HETEROSIS STUDIES FOR SEED YIELD AND ITS ATTRIBUTING TRAITS IN PEARL MILLET (PENNISETUM GLAUCUM (L.) R. BR.)

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ABSTRACT

The present heterosis study comprises of twelve parents which includes eight males, four females and thirty-two crosses along with two checks of pearl millet. The genotypes were evaluated in Randomized Block Design with two replications during *Kharif 2025*, at experimental farm of National Agricultural Research Project, Chh. Sambhajinagar. Observations were recorded for 11 characters *viz.*, days to 50% flowering, days to maturity, plant height, number tillers per plant, panicle length, panicle girth, Zn content, Fe content, fodder yield per plant, test weight and grain yield per plant. The mean sum of squares for parents and crosses exhibited highly significant differences for all the characters. Parents *vs* crosses differed significantly for all the characters. The mean sum of squares for parents further partitioning of the variance due to various source of variation also showed the significant differences for all the characters under study. Among the parents, ICMA-92888A among the lines and 17592R and 15333R among testers exhibited significant and desirable GCA effects for seed yield and most of the traits. These parents can be utilized for future breeding programme to produce high yielding pearl millet crosses. The crosses ICMA-92888A x 18111R, ICMA-99555A x 17592R, ICMA-95111A x 15333R, ICMA-92888A x SBP-2R and ICMA-99555A x 15385R exhibited higher *per se* performance, heterobeltosis and standard heterosis with positive and significant SCA effects and positive GCA effects for at least one of the parents of every cross for seed yield per plant. Such crosses can be utilized for commercial exploitation in peal millet.

Keywords: Pearl millet, heterosis.

INTRODUCTION:

Pearl millet, also known as *bajra* (*Pennisetum glaucum* (L.) R. Br.), ranks as the sixth most important cereal crop globally and the fourth in India, following rice, wheat, and maize. It is widely referred to by various names such as cat tail millet, spiked millet, bulrush millet, cumbu, and is locally called bajra or bajari in different regions. This crop belongs to the Poaceae (Gramineae) family, with a chromosome number of 2n = 14, and falls under the *Pennisetum* genus and *glaucum* species. Pearl millet is cultivated on 30 million ha in the arid and semi-arid tropical regions of Asia and Africa, contributing 40.51% to global millet production, with 60% of the cultivation area located in Africa and 35% in Asia (*Anonymous*, 2024). Pearl millet is an erect annual plant, growing between 5 to 6 feet tall, with varying numbers of tillers. It is known to have a secondary polyploidy nature (*Swaminathan and Nath*, *et al.* 1956). Pearl millet has a balanced genetic makeup but exhibits notable inbreeding depression (*Harinarayana et al.* 1980). Therefore, varieties developed for pearl millet need to be heterozygous to ensure heterosis (hybrid vigor) while also maintaining a homogeneous structure for uniform and synchronous productivity. It is predominantly cross-pollinated due to protogynous flowering and wind-mediated pollen dispersal, with an outcrossing rate generally exceeding 85% (*Gupta et al.*, 2022). These characteristics make it ideal for hybrid breeding programs.

MATERIALS AND METHODS

The experimental material consists of four lines (ICMA-98222A, ICMA-95111A, ICMA-92888A, ICMA-99555A) and eight diverse testers (F6-6R, 18111R, 15333R, 17592R, 16739R, 15535R, SBP-2R, 15385R). The detailed information of parents including lines and testers with salient characteristics and crosses is presented in (table 1 and table 2). These Four lines and Eight testers were crossed in Line × Tester mating system and thirty-two crosses were effected during *Summer* 25. The experimental material included total forty-six entries comprising thirty-two crosses, four lines and eight testers along with two checks AHB 1200 Fe and AHB 1269 were evaluated during *Kharif* 2025 at the Experimental field of National Agricultural Research Project (NARP) Chh. Sambhajinagar. In the form of modified line x tester design as suggested by *Arunachalam* (1974).

Table 1. Source and features of parental lines and check.

Sr. No.	Lines	Sr. No.	Testers	Sr. No.	Checks
1.	ICMA-98222A	1.	F6-6R	1.	AHB 1200 Fe
2.	ICMA-95111A	2.	18111R	2.	AHB 1269
3.	ICMA-92888A	3.	15333R		
4.	ICMA-99555A	4.	17592R		
		5.	16739R		
		6.	15535R		
		7.	SBP-2R		
		8.	15385R		

Table 2. Details of Pearl millet crosses.

Sr. No.	Crosses	Sr. No.	Crosses
1.	ICMA-98222A x F6-6R	17.	ICMA-92888A x F6-6R
2.	ICMA-98222A x 18111R	18.	ICMA-92888A x 18111R
3.	ICMA-98222A x 15333R	19.	ICMA-92888A x 15333R
4.	ICMA-98222A x 17592R	20.	ICMA-92888A x 17592R
5.	ICMA-98222A x 16739R	21.	ICMA-92888A x 16739R
6.	ICMA-98222A x 15535R	22.	ICMA-92888A x 15535R
7.	ICMA-98222A x SBP-2R	23.	ICMA-92888A x SBP-2R
8.	ICMA-98222A x 15385R	24.	ICMA-92888A x 15385R
9.	ICMA-95111A x F6-6R	25.	ICMA-99555A x F6-6R
10.	ICMA-95111A x 18111R	26.	ICMA-99555A x 18111R
11.	ICMA-95111A x 15333R	27.	ICMA-99555A x 15333R
12.	ICMA-95111A x 17592R	28.	ICMA-99555A x 17592R
13.	ICMA-95111A x 16739R	29.	ICMA-99555A x 16739R
14.	ICMA-95111A x 15535R	30.	ICMA-99555A x 15535R
15.	ICMA-95111A x SBP-2R	31.	ICMA-99555A x SBP-2R
16.	ICMA-95111A x 15385R	32.	ICMA-99555A x 15385R

RESULTS AND DISCUSSION

Heterosis is a natural phenomenon which makes hybrid offspring of genetically diverse individual and display improved physical and functional characteristics relative to their parents (Shull 1948).

Negative heterosis is desirable for the character days to 50% flowering. The values for better parent heterosis fluctuated between -16.70% to 5.42% whereas, the cross ICMA-92888A x SBP-2R (-16.70%) showed highest negative significant heterosis over better parent. The cross ICMA-92888A x 15535R (5.42 %) showed positive heterosis over better parent. The heterosis over standard hybrid check AHB 1200 Fe ranged from (-15.41 %) to (6.02%) whereas the cross ICMA-92888A x 18111R (-15.41%) recorded highest significant negative heterosis over standard check AHB 1200 Fe. The heterosis over standard check AHB 1269 ranged from (-14.45%) to (7.22%). The cross ICMA-92888A x 18111R (-14.45 %) showed highest significant negative heterosis. Twenty-five crosses showed significant negative heterosis over both the checks.

Negative heterosis is desirable for days to maturity. The values for better parent heterosis fluctuated between -13.87% to 2.47 % whereas, the cross ICMA-92888A x SBP-2R (-13.87%) showed highest negative significant heterosis over better parent. The cross (ICMA-95111A x 15385R) 2.47 % showed lowest heterosis over better parent for days to maturity. The heterosis over standard hybrid check AHB 1200 Fe ranged from (-8.30%) to (1.25%) whereas the cross ICMA-92888A x 18111R (-8.30%) showed highest significant negative heterosis over standard check AHB 1200 Fe. The heterosis over standard check AHB 1269 ranged from (-10.04%) to (1.79%) The cross from ICMA-92888A x 15385R (-10.04%) showed highest significant negative heterosis. Twenty-one crosses showed significant negative heterosis over both the checks.

Under the investigation, the negative heterosis for plant height was considered as desirable, and over better parents it ranged between (-27.36%) to (20.88%). The cross ICMA-98222A x 17592R (-27.36%) showed significantly highest negative heterosis over better parents. The heterosis over standard hybrid check AHB 1200 Fe ranged from (-18.90%) to (25.26%) whereas the cross ICMA-98222A x 15333R (-18.90%) showed highest significant negative heterosis over standard check AHB 1200 Fe. The heterosis over standard check AHB 1269 ranged from (-22.99%) to (18.94%) The cross ICMA-98222A x 15333R (-22.99%) recorded highest negative significant heterosis. Seventeen crosses showed significant negative heterosis over both the checks.

Positive heterosis for number of tillers per plant was considered as desirable. The heterosis over better parent ranged from (-56.52 %) to (217.27 %). The cross ICMA-92888A x 18111R (217.27 %) showed highest positive heterosis over better parent, followed by ICMA-92888A x SBP-2R (119.23 %). The heterosis over standard hybrid check AHB 1200 Fe ranged from (-47.86 %) to (84.21 %) and AHB 1269 ranged from (-42.86 %) to (100 %). The heterosis over standard hybrid check AHB 1200 Fe (84.21 %) ICMA-99555A x 17592R and second heterosis over standard hybrid check AHB 1269 (100 %) ICMA-99555A x 17592R displayed highest positive over standard check. Eleven crosses showed positive heterosis over both the checks.

Positive heterosis for panicle length was considered as desirable. The heterosis over better parent ranged from (-33.33%) to (22.61%). The hybrid ICMA-92888A x 18111R (22.61%) recorded highest positive significant heterosis over better parent, followed by ICMA-99555A x 17592R (13.39 %). The heterosis over standard hybrid check AHB 1200 Fe ranged from (-26.27) % to (29.95 %) and AHB 1269 ranged from (-27.70 %) to (27.60 %). The heterosis over standard hybrid check AHB 1200 Fe (29.95%), ICMA-92888A x 18111R and second standard hybrid check AHB 1269 (27.60 %) ICMA-92888A x 18111R exhibited highest positive heterosis over standard check. Twelve crosses showed positive heterosis over both the checks.

Positive heterosis for panicle girth was considered as desirable. The heterosis over better parent ranged from (-44.62%) to (19.54%). The hybrid ICMA-98222A x 17592R (19.54 %) showed highest positive significant heterosis over better parent, and hybrid ICMA-98222A x SBP-2R (-44.62 %) showed negative heterosis over better parent. The heterosis over standard hybrid check AHB 1200 Fe ranged from (-20.45 %) to (64.09 %) and AHB 1269 ranged from (-25.53 %) to (53.62). The heterosis over standard hybrid check AHB 1200 Fe (64.09%) ICMA-98222A x 17592R and second standard hybrid check AHB 1269 (53.62%) ICMA-98222A x 17592R recorded highest positive significant heterosis over standard check. Sixteen crosses showed positive heterosis over both the checks.

Positive heterosis for test weight was considered as desirable. The heterosis over better parent ranged from (-23.16 %) to (61.40%). The hybrid ICMA-99555A x 17592R (61.40%) showed highest positive significant heterosis over better parent, and hybrid ICMA-92888A x 16739R (-23.16 %) showed negative heterosis over better parent. The heterosis over standard hybrid check AHB 1200 Fe ranged from (-17.59 %) to (69.64 %) and AHB 1269 ranged from (-17.92 %) to (61.02 %). The heterosis over standard hybrid check AHB 1200 Fe (69.64 %) ICMA-92888A x 18111R and another standard hybrid check AHB 1269 Fe (61.02 %) ICMA-92888A x 18111R displayed highest positive significant heterosis over standard check. Ten crosses showed positive heterosis over both the checks.

Positive heterosis for grain yield was considered as desirable. The heterosis over better parent ranged from (-33.41 %) to (22.89%). The hybrid ICMA-99555A x 15385R (22.89 %) showed highest positive significant heterosis over better parent, and hybrid ICMA-99555A x F6-6R (-33.41 %) showed lowest heterosis over better parent. The heterosis over standard hybrid check AHB 1200 Fe ranged from (-20.18 %) to (48.19 %) and AHB 1269 ranged from (-25.98 %) to (37.43 %). The heterosis over standard hybrid check AHB 1200 Fe (48.19%) ICMA-92888A x 18111R and second standard hybrid check AHB 1269 Fe (37.43%) ICMA-92888A x 18111R displayed highest positive heterosis over standard check. Eleven crosses showed positive heterosis over both the checks.

Positive heterosis for fodder yield was considered as desirable. The heterosis over better parent ranged from (-29.79%) to (28.60 %). The hybrid ICMA-92888A x 17592R (28.60%) showed highest positive significant heterosis over better parent, and hybrid ICMA-98222A x 15333R (-29.79 %) showed lowest heterosis over better parent. The heterosis over standard hybrid check AHB 1200 Fe ranged from (-20.57 %) to (15.60 %) and AHB 1269 ranged from (-17.04 %) to (20.74 %). The heterosis over standard hybrid check AHB 1200 Fe (15.60%) ICMA-92888A x 17592R and second standard hybrid check AHB 1269 (20.74%) ICMA-92888A x 17592R displayed highest positive heterosis over standard check. Eighteen crosses showed positive heterosis over both the checks.

CONCLUSION

1. Significant negative heterosis for earliness was observed in twenty-five crosses. The cross ICMA-92888A x SBP-2R recorded the highest negative better-parent heterosis (-16.70%) for days to 50% flowering, indicating its suitability for developing early maturing hybrids.
2. For grain yield per plant, the highest significant standard heterosis over both checks was exhibited by ICMA-92888A x 18111R, followed by ICMA-99555A × 17592R, ICMA-95111A × 15333R, ICMA-92888A x SBP-2R and ICMA-99555A × 15385R, indicating their superiority for yield improvement.
3. The cross ICMA-99555A × 17592R expressed the highest positive standard heterosis for test weight over better parent, while ICMA-92888A x 18111R showed highest significant standard heterosis over both checks and ICMA-95111A × 15333R also showed remarkably high positive heterosis for both test weight and grain yield. Four hybrids recorded significant superior standard heterosis over both the ckecks.

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Table 3 Analysis of variance for different characters in Pearl millet.

Source	D.F.	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of tillers/plant	Panicle length (cm)	Panicle girth (cm)	Test weight (g)	Grain yield (g)	Fodder yield (g)
Replications	1	0.08	0.98	3.76	0.05	0.52	0.02	0.07	0.01	0.26
Genotypes	43	12.61 **	22.30 **	717.67 **	0.92 **	20.78 **	0.46 **	15.66 **	91.43 **	68.84 **
Parents	11	14.64 **	19.75 **	1105.16 **	0.81 **	7.18 **	0.03 **	3.38 **	29.81 **	100.53 **
Crosses	31	10.31 **	16.21 **	602.49 **	0.99 **	25.13 **	0.51**	20.06 **	111.37 **	59.58 **
Parents v/s Crosses	1	61.63 **	238.95 **	26.19 **	1.17	35.75 **	3.03 **	14.25 **	150.98 **	7.35 **
Error	43	0.34	0.66	10.28	0.07	0.43	0.02	0.07	0.45	0.69

Table 4. The estimates of heterosis over better parent (BP) and standard check (SH) for various characters in Pearl millet.

Sr. No.	Crosses	Days to 50% flowering			Days to maturity			Plant height (cm)		
		BPH	SH1	SH2	BPH	SH1	SH2	BPH	SH1	SH2
1.	ICMA-98222A x F6-6R	-1.94	-4.89 **	-3.80 **	-6.28 **	-6.60 **	-8.37 **	0.80	1.17	-3.93 *
2.	ICMA-98222A x 18111R	-1.21	-7.71 **	-6.65 **	-4.46 **	0.00	-1.90 *	20.88 **	19.09 **	13.08 **
3.	ICMA-98222A x 15333R	-2.47 *	-3.57 **	-2.47 *	-1.26	-1.59	-3.46 **	-26.03 **	-18.90 **	-22.99 **
4.	ICMA-98222A x 17592R	-6.33 **	-8.27 **	-7.22 **	-3.08 **	-3.41 **	-5.25 **	-27.36 **	-17.67 **	-21.82 **
5.	ICMA-98222A x 16739R	-1.21	-7.71 **	-6.65 **	-3.65 **	-3.98 **	-5.80 **	-18.80 **	-5.56 **	-10.32 **
6.	ICMA-98222A x 15535R	-11.03 **	-10.53 **	-9.51 **	-4.45 **	-2.39 *	-4.24 **	-0.98	0.31	-4.75 *
7.	ICMA-98222A x SBP-2R	-12.00 **	-4.89 **	-3.80 **	-13.45 **	-6.26 **	-8.04 **	-3.80	-3.09	-7.98 **
8.	ICMA-98222A x 15385R	-7.45 **	-4.32 **	-3.23 **	-1.14	-1.48	-3.35 **	-20.91 **	-15.19 **	-19.47 **
9.	ICMA-95111A x F6-6R	-1.74	-4.70 **	-3.61 **	-7.30 **	-6.14 **	-7.92 **	-4.00	-3.64	-8.50 **
10.	ICMA-95111A x 18111R	-2.56 *	-6.95 **	-5.89 **	-8.70 **	-4.44 **	-6.25 **	3.13	1.61	-3.52
11.	ICMA-95111A x 15333R	-9.32 **	-10.34 **	-9.32 **	-8.76 **	-7.62 **	-9.38 **	-17.46 **	-9.51 **	-14.08 **
12.	ICMA-95111A x 17592R	-4.99 **	-6.95 **	-5.89 **	-5.51 **	-4.32 **	-6.14 **	-20.93 **	-10.38 **	-14.90 **
13.	ICMA-95111A x 16739R	-2.56 *	-6.95 **	-5.89 **	-9.10 **	-7.96 **	-9.71 **	-27.35 **	-15.50 **	-19.77 **
14.	ICMA-95111A x 15535R	-8.41 **	-7.89 **	-6.84 **	-0.89	1.25	-0.67	3.72	5.06 *	-0.23
15.	ICMA-95111A x SBP-2R	-12.70 **	-5.64 **	-4.56 **	-8.61 **	-1.02	-2.90 **	8.71 **	9.51 **	3.99 *
16.	ICMA-95111A x 15385R	-5.27 **	-2.07	-0.95	2.47 *	3.75 **	1.79	-12.27 **	-5.93 **	-10.67 **
17.	ICMA-92888A x F6-6R	0.77	-1.13	0.00	-3.81 **	-2.39 *	-4.24 **	-3.82	-3.46	-8.33 **
18.	ICMA-92888A x 18111R	-13.79 **	-15.41 **	-14.45 **	-12.17 **	-8.08 **	-9.82 **	-9.09 **	-10.44 **	-14.96 **
19.	ICMA-92888A x 15333R	-1.14	-2.26 *	-1.14	-1.35	0.11	-1.79	-2.59	6.79 **	1.41
20.	ICMA-92888A x 17592R	-2.87 *	-4.70 **	-3.61 **	-4.71 **	-3.30 **	-5.13 **	-14.71 **	-3.34	-8.21 **
21.	ICMA-92888A x 16739R	-4.21 **	-6.02 **	-4.94 **	-2.13 *	-0.68	-2.57 **	2.23	18.90 **	12.90 **
22.	ICMA-92888A x 15535R	5.42 **	6.02 **	7.22 **	1.22	3.41 **	1.45	5.55 **	6.92 **	1.52
23.	ICMA-92888A x SBP-2R	-16.70 **	-9.96 **	-8.94 **	-13.87 **	-6.71 **	-8.48 **	-9.07 **	-8.40 **	-13.02**
24.	ICMA-92888A x 15385R	-9.27 **	-6.20 **	-5.13 **	-9.64 **	-8.30 **	-10.04**	-11.29 **	-4.88 *	-9.68 **
25.	ICMA-99555A x F6-6R	-11.43 **	-14.10 **	-13.12 **	-9.88 **	-6.60 **	-8.37 **	-15.38 **	-8.89 **	-13.49**
26.	ICMA-99555A x 18111R	-0.20	-5.26 **	-4.18 **	-6.20 **	-1.82	-3.68 **	-21.34 **	-15.32**	-19.59**
27.	ICMA-99555A x 15333R	-0.38	-1.50	-0.38	-5.49 **	-2.05 *	-3.91 **	-14.82 **	-6.61 **	-11.32**
28.	ICMA-99555A x 17592R	-10.94 **	-12.78 **	-11.79 **	-10.10 **	-6.83 **	-8.59 **	-5.29 **	7.35 **	1.94
29.	ICMA-99555A x 16739R	1.98	-3.20 **	-2.09	-6.92 **	-3.53 **	-5.36 **	7.70 **	25.26 **	18.94 **
30.	ICMA-99555A x 15535R	-7.48 **	-6.95 **	-5.89 **	-7.79 **	-4.44 **	-6.25 **	-11.19 **	-4.39 *	-9.21 **
31.	ICMA-99555A x SBP-2R	-7.30 **	0.19	1.33	-8.61 **	-1.02	-2.90 **	-3.04	4.39 *	-0.88
32.	ICMA-99555A x 15385R	-12.55 **	-9.59 **	-8.56 **	-8.56 **	-5.23 **	-7.03 **	-4.82 *	2.47	-2.70

Table 3. cont…

Sr. No.	Crosses	No. of tillers per plant			Panicle length (cm)			Panicle girth (cm)		
		BPH	SH1	SH2	BPH	SH1	SH2	BPH	SH1	SH2
1.	ICMA-98222A x F6-6R	-52.17 **	-42.11 **	-37.14 *	-19.63 **	-18.89 **	-20.36**	-28.37 **	-5.91	-11.91
2.	ICMA-98222A x 18111R	-43.48 **	-31.58 *	-25.71	-17.83 **	-12.90 **	-14.48**	-23.53 **	0.45	-5.96
3.	ICMA-98222A x 15333R	-10.87	7.89	17.14	-11.33 **	4.61	2.71	-7.79	21.14 **	13.40
4.	ICMA-98222A x 17592R	-13.04	5.26	14.29	4.18	14.75 **	12.67 **	19.54 **	64.09 **	53.62 **
5.	ICMA-98222A x 16739R	-52.17 **	-42.11 **	-37.14 *	-13.25 **	-0.46	-2.26	-21.45 **	3.18	-3.40
6.	ICMA-98222A x 15535R	-50.00 **	-36.84 *	-31.43	-33.33 **	-26.27 **	-27.60**	-26.35 **	5.45	-1.28
7.	ICMA-98222A x SBP-2R	-56.52 **	-47.37 **	-42.86 **	1.52	23.04 **	20.81 **	-44.62 **	-20.45**	-25.53**
8.	ICMA-98222A x 15385R	-52.17 **	-42.11 **	-37.14 *	-18.02 **	-16.13 **	-17.65**	-34.92 **	-6.82	-12.77
9.	ICMA-95111A x F6-6R	-35.00 *	-31.58 *	-25.71	-14.09 **	-12.90 **	-14.48**	-34.48 **	-5.00	-11.06
10.	ICMA-95111A x 18111R	-12.50	-26.32	-20.00	-28.70 **	-24.42 **	-25.79**	-40.13 **	-13.18	-18.72**
11.	ICMA-95111A x 15333R	30.43 *	57.89 **	71.43 **	8.20 **	27.65 **	25.34 **	1.41	47.05 **	37.66 **
12.	ICMA-95111A x 17592R	62.50 **	36.84 *	48.57 **	2.09	12.44 **	10.41 **	-11.13 *	28.86 **	20.64 **
13.	ICMA-95111A x 16739R	-18.75	-31.58 *	-25.71	-26.51 **	-15.67 **	-17.19**	-36.05 **	-7.27	-13.19
14.	ICMA-95111A x 15535R	-20.83	0.00	8.57	-11.25 **	-1.84	-3.62	-34.17 **	-4.55	-10.64
15.	ICMA-95111A x SBP-2R	-31.25	-42.11 **	-37.14 *	2.28	23.96 **	21.72 **	-27.27 **	5.45	-1.28
16.	ICMA-95111A x 15385R	-6.25	-21.05	-14.29	-10.36 **	-8.29 *	-9.95 **	-26.33 **	6.82	0.00
17.	ICMA-92888A x F6-6R	-35.00 *	-31.58 *	-25.71	-11.42 **	-10.60 **	-12.22**	-1.34	33.64 **	25.11 **
18.	ICMA-92888A x 18111R	217.27 **	83.68 **	99.43 **	22.61 **	29.95 **	27.60 **	16.61 **	57.95 **	47.87 **
19.	ICMA-92888A x 15333R	-39.13 **	-26.32	-20.00	-25.78 **	-12.44 **	-14.03**	-14.43 *	15.91 *	8.51
20.	ICMA-92888A x 17592R	90.91 **	10.53	20.00	-1.26	8.76 **	6.79 *	-9.77	23.86 **	15.96 *
21.	ICMA-92888A x 16739R	-31.25	-42.11 **	-37.14 *	-24.10 **	-12.90 **	-14.48**	-10.07	21.82 **	14.04 *
22.	ICMA-92888A x 15535R	-45.83 **	-31.58 *	-25.71	-25.83 **	-17.97 **	-19.46**	-13.65 *	23.64 **	15.74 *
23.	ICMA-92888A x SBP-2R	119.23 **	50.00 **	62.86 **	1.52	23.04 **	20.81 **	-1.11	42.05 **	32.98 **
24.	ICMA-92888A x 15385R	-6.25	-21.05	-14.29	-9.46 **	-7.37 *	-9.05 **	-29.21 **	1.36	-5.11
25.	ICMA-99555A x F6-6R	-31.82 *	-21.05	-14.29	-6.47 *	0.00	-1.81	-28.66 **	4.09	-2.55
26.	ICMA-99555A x 18111R	-40.91 **	-31.58 *	-25.71	-15.95 **	-10.14 **	-11.76**	-28.97 **	3.64	-2.98
27.	ICMA-99555A x 15333R	-17.39	0.00	8.57	-18.36 **	-3.69	-5.43	-6.23	36.82 **	28.09 **
28.	ICMA-99555A x 17592R	59.09 **	84.21 **	100.00 **	13.39 **	24.88 **	22.62 **	6.39	55.23 **	45.32 **
29.	ICMA-99555A x 16739R	-36.36 **	-26.32	-20.00	-12.05 **	0.92	-0.90	-26.48 **	7.27	0.43
30.	ICMA-99555A x 15535R	-29.17 *	-10.53	-2.86	-12.50 **	-3.23	-4.98	-35.51 **	-5.91	-11.91
31.	ICMA-99555A x SBP-2R	-27.27 *	-15.79	-8.57	-12.55 **	5.99	4.07	4.36	52.27 **	42.55 **
32.	ICMA-99555A x 15385R	18.18	36.84 *	48.57 **	-5.17	18.89 **	16.74 **	-4.98	38.64 **	29.79 **

Table 3. cont…

Sr. No.	Crosses	Test weight (g)			Grain yield (g)			Fodder Yield (g)		
		BPH	SH1	SH2	BPH	SH1	SH2	BPH	SH1	SH2
1.	ICMA-98222A x F6-6R	-3.30	7.32 **	1.86	-25.88 **	-5.12 *	-12.01**	-8.12 **	-3.72 *	0.56
2.	ICMA-98222A x 18111R	-5.78 *	3.30	-1.95	-28.06 **	-15.06 **	-21.23**	0.68	5.50 **	10.19 **
3.	ICMA-98222A x 15333R	14.82 **	25.89 **	19.49 **	2.68	27.11 **	17.88 **	-29.79 **	-16.84**	-13.15**
4.	ICMA-98222A x 17592R	4.15	14.20 **	8.39 **	9.27 **	31.33 **	21.79 **	-24.20 **	-20.57**	-17.04**
5.	ICMA-98222A x 16739R	-21.03 **	-10.80 **	-15.34 **	-25.00 **	-3.31	-10.34**	-21.61 **	-13.83**	-10.00**
6.	ICMA-98222A x 15535R	-21.09 **	-13.48 **	-17.88 **	-22.96 **	-9.04 **	-15.64**	-23.92 **	-9.75 **	-5.74 **
7.	ICMA-98222A x SBP-2R	-9.12 **	-0.36	-5.42 *	-26.79 **	-13.55 **	-19.83**	-11.37 **	-6.03 **	-1.85
8.	ICMA-98222A x 15385R	-17.59 **	-9.64 **	-14.24 **	-21.43 **	-7.23 **	-13.97**	-9.84 **	0.71	5.19 **
9.	ICMA-95111A x F6-6R	-12.63 **	-3.04	-7.97 **	-22.82 **	-1.20	-8.38 **	16.13 **	14.89 **	20.00 **
10.	ICMA-95111A x 18111R	-14.68 **	-11.25 **	-15.76 **	-19.75 **	-4.52 *	-11.45**	-13.99 **	-12.77**	-8.89 **
11.	ICMA-95111A x 15333R	60.60 **	61.61 **	53.39 **	17.03 **	44.88 **	34.36 **	-22.16 **	-7.80 **	-3.70 *
12.	ICMA-95111A x 17592R	43.47 **	50.00 **	42.37 **	13.78 **	36.75 **	26.82 **	10.63 **	-4.08 **	0.19
13.	ICMA-95111A x 16739R	-21.34 **	-11.16 **	-15.68 **	-25.93 **	-4.52 *	-11.45**	-6.61 **	2.66	7.22 **
14.	ICMA-95111A x 15535R	-18.10 **	-17.59 **	-21.78 **	-29.37 **	-15.96 **	-22.07**	-4.63 **	13.12 **	18.15 **
15.	ICMA-95111A x SBP-2R	-9.67 **	-9.11 **	-13.73 **	-21.01 **	-6.02 **	-12.85**	-19.40 **	-14.54**	-10.74**
16.	ICMA-95111A x 15385R	-12.51 **	-11.96 **	-16.44 **	-24.81 **	-10.54 **	-17.04**	-17.46 **	-7.80 **	-3.70 *
17.	ICMA-92888A x F6-6R	-6.60 **	3.66	-1.61	-18.59 **	4.22 *	-3.35	5.38 **	4.26 **	8.89 **
18.	ICMA-92888A x 18111R	54.72 **	69.64 **	61.02 **	19.13 **	48.19 **	37.43 **	-2.27	-0.89	3.52 *
19.	ICMA-92888A x 15333R	-15.31 **	-7.14 **	-11.86 **	-10.90 **	10.84 **	2.79	-2.99 *	14.89 **	20.00 **
20.	ICMA-92888A x 17592R	28.66 **	41.07 **	33.90 **	6.05 **	31.93 **	22.35 **	28.60 **	15.60 **	20.74 **
21.	ICMA-92888A x 16739R	-23.16 **	-13.21 **	-17.63 **	-28.97 **	-8.43 **	-15.08 **	-5.16 **	4.26 **	8.89 **
22.	ICMA-92888A x 15535R	-20.44 **	-12.77 **	-17.20 **	-31.48 **	-14.76 **	-20.95 **	-13.75 **	2.30	6.85 **
23.	ICMA-92888A x SBP-2R	41.69 **	55.36 **	47.46 **	15.50 **	43.67 **	33.24 **	1.34	7.45 **	12.22 **
24.	ICMA-92888A x 15385R	-21.25 **	-13.66 **	-18.05 **	-30.02 **	-12.95 **	-19.27 **	-0.32	11.35 **	16.30 **
25.	ICMA-99555A x F6-6R	-22.12 **	-13.57 **	-17.97 **	-33.41 **	-14.76 **	-20.95 **	2.33	1.24	5.74 **
26.	ICMA-99555A x 18111R	-13.39 **	-9.91 **	-14.49 **	-30.26 **	-20.18 **	-25.98 **	-4.20 **	-2.84	1.48
27.	ICMA-99555A x 15333R	-1.51	-0.80	-5.85 *	-7.06 **	15.06 **	6.70 **	-8.38 **	8.51 **	13.33 **
28.	ICMA-99555A x 17592R	61.40 **	68.75 **	60.17 **	22.31 **	46.99 **	36.31 **	26.99 **	10.11 **	15.00 **
29.	ICMA-99555A x 16739R	-17.71 **	-7.05 **	-11.78 **	-23.25 **	-1.05	-8.24 **	-9.84 **	-0.89	3.52 *
30.	ICMA-99555A x 15535R	-15.96 **	-15.36 **	-19.66 **	-20.26 **	-8.73 **	-15.36 **	-14.80 **	1.06	5.56 **
31.	ICMA-99555A x SBP-2R	-12.41 **	-11.79 **	-16.27 **	-21.58 **	-10.24 **	-16.76 **	-0.17	5.85 **	10.56 **
32.	ICMA-99555A x 15385R	50.71 **	51.79 **	44.07 **	22.89 **	40.66 **	**	-8.73 **	1.95	6.48 **