



Impact of Intercropping with Black Gram on Incidence of Stem Fly, *Melanagromyza sojae* (Zehntner) during the *Kharif* Season in Gujarat

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Abstract: Investigation on impact of intercropping with black gram on incidence of stem fly, *Melanagromyza sojae* (Zehntner) were carried out at Anand Agricultural University, Anand during *kharif* season (2017 and 2021). Black gram intercropped with either maize or sorghum (3:2) proved superior over rest of intercropping systems with lower infestation (22.20 %), tunnelling (8.00 %), larval population (0.14 /plant) and pupal population (0.19 /plant) of stem fly, *M. sojae*. Higher black gram equivalent seed yield was registered in all the treatments of intercropping systems i.e., black gram + maize (3:2 and 5:1 ratio) and black gram + sorghum (3:2 and 5:1 ratio) in comparison to black gram as sole crop.

Keywords: Black gram, Maize, Sorghum, Intercropping and stem fly

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. 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 2019). On an average, 2.5 to 3.0 million tonnes of pulses are lost annually due to pest problems (Rabindra *et al* 2004). In India, 60 insect species are known to attack black gram at different stages of crop growth. 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 Pant Nagar in Uttarakhand. Pathan *et al* (2023a) from Anand, Gujarat reported that *Melanagromyza sojae* (Zehntner) severely damages black gram at the seedling stage and exhibited a highly significant positive association with bright sunshine hours and maximum temperature. The black gram crop sown during the fourth week of August demonstrated the highest level of infestation (53.68%) and tunnelling (15.44%) followed by the crop sown during the third week of August (Pathan *et al* 2023c). The crop sown late i.e. 1st week of April showed significantly higher infestation (64.28%) of stem fly (Pathan *et al* 2022b). In the Gujarat region, the dipteran insect species *M. sojae* (Diptera: Agromyzidae) has emerged as a novel pest affecting black gram crop. Stem fly infestation exhibited a highly significant positive association ($r = 0.519^{**}$

and 0.655^{*}) with bright sunshine hours (BSS) and maximum temperature (MaxT), respectively in *kharif* (Pathan *et al* 2023b) while minimum temperature ($r = 0.769^{**}$) and evening during summer respectively in summer (Pathan *et al* 2022a). SKNU-11-11 proved to be susceptible genotype against *M. sojae* (Pathan and Sisodiya 2023, Pathan *et al* 2023d). Presently, there exists a deficiency of effective pest management strategies beyond the application of chemical insecticides. Given this scenario, it becomes imperative to explore and implement eco-friendly sustainable alternatives for insect pest control such as adopting cultural practices like intercropping. The comprehensive investigations were conducted to assess the influence of intercropping involving black gram on the incidence of the stem fly, *M. sojae* during the *kharif* season.

MATERIAL AND METHODS

In order to study the effect of intercropping on the incidence of stem fly, maize and sorghum was used as an intercrop with black gram. The experiment was conducted during *kharif*, 2017 and 2021. The variety of maize i.e. GAWMH-2 and for sorghum GNJ-1 (Gujarat Navsari Jowar 1) were used as an intercrop. There were four intercropping combinations *viz*, black gram + maize (5:1), black gram + maize (3:2), black gram + sorghum (5:1), black gram + sorghum (3:2) and sole black gram. The experiment was laid out in a randomized block design with four replication at Anand Agricultural University, Anand. Blackgram (Gujarat

Urad 1) were sown with the spacing of 45 x 10 cm with the plot size of 2.70 x 5.00 m.

For stem fly infestation, ten randomly selected seedlings were uprooted from each plot and brought to the departmental laboratory. The roots were gently washed in tap water to remove adhering soil. Stem of each plant was dissected and observations on the length of the stem, length of the tunnel and the number of larva (e) and pupae (e) present in the stem were recorded. The number of stem fly infested plants in each sample was also recorded at weekly interval starting from one week after germination.

Statistical analysis: The data were analysed by following standard statistical technique (Steel and Torrie 1980). Crop equivalent yield tunnelling and infestation per cent were calculated (Laxmigudi et al 2014). The software GWBASIC command prompt was used.

RESULTS AND DISCUSSION

Pest infestation (%): The impact of intercropping on pest infestation was significant as the treatments differed significantly (Table 1). The black gram crop intercropped either with maize or sorghum (3:2) registered 22.10 and 23.43% infestation of stem fly in black gram crop, respectively. Intercropping of black gram either maize or sorghum (5:1) exhibited 36.55 to 38.04% infestation of *M. sojae* but was at par. The black gram crop sown alone showed significantly higher infestation of the pest (51.33%).

Tunnelling (%): The black gram intercropped with maize

(3:2 ratio) and sorghum (3:2) registered 7.63 and 7.95% tunnelling, respectively. These cropping systems proved best in significant reduction of tunnelling (%) due to stem fly in black gram. The intercropping systems of black gram with either maize or sorghum (5:1) also proved moderately effective but found significantly better than black gram crop grown alone. Significantly highest tunnelling was in sole black gram crop over the rest of the treatments (16.02%).

Number of larva: The black gram intercropped with maize or sorghum (3: 2) exhibited significantly low larval population (0.14 to 0.16 larva/ plant) over other treatments. Larval numbers were also suppressed moderately where black gram was intercropped with either maize or sorghum (5:1), but it was significantly better over black gram grown as sole crop.

Number of pupa: The pupal population of stem fly, *M. sojae* in black gram reduced significantly when it was intercropped either with maize (3:2) or sorghum (3:2). Promising effect of these intercropping systems also observed when it was evaluated as 5:1 ratio. Black gram crop grown as sole crop exhibited significantly highest (0.87 pupa/plant) pupal count over rest of the treatments of intercropping systems.

Yield: The maximum seed yield was harvested in black gram + maize (3:2) treatments (562 kg/ha) followed by black gram + sorghum (3:2), black gram + maize (5:1) and black gram + sorghum (5:1). All these treatments were at par and registered significantly higher yield in comparison to black gram as sole crop (460 kg/ha). The black gram intercropped either with maize or sorghum in 3:2 ratio yielded significantly

Table 1. Effect of intercropping on incidence of stem fly, *M. sojae* infesting black gram (Pooled: 2017 and 2021)

Treatments	Infestation (%)	Tunnelling (%)	Larva (e)/plant	Pupa (e)/plant
Black gram + Maize (5:1)	37.20 (36.55)	20.22 (11.95)	0.94 (0.38)	0.99 (0.48)
Black gram + Maize (3:2)	28.04 (22.10)	16.43 (8.00)	0.80 (0.14)	0.83 (0.19)
Black gram + Sorghum (5:1)	38.08 (38.04)	20.66 (12.45)	0.97 (0.44)	1.02 (0.54)
Black gram + Sorghum (3:2)	28.95 (23.43)	16.79 (8.34)	0.81 (0.16)	0.84 (0.21)
Black gram as sole crop	45.76 (51.33)	23.59 (16.02)	1.10 (0.71)	1.17 (0.87)
CD (p=0.05) T	1.17	0.52	0.03	0.03
P	1.81	0.80	0.03	0.03
Y	0.74	0.32	0.02	0.02
T x P	NS	NS	NS	NS
T x Y	NS	NS	NS	NS
P x Y	NS	NS	NS	NS
T x P x Y	NS	NS	NS	NS
C.V. (%)	13.83	11.18	8.30	8.52

Figures in parentheses are retransformed values and those outside are arc sine transformed values, NS = Not Significant

Table 2. Yield of maize and sorghum intercropped with black gram (Pooled: 2017 and 2021)

Treatments	Yield (kg/ha)							
	Black gram		Maize		Sorghum		Equivalent yield	
	Seed	Haulm	Seed	Dry fodder	Seed	Dry fodder	Seed	Haulm
Black gram + Maize (5:1)	490	638	164	225	-	-	540	936
Black gram + Maize (3:2)	465	548	319	392	-	-	562	1070
Black gram + Sorghum (5:1)	496	624	-	-	126	159	534	834
Black gram + Sorghum (3:2)	470	570	-	-	275	332	553	1013
Sole black gram	461	682	-	-	-	-	460	681
CD (p=0.05) T	-	-	-	-	-	-	34.74	75.45
Y	-	-	-	-	-	-	NS	NS
T x Y	-	-	-	-	-	-	NS	NS

Price

Black gram = ₹63 /kg;
Black gram haulm = ₹ 1.5 /Kg;

Maize grain = ₹19 /Kg;
Maize fodder = ₹ 2 /kg;

Sorghum grain = ₹ 27 /Kg;
Sorghum fodder = ₹ 2/kg

Table 3. Economics of different intercropping systems evaluated in black gram (Pooled: *Kharif* 2017 and 2021)

Treatments	Yield (kg/ha)						Cost of treatment (₹/ha)	Income (₹/ha)	Gross income (₹/ha)	Net profit (₹/ha)	ICBR
	Black gram		Maize		Sorghum						
	Seeds	Haulm	Grain	Fodder	Grain	Fodder					
Black gram + Maize (5:1)	490	638	164	225	-	-	2847	35393	5327	2480	1:1.87
Black gram + Maize (3:2)	465	548	319	392	-	-	2865	36962	6896	4031	1:2.41
Black gram + Sorghum (5:1)	496	624	-	-	126	159	2229	35904	5838	3609	1:2.62
Black gram + Sorghum (3:2)	470	570	-	-	275	332	1629	38554	8488	6859	1:5.21
Sole black gram	461	682	-	-	-	-	2829	30066	-	-	-

See Table 2 for details

higher haulm yield than rest of the treatments. Black gram + maize and black gram + sorghum (5:1) produced 936 and 834 kg/ha haulm yield, respectively.

Economics: The maximum (₹ 6859 /ha) net profit was in black gram + sorghum (3:2) followed by black gram + maize (5:1). The black gram + sorghum (3:2) registered highest ICBR (1:5.27) followed by the treatment of black gram + sorghum (5:1) wherein it was 1:2.62 ICBR (Table 3).

The black gram crop intercropped either with maize or sorghum (3:2 ratio) registered low infestation of stem fly, *M. sojae* in black gram. Similarly, intercropping system of black gram with either maize or sorghum at 5:1 ratio was also promising in suppressing the infestation of stem fly. This finding is strongly supported by the report of Prodhon et al (2000) and Pathan et al (2024) where black gram crop intercropped with maize significantly reduced larval and pupal population, stem tunnelling, infested plants and produced higher yield over sole black gram crop. Peter et al (2009) observed that the population of *Ophiomyia* spp. was higher in pure stands of common beans in Tanzania than in the intercrop with maize. Low counts of larvae and pupae were recorded in intercropping system.

CONCLUSION

The black gram crop intercrop with maize (3:2) proved superior over rest of the other treatments followed by black gram + sorghum (3:2) intercropping system by recording less number of larvae, pupae as well as lower percent infestation and tunnelling. Intercropping black gram with either maize or sorghum (5:1) suppressed the pest at moderate level. Black gram crop grown alone exhibited maximum infestation. Relatively higher black gram equivalent seed yield was registered in all the treatments of intercropping in comparison to seed yield recorded from black gram sown as sole crop.

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