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HETEROSIS STUDIES FOR YIELD AND YIELD ATTRIBUTING TRAITS IN FORAGE MAIZE (*ZEA MAYS* L.)

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ABSTRACT

The utility of heterosis *per se* may not be of much use, but cross combinations showing excellent hybrid vigour can be used in developing high yielding forage hybrids in maize crop. The present investigation was conducted at Main Forage Research Station, Anand Agricultural University, Anand during *rabi*, 2012 season. The experimental material consisted of 45 F_1 and their 14 parents. Material was sown in randomized complete block design with three replications. The hybrids were evaluated to know the extent of heterosis over better parent. For green forage yield per plant, maximum heterobeltiosis observed in the hybrid African Tall x GWC-0319 (104.87 per cent). This hybrid can be identified as potential hybrid for wide spread cultivation and commercial exploitation after necessary testing. This cross can also be advanced for isolation of superior genotypes and selected genotypes may intermated to map up fixable genetic variance.

Key words : Forage Maize, Heterosis, Heterobeltiosis, Hybrid, Parents

Maize (*Zea mays* L.) ranks second in position after sorghum among the cereal fodder crops. It is one of the most important dual purpose crops grown in *kharif*, *rabi* and summer for grain and fodder purpose. Its quick growth and high palatability of fodder for cattle and wider adaptability over a wide range of environmental conditions and cropping seasons signifies as a good forage crop. It has no toxins and can be fed to the cattle at all growth stages in any quality. Indeed, maize green fodder has some lactogenic properties resulting in increased milk production. It is also fact that very few hybrid varieties have been released in forage maize. Information available on heterosis breeding in forage maize is limited; hence, this attempt was made to investigate the extent of heterosis for forage yield and its attributing traits.

MATERIALS AND METHODS

The field experiment was conducted at the Main Forage Research Station, Anand Agricultural University, Anand during *rabi*-2012 season. The experiment was laid out in randomized block design (RBD) with three replications having a plot size of 4.5 m x 0.60 m. The present study consisted of a set of 9 lines (female parents) and 5 testers (male parents). Parents were crossed in a line x tester mating design (9 x 5) during *rabi*-2011. Seeds of each entry were grown in two rows of 4.5 m length with 30 cm spacing between rows and 15 cm within rows. Recommended agronomic practices were followed for raising the crop. Observations were recorded on five randomly competitive plants for fodder yield and related traits. The data obtained for each character were analyzed by the statistical procedure given by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Heterobeltiosis (superiority over better parent) for all the characters were estimated while interpreting the results, positive heterobeltiosis effects were considered as favourable effect for the traits *viz.*, plant height, number of leaves, leaf length, leaf width, leaf : stem ratio and green forage yield per plant.

Positive heterosis is desirable for plant height. Heterobeltiosis ranged from -27.39 to 15.89 per cent (Table 1). Total 14 crosses were found significantly positive for heterobeltiosis in this character. The cross combination J-1006 x GWC-0401 (15.89%) had significantly the highest estimate of heterobeltiosis.

TABLE 1
Heterosis in percentage in F_1 hybrid over better parent (BP) in forage maize

Cross	Plant height (BP%)	No. of leaves/plant (BP%)	Leaf length (BP%)	Leaf width (BP%)	Leaf : stem ratio	Green forage yield/plant (BP%)
IC-107121 x IC-130643	-27.39**	-6.22	5.72	2.76	94.35**	-42.22**
IC-107121 x IC-130693	-9.26*	-7.25	-3.04	10.04	11.57**	-18.51**
IC-107121 x GWC-0319	-7.75	-12.44*	-0.68	-10.31	-14.12**	-40.23**
IC-107121 x GWC-0320	-15.50**	-9.80	4.80	-3.44	87.12**	-23.17**
IC-107121 x GWC-0321	3.36	-6.54	3.74	0.18	29.46**	-30.43**
IC-107121 x GWC-0401	1.71	-8.79*	9.42	-14.10	18.39*	-25.43**
IC-107121 x GWC-0511	-4.08	-4.85	5.67	3.26	35.17**	-10.97**
IC-107121 x GWC-0512	-4.15	-4.15	-3.09	9.43	22.86**	-28.17**
IC-107121 x GWC-9603	-1.06	-5.70	4.22	-0.62	-17.84**	-15.15**
IC-130726 x IC-130643	11.61**	1.54	2.06	-11.73	23.88**	-30.60**
IC-130726 x IC-130693	-20.24**	-7.69	-9.74	-2.45	-53.31**	-30.33**
IC-130726 x GWC-0319	-23.94**	-11.79*	-13.71*	-11.60	-5.50	-42.68**
IC-130726 x GWC-0320	-12.34**	-8.33	-0.81	6.60	19.22**	-34.41**
IC-130726 x GWC-0321	8.03	-9.93*	-4.51	1.42	-21.34**	-5.19*
IC-130726 x GWC-0401	14.00**	-4.51	-5.77	0.09	46.03**	-31.65**
IC-130726 x GWC-0511	0.73	-5.34	1.35	-5.84	45.13**	-36.31**
IC-130726 x GWC-0512	13.73**	5.13	7.03	27.83**	8.84	33.29**
IC-130726 x GWC-9603	14.94**	-1.03	1.62	1.45	72.82**	-17.86**
GM-6 x IC-130643	5.86	1.06	-2.59	-4.52	24.09**	-35.96**
GM-6 x IC-130693	4.22	0.00	7.82	2.28	-23.07**	2.33
GM-6 x GWC-0319	8.22	-3.19	14.41*	-2.72	3.89	-21.62**
GM-6 x GWC-0320	-6.68	-3.43	5.74	-2.28	-17.21**	-17.98**
GM-6 x GWC-0321	11.17**	-7.99	4.80	-4.39	46.30**	-38.64**
GM-6 x GWC-0401	9.63*	-8.31	12.52*	-6.67	-14.11*	-12.83**
GM-6 x GWC-0511	11.50**	0.97	1.41	-12.02	42.73**	-28.83**
GM-6 x GWC-0512	15.21**	1.06	8.83	-1.05	38.65**	15.65**
GM-6 x GWC-9603	10.63*	0.53	18.48**	-0.09	36.99**	-11.39**
J-1006 x IC-130643	10.01**	-2.07	14.17*	-16.93*	-4.38	-15.55**
J-1006 x IC-130693	12.66**	0.52	4.61	-6.00	20.47**	12.13**
J-1006 x GWC-0319	11.96**	2.59	13.37*	-12.16	-41.34**	-1.10
J-1006 x GWC-0320	-10.04**	-6.37	10.81	-15.78*	43.74**	-30.26**
J-1006 x GWC-0321	5.51	3.63	10.98	2.63	-28.87**	7.48**
J-1006 x GWC-0401	15.89**	-0.71	10.98	-7.97	-35.57**	25.16**
J-1006 x GWC-0511	-7.00	-2.43	11.87*	3.78	-23.73**	0.65
J-1006 x GWC-0512	2.34	-0.52	-5.92	-6.33	-25.87**	-4.26
J-1006 x GWC-9603	9.15*	-1.04	7.00	-24.40**	13.90**	-40.84**
African Tall x IC-130643	-0.88	15.12**	-4.28	2.68	-2.80	14.83**
African Tall x IC-130693	-0.59	6.08	2.22	11.33	-53.25**	22.53**
African Tall x GWC-0319	0.69	8.38	-4.94	21.91*	-44.35**	104.87**
African Tall x GWC-0320	-15.79**	-2.45	-3.21	18.93*	-24.53**	20.74**
African Tall x GWC-0321	1.07	-1.69	-18.20**	11.11	-37.93**	101.87**
African Tall x GWC-0401	-2.08	-4.51	-7.08	22.07*	40.32**	13.53**
African Tall x GWC-0511	-0.93	-2.91	-3.46	5.65	8.06	48.01**
African Tall x GWC-0512	6.60	12.29*	-9.14	2.79	34.56**	42.46**
African Tall x GWC-9603	-7.98*	-10.81*	-27.59**	-31.00**	-35.57**	-18.22**
Range						
Min.	-27.39	-12.44	-27.59	-31.00	-53.31	-42.68
Max.	15.89	15.12	18.48	27.83	94.35	104.87
S. E±	7.62	0.61	4.43	0.58	0.04	13.34
No. of significant crosses	23	7	9	8	39	41
Positive	14	2	6	4	22	13
Negative	9	5	3	4	17	28

*, **Significant at 5% and 1% respectively.

Similar results were also reported by Shete *et al.* (2011).

Estimates of heterobeltiosis for number of leaves per plant varied from -12.44 to 15.12 per cent (Table 1). Out of 45 crosses, only 2 crosses had shown significant heterobeltiosis. The cross combination African Tall x IC-130643 (15.12%) depicted the highest significant positive heterobeltiosis. These results were akin with reports of Patel *et al.* (2004).

Estimates of heterobeltiosis for leaf length varied from -27.59 to 18.48 per cent (Table 1). Total 6 crosses were found significantly positive for heterobeltiosis in this character. The cross combination GM-6 x GWC-9603 (18.48%) recorded significantly the highest heterobeltiosis in desirable direction for this trait. Similar results were also reported by Patel *et al.* (2004).

For leaf width, the estimates of the range of heterobeltiosis was -31.00 to 27.83 per cent (Table 1). Out of 45 crosses, 4 crosses had shown significantly positive heterobeltiosis. The cross combination IC-130726 x GWC-0512 (27.83%) recorded significantly the highest heterobeltiosis effect among all crosses. Appreciable levels of heterobeltiosis for this character had been reported earlier by Choi *et al.* (1995) and Patel *et al.* (2004).

Positive heterosis is desirable for leaf : stem ratio. More leaves may increase the palatability of fodder. The estimates of heterobeltiosis ranged from -53.31 to 94.35 per cent (Table 1). Total 22 crosses were found significantly positive for heterobeltiosis in this character. Among the cross combinations, IC-107121 x IC-130643 (94.35%) showed significantly the highest heterobeltiosis in desired direction. Similar results were also reported by Patel *et al.* (2004).

For most important character green forage yield per plant, the values of heterobeltiosis ranged from -42.68 to 104.87 per cent (Table 1). Out of 45 crosses, 13 crosses exhibited significantly positive heterobeltiosis. Among the cross combinations, African Tall x GWC-0319 (104.87%) depicted significantly the highest heterobeltiosis suggesting as good cross combination for this important character. Similar results were also reported by Mistri and Patil (1994), Santos *et al.* (1994) and Patel *et al.* (2004).

CONCLUSION

It was concluded that the cross combinations *viz.*, African Tall x GWC-0319 depicted significantly the highest heterobeltiosis and considered as good cross combination for green forage yield. This hybrid can be identified as potential hybrids for wide spread cultivation and commercial exploitation after necessary testing. This cross can also be advanced for isolation of superior genotypes and selected genotypes may intermated to map up fixable genetic variance.

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