Field screening of black gram genotypes for resistance againstthe spotted pod borer,*Marucavitrata*(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, aimed 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 and4.07 %, 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, mashkalaior 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-tolerantand self-pollinating crop (Gupta and Gopala Krishna, 2009). It provides high nutritional value, containing 24% protein, 3.2% mineralsand 59.6% carbohydrates. A 100-gram serving of split dal offers 154 mg of calcium, 9.1 mg of ironand 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 tonnesand 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 (Rachappaet al. 2015). Yield losses due to this pest generally range from 20% to 88% and can reach up to 100% in certain areas (Jayashingeet al.2015).Blackgram 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, microorganismsand pollinators (Luckman and Metcalf, 1978; Hussain, 1984). Recent reference 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 includingsusceptible 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 measuresas per Professor Jayashankar Telangana Agricultural University, Telangana VyavasayamDiksoochi,

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.

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

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.PestSusceptibilityRating/Index(Standardscale)

PRP	PRR	Categoryof resistance
100	1	Immune
75to99	2	Highly Resistant
50to75	3	Resistant
25to50	4	ModeratelyResistant
10to25	5	Tolerant
(-10)to(10)	6	Equal to check
(-25)to(-10)	7	Moderately Susceptible
(-50)to(-25)	8	Susceptible
Lessthan-50	9	HighlySusceptible

PRP-PestResistancePer cent,PRR-PestResistanceRating

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 susceptiblecheck were screenedagainst spottedpodborer, *M. vitrata*under fieldconditions. The results on relative resistance of black gram genotypes against spotted pod borerrevealed that none ofthe genotypes was found completelyfree fromthe spotted pod borer attack however, some genotypes *viz.,* GBG-1 and PU-31 showedresistance whereas, TBG-104,MBG-1110, MBG-1123, MBG-1133, MBG-1247,MBG-1248, MBG-1238, MBG-1245, MBG-1134 andMBG-1171 showed moderatelyresistancewhencomputedunderPest 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 larvalpopulationofspotted podborer per plant was noticed inentriesGBG-1(2.21 larvae/plant) andPU-31 (2.31 larvae/plant). The results are in accordancewithManojandSingh(2018)whoreportedthatthehighest larvalpopulation of spotted pod borer wasobservedinsusceptibleblack gram genotypes*viz.*,CO5,VBN4andAzad4,theleastpopulation was observed in resistant genotypes, IPU 94-1 and IPU 7-3.

Theincidenceofspotted pod borer wasrecordedintermsofpoddamageatharvestduring *Rabi* 2023. The poddamage intestedgenotypes varied significantlyand ranged from3.98 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,twogenotypes*viz.*,GBG-1 and PU-31 weregrouped under the resistant (R) categorywithPRR rating 3.0, tengenotypes *viz.,* TBG-104,

MBG- 1110, MBG-1123,MBG-1133,MBG-1247,MBG-1248,MBG-1238,MBG-1245, MBG-1134 and MBG-1171wereinthecategoryofmoderatelyresistant(MR)withrating4.0,Tengenotypes*viz.*,MBG-1167, MBG-1155, MBG-1194, MBG-1183, MBG-1237, MBG- 1179, MBG-1206,MBG-1230,MBG-1214andMBG-1220weregroupedasmoderatelysusceptible(MS)withrating7.0andremainingfivegenotypes*viz.*, MBG-1240,MBG-1226,MBG-1221,MBG-1241 andMBG-1242wereinthecategoryofsusceptible(S) withrating8.0 (Table3).

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-31has pest resistance ratingof3with 3.98 and 4.07 percentpoddamage,ten genotypes*viz.*,TBG-104, MBG- 1110, MBG-1123,MBG-1133,MBG-1247,MBG-1248,MBG-1238, MBG-1245, MBG-1134 and MBG-1171hasPSRof4(4.61 – 6.01%), ten genotypes*viz.*, MBG-1167, MBG-1155, MBG-1194, MBG-1183, MBG-1237, MBG- 1179, MBG-1206,MBG-1230,MBG-1214andMBG-1220has PSR of 7 (10.03 – 10.31%),fivegenotypes*viz*MBG-207,MBG-1240,MBG-1226,MBG-1221,MBG-1241 andMBG-1242hasPSRrating of8 (10.41 – 10.55%).ManojandSingh(2018)evaluated twenty blackgram genotypes against spotted pod borer and reported that IPU 94-1, IPU 7-3andIPU2-43arehighlyresistant recording least pod damageascomparedto susceptible genotypes, VBN4 and CO 5.Naik and Mallapur (2019) reported that among fifteen black gram genotypes,the maximumpod damage done by spotted pod borer was found inRUG-10 (32.85%) and significantly least pod damage was noticed in LBG-685 (8.25%). Similarly, Pavitradevi and Muthukumaran (2021) reported that among 100 blackgram accessions, six accessions were categorized under resistant with no pod damage thirteen accessions were grouped undermoderatelyresistant,twenty-fiveaccessionswerecategorizedundertolerant,fifty- four accessions were classified as moderately susceptible and two were grouped under highly susceptible against spotted pod borer.

Table 2. Larvalpopulation, percentpoddamageandPestResistance Rating (PRR)of black gram genotypes for spotted pod borer

S. No.	Genotype	Mean no. of larvae/plant*	Percentpod damage (%)**	PestresistancePercent	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	-	-	-

Figuresinparenthesesaresquareroot(*)andarcsine(**)transformedvalues. R:Resistant, MR:ModeratelyResistant, MS:ModeratelySusceptible, S:Susceptible, SC: Susceptible check

Table 3. Categorizationofblack gramgenotypesbasedonPestResistance 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	Moderatelyresistant
3	MBG-1167, MBG-1155, MBG-1194, MBG-1183, MBG-1237, MBG- 1179, MBG-1206,MBG-1230,MBG-1214, MBG-1220	7	Moderatelyresistant
4	MBG-207,MBG-1240,MBG-1226,MBG-1221,MBG-1241, MBG-1242	8	Moderatelysusceptible

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.

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.

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