ISSN: 0974 - 0376

The Ecoscan : Special issue, Vol. VII: 47-50: 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES
www.theecoscan.in

HETEROSIS FOR GRAIN YIELD AND SHOOTFLY RESISTANCE IN MAS DERIVED MALE STERILE LINES IN *RABI* SORGHUM [*SORGHUM BICOLOR* (L.) MOENCH.]

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KEYWORDS

Heterosis
Grain yield
Shootfly
Resistance
Rabi
Sorghum

Proceedings of National Conference on
Harmony with Nature in Context of
Bioresources and Environmental Health
(HORMONY - 2015)
November 23 - 25, 2015, Aurangabad,
organized by
Department of Zoology,
Dr. Babasaheb Ambedkar Marathwada University
Aurangabad (Maharashtra) 431 004
in association with
National Environmentalists Association, India
www.neaindia.org

The Ecoscan
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES

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ABSTRACT

The present investigation was undertaken using B and R lines, that are in advanced stage of introgression of shootfly resistance QTLs available for development of experimental hybrids with an object to study heterosis for grain yield, its attributes and shootfly resistance components traits during *rabi* 2009. High and significant heterosis was observed in the crosses *viz.*, 1062-6 x RSF 16-3, 1062-6 x RSF 354-1, 1071-1x RSF 12-4, 1071-1 x RSF 19-3, 1076-1 x RSF 19-3, 1076-1 x RSF 16-3, 1077-1x RSF 6-1, 1077-1 x RSF 12-4, 1077-1 x RSF 25-1 and 1261-3 x RSF 19-3 for grain yield and its associated attributes like panicle length, panicle girth, panicle weight , test weight and fodder yields per plant. Among hybrid combination crosses *viz.*, 1062-6 x RSF 16-3, 1071-1 x RSF 12-4, 1071-1 x RSF 19-3, 1071-1 x RSF 16-3, 1076 -1 x RSF 12-4, 1076-1 x RSF 19-3, 1076-1 x RSF 16-3, 1076-1 x RSF 354-1, 1077-1 x RSF 12-4 and 1077-1 x RSF 19-3 exhibited significantly desirable heterosis for all the seven shootfly resistance attributes *viz.*, glossiness intensity, seddling vigor source, oviposition-I, oviposition-II, trichome density, dead heart-I, deadheart-II. The present study suggests that heterosis for grain yield should be through component trait heterosis, specially panicle length, panicle girth and panicle weight.

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INTRODUCTION

Although high yielding varieties and hybrids have been released in sorghum since 1960s, several biotic and abiotic constraints have affected its productivity. One of the most important biotic stress is the shootfly (*Atherigona soccata* Rond.) causing infestation up to 90-100 %. Resistance is needed in both the parents to develop shoot fly-resistant hybrids (Sharma *et al.*, 2006). However, expression of resistance to shoot fly damage varies between the rainy and the postrainy seasons (Sharma, 2014). Srilaxmi and Ravindra Paul (2011) also reported severe damage caused by shoot fly in deccan plateau. Exploitation of heterosis by developing the hybrids is one of the quickest and simplest ways to improve productivity for grain as well as fodder yield. Hybrid vigour and its commercial exploitation have paid rich dividends in kharif sorghum leading to quantum jump in sorghum production. However, the progress in rabi sorghum is limited and there is a need for critical studies on exploitation of the phenomenon of heterosis in post rainy (rabi) sorghum. Heterosis in the sorghum has been reported by several workers including Harer and Patel *et. al.* (1990), Sankarpandian *et al.* (1994), Khapre *et al.* (2000) and Kalpande (2015). The present investigation were undertaken using B and R lines that are in advanced stage of introgression of shootfly resistance QTLs and these were available for development of experimental hybrids with an object to study heterosis for grain yield, its attributes and shootfly resistance components traits.

MATERIALS AND METHODS

The present investigation was undertaken in sorghum at Department of Agriculrural Botany, Vasantrao Naik Krishi Vidyapeeth, Parbhani. Five female lines crossed with six males in a line x tester mating design to produce 30 hybrids during *rabi* season of 2009-10.

Experiment was conducted in two sets, first set includes thirty hybrids along with their eleven parents and two checks IS 18551 (shoot fly resistance), DJ 6514 (shootfly succeptible), total 43 genotypes were planted in randomized block design with three replications. Each genotype was planted in one row of four meter length with spacing of 45 x 15 cm in shootfly screening nursery during second fortnight September of *rabi* 2009 (early *rabi*) for exposing them to shoot fly pressure (Sharma *et al.*, 2015) as demonstrated by Gomase *et al.*, 2010. Interland fish meal technique was used for screening these 43 genotypes as suggested by Soto (1974). Ten days after seedling emergence polythene bags containing moistened fish meal were kept in test entries at uniform interval covering the entire area to attract emerging shootflies Plant protection measures were avoided until the shoot fly infestation period (up to one month after sowing) was over. Observations were recorded for Glossiness intensity, seedling vigor score, oviposition-I, oviposition-II, deadheart-I, deadheart-II. Second set comprised thirty hybrids along with their eleven parents and three checks (Parbhani Moti, Parbhani Jyoti and Akola Kranti) total 44 genotypes were planted in similar way as in set one during first fortnight of October of *rabi* 2009. In a normal sown and shootfly controlled condition observations were recorded for grain yield and its attributes. The heterosis was calculated as per procedure suggested by Fonesca and Patterson (1968).

RESULTS AND DISCUSSION

Heterosis over the best check or the local variety could be considered as the better criteria for evaluation of hybrids (Sharma, 1994). The present study revealed the distribution of heterosis in both positive and negative directions for all the traits. The potentiality of hybrid might be Judged by comparing the *Per se* performance and heterotic vigor. Close association between *per se* Performance of hybrids and heterosis was observed for all the traits, suggesting that selection of the crosses based on *per se* performance would be more realistic in sorghum.

In the resent study heterosis over mid parent, better parent (heterobeltiosis) and standard heterosis over checks Parbhani Moti, Parbhani Jyoti and Akola Kranti were calculate. In general, higher heterotic effect were observed in crosses involving MAS1076-1, MAS 1077-1, MAS 1261-3 as the female parents and RSF 12-4, RSF 16-3, RSF 354-1, RSF 25-1 as the male parent. Among all cross combination of 26, 27, 24, 26 and 24 hybrids combination exhibited positive and significant heterosis for grain yield per plant over mid parent, better parent and standard checks *viz.,* Parbhani Moti, Parbhani Jyoti and Akola Kranti respectively Prabhakar (2010) also reported significant heterosis for grain yield.

High and significant heterosis was observed in ten crosses *viz.,* MAS 1062-6 x RSF 16-3, MAS 1062-6 x RSF 354-1, MAS 1071-1x RSF 12-4, MAS 1071-1 x RSF 19-3, MAS 1076-1 x RSF 19-3, MAS 1076-1 x RSF 16-3, MAS 1077-1x RSF 6-1, MAS 1077-1 x RSF 12-4, MAS 1077-1 x RSF 25-1 and 1261-3 x RSF 19-3 for grain yield and its associated attributes like panicle length, panicle girth, panicle weight , test weight and fodder yields per plant (Table 1). Similar finding have also been reported by Jahagirdar and Borikar (2004) and Prabhakar (2010) for test weight. Among hybrid combination ten hybrids *viz.,* MAS 1062-6 x RSF 16-3, MAS 1071-1 x RSF 12-4, MAS 1071-1 x RSF 19-3, MAS 1071-1 x RSF 16-3, MAS 1076 -1 x RSF 12-4, MAS 1076-1 x RSF 19-3, MAS 1076-1 x RSF 16-3, MAS 1076-1 x RSF 354-1, MAS 1077-1 x RSF 12-4 and MAS 1077-1 x RSF 19-3 exhibited significantly desirable heterosis for all the seven shootfly resistance attributes *viz.,* glossiness intensity, seedling vigor source, oviposition-I, oviposition-II, trichome density, dead heart-I, deadheart-II (Table 2). Significant heterosis for grain yield and its component was associated with high mean in most of the crosses. However, significant, (negative / positive) heterosis for shoot fly resistance parameters recorded on few crosses and non significant heterosis

Table 1: The best hybrids showing high heterosis for grain yield and their performance to selected characters

Sr.no.	Crosses with maximum heterosis for grain yield	MP	BP	Parbhani Moti	Parbhani Jyoti	Akola Kranti	Characters with significantly desirable responses for heterosis
1	MAS 1062-6 x RSF 16-3	449.25**	399.00**	228.65**	245. 32**	211.16**	Days to 50% flowering, Days to maturity, Fodder yield per plant.
2	MAS 1076-1 x RSF 16-3	317.27**	87.91**	151.69**	386.21**	336.10**	Days to 50% flowering, Days to maturity, Plant height, Fodder yield per plant.
3	MAS 1261-3 x RSF 19-3	269.16**	203.42**	205.92**	221.44**	189.63**	Days to maturity, Plant height, Fodder yield per plant.
4	MAS 1076 -1x RSF 19-3	260.66**	200.15**	202.62**	217.97**	186.51**	Plant height, Panicle girth, Panicle weight, Test weight, Fodder yield per plant.
5	MAS 1071-1 x RSF 12-4	248.14**	212.98**	133.83**	145.70**	121.39**	Days to 50% flowering, Days to maturity, panicle length, Test weight, Fodder yield per plant.
6	MAS 1261-3 x RSF 12-4	243.32**	220.87**	139.73**	151.89**	126.97**	Plant height, Fodder yield per plant.
7	MAS 1071-1 x RSF 19-3	215.25**	159.07**	68.24**	76.77**	59.20**	Days to 50% flowering, Days to maturity, Plant height, Fodder yield per plant.
8	MAS 1261-3 x RSF 6-1	231.82**	164.02**	166.20**	179.70**	152.03**	Days to 50% flowering, Plant height, Test weight, Fodder yield per plant.
9	MAS 1076-1 x RSF 12-4	207.11**	191.21**	119.57**	128.61**	105.99**	Days to 50% flowering, Days to maturity, Plant height, panicle length, Test weight, Fodder yield per plant.
10	MAS 1071-1 x RSF 16-3	202.04**	164.02**	166.20**	171.70**	152.03**	Plant height, Fodder yield per plant.

Table 2: The best hybrids showing high heterosis for shoot fly resistance and its components

Sr. No.	Crosses with maximum heterosis for shoot fly resistance	MP	BP	IS- 18551	DJ 6514	Characters with significantly desirable responses for heterosis
1	MAS 1062-6 x RSF 16-3	4.41	-9.94	-33.91**	0.00	Glossiness intensity, Oviposition-I, deadheart-II
2	MAS 1071-1 x RSF 12-4	89.17**	50.70**	24.47**	0.00	Glossiness intensity, deadheart-I, deadheart-II
3	MAS 1071-1 x RSF 19-3	-13.62	-14.72	-27.90**	0.00	Glossiness intensity, oviposition-II, deadheart-II
4	MAS 1071-1 x RSF 16-3	17.13	-4.57	19.31**	0.00	Glossiness intensity, oviposition-II, deadheart-I.
5	MAS 1076-1 x RSF 12-4	-6.31	-34.58**	-17.17**	0.00	Glossiness intensity, seedling vigor score, deadheart-I.
6	MAS 1076-1 x RSF 19-3	-41.68**	-51.66**	-39.06**	0.00	Oviposition-I, oviposition-II, deadheart-I, deadheart-II
7	MAS 1076-1 x RSF 16-3	-20.76**	-43.73**	-28.76**	0.00	Glossiness intensity, deadheart-I, deadheart-II
8	MAS 1076-1 x RSF 354-1	-27.62	-38.64**	-23.32**	0.00	Oviposition-I, oviposition-II, deadheart-I, deadheart-II
9	MAS 1077-1 x RSF 6-1	8.54	23.05**	15.45**	0.00	Glossiness intensity, oviposition-II, deadheart-I.
10	MAS 1077-1 x RSF 12-4	11.16	-2.73	6.87	0.00	Glossiness intensity, deadheart-II

Table 3: The best hybrids showing high heterosis for grain yield and its traits and shootfly resistance traits.

Sr.n.	Crosses	For yield	For shoot fly
1	MAS 1071-1x RSF 12-4	Days to 50% flowering, Days to maturity, Plant height, panicle length, Test weight, Fodder yield per plant.	Glossiness intensity, seedling vigor score, oviposition-I, oviposition-II, deadheart-II
2	MAS 1071-1 x RSF 19-3	Days to 50% flowering, Days to maturity, Plant height, Test weight, Fodder yield per plant.	Glossiness intensity, seedling vigor score, oviposition-I, oviposition-II, deadheart-I, deadheart-II
3	MAS 1071-1 x RSF 16-3	Days to 50% flowering, Days to maturity, Plant height, panicle length, Test weight, Fodder yield per plant.	Glossiness intensity, seedling vigor score, oviposition-I, oviposition-II, deadheart-I
4	MAS 1076-1 x RSF 12-4	Days to 50% flowering, Days to maturity, Plant height, panicle length, Test weight, Fodder yield per plant.	Glossiness intensity, seedling vigor score, oviposition-I, oviposition-II, deadheart-I
5	MAS 1076-1 x RSF 19-3	Days to 50% flowering, Days to maturity, Plant height, panicle length, Test weight, Fodder yield per plant.	Glossiness intensity, seedling vigor score, oviposition-I, oviposition-II, deadheart-I, deadheart-II
6	MAS 1076-1 x RSF 16-3	Days to 50% flowering, Days to maturity, Plant height, panicle length, anicle girth, panicle weight, Test weight, Fodder yield per plant.	Glossiness intensity, seedling vigor score, oviposition-I, oviposition-II, deadheart-I, deadheart-II

(negative/ positive) also recorded on reasonable high number of crosses. These results are in agreement with the results reported by Singh *et. al*. (1980). Among hybrid combinations six crosses recorded significantly desirable heterosis for grain yield and shootfly resistance components traits. These crosses were advanced for development of *rabi* sorghum cultivars having high grain yield coupled with shootfly resistance.

The present study revealed that hybrids that exhibited heterosis for grain yield were not heterotic for all the traits. Among the lines, MAS 1071-1 and MAS 1076-1 performed well for most of the characters studied. The performance of testers RSF 12-4, RSF 19-3 and RSF 16-3 with the above lines was considerably good and exhibited significant levels of heterosis for most of the characters that contributes to yield. The results indicated that exploitation of the heterosis or hybrid vigor might be one of the promising methods to effect crop improvement in sorghum for grain purpose. The result also indicated that the heterosis for grain yield can be exploited commercially. Higher level heterosis in across always represents genetically more diverse parents than the crosses, which show little or no heterosis. From the results, an appreciable level of heterosis over standard checks and better parent was evident for the characters under study.

In conclusion best heterotic crosses for different attributes involve parental contribution of high x high and high x low yielder. The present study further suggests that heterosis for grain yield should be through component trait heterosis. In general, the heterosis for grain yield was reflected through heterosis in yield components specially panicle length, panicle girth and panicle weight.

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