Original Research article

SCREENING OF BLACK GRAM GENOTYPES FOR RESISTANCE TO WHITEFLY, *Bemisia tabaci* (GENNADIUS) IN SOUTHERN TELANGANA, INDIA

ABSTRACT

Black gram (*Vigna mungo* L. Hepper) ranks as the third most important pulse crop in India, but it is highly vulnerable to various insect pests throughout its growth. Among these, the whitefly is a prominent sucking pest. A study conducted during *Rabi* 2023 at the Student Farm, College of Agriculture, Rajendranagar, Hyderabad, aimed to identify black gram genotypes resistant to whitefly. Twenty-eight genotypes were evaluated under field conditions using a whitefly leaf injury grade scale and a whitefly resistance index. The screening identified three resistant genotypes, six moderately resistant, fourteen moderately susceptible and five susceptible genotypes. The genotypes PU-31, TBG-104 and GBG-1 with the lowest whitefly populations per plant (2.81, 3.40, and 3.99, respectively), were classified as resistant. Whereas, the genotypes MBG-1240, MBG-1226, MBG-1221, MBG-1155 and MBG-207 with the highest whitefly populations per plant (7.71, 7.75, 7.79, 8.11 and 8.05, respectively) were categorized as susceptible.

Keywords: Black gram genotypes, Field screening, Whitefly, Whitefly leaf injury grade scale, Whitefly resistance index

Introduction

Black gram (*Vigna mungo* L. Hepper) is the third most important pulse crop in India, belonging to the family leguminosae and the subfamily papilionaceae, is also commonly referred to as urd bean, mung bean, mash, mashkalai and black matpe. It is a short-duration, drought-tolerant and self-pollinating pulse crop (Gupta and Gopala Krishna, 2009). It is rich in protein 24 %, minerals 3.2 % and carbohydrates 59.6 %. Additionally, 100 grams of split dal provides 154 mg of calcium, 9.1 mg of iron and 38 mg of β-carotene (Nene, 2006). India's black gram cultivation covers 32.11 lakh ha, yielding 20.55 lakh tonnes with a productivity of 640 kg ha^{-1} (Indiastat, Second Advance Estimates, 2023-2024). For the *Kharif* and *Rabi* seasons, the respective area, production and productivity are 26.19 and 5.92 lakh hectares, 15.5 and 5.05 lakh tonnes, and 592 and 853 kg ha^{-1} (Indiastat, Second Advance Estimates, 2023-2024). Major black gram growing states of India are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Telangana and West Bengal. The production and productivity of black gram are hampered by both biotic and abiotic factors. Among biotic stresses, insect pests and diseases cause significant losses. Every year, approximately 2.0 to 2.4 million tonnes of pulses, valued at around Rs. 6000 crores are lost due to damage inflicted by insect pests (Reddy, 2009). In India, approximately 60 insect species are known to infest black gram crop at various growth stages (Lal and Sachan, 1987). Among sucking pests, whitefly is notorious for its devastating impact, causing substantial damage. Both nymphs and adults feed on the underside of the leaves, secreting honeydew that promotes sooty mold growth and hampers photosynthesis. Whiteflies also act as a vector for the yellow mosaic virus, known as the "Yellow plague of *Kharif* pulses". Infected plants produce fewer, smaller flowers and pods with reduced seed yield, impacting both the quantity and quality of seed. Reported avoidable losses due to whiteflies and other insect pests in black gram range from 17.42 % to 71 % across different locations (Mansoor *et al*., 1998). 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 whitefly. Therefore, keeping these views in mind, the present study was conducted to identify the resistant cultivars that are less susceptible to whitefly in black gram.

Materials and methods

The experiment was carried out at Student farm, College of Agriculture, Rajendranagar, Hyderabad, Telangana, to determine the resistance in black gram genotypes against whitefly. 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 a Randomized Block Design with 28 genotypes including resistant and susceptible check in three replications. Each entry was sown in two rows with a row length of 4 meters 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: Observations of insect pest infestations were recorded standard week wise, early in the morning. The whitefly population and leaf injury were assessed in the early morning from 6:00 AM to 9:00 AM by counting the number of nymphs and adults on three leaves *viz*., one each from the top, middle and lower canopy of five randomly selected plants per genotype in each replication. Leaf injury grades, ranging from I to V, were categorized based on the type and severity of symptoms caused by whitefly feeding on black gram, following the classification by Taggar *et al*., 2013 (Table 1).

Table-1: Whitefly leaf injury grade scale

Leaf injury grade	Symptoms
I	No damage
II	Appearance of yellow chlorotic spots
III	Starting of black sooty mould
IV	Severe blackening of leaves
V	Complete drying of leaves

The test genotypes were monitored weekly for the whitefly infestation following the development of leaf injury grades. After calculating the Whitefly Resistance Index (WRI), the genotypes were classified into various categories of resistance or susceptibility using the formula below.

$$\text{Whitefly Resistance Index (WRI)} = \frac{G_1 \times P_1 + G_2 \times P_2 + G_3 \times P_3 + G_4 \times P_4 + G_5 \times P_5}{P_1 + P_2 + P_3 + P_4 + P_5}$$

G = Number of the leaf-injury grade, P = Number of plants falling under that grade

Each grade is associated with a specific range of scores used to classify the genotypes into resistant or susceptible categories as outlined by Taggar *et al*., 2013 (Table 2).

Table-2: Whitefly Resistance Index (WRI) against Leaf injury in Black gram

Leaf injury grade	Symptoms	Score	Category
I	No damage	< 1.00	Resistant (R)
II	Appearance of yellow chlorotic spots	1.01 - 1.50	Moderately Resistant (MR)
III	Starting of black sooty mould	1.51 - 2.50	Moderately Susceptible (MS)
IV	Severe blackening of leaves	2.51 - 3.50	Susceptible (S)
V	Complete drying of leaves	> 3.50	Highly Susceptible (HS)

Statistical analysis: The mean whitefly populations were normalized using square root transformation and were then subjected to DMRT (Duncan Multiple Range Test) to determine the level of significance.

Results and discussion

Certain genotypes of crops are less infested by a specific insect pest than others because of their naturally governing resistance factors. Resistance is the inheritable quality possessed by the plant which will ultimately influence the amount of damage done by the insects. In an integrated pest management approach, growing resistant or tolerant varieties against insect pests is of the utmost importance to tackle insect pest control with minimum cost. A total of twenty-six black gram genotypes along with one resistant and one susceptible check screened against whitefly, *B. tabaci* to identify the sources of resistance and the results revealed that resistant check entry PU-31, TBG-104 and GBG-1 exhibited resistance (R) reaction with rating of 1.0. Six genotypes *viz.*, MBG-1110, MBG- 1123, MBG-1179, MBG-1248, MBG-1238 and MBG-

1183 were in the category of moderately resistant (MR) with a rating of 2.0, fourteen genotypes *viz.*, MBG-1133, MBG- 1134, MBG-1167, MBG-1171, MBG-1194, MBG-1241, MBG-1242, MBG-1245, MBG-1247, MBG-1237, MBG-1206, MBG-1230, MBG-1214 and MBG-1220 were in the category of moderately susceptible (MS) with a rating of 3.0 and remaining five entries *viz.*, MBG-1240, MBG-1226, MBG-1221, MBG-1155 and MBG-207 were in the category of susceptible (S) with a rating 4.0.

The pooled data revealed that the mean population of whitefly per plant varied significantly and ranged from 2.81 to 8.11 (Table 3). However, the lowest population of whitefly per plant was noticed in PU-31, TBG-104 and GBG-1 (2.81, 3.40 and 3.99, respectively) and varied significantly from the other genotypes tested. These results are consistent with the findings of Sekar and Nalini (2017) who observed that the incidence of whitefly population ranged from 2.5 to 7.7 per three leaves in mungbean. Two cultures *viz*., VBN 2 and CO 8 recorded low mean population of whitefly 2.5 and 2.7 no/3 leaves, respectively. Whereas RM 612 recorded a high mean population of whitefly (7.7 no. /3 leaves). Similarly, field screening of five mungbean varieties for resistance against whitefly was carried out by Khaliq *et al.* (2017) who observed that the population of whitefly ranged from 3.22 to 7.69 per plant. Only one variety Pant Moong-1 was found to be resistant to whitefly. The observations of Singh and Singh (2014), Panduranga *et al.* (2011) and Kooner and Cheema (2007) also corroborate with the present one.

Based on leaf injury grades, the genotypes were given a whitefly resistance index rating scale of (1-5). From the Table 4, it was evident that out of 28 genotypes, three genotypes had WRI scale rating 1 with whitefly population of 2.81-3.99 per plant, six genotypes had WRI of 2 (4.80-5.41 whiteflies/plant), fourteen genotypes had WRI of 3 (5.77-6.81 whiteflies/plant) and remaining five genotypes had WRI of 4 (7.71-8.11 whiteflies/plant). These results are in agreement with those of Yadav and Dahiya (2000), who evaluated thirty mungbean genotypes against whitefly, YMV and reported that the genotypes ML5, ML803, ML839, PDM91-249 and PMB5 were found less incidence of whitefly population per plant simultaneously low incidence of YMV and categorized as resistant whereas, maximum incidence of whitefly population per plant was noticed in genotype Copergoan. Further, Tagger *et al.* (2012) evaluated nine black gram genotypes against whitefly and reported that the genotypes, KU 99-20 and NDU 5-7 were categorized as moderately resistant as they recorded WRI of 1.50, genotypes IPU 02-043, KU 7-602, KU 7-605, KU 7-618 and Mash 1-1 recorded WRI ranging from 2.59 to 3.05 and hence were categorized as susceptible and remaining two genotypes, *viz.*, KU 7-504 and KU 7-505 recorded the highest WRI ranging from 3.66 to 3.70. Abdulrahimzai *et al.* (2019) reported that among twenty black gram genotypes, eleven genotypes were recorded less incidence of YMV and classified as resistant while the remaining seven genotypes as moderately resistant against whitefly and YMV. Similarly, Bag *et al*. (2014) reported that among 344 mungbean accessions, two accessions *viz.*, IC 144901 and IC 001572 recorded minimum incidence of YMV (< 10 %) and were categorized as highly resistant. Whereas, IC 011613 and IC 485638 recorded minimum incidence of YMV (< 20 %) and were categorized as resistant. Neupane *et al.* (2021) screened seventeen black gram genotypes for resistance to whitefly and reported that genotypes BLG0069-1, BLG0036-1 and BLG0079-1 exhibited more resistant and produced higher grain yield than other genotypes.

Table-3: Whitefly population (Nymphs and adults) and Whitefly Resistance Index (WRI) rating against different black gram genotypes during *Rabi,* 2023-24

S. No.	Genotype	Whitefly population/plant	WRI rating	Category/host reaction
1	GBG-1	3.99 (2.14)	1	R
2	TBG-104	3.40 (1.97)	1	R
3	MBG-1110	4.80 (2.30)	2	MR
4	MBG-1123	4.81 (2.30)	2	MR
5	MBG-1133	5.77 (2.59)	3	MS
6	MBG-1134	6.30 (2.60)	3	MS
7	MBG-1155	8.11 (2.93)	4	S
8	MBG-1167	6.34 (2.61)	3	MS
9	MBG-1171	6.40 (2.62)	3	MS
10	MBG-1179	4.85 (2.31)	2	MR
11	MBG-1183	5.41 (2.43)	2	MR
12	MBG-1194	6.41 (2.62)	3	MS
13	MBG-1206	6.71 (2.68)	3	MS
14	MBG-1214	6.75 (2.69)	3	MS
15	MBG-1220	6.81 (2.70)	3	MS
16	MBG-1221	7.79 (2.91)	4	S
17	MBG-1226	7.75 (2.90)	4	S
18	MBG-1230	6.71 (2.68)	3	MS
19	MBG-1237	6.69 (2.68)	3	MS
20	MBG-1238	5.30 (2.40)	2	MR
21	MBG-1240	7.71 (2.89)	4	S
22	MBG-1241	6.50 (2.64)	3	MS
23	MBG-1242	6.60 (2.66)	3	MS
24	MBG-1245	6.64 (2.67)	3	MS
25	MBG-1247	6.68 (2.68)	3	MS
26	MBG-1248	4.87 (2.32)	2	MR
27	PU-31 (R)	2.81 (1.80)	1	R
28	MBG-207 (S)	8.05 (2.92)	4	S
	CD (p = 0.05)	0.15	-	-
	SEm (±)	0.05	-	-
	CV %	6.57	-	-

Figures in parentheses are square root transformed values
R: Resistant, MR: Moderately Resistant, MS: Moderately Susceptible, S: Susceptible

Table-4: Classification of black gram genotypes based on Whitefly Resistance Index

S. No.	Genotypes	WRI rating	Category
1	PU-31, TBG-104, GBG-1	1	Resistant
2	MBG-1110, MBG-1123, MBG-1179, MBG-1248, MBG-1238, MBG-1183	2	Moderately resistant
3	MBG-1133, MBG-1134, MBG-1167, MBG-1171, MBG-1194, MBG-1241, MBG-1242, MBG-1245, MBG-1247, MBG-1237, MBG-1206, MBG-1230, MBG-1214, MBG-1220	3	Moderately susceptible
4	MBG-1240, MBG-1226, MBG-1221, MBG -1155, MBG-207	4	Susceptible

Conclusion

The black gram genotypes PU-31, TBG-104 and GBG-1 were identified as resistant to whitefly. Whereas, the genotypes MBG-1110, MBG-1123, MBG-1179, MBG-1248, MBG-1238 and MBG-1183 were found to be moderately resistant to whitefly. These findings will significantly contribute to the development of desirable black gram genotypes that are resistant to whitefly, ultimately providing an efficient and economical control strategy for black gram growers.

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