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Short Communication

Variability, heritability and genetic advance in nine germplasm lines of mulberry (*Morus* spp.)

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Mulberry (*Morus* spp.) is the sole food plant of silkworm (*Bombyx mori* L.). As higher productivity of silk is correlated with the quality of leaf produced per unit area of cultivation and thus to economic returns in sericulture, high yielding mulberry varieties coupled with quality are the prime targets set before the mulberry breeders. Therefore, the present study was undertaken to assess the variability, heritability and genetic advance of different growth and foliar characters along with foliage yield in different species of mulberry in order to utilizing them in future breeding programme.

Nine germplasm lines comprising six mulberry species *viz.*, *Morus alba, M. rotundiloba, M. nigra, M. cathyana, M. australis* and *M. multicaulis* and three germplasm lines of the species *M. indica viz., M. indica* "x", *M. indica* "Black" and *M. indica* "HP" were planted in augmented randomized block design during the year 2000. There were 25 plants (5 × 5) for each species and were in 60 cm × 60 cm spacing. After one year of establishment of plants in the field, the plants were pruned and data were recorded by following 5 crop schedule of the zone for consecutive 2 years. Pruning schedule and cultural practices were followed as per the recommendations of Ray *et al.*, [1]. Middle nine plants were considered for recording of data excluding the border plants. Different growth characters *viz.*, number of shoots/plant, length of longest shoot, nodal distance, total shoot length, leaf/twig ratio, leaf harvest index (%); foliar characters *viz.*, fresh and dry weight of 100 leaves, leaf/petiole ratio by length and weight, single leaf area, leaf moisture content, specific leaf weight (SLW) and leaf yield were recorded. The genotypic and phenotypic coefficients of variations were computed by following the formula given by Burton [2]. Heritability (in broad sense) and genetic advance were estimated according to Lush [3].

The analysis of variance showed the presence of significant genotypic differences among the species for growth, yield attributing (Table 1 and 2) and foliar characters (Table 3 and 4) except leaf/petiole ratio by length. Co-efficient of variation for different growth and yield attributing characters ranged from 10.67% (Leaf harvest index) to 30.92 % (nodal distance), while for foliar characters it was from 6.99% (leaf moisture content) to 43.18 % (weight of 100 fresh leaves), suggesting wide variations among these characters. Genotypic variance (σ^2g) and genotypic co-efficient of variation (GCV) were lesser than that of the phenotypic variance (σ^2p) and phenotypic co-efficient of variation (PCV), respectively, for most of the characters. The small differences between GCV and PCV indicate that the variability was primarily due to genotypic differences among the species. The higher difference between GCV and PCV was observed for the characters leaf/petiole ratio (l) and leaf/petiole ratio (w), suggests the influence of environment on these characters. Heritability (h^2) (in broad sense) was found high (>75%) in both the yield attributing and foliar characters, which varies from 0.91-0.99, offering a considerable scope for selection except the particular two foliar characters *viz.*, leaf/petiole ratio (l) and leaf /petiole ratio (w) where it was found 0.59 and 0.67, respectively, confirming the influence of environment on these characters.

Heritability alone will not able to give successful results in improving specific traits unless there is a higher genetic gain, which is attributable to additive gene action. Higher expected genetic advance as percent mean was obtained for yield attributing characters like nodal distance (54.79 %), total shoot length (49.57 %) and leaf/twig ratio (42.73 %) and among foliar characters it was in weight of 100 fresh leaves (91.02 %), single leaf area (78.47 %) and weight of 100 dry leaves (76.95 %). High heritability coupled with high genetic gain and co-efficient of variability was observed for the yield attributing characters *viz.*, nodal distance, total shoot length, leaf/twig ratio and leaf yield and foliar characters *viz.*, weight of 100 fresh and dry leaves and single leaf area indicating a possible role of additive gene effects for genotypic variance of these characters. The mulberry species identified as superior genotypes for different traits, from among the species studied, could be exploited for hybridization and high magnitude of transgression of specific characters in the F_1 population.

Table 1. Character means for different growth and yield attributing characters in 9 different mulberry (*Morus*) species

Variety	No. of shoots	LLS (cm)	ND (cm)	TSL (cm)	Leaf/twig ratio	LHI (%)	Leaf yield/plant (g)
M. alba.	10.68	83.33	3.92	578.40	1.24	54.75	228.88
M. rotundiloba	10.06	64.95	3.22	414.00	1.43	56.01	114.66
M. Indica X	8.15	80.60	7.69	467.60	1.37	55.84	192.33
M. indica Black	7.88	77.46	3.77	525.51	1.85	58.83	216.17
M. indica HP	12.62	69.73	4.68	554.56	1.36	56.52	244.22
M. nigra	11.02	86.46	4.66	541.80	1.16	52.47	176.66
M. cathyana	8.62	77.62	5.69	511.40	1.46	58.09	194.00
M. australis	11.80	114.91	4.53	880.48	0.71	40.93	185.44
M. multicaulis	8.13	68.33	4.26	443.06	1.70	61.48	269.55
Range	6.00-15.20	50.80-122.00	3.08-11.08	306.00-1053.20	0.59-1.86	37.00-67.35	98.00-356.00
Mean	9.88	80.38	4.71	546.31	1.33	54.99	202.44
SE	0.23	1.68	0.16	16.44	0.03	0.65	6.12
CD at 5% level	1.30	5.60	0.78	73.02	0.10	1.96	36.84
CV (%)	21.25	18.77	30.92	26.91	21.14	10.67	27.05

Table 2. Variability, heritability and genetic advance for different growth and yield attributing characters in mulberry

Parameter	No. of shoots	LLS (cm)	ND (cm)	TSL (cm)	Leaf/twig ratio	LHI (%)	Leaf yield/plant (g)
σ^2 g	2.88	214.90	1.64	17932.55	0.077	33.83	1826.10
σ^2 p	3.09	218.83	1.72	18600.66	0.078	34.32	1996.10
GCV (%)	17.16	18.23	27.20	24.51	20.90	10.57	21.11
PCV (%)	17.79	18.40	27.83	24.96	21.06	10.65	22.07
h^2	0.93	0.98	0.95	0.96	0.98	0.98	0.91
GA	3.37	29.92	2.58	270.86	0.57	11.89	84.19
GA (% of mean)	34.12	37.23	54.79	49.57	42.73	21.63	41.59

LLS-Length of longest shoot; ND-Nodal distance; TSL-Total shoot length; LHI-Leaf harvest index (%).

Table 3. Character means for different foliar characters in 9 different mulberry (*Morus*) species

Variety	Wt. of 100 leaves (g) (fr)	Wt. of 100 leaves (g) (dr)	Leaf/ratio (l)	Leaf petiole ratio (w)	Single Leaf area (cm^2)	LMC (%)	SLW (g/m^2)
M. alba.	135.277	27.869	5.997	9.485	85.062	78.35	32.785
M. rotundiloba	90.032	13.972	4.125	7.315	48.958	77.22	30.776
M. Indica X	247.707	42.072	6.406	14.541	135.988	81.37	30.938
M. indica Black	243.910	44.239	6.005	11.398	140.595	78.94	30.208
M. indica HP	198.926	40.970	4.930	10.349	110.578	71.07	40.279
M. nigra	95.042	21.018	4.834	12.997	66.559	75.09	38.245
M. cathyana	214.485	45.242	6.017	10.605	126.939	81.58	40.680
M. australis	108.084	32.946	4.038	9.186	69.795	67.12	47.647
M. multicaulis	325.911	58.342	5.277	9.944	170.449	83.20	34.922
Range	78.09-367.07	12.09-67.57	3.38-18.53	4.72-29.59	39.65-191.42	61.43-86.44	24.21-56.56
Mean	184.37	36.30	5.29	10.64	106.10	77.10	36.28
SE	8.90	1.51	0.19	0.43	4.43	0.60	0.73
CD at 5% level	18.19	3.72	1.56	3.41	9.93	2.03	3.31
CV (%)	43.18	37.23	33.43	36.21	37.40	6.99	18.17

Table 4. Variability, heritablility and genetic advance for different foliar characters in mulberry

Variety	Wt. of 100 leaves (g) (fr)	Wt. of 100 leaves (dr)	Leaf/petiole ratio (l)	Leaf petiole ratio (w)	Single leaf area (cm^2)	LMC (%)	SLW (g/m^2)
σ^2g	6682.44	185.56	0.44	3.08	1646.07	27.03	33.39
σ^2p	6727.24	187.30	0.75	4.55	1658.44	27.55	34.77
GCV (%)	44.33	37.53	12.67	16.50	38.23	6.74	15.93
PCV (%)	44.48	37.70	16.42	20.03	38.38	6.80	16.26
h^2	0.99	0.99	0.59	0.67	0.99	0.98	0.96
GA	167.83	27.93	1.06	2.98	80.26	10.60	11.66
GA (% of mean)	91.02	76.95	20.13	27.99	78.47	13.75	32.15

LMC-Leaf moisture content (%); SLW-Specific leaf weight.

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