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Heterosis for yield and yield components in grain amaranth (*Amaranthus* spp.)

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ABSTRACT

Forty five hybrids of grain amaranth (*Amaranthus* spp.) derived through 10x10 diallel fashion excluding reciprocals along with their ten parents were evaluated to estimate the magnitude of heterobeltiosis and standard heterosis. Heterosis to the extent of 35.6 and 20.7 per cent in desirable direction was recorded for seed yield per plant over better parent and standard check *viz.*, GA-2, respectively. Crosses with high x high and high x low gca parents exhibited greater heterosis. Heterosis for seed yield was generally accompanied by heterosis for yield components. From present investigation the hybrids GA-1xGA-2, GA-1xIC-120588-1-1 and GA-1xSKNA-18-1 were identified as promising for most of the desirable traits which could be considered for exploitation of hybrid vigour in grain amaranth.

Key words : Heterosis, Standard heterosis, *Amaranthus* spp. and Yield attributing traits

INTRODUCTION

Grain amaranth is one of the important pseudo-cereal crops and an excellent source of easily digestible protein. The choice of the parents and breeding methodology are matters of great concern to plant breeders. The magnitude of heterosis provides a basis for determining genetic diversity and also serves as a tool to the choice of desirable parents. The present investigation was, therefore, carried out to assess the extent heterosis over better parents and standard check *viz.* GA-2 for yield and yield components in grain amaranth.

MATERIALS AND METHODS

Ten diverse genotypes of grain amaranth (*Amaranthus* spp.) were crossed 10 x 10 diallel crosses excluding reciprocals. The resultant F_1s along with their ten parents were evaluated in randomized block design replicated thrice during *rabi* 2004-2005 at All India Co-ordinated Research Project on Underutilized Crops, Regional Research Station, Sardarkrushinagar Dantiwada Agricultural University. Each genotype was sown 3m long single row keeping spacing of 45cm between rows and 15cm between plants in a row. The observations were recorded on five competitive plants selected randomly for seed yield per plant (g) and its component traits like, days to 50 per cent flowering, days to 80 per cent maturity, plant height (cm), earhead length(cm), number of fingers per earhead, number of branches per plant, finger length (cm), straw yield per plant (g),1000-seed weight (g), harvest index (%) and protein content (%). Heterosis over better parent (BP) and standard check (SC) was estimated as suggested by Fonesca and Patterson(1968) and Meredith and Bridge (1972), respectively.

RESULTS AND DISCUSSION

The estimates of mean squares were highly significant for all the characters except for 1000-seed weight and protein content indicating the large genetic variability of parents. The range, heterosis over better parent (BP) and standard check(SC) and most heterotic crosses are presented in Table 1. The magnitude of heterosis varied from cross to cross for all the characters. Considerable high heterosis in certain crosses and low in other crosses revealed that nature of gene action varied with the genetic architecture of parents.

Amongst forty five crosses, five most promising combinations were identified and their heterotic expression for different characters are presented in Table 2. Eight and one cross exhibited significant positive heterobeltiosis and standard heterosis for seed yield per plant, respectively. Cross GA-2xSKNA-21 registered highest heterobeltiosis(35.61%) for seed yield per plant. Cross GA-1xGA2 manifested highest standard heterosis (20.73%) over GA-2 for seed yield per plant accompanied by desirable standard heterosis for number of fingers per plant, straw yield per plant and 1000-seed weight. These results are in accordance with Fesenko and Antonov (1973), Shcheglakova (1976), Lehman *et al.* (1991) and Aruna and Ponnuswami(1998).

In general, crosses sowing high heterosis for seed yield per plant also manifested heterotic effects for other yield components. This association among yield and yield attributes have been reported as the case of "combination heterosis" (Harberg, 1952).

For protein content, heterobeltiosis and standard heterosis was expressed by seven and two crosses, respectively. Two promising crosses for this trait were IC-120588-1xIC-95307(8.53%) and IC-120588-1xAG-

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Table 1 : Range of heterosis over better parents (BP) and standard check (SC) and best heterotic crosses for twelve characters in grain amaranth

Characters	Range		Heterosis (%) over		No. of crosses showing desirable significant heterosis		Best parents	Most heterotic crosses
	Parents	Crosses	BP	SC	BP	SC		
Seed yield per plant(g)	37.67 to 61.00	35.33 to 64.00	-31.88 to 35.61 GA-1XIC-35713	-56.44 to 20.34 GA-1 X GA-2	8	1	GA-1, GA-2, IC-120588-1-1	GA-1XGA-2, GA-1XIC-120588-1-1, GA-1XSKNA-18-1
Days to 50% flowering	87.00 to 113.00	81.00 to 115.00	-25.41 to 37.14 GA-2 XAG-114-1	-25.88 to 34.15 SKNA-7-1 X AG-114-1	9	3	SKNA-7-1, IC-120588-1, GA-2	SKNA-7-1XAG-114-1, IC-120588-1XSKNA-7-1, GA-2XSKNA-7-1
Days to 80% maturity	74.20 to 165.20	68.32 to 166.70	-12.96 to 14.56 AG-114-1X SKNA-21	-6.93 to 19.80 AG-114-1 X SKNA-21	11	3	SKNA-7-1, IC-120588-1, GA-2	AG-114-1XSKNA-21, IC-120588-1XSKNA-7-1, IC-120588-1XSKNA-7-1
Plant height (cm)	54.62 to 89.23	50.23 to 91.23	-7.92 to 108.37 SKNA-7-1XAG-114-1	-56.49 to 0.00 SKNA-7-1X AG-114-1	4	14	SKNA-7-1, IC-95307, AG-114-1	SKNA-7-1XAG-114-1, SKNA-7-1XSKNA-18-1, SKNA-7-1XSKNA-21
Earhead Length(cm)	25.16 to 85.89	22.17 to 90.58	-29.18 to 5.39 AG-114-1XSKNA-20	-43.70 to 2.24 GA-1 X GA-2	4	0	GA-2, GA-1, SKNA-21	-
No. of finger per earhead	13.52 to 27.53	9.80 to 27.78	-65.45 to 33.26 GA-2XAG-114-1	-71.92 to 14.71 GA-1 X SKNA-18-1	4	2	GA-1, GA-2, IC-35713	GA-1XSKNA-18-1, GA-1XGA-2
Finger length (cm)	2.00 to 7.73	1.00 to 6.86	-47.73 to 15.23 AG-114-1XSKNA-21	-68.65 to 68.77 AG-114-1XSKNA-21	5	6	SKNA-7-1, GA-1, GA-2	SKNA-7-1XAG-114-1, SKNA-7-1XIC-35713, SKNA-7-1XSKNA-21
No. of branches per plant	11.39 to 28.08	11.09 to 30.74	-100.00 to 51.82 SKNA-18-1XIC-35713	-	3	-	SKNA-7-1, SKNA-20, SKNA-18-1	-
straw yield per plant(g)	51.29 to 94.23	46.29 to 95.26	-37.69 to 23.92 GA-1 X SKNA-20	-26.01 to 52.24 GA-1XGA-2	6	14	GA-1, AG-114-1, SKNA-18-1	GA-1XGA-2, GA-1XSKNA-7-1, GA-1XIC-120588-1
1000-seed weight (g)	0.63 to 0.72	0.62 to 0.88	-16.59 to 37.82 GA-1 X GA-2	-0.06 to 0.37 GA-1X GA-2	20	34	IC-35713, SKNA-20, SKNA-18-1	GA-1XGA-2,GA-1XAG-114-1 GA-2XIC-35713
Harvest index(%)	16.30 to 28.97	14.41 to 29.47	-29.46 to 14.22 GA-1 XSKNA-18-1	-50.25 to 1.72 GA-1XSKNA-18-1	5	-	GA-2, GA-1, SKNA-7-1	-
protein content(%)	12.70 to 14.98	13.00 to 15.39	-7.47 to3.92 SKNA-21 X IC-3571	-8.60 to 8.53 IC-120588-1X IC-95307	7	2	IC-120588-1	IC-120588-1XIC-95307, IC-120588-1XAG-114-1

NE: For trait DF, DM and FH, negative heterosis is desirable

Table 2 : Heterosis for twelve characters in grain amaranth

Characters	Heterosis in promising crosses (%) for seed yield					
	Over better parent					Over standard check
	GA-1X IC-35713	SKNA-21X IC-35713	SKNA-20X IC-95307	GA-1XGA-2	IC-95307X IC-35713	GA-1XGA-2
Days to 50% flowering	8.39**	4.71**	4.29**	-2.10**	13.57**	-2.09
Days to 80% maturity	3.45**	1.85**	-1.90**	2.64**	3.60**	2.64
Plant height (cm)	8.49**	3.27**	5.53**	3.48**	7.27	3.48**
Earhead length (cm)	0.26	0.94	0.23	2.24*	-0.45	2.24
No. of fingers per earhead	-12.46**	-7.13*	1.75	5.08**	-11.29**	14.29**
Fingers length (cm)	5.69	-7.42	-3.75	12.48**	-1.21	17.73
No. of branches per plant	-100.00**	-42.31**	-45.95**	-	-13.64**	-
Straw yield per plant (g)	-27.37**	12.98**	1.63	1.09	-5.16*	52.24**
1000-seed weight (g)	-9.22**	-16.59**	-3.74**	37.82**	-5.53*	0.37**
Harvest index (%)	-8.71**	-15.15	5.59*	-29.46**	-1.65	-29.47**
Protein content (%)	-1.13	3.92**	-1.02	0.36	-5.48**	4.79

* and ** indicates significant of values at P=0.05 and 0.01, respectively

114-1(8.46%) by registering highest significant economic heterosis.

The magnitude of standard heterosis in desirable direction was high for finger length (68.77%), plant height (-56.49%), straw yield per plant (52.24%), whereas low to moderate for days to 50% flowering (-25.88%), number of fingers per earhead (14.71%), days to maturity (–6.93%) and 1000-seed weight (0.37%) (Table 2).

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