4.84 (12.71)	41.33	4	MR
6	MBG-1134	4.41 (2.32)	5.97 (14.14)	27.63	4	MR
7	MBG-1155	5.03 (2.45)	10.07 (18.57)	-22.06	7	MS
8	MBG-1167	5.01 (2.45)	10.03 (18.52)	-21.57	7	MS
9	MBG-1171	4.45 (2.33)	6.01 (14.20)	27.15	4	MR
10	MBG-1179	5.05 (2.45)	10.17 (18.67)	-23.27	7	MS
11	MBG-1183	5.03 (2.45)	10.11 (18.64)	-22.54	7	MS
12	MBG-1194	5.03 (2.45)	10.09 (18.62)	-22.30	7	MS
13	MBG-1206	5.05 (2.45)	10.15 (18.65)	-23.03	7	MS
14	MBG-1214	5.07 (2.46)	10.25 (18.73)	-24.24	7	MS
15	MBG-1220	5.25 (2.50)	10.31 (18.79)	-24.96	7	MS
16	MBG-1221	5.45 (2.53)	10.47 (18.96)	-26.90	8	S
17	MBG-1226	5.41 (2.53)	10.45 (18.94)	-26.66	8	S
18	MBG-1230	5.05 (2.45)	10.19 (18.69)	-23.51	7	MS
19	MBG-1237	5.03 (2.45)	10.13 (18.66)	-22.78	7	MS
20	MBG-1238	4.10 (2.26)	5.03 (12.96)	39.03	4	MR
21	MBG-1240	5.31(2.51)	10.41(18.91)	-26.18	8	S
22	MBG-1241	5.47 (2.54)	10.51 (19.00)	-27.39	8	S
23	MBG-1242	5.51 (2.55)	10.55 (19.04)	-27.87	8	S
24	MBG-1245	4.40 (2.32)	5.83 (13.98)	29.33	4	MR
25	MBG-1247	3.10 (2.02)	4.90 (12.79)	40.60	4	MR
26	MBG-1248	3.5 (2.12)	4.91 (12.80)	40.48	4	MR
27	PU-31	2.31 (1.81)	4.07 (11.64)	50.66	3	R
28	MBG-207 (SC)	4.91 (2.43)	8.25 (16.68)	-	-	-
	CD (p = 0.05)	0.10	0.74	-	-	-
	SEm (±)	0.03	0.24	-	-	-
	CV %	6.62	7.82	-	-	-

Figures in parentheses are square root (*) and arcsine (**) transformed values. R: Resistant, MR: Moderately Resistant, MS: Moderately Susceptible, S: Susceptible, SC: Susceptible check

Table 3. Categorization of black gram genotypes based on Pest Resistance Rating (PRR) for spotted pod borer

S. No	Genotype	PSR	Category

1	PU-31, GBG-1	3	Resistant
2	TBG-104, MBG- 1110, MBG-1123, MBG-1133, MBG-1247, MBG- 1248, MBG-1238, MBG-1245, MBG-1134, MBG-1171	4	Moderately resistant
3	MBG-1167, MBG-1155, MBG-1194, MBG-1183, MBG-1237, MBG- 1179, MBG-1206, MBG- 1230, MBG- 1214, MBG- 1220	7	Moderately resistant
4	MBG-207, MBG-1240, MBG- 1226, MBG-1221, MBG-1241, MBG-1242	8	Moderately susceptible

4. CONCLUSION

It can be concluded that the black gram genotypes PU-31 and GBG-1 were identified as resistant to spotted pod borer. Whereas, the genotypes TBG-104, MBG- 1110, MBG-1123, MBG-1133, MBG-1247, MBG- 1248, MBG-1238, MBG-1245, MBG-1134 and MBG-1171 were found to be moderately resistant to spotted pod borer. These findings will significantly contribute to the development of desirable black gram genotypes that are resistant to spotted pod borer, ultimately providing an efficient and economical control strategy for black gram growers.

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AUTHOR CONTRIBUTIONS

M.S.: data observations, analysis, manuscript writing, data recording. K.K.: conceptualization, planning, monitoring of experiment and manuscript editing. G.S., K.A., S.A.B.: manuscript editing and K.R.D.: Provided black gram genotypes seeds.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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