Screening of different genotypes/cultivars of black gram against stem fly, *Melanagromyza sojae* (Zehntner) in Kharif season

NP Pathan[1#] and DB Sisodiya[2]

Summary

Total thirteen black gram genotypes/cultivars (SKNU-13-02, SKNU-13-03, SKNU-13-05, SKNU-11-11, SKNU-12-04, SKNU-12-07, SKNU-12-08, SKNU-15-01, SKNU-15-02, SKNU-15-03, T9, GU 1 and Rajasthan local) were screened for their relative susceptibility against stem fly, *Melanagromyza sojae* during summer (2017) at Entomological farm, B. A. College of Agriculture, Anand Agricultural University, Anand.SKNU-15-01 (17.99%), SKNU-15-02 (18.81%) and SKNU-12-07 (19.48%) registered less infestation of stem fly and emerged as resistant genotypes. The genotypes/cultivars SKNU-13-05 (35.43%), SKNU-12-08 (35.83%) and Rajasthan local (38.26%) proved to be moderately resistant. GU 1 (51.43%), T9 (55.00%), SKNU-13-02 (55.05%), SKNU-12-04 (55.05%), SKNU-15-03 (58.03%) and SKNU-13-03 (59.25%) categorized as moderately susceptible. At the same time, SKNU-11-11 (60.36%) proved to be susceptible against stem fly. Maximum seed yield was harvested from the genotype SKNU-15-02 (833 kg/ha) during *Kharif*, 2017 followed by SKNU-12-07 (786 kg/ha).

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Introduction

Pulse crops are hugely important in India since they help with crop diversity, revenue production, food security, sustainable agriculture, resilience to climate change, and export potential. One of the main pulse crops farmed in India is black gram, which is essential to Indian cuisine. It is believed that black gram (*Vigna mungo* L.) originated in India. In India, the total production of black gram is 30,59,990 tons with 546 kg/ha productivity from an area of 56,02,470 ha in 2018-19 (Anonymous 2019a). It is mainly cultivated in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal, Punjab, Haryana, Tamil Nadu and Karnataka. In Gujarat, the production of black gram is 73560 tons with 669 kg/ha productivity from an area of 1,09,960 hectares in 2018-19. Gujarat's major black gram growing districts are Sabarkantha, Panchmahal, Dahod, Vadodara, Mehsana and Bharuch. It is also cultivated to some extent in Rajkot, Surendranagar and Junagadh districts (Anonymous 2019b). In India, quantitative avoidable losses (7-35%) caused by insect-pest complexes, both in black gram and green gram, vary with agro-climatic conditions (Hamad & Dubey 1983). On average, 2.5 to 3.0 million tonnes of pulses are lost annually due to pest problems (Rabindra *et al*. 2004). The annual yield loss due to insect-pests has been estimated as 30 per cent in urd bean and mung bean (Justin et al. 2015). In India, 60 insect species are known to attack black gram at different crop growth stages (Lal & Sachan 1987). Yield loss due to stem fly varies between locations and according to the plant growth stage. Gaur et al. (2015) reported 100% infestation and 33.84% stem tunnelling caused by *M. sojae* in soybean at Pantnagar in Uttarakhand. Pathan et al. (2023) from Anand, Gujarat reported that *Melanagromyza sojae* (Zehntner) severely damages black gram at the seedling stage. The first set of seedling leaves are favored locations for oviposition, resulting in widespread tunnelling in young plants. Infested plants grow yellowish, stunted, and in severe situations, the pest destroys the crop due to the maggot feeding inside the stem after the egg hatches. Stem fly infestation exhibited a highly significant positive association (r = 0.519** and 0.655**, respectively) with bright sunshine hours (BSS) and maximum temperature (MaxT), respectively (Pathan et al. 2023). Crop sown early *i.e.*, 3rd and 4th week of July, registered low larval (0.11 and 0.16/plant, respectively) and pupal (0.16 and 0.19/plant, respectively) counts in comparison to crop sown during August (Pathan et al. 2023).

In Gujarat, the stem fly, *M. sojae* (Diptera: Agromyzidae), is a new pest of black gram. Effective management strategies other than applying insecticides to the pest are unavailable in the current situation. Under these conditions, it becomes crucial to identify some environmentally friendly alternative techniques for managing insect pests, including cultural norms like the usage of resistant varieties. Utilizing pest-resistant varieties identified through varietal screening can reduce the reliance on synthetic insecticides and other pest control measures. Considering these points, detailed investigations were undertaken to screen the different genotypes/cultivars against *M. sojae* during *Kharif*.

Materials and Methods

To determine the comparative resistance as well as to

[1]Assistant Professor, Department of Plant Protection, College of Horticulture, S. D. Agricultural University, Jagudan
[2]Professor and Head, Department of Entomology, B. A. College of Agriculture, Anand Agricultural University, Anand
#*Corresponding author:* NP Pathan, *E-mail:* naziya.p.pathan@gmail.com

locate the source of resistance against stem fly, 13 genotypes/ cultivars (SKNU-13-02, SKNU-13-03, SKNU-13-05, SKNU-11-11, SKNU-12-04, SKNU-12-07, SKNU-12-08, SKNU-15-01, SKNU-15-02, SKNU-15-03, T9, GU 1 and Rajasthan local) of black gram were screened under field conditions during *kharif*2017 at Entomological farm, B. A. College of Agriculture, Anand Agricultural University, Anand. The genotypes/cultivars were grown in a plot of 1.35 x 5.00 m at 45 × 10 cm spacing in a Randomized Block Design with three replications. All the recommended agronomical practices were adopted to raise the crop except plant protection measures. Genotypes used under the present investigation were procured from Pulse Research Station, S. D. Agricultural University, Dantiwada.

Ten randomly selected seedlings were uprooted from each plot and brought in the departmental laboratory to record the stem fly infestation. The roots were gently washed in tap water to remove adhering soil. The Stem of each plant was dissected with a scalpel, and observations on the length of the stem, length of tunnel and the number of larva (e) and pupa (e) present in the stem were recorded. The number of stem fly infested plants in each sample was also recorded. The observations were recorded at weekly intervals starting from one week after germination. Tunnelling and infestation per cent were calculated based on given formula (Laxmigudi et al. 2014). The seed and haulm yield (kg/plot) were also recorded from the net plot area and were converted to kg/ha. The data thus obtained were analysed by following standard statistical techniques (Steel & Torrie 1980).

$$\text{Infestation (\%)} = \frac{\text{No. of plants infested}}{\text{Total no. of uprooted plants}} \times 100$$

$$\text{Tunnelling (\%)} = \frac{\text{Length of tunnel}}{\text{Length of total stem}} \times 100$$

Different black gram genotypes/ cultivars were categorized into Highly Resistant (HR), Resistant (R), Moderately Resistant (MR), Moderately Susceptible (MS), Susceptible (S) and Highly Susceptible (HS) categories. The scale used for categorizing different genotypes/ cultivars is as per statistical tools followed by Patel et al. (2002).

Result and Discussion

Infestation and tunnelling caused by the pest to the black gram commenced from one week after germination and continued up to the end of the season. The larval population of *M. sojae* initiated from the first week after germination and continued up to the fifth week in *Kharif*. Similarly, the pupal population of *M. sojae* started from second week after germination and continued up to the seventh week in *kharif*. The data (Table 1) on stem fly infestation, tunnelling, number of larvae, and pupae in different black gram genotypes and cultivars are shown as pooled over period data throughout season which was taken at weekly intervals.

Table 1. Screening of black gram genotypes/ cultivars for their susceptibility against stem fly, *M. sojae* (*Kharif*, 2017)

S. No.	Genotypes /cultivars	Infestation (%)	Tunneling (%)	Larva/ plant	Pupa/ plant
T_1	SKNU-13-02	*47.90d (55.05)	*22.80c (15.02)	**1.10c (0.71)	**1.13c (0.78)
T_2	SKNU-13-03	50.33e (59.25)	22.43c (14.56)	1.13c (0.78)	1.15c (0.82)
T_3	SKNU-13-05	36.53b (35.43)	17.04b (8.59)	0.93b (0.36)	0.95b (0.40)
T_4	SKNU-11-11	50.98e (60.36)	23.07c (15.36)	1.13c (0.78)	1.16c (0.85)
T_5	SKNU-12-04	47.90d (55.05)	22.80c (15.02)	1.12c (0.75)	1.14c (0.80)
T_6	SKNU-12-07	26.19a (19.48)	12.00a (4.32)	0.77a (0.09)	0.80a (0.14)
T_7	SKNU-12-08	36.77b (35.83)	16.94b (8.49)	0.93b (0.36)	0.96b (0.42)
T_8	SKNU-15-01	25.10a (17.99)	11.50a (3.97)	0.77a (0.09)	0.78a (0.11)
T_9	SKNU-15-02	25.70a (18.81)	11.98a (4.31)	0.78a (0.11)	0.79a (0.12)
T_{10}	SKNU-15-03	49.62de (58.03)	22.81c (15.03)	1.11c (0.73)	1.14c (0.80)
T_{11}	T9	47.87d (55.00)	22.80c (15.02)	1.11c (0.73)	1.13c (0.78)
T_{12}	GU 1	45.82c (51.43)	22.63c (14.81)	1.08c (0.67)	1.13c (0.78)
T_{13}	Rajasthan local	38.21b (38.26)	16.65b (8.21)	0.94b (0.38)	0.97b (0.44)
S. Em.±	**T**	0.855	0.412	0.020	0.018

	P	0.750	0.361	0.013	0.013
	T x P	2.704	1.301	0.048	0.048
C. D. at 5%	T	Sig.	Sig.	Sig.	Sig.
C. V. (%)		10.01	9.33	8.21	8.08

Note:1.*Figures in parentheses are retransformed values, and those outside are arc sine transformed values; 2.**Figures in parentheses are retransformed values and those outside are $\sqrt{X+0.5}$ transformed values; 3. Treatment means with the letter(s) in common are not differing significantly by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance; 4. Significant parameters and its interactions: P

Plant infestation (%)

All 13 genotypes/ cultivars of black gram were screened against stem fly, *M. sojae,* for their susceptibility based on its infestation (%). Data on infestation caused by stem fly, *M. sojae,* recorded during *kharif* season in different genotypes/cultivars are presented in Table 1. Data indicated that most minor infestation of the pest was found in SKNU-15-01 (17.99%) followed by SKNU-15-02 (18.81%) and SKNU 12-07 (19.48%). These three genotypes exhibited significantly lower infestation than the other genotypes/cultivars screened. The genotypes SKNU-13-05 as well as SKNU-12-08 and cultivar Rajasthan local were also found to be promising against stem fly and recorded 35.43 to 38.26% infestation. The maximum infestation was registered in SKNU-11-11(60.36%), followed by SKNU-13-03 (59.25%) and SKNU-13-02 (55.05%). In terms of infestation, these three genotypes are found at par.

Stem tunnelling (%)

Data on tunnelling caused by stem fly, *M. sojae,* recorded during *Kharif* season in different genotypes/cultivars are presented in Table 1. A more or less similar trend of damage in the form of tunnelling (%) was noticed as it was observed in infestation (%), wherein significantly low tunnelling (%) was seen in SKNU-15-01, SKNU-15-02 and SKNU-12-07. The genotypes SKNU-11-11, SKNU-13-03 and SKNU-12-04 registered 15.36, 15.03 and 15.02% tunnelling, respectively. The rest of the genotypes/cultivars perform poorly against *M. sojae*.

Number of larva/ plant

Data on pupal population recorded during the *Kharif* season in different genotypes/cultivars are presented in Table 1. Minimum pupal counts were recorded in genotype SKNU-1501 (0.09/plant), followed by SKNU-12-07 (0.09/plant) and SKNU-15-02 (0.11/plant). These three genotypes registered significantly lower larval population than the other genotypes/cultivars screened. Looking at the larval population, SKNU-13-05 (0.36/plant), SKNU-12-08 (0.36/plant), and Rajasthan local (0.38/plant) were found at par and considered moderately resistant to stem fly. The rest of the genotypes/cultivars were found inferior by registering a relatively higher number of larvae and pupae per plant.

Number of pupae/ plant

Data on larval populations recorded during the summer season in different genotypes/cultivars are presented in Table 1. Minimum pupal counts were recorded in genotype SKNU-1501 (0.11/plant), followed by SKNU-15-02 (0.12/plant) and SKNU-12-07 (0.14/plant). These three genotypes registered a significantly lower pupal population than the other genotypes/cultivars screened. Looking at the pupal population, SKNU-13-05 (0.40/plant), SKNU-12-08 (0.42/plant), and Rajasthan local (0.44/plant) were found at par and considered moderately resistant to stem fly. The rest of the genotypes/cultivars were found inferior by registering a relatively higher number of pupae per plant.

Categorisation of varieties

Looking at the level of infestation (%) due to stem fly, *M. sojae*, all the genotypes/cultivars screened during *Kharif* 2017 were classified into six categories *viz.*, Highly resistant, resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible (Table 2). The genotypes/cultivars screened during *Kharif* 2017 were classified into six categories (Table 2). Considering the level of stem fly infestation, the SKNU-15-01 (17.99%), SKNU-15-02 (18.81%) and SKNU-12-07 (19.48%), genotypes categorized as resistant, SKNU-13-05 (35.43%), SKNU-12-08 (35.83%) and Rajasthan local (38.26%) as moderately resistant, GU 1 (51.43%), T9 (55.00%), SKNU-13-02 (55.05%), SKNU-12-04 (55.05%), SKNU-15-03 (58.03%) and SKNU-13-03 (59.25%) as moderately susceptible and SKNU-11-11 (60.36%) as susceptible genotypes/cultivars.

Table 2. Categorization of different genotypes/cultivars of black gram for their susceptibility to stem fly, *M. sojae* (*Kharif*, 2017)

Category of resistance	Scale	Genotype/cultivar
	$\bar{X}$= 43.07	SD = 16.30
Highly Resistant (HR)	$\bar{X}_i$< (10.45)	-
Resistant (R)	$\bar{X}_i$> (10.45) < (26.76)	SKNU-12-07
		SKNU-15-01
		SKNU-15-02
Moderately Resistant (MR)	$\bar{X}_i$> (26.76) < (43.07)	SKNU-13-05
		SKNU-12-08
		Rajasthan local
Moderately Susceptible (MS)	$\bar{X}_i$> (43.07) < (59.38)	SKNU-13-02
		SKNU-12-04
		SKNU-15-03
		T9
		GU 1

		SKNU-13-03
Susceptible (S)	$\bar{X}_i$> (59.38) < (75.69)	SKNU-11-11
Highly Susceptible (HS)	$\bar{X}_i$ > (75.69)	-

Seed and haulm yield (kg/ha)

Data on seed and haulm yield recorded for different genotypes/cultivars screened for their susceptibility against stem fly, *M. sojae* during the *Kharif* season of 2017 are presented in Table 3. The data revealed that a significant maximum seed yield was harvested from genotype SKNU-15-02 (833 kg/ha) during *Kharif*2017 followed by SKNU-12-07 (786 kg/ha). The former genotype differs significantly from the rest of the genotypes/cultivars screened except SKNU-12-07. The cultivars, i.e., T9 and GU 1, were found at par and produced 720 and 700 kg/ha seed yield, respectively. In addition to these, the genotypes SKNU-13-05 (651 kg/ha), SKNU-15-01 (671 kg/ha) and cultivar Rajasthan local (672 kg/ha) were found to be mediocre in producing seed yield. A more or less similar trend of treatment effect on haulm yield was revealed as it was observed in seed yield. The genotypes/cultivars screened during the present investigation had not been screened by earlier workers. Hence, comparing and discussing these genotypes/cultivars with earlier findings could not be possible.

Table 3. Yield of different genotypes/cultivars of black gram evaluated for their susceptibility against stem fly, *M. sojae* (*Kharif*, 2017)

T. No.	Genotypes/cultivars	Yield (kg/ha)	
		Seed	Haulm
T_1	SKNU-13-02	498d	672d
T_2	SKNU-13-03	438d	592d
T_3	SKNU-13-05	651c	886c
T_4	SKNU-11-11	427d	576d
T_5	SKNU-12-04	430d	581d
T_6	SKNU-12-07	786ab	1100ab
T_7	SKNU-12-08	432d	583d
T_8	SKNU-15-01	671c	913c
T_9	SKNU-15-02	833a	1166a
T_{10}	SKNU-15-03	441d	596d
T_{11}	T9	720bc	979bc
T_{12}	GU 1	700bc	952c
T_{13}	Rajasthan local	672c	913c
S. Em. ±		28.49	37.44
C. D. at 5%		Sig.	Sig.
C.V. (%)		8.33	8.02

Note: Treatment means with the letter(s) in common are not differ significantly by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance

Plants and insects have been living together for more than 350 million years. In co-evolution, both have evolved strategies to avoid each other's defense systems. This evolutionary arms race between plants and insects has resulted in the development of an elegant defense system that can recognize the non-self-molecules or signals from damaged cells, much like animals. It activates the plant's immune response against herbivores. Plant-arthropod interactions are of utmost importance for understanding the dynamics of ecological communities (Justin et al. 2015; Haldhar et al. 2018a,b,c). Host plants play an essential role in determining insect populations with respect to concentrations and proportions of nutrients, which differ among species. Plants having antibiosis characteristics such as flavonoids, phenols, tannins etc., may cause reduced insect survival, prolonged development time, decreased size and reduced fitness of new generation adults (Rabindro et al. 2004; Haldhar et al. 2013; 2023). The utilization of native and introduced genetic material of arid horticulture crops for breeding varieties over a long period in the country resulted in the generation of many new genotypes/ lines in the form of selections and, to some extent, through hybridization. Thereby, considerable generated material/ variations may have existed in targeted species regarding the plant type, flowering, fruiting, morphological and physiological of fruits, reaction to biotic and abiotic factors and eco-adaptations (Guar et al. 2015; Haldhar et al. 2019). Since the detailed evaluation of identified genotypes is essential for further breeding programme and incorporating desirable gene(s) through combination breeding. Wild and relative species gene pool possesses unique traits that can be exploited by direct selection for use in combination breeding or improvement through advanced approaches. They also constitute priceless reservoirs containing gene (s) conferring better adaptations to stressed environments and are resistant to diseases and insects or have more nutritional and medicinal properties. Therefore, there is an urgent need to promote the systematic utilization of a wild gene pool in strategic breeding work for developing biotic and abiotic stress resistance or tolerance genotypes and their conservation as relative species (Haldhar et al. 2016; Pathan et al. 2023).

Conclusion

The genotypes/cultivars SKNU-13-05 (35.43%), SKNU-12-08 (35.83%) and Rajasthan local (38.26%) proved to be moderately resistant. GU 1 (51.43%), T9 (55.00%), SKNU-13-02 (55.05%), SKNU-12-04 (55.05%), SKNU-15-03 (58.03%) and SKNU-13-03 (59.25%) categorized as moderately susceptible. While SKNU-11-11 (60.36%) proved to be susceptible against stem fly. Maximum seed yield was harvested from the genotype SKNU-15-02 (833 kg/ha) during *Kharif*, 2017 followed by SKNU-12-07 (786 kg/ha). From the above screening study, it can be concluded that the black gram genotypes SKNU-12-07, SKNU-15-01 and SKNU-15-02 were found resistant to *M. sojae*. In the present investigation, genotypes and cultivars, *i.e.*, SKNU-13-05, SKNU-12-08 and Rajasthan local found to be moderately resistant to *M. sojae*.

References

1. Anonymous. 2019. State-wise area, production and productivity of Urad in Gujarat. India stat. Retrieved from:http://www.indiastat.com. Book Company, New York, USA, p. 137.
2. Gaur N, Sharma P & Nautiyal A. 2015. Seasonal incidence of major insect pests of soybean and their correlation with abiotic factors. *Journal of Hill Agriculture*, 6 (1), 75-78.
3. Hamad SE & Dubey SL. 1983. Losses due to insect pests in North Bihar. *Indian Journal of Entomology*, 1: 136-146.
4. Haldhar SM, Bhargava R, Krishna H, Berwal MK, Saroj PL. 2018a. Bottom-up effects of different host plant resistance cultivars on ber (*Ziziphus mauritiana*)-fruit fly (*Carpomyia vesuviana*) interactions. *Crop Protec*., 106: 117-124.
5. Haldhar SM, Berwal MK, Samadia DK, Kumar R, Gora JS & Choudhary S. 2018b. Biochemical basis of plant-insect interaction in arid horticulture crops: a scientific review. *Journal of Agriculture and Ecology*, 6: 1-16.
6. Justin GLC, Anandhi P & Jawahar D. 2015. Management of major insect pests of black gram under dryland conditions. *Journal of Entomology and Zoology Studies*, 3 (1): 115-121.
7. Lal SS & Sachan JN. 1987. Recent advances in pest management in pulses. *Indian Farm*., 37: 29-32.
8. Laxmigudi R, Gopali JB, Hosamani A & Yelshetty S. 2014. Estimation of avoidable loss due to stem fly, *Ophiomyia phaseoli* (Tryon) and its management using new molecules as seed dressers in greengram. *Karnataka Journal of Agricultural Sciences*, 27 (1): 32-35.
9. Patel IS, Prajapati BG, Patel GM & Pathak AR. 2002. Response of castor genotypes to castor semilooper, *Achaea janata* Fab. *Journal of Oilseeds Research*, 19 (1): 153.
10. Pathan NP, Sisodiya DB & Raghunandan BL. 2023. First Report of Stem Fly *Melanagromyza sojae* (Zehntner) Infesting Black Gram (*Vigna mungo* L.) in India. *Biological Forum – An International Journal*, 15 (4): 637-642.
11. Pathan NP, Sisodiya DB, Dodiya RD & Kalola AD. 2023. Seasonal incidence of stem fly, *Melanagromyza sojae* (Zehntner) infesting black gram (*Vigna mungo* L.) in *kharif*. *Journal of Agriculture and Ecology*, 15: 94-99.
12. Pathan NP, Sisodiya DB, Dodiya RD and Thumar RK. 2023. Impact of sowing periods on incidence of stem fly, *Melanagromyza sojae* (Zehntner) in *kharif* black gram. *The Pharma Innovation Journal*, 12(6): 6260-6265.
13. Haldhar SM, Bhargava R, Choudhary BR, Pal G & Kumar S. 2013. Allelochemical resistance traits of muskmelon (*Cucumis melo*) against the fruit fly (*Bactrocera cucurbitae*) in a hot arid region of India. *Phytoparas.*, 41: 473-481.
14. Haldhar SM, Singh AK, Kumar K & Sarolia DK. 2018c. Antixenotic and allelochemical resistance traits of ber (*Ziziphus mauritiana*) against stone weevil, *Aubeus himalayanus* in hot arid region of India. *Indian Journal of Arid Horticulture*, 13: 50-58.
15. Haldhar SM, Singh AK, Gora JS, Berwal MK & Hussain T. 2023. Plant-insect interactions in different genotypes of ber (*Ziziphus mauritiana* L) against fruit borer (*Meridarchis scyrodes* Meyrick). *Journal of Agriculture and Ecology*, 16: 78-87; https://doi.org/10.58628/JAE-2316-216.
16. Haldhar SM, Bhargava R, Singh RS, Samadia DK, Jat GC & Singh D. 2019. Do bottom-up effects (resistance) of different accessions of Indian cherry (*Cordia myxa* L.) help against tingid bug [*Dictyla cheriani* (Drake)] attack? *Journal of Agriculture and Ecology*, 8: 84-103.
17. Haldhar SM, Singh S, Singh AK, Bhargava R, Singh RS & Singh D. 2016. Host Plant Resistance (HPR) study in Jamun (*Syzygium cumini*) against fruit borers, *Meridarchis scyrodes* Meyrick and *Dudua aprobola* (Meyrick) in semi-arid region. International Conference on Entomology organized by Punjabi University, Patiala during 03 to 05, December 2016.
18. Rabindra RJ, Ballal CR & Ramanujan B. 2004. Biological options for insect pests and nematode management in pulses. Kalyani Publishers, New Delhi, India, p. 487.
19. Steel RGD & Torrie JH 1980. Principles and procedures of statistics. Publ. McGraw Hill.

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