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Research Note

Correlation studies for shoot fly [*Atherigona soccata* (Rondani)] resistance traits in F_3 generation of Sorghum [*Sorghum bicolor* (L.) Moench]

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Abstract
Field screening of 120 F_3 families of sorghum lines against shoot fly resistance was carried out at Millet Breeding Station, Tamil Nadu Agricultural University during Summer 2018. Leaf trichome density on adaxial and abaxial leaf surfaces showed significant negative correlation with oviposition preference of shoot fly on 14 and 21 days after emergence and dead heart incidence on 21 and 28 DAE. Leaf glossiness and seedling vigour rating scale showed high significant positive correlation with shoot fly oviposition and dead hearts. Genotypic correlation confirmed that the number of trichomes on both surfaces of lamina, leaf glossiness and seedling vigour contributed resistance to shoot fly. Thus these characters can be used as selection criteria for breeding shoot fly resistance genotypes.

Keywords
Sorghum shoot fly, F_3 generation, correlation, shoot fly resistance traits

Sorghum [*Sorghum bicolor* (L.) Moench] is the third most important cereal crop in India. In India, the total production of sorghum is 4.80 million metric tonnes and India ranks 3rd in world after Sudan and Nigeria USDA(2017) but in reducing the productivity of sorghum insect-pests are major constraints. Seven to eight major pests causes economic losses to this crop. In view of seriousness of shoot fly (*Atherigona soccata* Rondani) problem in sorghum and owing to the limitations like high costs and toxic hazards of chemicals, it is necessary to develop varieties or hybrids which possess resistance to shoot fly. Plant resistance to sorghum shoot fly appears to be complex character and depends on the interplay of number of componential characters, which finally sum up in the expression of resistance to shoot fly Dhillon (2005). In this context, it is important to identify genotypes with different mechanisms to increase the levels and diversity of resistance to shoot fly. Therefore, the present studies were carried out on a diverse array of sorghum genotypes with a view to identify plant characteristics influencing the resistance/susceptibility to *A. soccata* to further genetic programs like molecular breeding and QTLs mapping.

Field experiment was carried out at Millet Breeding Station, Tamil Nadu Agricultural University during Summer 2018. A set of 120 F_3 families (K 8 X IS 2205) were planted along with parents and two checks, *viz.*, susceptible variety (Swarna), resistant check (IS 2205) and commercial hybrid (K8). The materials were raised in randomized block design with two replications. Each parental line and F_3 families were planted in a single row (1.5 metre) with row to row and plant to plant spacing of 45 and 15cm, respectively. The crop was grown by following recommended agronomic practices Crop Production Guide(2014) without spraying any insecticide. To attain uniform shoot fly pressure under field condition the inter lard fish meal technique Soto(1974) was followed for screening.

Screening of genotypes was carried out by recording observations on the number of eggs per seedling and number of seedling with eggs at 14 and 21 days after emergence (DAE) and plants with dead hearts at 21 and 28 DAE. Observation on plants with eggs and dead hearts were expressed in terms of percentage.
Observations were recorded on physical traits v*iz.*, trichome density on abaxial (lower) and adaxial (upper) surfaces of the leaf, leaf glossiness and seedling vigour. From 10 tagged plant in all the 120

F3 families, the leaf glossiness was visually estimated at 10 DAE in the early morning hours when there was maximum reflection of light from the leaf surfaces on 1 to 5 rating scale (1= highly glossy, light green, shining, narrow and erect and 5= non-glossy, dark green, dull, broad, and drooping leaves) Sharma and Nwanze (1997). For trichome density, fifth leaf at central portion of the plant was taken from three seedlings selected at random. The leaf were cut into 2 sq. cm pieces and placed in a solution of acetic acid and alcohol solution (2:1ratio) in a stoppered glass vial (10 ml capacity). The leaf pieces were kept in this solution for 24 h and thereafter transferred into lactic acid (90%). Leaf segments with cleared chlorophyll content were observed for the trichome density. The leaf sections were mounted on a slide in a drop of lactic acid and observed under stereomicroscope at a magnification of 10 X. The trichomes on both abaxial and adaxial surfaces of the leaf were counted in microscopic fields selected at random and expressed as number of trichomes per sq. cm. The seedling vigour was recorded at 10 DAE on 1 to 5 rating scale (1= highly vigorous, plants showing maximum height, more number of fully expanded leaves, good adaptation, and robust seedlings and 5 = poor seedling vigor, plants showing poor growth, and weak seedlings) Sharma and Nwanze (1997).

Correlation between shoot fly resistance as defined by oviposition and dead heart percentage with shoot fly resistance attributing traits like leaf glossiness, seedling vigour, trichome density on adaxial (upper) and abaxial (lower) surface of lamina were estimated and significance was tested using SPSS ver. 13.0.

Resistance to shoot fly was found to be highly correlated with the shoot fly resistance contributing traits (Table1). Highly significant negative association was observed for trichome density at adaxial and abaxial surface of leaf lamina and shoot fly damage parameters (ovipositional preference at 14 and 21 DAE and per cent dead hearts on 21 and 28 DAE). Leaf glossiness mainly acts as non preference mechanism. The intensity of leaf glossiness at the seedling stage is positively associated with level of resistance to shoot fly Sharma and Nwanze(1997). Seedling vigour revealed negative association with shoot fly damage parameters (Ovipositional and dead heart incidence). These finding are in accordance with the reports of Patel and Sukhani (1990), Dhillon *et al*. (2005), Gomashe (2010), Chamarthi *et al.* (2010) and who reported that the genotypes with highest leaf glossiness and trichome density were relatively less susceptible to shoot fly damage. Seedling vigour revealed significant association with shoot fly damage parameters (ovipositional and dead hearts incidence) .These finding was in close agreement with Bhagwat *et al.* (2011) and Syed *et al.* (2017). Trichomes or plant hairs are common anatomical features on leaves, stem and/or reproductive structures in higher plants. Levin(1973) described the role of trichomes in plant defense and pointed out in numerous species, there is negative association between trichome density and insect feeding, oviposition responses. Glossiness plays a significant role in shoot fly resistance in sorghum, since and it is an inherited character Omori *et al.(*1972). From these studies it holds that, trichomes on both the surface of lamina, leaf glossiness and seedling vigour played important role in shoot fly resistance. Therefore, magnitude of resistance by two or more resistance characters together is higher than the magnitude of resistance by the single trait alone. Thus these characters can be kept in mind and be used as selection criteria for breeding shoot fly resistance genotypes.

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Table 1. Simple correlation analysis between shoot fly resistant parameters and shoot fly resistance traits of F_3 families of sorghum lines

		Trichome Density		Leaf glossiness	Seedling vigour	Nos. of eggs / seedling		Seedling with eggs (%)		Dead hearts (%)	
		Abaxial surface	Adaxial surface			14 DAE	21 DAE	14 DAE	21 DAE	21 DAE	28 DAE
Trichome Density	**Abaxial Surface**	*1*									
	Adaxial Surface	*0.95*	*1*								
Leaf glossiness		*0.78*	*0.86*	*1*							
Seedling vigour		*0.73*	*0.83*	*0.88*	*1*						
Nos. of eggs / seedling	**14 DAE**	***-0.61*****	***-0.67*****	***050*****	***0.50*****	*1*					
	21 DAE	***-0.69*****	***-0.67*****	***0.52*****	***0.55*****	*0.96*	*1*				
Seedling with eggs (%)	**14 DAE**	***-0.65*****	***-0.65*****	***0.55*****	***0.51*****	*-0.85*	*-0.84*	*1*			
	21 DAE	***-0.61*****	***-0.70*****	***0.51*****	***0.82*****	*-0.78*	*-0.78*	*0.78*	*1*		
Dead hearts (%)	**21 DAE**	***-0.52*****	***-0.63*****	***0.62*****	***0.61*****	*0.60*	*0.61*	*-0.38*	*-0.35*	*1*	
	28 DAE	***-0.66*****	***-0.74*****	***0.68*****	***0.52*****	*0.76*	*0.80*	*-0.65*	*-0.60*	*0.75*	*1*

Correlation coefficient significant at P = 0.01**
(**Scale**: Glossiness (1- glossy, 5-non glossy, Seedling vigour (1-highly vigorous, 5- poor vigorous)