HYBRID VIGOUR FOR GRAIN YIELD AND ITS COMPONENTS IN PEARL MILLET (*Pennisetum glaucum* (L.) R. Br.)

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ABSTRACT

An experiment comprised of five male sterile lines and 14 inbred testers of pearl millet and their 70 hybrids was conducted at Regional Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during Kharif 2007 for studying the extent of hybrid vigour in F_1 for grain yield and its components. Highest and significant negative relative heterosis, heterobeltiosis and standard heterosis for days to 50 per cent flowering was observed in the cross JMSA 101 x J 2454, ICMA 91777 x J 2466 and JMSA 101 x J 2452, respectively. The standard negative heterosis exhibited by the cross ICMA 91777 x J 2454 for plant height. The cross combination ICMA 99555 x J 2473 showed higher magnitude of positive relative heterosis and heterobeltiosis for total number of tillers. Highest and significant positive heterobeltiosis was recorded in ICMA 91777 x J 2441 for grain yield per plant. The hybrid ICMA 91777 x J 2466 recorded highest and significant positive standard heterosis for grain yield per plant, spike girth, number of productive tillers per plant, days to 50 per cent flowering and chlorophyll content at 30 & 60 days. Among 70 hybrids tested, five hybrids namely ICMA 91777 x J 2466, ICMA 91777 x J 2467, JMSA 101 x J 2452, ICMA 96444 x J 2464 and ICMA 91777 x J 2441 were considered as best cross combinations, since they expressed high standard heterosis over standard hybrid (GHB 558) for many of the traits studied.

KEY WORDS: Heterobeltiosis, pearl millet, relative heterosis, standard heterosis

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.) R. Br.) is a stable diet for the vast majority of poor farmers and also an important fodder crop for livestock population in arid and semi-arid regions of India (Vetriventhan *et al.*, 2008). Pearl millet belongs to C_4 pathway, it withstands all vagaries of monsoon and adapted to dry land system. Heterosis breeding has been recognized as the most suitable breeding methodology for augmenting yield in pearl millet. Selection of suitable parents and assessment of degree of heterosis in the resulting crosses forms an important step in hybrid breeding programme. An extensive study of pearl millet literature revealed that 40 per cent average better parent heterosis recorded for grain yield (Virk, 1988). Previous studies showed that high amount of heterosis for grain yield and harvest index (Yadav and Nijhawan, 1994), high magnitude of heterosis for

grain yield (Chavan and Nerkar, 1994) and standard heterosis for grain yield and its component traits (Karthigeyan, 1994). Heterosis breeding was ideal for increasing yield in pearl millet (Ramamoorthi and Nadarajan, 2001). Therefore, the present investigation was conducted to study the extent of hybrid vigour in F_1 for grain yield and its components.

MATERIALS AND METHODS

Present study involving five male sterile lines and fourteen inbreds of pearl millet, were obtained from Main Pearl Millet Research Station, Junagadh Agricultural University, Jamnagar. Among the five male sterile lines used as female parents, JMSA 101, ICMA 91777, ICMA 94555 and ICMA 96444 of A_1 cytoplasm, whereas ICMA 99555 having an A_4 cytoplasm, an inbred line originated from Gujarat, Jndia. Crosses were made by using Line x Tester mating design (Kempthorne, 1957). Resultant 70 hybrids along with their parents and standard check (GHB 558) were evaluated in Randomized Block Design (RBD) replicated thrice during *Kharif* 2007. The observations were recorded on ten randomly selected competitive plants from each replication for twelve traits *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), total numbers of tillers per plant, spike length (cm), spike girth (cm), dry fodder yield per plant (cm), grain yield per plant (gm), harvest index (gm), protein content (%) and chlorophyll content at 30 and 60 days. The expression of heterosis in 70 hybrids involving five lines and fourteen testers was measured in terms of relative heterosis in relation to mid-parents, heterobeltiosis in relation to better parent and standard heterosis in comparison to standard hybrid, GHB 558.

RESULTS AND DISCUSSION

The analysis of variance for grain yield and its components showed that the parents and their hybrids involved in the present study differed significantly for all the traits studied. Mean values of grain yield and its component traits of parents (line and testers) and their hybrids are presented in Table 1. The range of mid-parent heterosis, heterobeltiosis and standard heterosis, as well as, number of hybrids showing significant heterosis in desirable direction is presented in Table 2. Similarly, the best hybrid with respect to significant mid-parent heterosis, heterobeltiosis and standard heterosis is given in Table 3. The results obtained under the present investigation are discussed as under herewith.

For days to 50 per cent flowering, 23 and 10 hybrids showing significant heterosis in desirable direction over mid-parent and better parent, respectively, while none of cross exhibited significant desirable standard heterosis. Highly significant negative relative heterosis (-16.77 %) and heterobeltiosis (-15.23 %) was recorded by the cross JMSA 101 x J 2454 and ICMA 91777 x J 2466, respectively for days to 50 per cent flowering. Earliness in flowering is reported by Ahulwalia and Patnaik, 1963, Karad and Harare (2005) and Vetriventhan *et al.* (2008). The relative heterosis for days to maturity varied from -7.16 per cent (ICMA 91777 x J 2467) to 8.37 per cent (ICMA 96444 x J 2444) and heterobeltiosis, the range lied in between -6.99 per cent (ICMA 91777 x J 2467) to 15.73 per cent (ICMA 91777 x J 2444). Karad and Harare (2005) and Vetriventhan *et al.* (2008) reported the similar results for days to maturity. For plant height, none of cross exhibited significant desirable mid-parent heterosis as well as heterobeltiosis, while 43 crosses manifested significant

desirable standard heterosis. Karad and Harare (2005) and Vetriventhan *et al.* (2008) found the similar results for plant height. Out of 70 hybrids, only one hybrid, ICMA 91777 x J 2466 (9.89 %) observed higher magnitude of positive and significant standard heterosis for number of productive tillers per plant. Highly positive and significant heterobeltiosis was observed in ICMA 99555 x J 2473 (124.56 %) and relative heterosis in ICMA 99555 x J 2473 (130.63 %) for number of productive tillers per plant. Balkrishnan and Vijendra Das (1996), Ramamoorthi and Govindarasu (2001) and Vetriventhan *et al.* (2008) found the similar results for number of productive tillers per plant. Highest significant positive relative heterosis, heterobeltiosis and standard heterosis was recorded in hybrid ICMA 91777 x J 2473 (86.20 %), ICMA 94555 x J 2473 (54.47%) and 91777 x J 2466 (15.98 %) for the trait spike length, respectively. ICMA 91777 x J 2466 was the promising hybrids on the basis of standard heterosis for spike length. The results are akin to those of Bidinger *et al.* (2002).

The heterobeltiosis for dry fodder yield per plant ranged from -31.81 per cent (ICMA 96444 x J 2455) to 146.76 per cent (JMSA 101 x J 2473**).** Out of 70 hybrids, 52, 38 and 8 crosses showed significant and positive heterosis over its relative heterosis, better parent and standard heterosis, respectively for dry fodder yield per plant. The cross combination, ICMA 91777 x J 2405 was the best with respect to standard heterosis for dry fodder yield per plant. Similar results for dry fodder yield per plant were reported by Sheoran *et al.* (2000). Among the crosses, 52, 43 nad 1 hybrid exhibited significant and positive relative heterosis, heterobeltiosis and standard heterosis, respectively. The hybrid, ICMA 91777 x J 2466 recorded highest and significant positive standard heterosis for grain yield per plant. Patil *et al.* (1994) and Vetriventhan *et al.* (2008) observed high magnitude of heterosis for dry fodder yield per plant as well as grain yield per plant. For the 1000 grain weight, 42 and 30 hybrids exhibited significant and positive heterosis over mid-parent and better parent, respectively. Highly significant positive relative heterosis (55.32 %) and heterobeltiosis (44.97 %) was recorded for 1000 grain weight by the cross ICMA 96444 x J 2467 and ICMA 91777 x J 2405, respectively. Hybrid, JMSA 101 x J 2405 recorded the highest and significant positive relative heterosis (35.52 %) and heterobeltiosis (31.59 %) for harvest index.

The relative heterosis, heterobeltiosis and standard heterosis ranged from – 17.38 per cent (ICMA 96444 x J 2452) to 52.45 per cent (ICMA 91777 x J 2455); -14.65 per cent (ICMA 96444 x J 2452) to 39.15 per cent (ICMA 91777 x J 2455) and -29.62 per cent (JMSA 101 x J 2464) to 13.36 per cent (ICMA 99555 x J 2444), respectively for protein content**.** Similar results for protein content were reported by Patil *et al.* (1994).

Among the 70 cross combinations, 25, 15 and 1 cross combinations recorded significant and positive heterosis over mid-parent, better parent and standard heterosis, over GHB 558 for chlorophyll content at 30 days. JMSA 101 x J 2405 (25.57 %) was promising on the basis of standard heterosis for this trait. Similarly, among all the crosses, 11 and 8 cross combinations recorded significant and positive heterosis over mid-parent and better parent, respectively, for chlorophyll content at 60 days. Similar results for protein

content were reported by Izge *et al.* (2007).

CONCLUSION

The hybrid ICMA 91777 x J 2466 recorded highest and significant positive standard heterosis for grain yield per plant, spike girth, number of productive tillers per plant, days to 50 per cent flowering and chlorophyll content at 30 & 60 days. Among 70 hybrids tested, five hybrids namely ICMA 91777 x J 2466, ICMA 91777 x J 2467, JMSA 101 x J 2452, ICMA 96444 x J 2464 and ICMA 91777 x J 2441 were considered as best cross combinations, since they expressed high standard heterosis over standard hybrid (GHB 558) for many of the traits studied could be exploited for pearl millet improvement.

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Table 1:Mean vales of grain yield and component traits of pearl millet among parent (line and testers) and their hybrids.

Traits	Mean Values			CD	CV %
	Lines	Testers	Hybrids		
Days to 50 per cent flowering	48.66	47.10	48.55	3.09	3.15
Days to maturity	86.26	88.56	88.31	3.74	2.65
Plant height (cm)	117.33	121.17	168.74	8.73	3.45
Number of productive tiller per plant	2.21	2.50	3.44	0.29	5.27
Spike length (cm)	19.96	15.97	22.10	0.42	5.81
Spike girth (cm)	6.99	6.74	7.50	2.81	4.94
Dry fodder yield per plant (g)	23.07	30.03	40.96	6.67	10.00
Grain yield per plant (g)	16.49	21.90	31.29	4.40	9.49
1000 grain weight (g)	8.93	9.47	9.71	0.76	4.99
Harvest index (%)	34.00	35.11	36.46	4.88	8.85
Protein content (%)	8.56	9.09	10.64	0.28	1.77
Chlorophyll content at 30 days	30.41	32.57	33.33	5.25	9.73
Chlorophyll content at 60 days	25.95	25.74	29.76	9.86	17.95

Table 2: Range of heterosis and number of crosses showing significant heterosis in desirable direction in pearl millet

Traits	Relative Heterosis		Heterobeltiosis		Standard Heterosis	
	Range (%)	No. of Crosses	Range (%)	No. of Crosses	Rang (%)	No. of Crosses
Days to 50 per cent flowering	-16.77 to 11.33	23	-15.23 to 19.71	10	-2.30 to 29.63	0
Days to maturity	-7.16 to 8.37	14	-6.99 to 15.73	34	-1.59 to 14.79	0
Plant height	2.66 to 108.05	0	3.91 to 117.38	0	-29.84 to 8.76	43
Number of productive tiller per plant	-23.30 to 130.63	56	40.60 to 124.56	46	-61.64 to 9.89	1
Spike length	-9.20 to 86.20	56	-26.87 to 54.47	35	-32.87 to 15.98	5
Spike girth	-22.04 to 42.22	45	-26.35 to 41.35	28	-32.47 to 3.49	0
Dry fodder yield per plant	-16.40 to 163.29	52	-31.81 to 146.76	38	-55.44 to 43.24	8
Grain yield per plant	-29.66 to 195.52	52	-48.56 to 170.59	43	-63.16 to 14.21	1
1000 grain weight	-21.19 to 55.32	42	-26.49 to 44.97	30	-35.11 to 1.72	0
Harvest index	-20.60 to 35.52	23	-25.74 to 31.59	7	-30.22 to 5.79	0
Protein content	-17.38 to 52.45	58	-14.65 to 39.15	55	-29.62 to 13.36	18
Chlorophyll content at 30 days	-50.46 to 82.75	25	-63.89 to 76.20	15	-62.67 to 25.57	1
Chlorophyll content at 60 days	-65.85 to 137.63	11	-76.86 to 95.48	8	-71.07 to 11.52	0

Table 3: Best hybrid with respect to significant relative heterosis, heterobeltiosis and standard heterosis in desirable direction for different characters in pearl millet.

Traits	Relative Heterosis	Heterobeltiosis	Standard Heterosis
Days to 50 per cent flowering	JMSA 101 x J 2454	ICMA91777 x J 2466	-
Days to maturity	ICMA 91777 x J 2467	ICMA 91777 x J 2467	-
Plant height	-	-	ICMA 91777 x J 2454
Number of productive tiller per plant	ICMA 99555 x J 2473	ICMA99555 x J 2473	ICMA 91777 x J 2467
Spike length	ICMA 91777 x J 2473	ICMA 94555 x J 2473	ICMA 99555 x J 2466
Spike girth	JMSA 101 x J 2473	JMSA 101 x J 2473	-
Dry fodder yield per plant	JMSA 101 x J 2473	JMSA 101 x J 2473	ICMA 91777 x J 2405
Grain yield per plant	ICMA 91777 x J 2473	ICMA 91777 x J 2441	ICMA 91777 x J 2466
1000 grain weight	ICMA 96444 x J 2467	ICMA 91777 x J 2405	-
Harvest index	JMSA 101 x J 2405	JMSA 101 x J 2405	-
Protein content	ICMA 96444 x J 2455	ICMA 91777 x J 2455	ICMA 99555 x J 2444
Chlorophyll content at 30 days	JMSA 101 x J 2405	JMSA 101 x J 2405	JMSA 101 x J 2405
Chlorophyll content at 60 days	ICMA 91777 x J 2473	ICMA 94555 x J 2452	-

[MS received: November 22, 2014] *[MS accepted: December 20, 2014]*