AGRES – An International e-Journal , (2015) Vol. 4, Issue 2: 157-162 **ISSN 2277-9663**

HETEROSIS FOR GRAIN YIELD AND QUALITY TRAITS IN PEARL MILLET (*Pennisetum glaucum* (L.) R. Br.)

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ABSTRACT

The extent of heterobeltiosis and standard heterosis for grain yield per plant and quality traits was studied in pearl millet during kharif 2007 in line × tester analysis involving 5 lines and 14 testers. Appreciate amount of heterobeltiosis was noticed for yield and quality traits studied. ICMA 91777 X J 2466 is the best heterotic cross, which possessed significantly highest standard heterosis for grain yield per plant. For grain yield per plant, ICMA 91777 x J 2441, ICMA 91777 x J 2467, ICMA 91777 x J 2466, ICMA 91777 x J 2462 and JMSA 101 x J 2450 were the five best crosses showed exhibited significantly positive heterobeltiosis. ICMA 91777 x J 2455 (39.15%), JMSA 101 x J 2405 (76.20%) and ICMA 94555 x J 2452 (95.48%) were the best crosses recorded significantly highest and positive heterobeltiosis for protein content, chlorophyll content at 30 DAS and chlorophyll content at 60 DAS, respectively. ICMA 99555 x J 2444 (13.36 %) and JMSA 101 x J 2405 (25.57%) were the best standard heterotic crosses for protein content and chlorophyll content at 30 DAS, respectively. None of the cross exhibited significantly standard heterosis for chlorophyll content at 60 DAS. Parents used in generating these hybrids are suitable candidates for their conversion to cytoplasmic male sterile and/or restorer lines for the commercial exploitation of heterosis.

KEY WORD: Heterobeltiosis, Pennisetum glaucum, standard heterosis

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.) R.Br.) is a stable diet for the vast majority of poor farmers and also form an important fodder crop for livestock population in arid and semi-arid regions of India (Vetriventhan *et al*., 2008). It is the principal food crop across sub-Saharan Africa and north-western India. It is considered as nutritious cereal crop in providing high quality grain both for human and animal consumption will continue to play an important role in the Indian economy. This crop grown in harsh environments, where other crops fail to grows well. Improvement in production, availability storage, utilization and consumption of this crop will significantly contribute to the food and nutrition security of the inhabitants of these areas.

Though pearl millet is the staple cereal supplying 80 to 90 per cent of the calories for many millions of the poor people in semi arid regions, the nutritive value of this crop has not received extensive attention and as a result the data available are limited. Grain quality of pearl millet divided into two categories, the evident quality character based on appearance and cooking quality and the cryptic quality characters based on nutritional value.

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MATERIALS AND METHODS

Present study involving five male sterile lines and fourteen inbreds of pearl millet chosen for the study were crosses in 5 x 14 line x tester mating design. The parents used were obtained from Pearl Millet Research Station, Junagadh Agricultural University, Jamangar. Among the five male sterile used as female parents, JMSA 101, ICMA 91777, ICMA 94555 and ICMA 96444 having A_1 cytoplasm, whereas ICMA 99555 having A_4 cytoplasm. The salient features of all the parents used in the study are presented in Table 1. Resultant 70 hybrids along with their parents and standard check (GHB 558) were raised in Randomized Block Design (RBD) with three replications during *Kharif* 2007. The grain yield per plant was recorded on ten randomly selected competitive plants from each replication. The chlorophyll content was measured at 30 and 60 DAS. The random sample of seed collected from each replication was analyzed for protein content. The heterobeltiosis as well as standard heterosis was calculated for all the 70 hybrids for all these four traits.

RESULTS AND DISCUSSION

The analysis of variance for grain yield per plant and quality traits is presented in Table 2. The results revealed that mean squares due to parents, testers, lines x testers, hybrids and parents vs, hybrids were significant for grain yield per plant and chlorophyll content at 30 and 60 DAS with the exception (parents vs. hybrids for chlorophyll content at 60 DAS). Mean squares dueto lines and parents vs. hybrids were significant for protein content. It indicated that the material used under the study was genetically variable.

The range of heterobeltiosis and standard heterosis, as well as, number of hybrids showing significant heterosis in desirable direction is presented in Table 3. The heterobeltiosis ranged from -48.56 to 170.59 per cent, -14.65 to 39.15 per cent, -63.89 to 76.20 per cent and -76.86 to 95.48 for grain yield per plant, protein content, chlorophyll content at 30 DAS and chlorophyll content at 60 DAS, respectively. Similarly standard heterosis ranged from -63.16 to 14.21 per cent, -29.62 to 13.36 per cent, -62.67 to 25.57 per cent and -71.07 to 11.52 for grain yield per plant, protein content, chlorophyll content at 30 DAS and chlorophyll content at 60 DAS, respectively. Total of 43, 45, 15 and 8 hybrids exhibited significant positive heterobeltiosis for grain yield per plant, protein content, chlorophyll content at 30 DAS and chlorophyll content at 60 DAS, respectively. Eighteen hybrids exhibited standard heterosis for protein content. One hybrid each for grain yield per plant and chlorophyll content manifested significant positive heterosis. None of the hybrids recorded significant standard heterosis for chlorophyll content at 60 DAS. The results were supported by Deore *et al*. (1997), Bidinger *et al*. (2002) and Manga and Dubey (2004).

Before placing strong emphasis on breeding for nutritional quality characters the knowledge on the association between yield and nutritional quality traits will enable the breeder for simultaneous improvement of yield with nutritional traits. The hybrid namely, ICMA 94555 x J 2467 observed high standard heterotic value for quality traits studied and including grain yield per plant. Appreciate amount of heterobeltiosis was noticed for yield and quality traits studied. ICMA 91777 X J 2466 is the best heterotic cross, which possessed significantly highest standard heterosis for grain yield per plant (Table 4). For grain yield per plant, ICMA 91777 x J 2441, ICMA 91777 x J 2467, ICMA 91777 x J 2466, ICMA 91777 x J 2462 and JMSA 101 x J 2450 were the five best crosses showed exhibited significantly positive heterobeltiosis. ICMA 91777 x J 2455 (39.15%), JMSA 101 x J 2405 (76.20%) and ICMA 94555 x J 2452 (95.48%) were the best crosses recorded significantly highest and positive heterobeltiosis for protein content, chlorophyll content at 30 DAS and chlorophyll content at 60 DAS, respectively. ICMA 99555 x J 2444 (13.36 %) and JMSA 101 x J 2405 (25.57%) were the best standard heterotic crosses for protein content and chlorophyll content at 30 DAS, respectively. None of the cross exhibited significantly standard heterosis for chlorophyll content at 60 DAS. These results are in accordance with findings of Izge *et al*. (2007).

CONCLUSION

Based on results, t can be seen that cross, ICMA 91777 X J 2466 possessed vey good correlation between grain yield per plant and quality traits studied. Appreciate amount of heterobeltiosis was noticed for yield and quality traits studied. ICMA 91777 X J 2466 is the best heterotic cross, which possessed significantly highest standard heterosis for grain yield per plant. For grain yield per plant, ICMA 91777 x J 2441, ICMA 91777 x J 2467, ICMA 91777 x J 2466, ICMA 91777 x J 2462 and JMSA 101 x J 2450 were the five best crosses showed exhibited significantly positive heterobeltiosis. ICMA 91777 x J 2455 (39.15%), JMSA 101 x J 2405 (76.20%) and ICMA 94555 x J 2452 (95.48%) were the best crosses recorded significantly highest and positive heterobeltiosis for protein content, chlorophyll content at 30 DAS and chlorophyll content at 60 DAS, respectively. Parents used in generating these hybrids are suitable candidates for their conversion to cytoplasmic male sterile and/or restorer lines for the commercial exploitation of heterosis.

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Table 1: Salient features of parents and hybrid check

Sr. No.	Parents	Salient features	Source
Female Parents (CMS lines)			
1.	JMSA 101	Early maturing, tall, 2-3 tillers, 6-7 node, long and thin ear head	JAU, Jamnagar
2.	ICMA 91777	Late maturing, tall,3-4 tillers, 5-6 nodes, medium long and medium thick ear head	ICRISAT, Hyderabad
3.	ICMA 94555	Early maturing, dwarf,3-4 tillers, 5-6 nodes, medium long and medium thick ear head	ICRISAT, Hyderabad
4.	ICMA 96444	Early maturing, dwarf, 3-4 tillers, 6-7 nodes, short and thick ear head	ICRISAT, Hyderabad
5.	ICMA 99555	Mid late maturing, dwarf, 2-3 tillers, 5-6 nodes, short and medium thick ear head	ICRISAT, Hyderabad
Male Parents (R lines)			
6.	J 2405	Mid late maturing, tall, 3-4 tillers, 6-7 nodes, short and medium thick ear head	JAU, Jamnagar
7.	J 2441	Late maturing, dwarf, 3-4 tillers, 6-7 nodes, medium long and medium thick ear head	JAU, Jamnagar
8.	J 2444	Early maturing, tall, 2-3 tillers, 6-7 nodes, medium long and medium thick ear head	JAU, Jamnagar
9.	J 2452	Mid late maturing, very tall, 2-3 tillers, 5-6 nodes, short and medium thick ear head	JAU, Jamnagar
10.	J 2454	Early maturing, dwarf, 4-5 tillers, 6-8 nodes, short and medium thick ear head	JAU, Jamnagar
11.	J 2455	Late maturing, tall, 3-4 tillers, 4-6 nodes, short and medium thick ear head	JAU, Jamnagar
12.	J 2462	Mid late maturing, tall, 2-3 tillers, 5-6 nodes, short and thin ear head	JAU, Jamnagar
13.	J 2464	Mid late maturing, tall, 3-4 tillers, 7-8 nodes, short and thin ear head	JAU, Jamnagar
14.	J 2465	Mid late maturing, tall, 3-4 tillers, 6-7 nodes, short and medium thick ear head	JAU, Jamnagar
15.	J 2466	Mid late maturing, tall, 3-4 tillers, 6-7 nodes, short and medium thick ear head	JAU, Jamnagar
16.	J 2467	Late maturing, dwarf, 3-4 tillers, 6-7 nodes, medium long and medium thick ear head	JAU, Jamnagar
17.	J 2473	Late maturing, dwarf, 2-3 tillers, 5-6 nodes, short and thin ear head	JAU, Jamnagar
18.	J 2474-1	Early maturing, tall, 2-3 tillers, 5-6 nodes, medium long and medium thick ear head	JAU, Jamnagar
19.	J 2477-1	Late maturing, dwarf, 2-3 tillers, 5-6 nodes, short and medium thick ear head	JAU, Jamnagar
Check Hybrid			
20.	GHB 558	Early maturing, very tall, 3-4 tillers, medium long, thick and compact ear head, bold seeded.	JAU, Jamnagar

Table 2: Analysis of variance in respect of Grain Yield and quality contributing traits in pearl millet

Traits	Replication	Parents	Lines	Testers	Lines x Tester	Hybrids	Parents vs hybrids	error	CD	CV
Degree of freedom	2	18	13	4	1	69	1	176	-	-
Grain Yield Per Plant	10.615	62.45**	12.86	57.96**	319.**	321.14*	52.57**	7.56	4.40	9.49
Protein Content	0.371	2.46	4.730**	1.954	0.110	3.79	107.02**	2.96	0.28	1.77
Chlorophyll Content at 30 DAS	9.082	289.4**	64.98	356.76**	312.98**	239.32**	29.34	10.74	5.25	9.73
Chlorophyll Content at 60 DAS	48.367	545.25**	121.82	679.36**	495.44**	435.51**	186.12**	37.96	9.86	17.95

Table 3: Range of heterobeltiosis and number of crosses showing significant heterobeltiosis (%) and standard heterosis desirable direction in pearl millet.

Traits	Heterobeltiosis (%)			Standard Heterosis (%)		
	Range	No. Crosses Showing +ve Significant	No. Crosses Showing -ve Significant	Range	No. Crosses Showing +ve Significant	No. Crosses Showing -ve Significant
Grain Yield Per Plant	-48.56 to 170.59	43	6	-63.16 to 14.21	1	52
Protein Content	-14.65 to 39.15	55	10	-29.62 to 13.36	18	40
Chlorophyll Content at 30 DAS	-63.89 to 76.20	15	30	-62.67 to 25.57	1	66
Chlorophyll Content at 60 DAS	-76.86 to 95.48	8	38	-71.07 to 11.52	0	56

Table 4: Best five crosses showing heterobeltiosis and standard check in desirable direction in pearl millet

Traits	Five Best Crosses Showing Heterobeltiosis	Per Cent Value of Heterobeltiosis	Five Best Crosses Showing Standard Heterosis	Per Cent Value of Standard Haterosis
Grain Yield Per Plant	ICMA 91777 x J 2441	170.59	ICMA 91777 x J2466	14.21
	ICMA 91777 x J 2467	170.43	ICMA 91777 x J 2467	7.78
	ICMA 91777 x J 2466	150.71	JMSA 101 x J 2452	6.94
	ICMA 91777 x J 2462	141.87	ICMA 96444 x J 2464	6.53
	JMSA 101 x J 2450	138.47	ICMA 91777 x J 2441	5.50
Protein Content	ICMA 91777 x J 2455	39.15	ICMA 99555 x J 2444	13.36
	ICMA 99555 x J 2444	31.41	ICMA 99555 x J 2452	8.69
	JMSA 101 x J 2405	30.31	ICMA 91777 x J 2452	7.10
	ICMA 91777 x J 2473	28.71	ICMA 94555 x J 2467	6.16
	ICMA 94555 x J 2473	26.77	ICMA 94555 x J 2473	6.16
Chlorophyll Content at 30 DAS	JMSA 101 x J 2405	76.20	JMSA 101 x J 2405	25.57
	ICMA 91777 x J 2466	56.29	ICMA 91777 x J 2466	6.34
	ICMA 91777 x J 2441	54.51	ICMA 99555 x J 2473	5.86
	ICMA 99555 x J 2474-1	44.52	JMSA 101 x J 2452	5.44
	ICMA 94555 x J 2452	40.02	ICMA 91777 x J 2473	5.44
Chlorophyll Content at 60 DAS	ICMA 94555 x J 2452	95.48	JMSA 101 x J 2405	11.52
	ICMA 101 x J 2405	85.13	ICMA 91777 x J 2466	5.95
	ICMA 91777 x J 2466	75.88	-	-
	ICMA 9555 x J2441	52.03	-	-
	ICMA 99555 x J 2477-1	52.03	-	-

[MS received: May 3, 2015] *[MS accepted: June 6, 2015]*