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HETEROSIS FOR YIELD AND RELATED CHARACTERS IN MULBERRY

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ABSTRACT

Heterosis in mulberry was studied for leaf yield and its component characters in 15 hybrids developed from 8 parents comprising of 3 females and 5 males. Analysis of variance showed significant differences among the parents and crosses. Greater variability in the parents indicated the possibility of getting higher heterosis in the crosses. None of the crosses showed uniformity in the heterosis for yield components. However, significant positive heterosis to the magnitude of 46.76 to 72.27% over better parent, 34.7 to 149.69% over mid parent and 38.1 to 38.54% over standard variety (S1)was observed among the crosses for leaf yield. Heterosis breeding in mulburry, thus, found to be quite achievable, though mulburry is known to be highly heterozygous. Berhampore-1 x Kajli seems to be highly promising for future utilisation.

Key words: Mulberry, heterosis, leaf yield.

Mulberry (*Morus* spp.) is an economically important, vegetatively propagated tree grown for its foliage in sericulture. In tropical countries,mulberry is generally propagated through vegetatively means hence, traits like high leaf yield, leaf quality can be perpetuated in successive clonal generations without much alterations. Exploitation of hybrid vigor is considered to be one of the outstanding achievements of plant breeding and the scope of its exploitation depends upon the direction and magnitude of gene interactions involved. In general heterosis for yield could always be attributed to a significant level of heterosis in at least one of the components. Since, in mulberry, only very few attempts [1] have been made to obtain information on these aspects, the present study was undertaken to investigate the level of heterosis results from the intra and inter allelic gene interactions among mulberry varieties to formulate appropriate breeding strategy to evolve varieties with higher leaf yield and better leaf quality.

MATERIALS AND METHODS

Eight mulberry varieties, comprising of 3 females namely Berhampore-1,

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China white and MS-5 and 5 males namely Mandalaya, Kosen, Assam Jati, MS-1 and Kajli were crossed in all possible combinations without reciprocals. The parents and the resultant 15 hybrids were planted in a randomized block design having three replications under 60 cm. × 60 cm spacing. The recommended (2) cultural practices were followed. In order to obtain stable results, observations were made after three years of plating. Data on morphological traits like number of branches sprouted form the the stump after pruning, height of the longest shoot on 90th day of pruning, inetrnodal distance, leaf-twig ratio, weight of 100 oven dry leaves were recorded from 15 plants in three seasons, namely, winter, rainy and summer for two years. The standard method of analysis of variances was adopted to test the genetic differences among the treatments, parents as well as crosses. Magnitude of heterosis as percent increases or decrease in F1 generation over mid parent [3], better parent [4] and standard variety in this zone i.e. S1 [5] for important characters were calculated.

RESULTS AND DISCUSSION

Analysis of variance (Table 1) revealed significant differences among the parents and crosses in all the characters under the study. Higher values of mean sum of square of variance for parents indicate greater variability among them due to which possibility of getting more heterosis opens up. In two characters, namely leaf yield and number of primary branches, values for parent vs. crosses were found to be highly significant while other characters such as weight of 100 dry leaves, plant height, internodal distance and leaf-twig ratio were found to be non-significant suggesting that these traits are under the control of additive genes. This significant

Table 1. Analysis of Variance for different characters in Mulberry

Source	d.f.	100 dry leaf wt.	No. of tillers	Plant height	Internodal distance	Leaf:Twig ratio	Survival (%)	Total leaf/yr
				Mean Sum of Squares				
Rep	2	19.8	98.7	270.9	0.04	0.002	4.5	1630570*
Var	22	1141.0**	736.7**	783.3**	1.58**	0.005**	585.6**	2994398**
P	7	2003.1**	807.4**	834.6**	2..53**	0.005**	952.6**	2938118**
C	14	773.9**	689.0**	813.4**	1.21**	0.005**	406.2**	2685217**
PvsC	1	244.9	909.3**	2.4	0.04	0.002	528.5**	7716892**
Error	44	67.4	123.2	111.3	0.19	0.001	9.1	499873

**Significant at P = 0-01

variance noticed for leaf yield and number of primary branches in parent vs. crosses suggests that means of parents as a group differs significantly from those of crosses as a group. Which may be due to heterosis resulting from dominant genes and its interactions or from complementary gene interactions, as reported [6] in rice.

None of the crosses showed uniformly high heterosis in all the traits under the study. The magnitude of heterosis differed widely for characters and crosses as well. Significant positive heterosis to the magnitude of 46.76 to 72.27 percent over better parent, 34.7 to 149.9 percent over mid parent and 38.10 to 38.54 percent over standard variety was observed among the crosses for leaf yield. Since leaf yield in mulberry is a complex trait under the influence of many characters, the cumulative effects of the heterosis of these characters decides the performance of crosses on leaf yield. Crosses which give high levels of heterosis for leaf yield over the better parent or superiority over the best parent are most desirable for plant breeders. Heterosis in Berhampore-1 × MS-1 (46.71), Berhampore-1 × Kajli (72.27), China white × MS-1 (64.83) were significantly more over better parent; Berhampore-1 × MS-1 (50.18), Berhampore-1 × Kajli (149.69), China white × Mandalaya (47.35), China white × Assamjati (34.71), China white × MS-1 (80.28), China white Kajli × (2.11) and MS-5 × Kajli (102.29) were showing high heterosis over mid parent. Similarly, Berhampore-1 × Kajli (38.10) China white × MS-1 (38.54) were better than the standard variety. The existence of considerable heterosis in yield exceeding 25% over the standard variety observed in 2 out of the 15 crosses suggests that it is possible to obtain hybrids showing superiority to the outstanding commercial varieties. Since an optimal strategy for consistently producing high yielding, highly heterotic crosses is lacking in mulberry, the most reliable crossing combinations would have to be determined by progeny testing to identify superior varieties for hybrid development [7].

Similar trend in heterosis for all other contributing characters is expected. Almost all the crosses showed high heterosis for weight of 100 dry leaves. The significant positive heterosis for weight of 100 dry leaves ranged from 37.29 to 143.91 percent over the mid parent, 49.65 to 134.94 percent over better parent and 37.14 to 74.10 percent over the local commercial high yielding variety. Out of the three female parents China white was found to have high heterosis with all the male parents. This positive heterosis over the mid parent and better parent suggest that dominant or overdominant genes controlled the expression of this character as reported in pea [8].

Only one cross i.e; Berhampore-1 × Kajli showed significant positive heterosis (50.7%) over the better parent for number of primary branches. Crosses Berhampore-1 × Kosen, Berhampore-1 × MS-1Berhampore-1 × Kajli, MS-5 × Kosen, MS-5 × MS-1 and MS-5 × Kajli were having significant positive heterosis over mid parent. None of them exhibited significant positive Heterosis over the standard commercial high yielder, rather it has decreased considerably in some of the crosses.

Table 2. Heterosis over better parent, mid parent and standard variety

Cross	Parent	100 dry leaf wt.	No. of tiller	Plant height	Internoral dist.	Leaf Twig ratio	Survival percentage	Total leaf/yr
Berhampore × Mandalaya	Better	−19.32	3.65	−1.92	0.02	−8.62	−1.50	−4.98
-do-	Mid	−18.53	19.16	3.27	1.44	−5.80	−0.76	5.48
-do-	Standard	−17.72	3.65	−1.92	0.02	−2.80	−1.50	−4.98
Berhampore × Kosen	Better	−50.26**	9.15	12.16	3.28	−26.74**	−0.76	−23.42
-do-	Mid	−36.08**	58.97	18.00**	6.76	−18.98**	41.30**	−7.84
-do-	Standard	−8.83	−19.27	0.88	0.40	−3.62	−2.26	−7.25
Berhampore x MS-1	Better	23.17	27.33	9.64	5.24	−11.13*	0.76	46.71*
-do-	Mid	50.32**	39.49*	12.66*	12.85*	−7.46	1.54	50.18**
-do-	Standard	25.63	14.06	−1.38	2.31	2.66	−0.75	23.31
Berhampore x Kajli	Better	−34.82*	50.70*	4.17	−24.07**	−18.51**	−1.53	72.27**
-do-	Mid	−13.59	59.70**	19.03**	−10.84	−12.08**	2.79	149.69**
-do-	Standard	−33.52*	11.46	−6.30	−26.19**	1.52	−3.01	38.10*
China White x Mandalaya	Better	49.65**	−25.52	−10.25	6.63	4.96	−4.51	24.99
-do-	Mid	75.73**	−8.63	−5.75	11.69	9.50*	−3.05	47.35**
-do-	Standard	49.65**	−25.52	−10.25	6.63	14.45*	−4.51	24.99
China White x Kosen	Better	−5.02	−9.09	−7.86	4.52	−5.10	1.55	−5.82
-do-	Mid	37.29**	26.44	−2.80	4.55	3.78	43.96**	19.58
-do-	Standard	74.10**	−42.71**	−16.65**	−4.96	24.84**	−1.50	14.05
China White x Assam Jati	Better	14.52	−3.73	−8.46	−11.38*	−2.03	0.78	14.01
-do-	Mid	49.09**	9.93	−3.43	1.52	−0.88	1.17	34.71*
-do-	Standard	50.15**	−19.27	−7.56	8.06	9.35	−2.26	14.63
China White x MS-5	Better	134.94**	−16.28	−5.02	7.50	2.44	0.78	64.83**
-do-	Mid	143.91**	−1.71	−2.13	11.70	5.39	0.78	80.28**
-do-	Standard	65.19**	−25.00	−14.07*	−2.24	18.33**	−2.26	38.54*

Chine White x Kajli	Better	95.04**	-1.59	-27.15**	-1.07	-3.97	3.88	38.06
-do-	Mid	124.76**	0.40	-16.56**	12.96	2.41	7.63**	91.11**
-do-	Standard	37.14	-35.42*	-34.10**	-10.04	19.62**	0.75	-3.85
M-5 x Mandalaya	Better	-35.25**	-23.96	-3.69	-11.61*	-5.43	-0.75	0.04
-do-	Mid	-14.72	13.62	-2.74	-4.89	2.87	8.20**	24.34
-do-	Standard	24.85	-23.96	-3.69	2.93	12.77*	-0.75	0.04
MS-5 x Kosen	Better	-46.49**	66.15	0.95	-14.64*	-8.71	-42.34**	-34.33*
	Mid	-45.14**	83.05*	10.55	-4.11	-4.23	-21.95**	-12.62
	Standard	3.17	-43.75**	-1.00	-0.60	20.10**	-51.88**	-20.47
MS-5 x Assam Jati	Better	-25.27**	-27.95	-19.12**	-14.94**	9.37*	-8.59**	-11.93
	Mid	-11.04	2.65	-17.93**	-12.99**	12.99**	-2.09	9.69
	Standard	44.08**	-39.58**	-18.32**	30.42**	30.42**	-12.03**	-11.45
MS-5 x MS-1	Better	-45.81**	25.58	1.08	-1.68	-11.56*	0.78	-8.91
	Mid	-18.98*	82.28**	8.22	14.18*	-10.16*	8.33**	5.62
	Standard	4.49	12.50	-0.88	14.49	5.46	-2.26	-23.44
MS-5 x Kajli	Better	-44.59**	32.54	-18.79**	-19.99**	-6.14	10.00**	51.71
	Mid	-12.62	74.87**	-3.80	0.83	-4.09	14.29**	102.29**
	Standard	6.84	-13.02	-20.37**	-6.83	16.92**	-0.75	-7.58

Negative heterosis for internodal distance has usually been considered desirable, as this would enhance the number of leaves per unit length of the stem thereby increases the leaf yield per unit area (9-10). The significant negative heterosis over better parent having less internodal distance ranged from 11.38 to –42.47 percent. Heterosis in Berhampore-1 × Assamjati and Berhampore-1 × Kajli were found to be significant over the standard variety.

For survival percentage, significant positive heterosis over better parent was observed in MS-5 x Kajli. Heterosis in Berhampore-1 × Kosen, China white × Kosen, China white × Kajli, MS-5 × Mandalaya, MS-5 × MS-1 and MS-5 × Kajli were significant over mid parent. Significant and positive heterosis over standard commercial variety for leaf-twig ratio ranged from 14.45 percent to 30.42 percent indicating the possibility of quantitative improvement in the crosses. However, no such cases happened relating to better or mid parent.

From this study, it can be concluded that heterosis breeding in mulberry is quite possible, though mulberry is known to be highly heterozygous. It has further, been observed that a hybrids Berhampore-1 × Kajli is highly promising for future utilisation.

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