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Research Notes

Genetic variability and correlation studies in selected mulberry (*Morus* spp.) germplasm accessions

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Abstract
Genetic variability analysis and heritability of different yield contributing characters were studied in 26 genotypes of mulberry. Variance analysis for characters revealed significant differences among the accessions. Phenotypic coefficient of variation (PCV %) was found higher than the genotypic coefficient of variation (GCV %) for all the characters studied. High genetic advance coupled with heritability was observed in the characters namely, number of branches per plant, leaf yield per plant, leaf-shoot ratio, hundred leaf weight and total shoot length. Significant positive correlations to leaf yield/plant were observed for the characters, number of branches/plant (0.835**), longest shoot length (0.823**) and total shoot length (0.707**). Leaf yield/plant is an important agronomic character induced by many associated traits and hence characters like number of branches/plant, longest shoot length and total shoot length should be considered crucial parameters for selection in mulberry breeding programme.

Keywords:
Mulberry, variability, heritability, correlation

Mulberry leaves are the exclusive food source of silkworm *Bombyx mori* L. and are cultivated under both tropical and temperate climatic conditions within India and across Asia. It is grown as small bushes and 60% of cost involved in total production of silkworm cocoon production goes to mulberry cultivation only (Das and Krishna swami 1965). Development of new high yielding varieties with superior leaf yield has been the major goal for the breeders. Variability assessment in the germplasm lines and creation of variability are two major components for any breeding programme to be successful. Yield being a quantitative character is always associated with many contributing traits hence a thorough knowledge of such traits is very important for the selection of genotypes. Prior knowledge of genetics on yield contributing traits of mulberry is very much necessary to formulate a breeding strategy. Such information with respect to mulberry is very scarce and in the present study an attempt was made to estimate the magnitude of genotypic and phenotypic variation, heritability, genetic advance and correlation of yield contributing traits among the selected accessions of mulberry.

Twenty six mulberry accessions maintained at germplasm bank, Department of Sericulture, Bangalore University, Bangalore, India were used for the present study. Recommended cultural practices (Ray *et al.,* 1973) were followed and irrigation was provided as and when required. Data were recorded in two wet seasons from 2006 to 2007 on characters like, leaf length, leaf width, petiole length, petiole width, leaf thickness, number of branches, longest shoot length, total shoot length, inter-nodal distance, hundred leaf weight, leaf area, leaf shoot ratio, leaf yield/plant. Data were computed for analysis of variance for all the characters according to Federer (1977). Phenotypic and genotypic coefficients of variation were computed as per Burton and Dewane

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(1953) and heritability and genetic advance by the method outlined by Hanson *et al.,* (1956) and Johnson *et al.,* (1955).

Genetic variability in any crop is a pre-requisite to initiate the breeding programme for the selection of superior entries over the existing cultivars. Variance analysis for characters revealed significant differences among the accessions studied and are presented in table 1 and table 2. Analyzed data indicated the presence of wide range of variability in the plant material thus providing the scope for selection of accessions to strategize the breeding programme. Maximum range of variation was observed for the character, total shoot length followed by hundred leaf weight and leaf area. Phenotypic, genotypic and environmental variances, heritability and genetic advance of the characters studied are presented in table 2. Higher values of most of the characters depict the high environmental influence. Higher variance was observed for the characters *viz.,* total shoot length, hundred leaf weight and leaf area.

Yield being a quantitative character is influenced by many genes and are highly controlled by environmental factors. Observed variability is the sum total of hereditary effects from concerned genes as well as the environment. Hence the variability is partitioned into heritable and non-heritable components with suitable genetic parameters such as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance (GA). These genetic parameters help the breeders in selection of genotypes and crop improvement.

Wide range of variation was observed for the characters studied under irrigated conditions. Phenotypic coefficient of variation (PCV %) was found higher than the genotypic coefficient of variation (GCV %) for all the characters studied. Minimum distance between PCV and GCV was found for all the characters studied except petiole width, suggesting the role of environment on this particular character. Heritability was also found higher in all the characters studied except petiole width. Such phenomenon of high heritability indicates the control of additive gene action in expression of these traits. Earlier studies of Johnson *et al.,(*1955*)* have proved that heritability estimates along with genetic gain is more useful than heritability alone in predicting the resultant effects of selection. Masilamani (year) also stated that certain quantitative traits having high heritability as well as genetic advance respond better to simple phenotypic selection as they contribute to additive gene action, which will aid in effective selection for aiding genetic improvement of quantitative traits in mulberry.

High genetic advance coupled with heritability was observed in the characters namely, number of branches per plant, leaf yield per plant, leaf-shoot ratio, hundred leaf weight and total shoot length. This suggests the prevalence of additive gene action with low environmental influence for the determination of these characters and could be effective in phenotypic selection. Moderate genetic advance coupled with high heritability noticed for the characters leaf width, petiole length and longest shoot length indicated the presence of intra and inter allelic interactions in the expression of these characters.

Correlation among the characters studied revealed considerable differences between phenotypic and corresponding genotypic correlations in all pairs of characters. The magnitude of genotypic correlations was always higher than their corresponding phenotypic correlations. Significant positive correlations to leaf yield/plant were observed for the characters, number of branches/plant (0.835**), longest shoot length (0.823**) and total shoot length (0.707**). Where as in earlier studies of Rahman *et al*.,(2006) positive correlations were observed between weight of 100 leaves and leaf area. Significant negative correlation with leaf yield/plant were observed for the characters, petiole length and leaf shoot ratio. Leaf yield/plant is an important agronomic character induced by many associated traits and hence characters like number of branches/plant, longest shoot length and total shoot length should be considered crucial parameters for selection in mulberry breeding programme.

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Table 1: Phenotypic variability of some selected characters in 26 mulberry germplasm accessions

Genotype	LL (cm)	LW (cm)	PL (cm)	PW (cm)	LT (µm)	Nob	LSL (cm)	TSL (cm)	IND (cm)	HLW (gm)	LA (sq.m)	LSR	LYP (kg)
Mysore local	14.27	11.71	3.99	0.28	171.75	27	159	3303.7	5.1	231.92	199.48	1.23	1.37
S 13	14.37	11.22	3.22	1.56	169.65	38	163.5	4298.8	4.8	227.95	204.1	1.41	1.95
S 36	14.65	12.69	3.88	0.35	143	33	141	2745.05	5.62	341.2	246.45	1.61	1.79
S 54	12.66	11.55	2.73	0.25	151.78	20	130	1228.3	5.5	233.7	238.7	1.77	1.33
S 31	14.51	11.68	3.71	0.29	154.95	21.5	135.35	1623.7	5.65	269.8	226.65	1.38	0.9
Akikalu	10.2	8.4	2.82	0.19	114.99	27	122.9	1795.05	4.84	127.85	129.8	1.61	0.8
DD/ Viswa	15.4	12.61	3.88	0.33	125.16	16.5	116.8	1604	4.75	248.45	229.15	1.69	0.91
V 1	20	14.01	3.93	0.33	139.46	31	146.3	3100	6.01	400.45	270.6	1.78	2.31
KNAVA 2/ M5	14.22	11.83	3.43	0.27	151.75	25.5	150.65	2168.7	5.63	283.6	269.05	1.57	1.55
S 41	14.31	11.35	3.88	0.31	168.81	23	141.83	2444.25	4.91	236.95	273.9	1.37	1.25
RFS 135	16.44	13.25	3.85	0.33	140.72	23	151.65	2196.5	5.96	315	269.65	1.39	1.3
RFS 175	17.75	13.87	3.74	0.36	173.41	22	143.25	1706.95	4.46	348	273.8	1.58	1.57
S 30	16.3	12.8	3.74	0.33	136.86	15	101.3	990.3	3.88	318.8	215.35	2.26	0.9
Berampore	14.61	19.84	6.05	0.4	146.25	10	79.07	1606.8	5.37	374.95	409.55	4.32	0.5
C 11	12.62	11.7	3.11	0.31	159.96	36	161	2408.5	4.42	226.7	233	1.4	2.3
S 14	17.61	14.45	3.5	0.32	117.25	33	149.5	3452.85	5.9	291.95	326.65	1.42	2.1
MR-2	15.72	10.68	3.84	0.3	181.75	29	139.5	3172.55	5.32	265.1	279.65	1.52	1.78
UAS 1	13.95	12.41	3.64	0.33	135.25	33	132.45	2737.2	5.03	295.45	253	1.53	1.7
CRR	16.08	11.67	3.43	0.3	151.5	57.75	163.25	2371.17	5.14	235.95	204.55	1.38	2.12
S 1	15.55	11.53	3.44	0.3	163.9	59	173.7	4983.3	5.43	238.45	195.55	1.33	2.43
Mysore local unlobed	14.5	11.61	3.25	0.29	178.85	30	161.5	3163.55	5.53	234.73	198.4	1.38	1.5
Famer house variety	15.89	21.45	6.61	0.4	137.15	11	79	1526.35	5.64	462	469.85	4.31	0.45
Channapatna local	15.13	11.73	3.68	0.27	171.25	23	151.9	2540.08	5.53	251.6	189.45	1.7	1.33
BC259	16.69	15.36	4.01	0.4	164.7	23.5	139.25	1827.5	5.42	400.4	310	2.03	1.55
Berampore local	15.81	21.15	6.17	0.32	136.05	12	78.65	1939.2	5.25	587.95	488.95	4.08	0.53
S 1708	17.64	16.23	5.34	0.4	181.5	14.5	133.3	1296.65	6.05	400.45	393.45	2.08	1.08
Range	10.20-20.00	8.40-21.45	2.73-6.61	0.19-1.56	114.99-181.75	10.00-59.00	78.65-173.70	990.30-4983.30	3.88-6.05	127.85-587.95	129.80-488.95	1.23-4.32	0.45-2.43
Mean	15.26	13.33	3.94	0.36	152.6	26.7	136.36	2393.5	5.27	301.89	269.18	1.88	1.43
SEm	0.22	0.28	0.08	0.25	0.63	1.54	1.17	137.94	0.25	21.68	15.76	0.24	0.13
CD (5%)	0.65	0.81	0.22	0.72	1.83	4.49	3.41	401.84	0.73	63.16	45.93	0.71	0.36
CV	2.1	2.9	2.8	95.9	0.6	8.2	1.2	8.1	6.7	10.2	8.3	18.2	12.3

Note: LL -Leaf longLL-Leaf length, LW-Leaf width, PL-Petiole length, PW-Petiole width, LT-Leaf thickness, Nob-Number of branches, LSL-Longest shoot length, TSL-Total shoot length, IND-Inter-nodal distance, HLW-Hundred leaf weight, LA-Leaf area, LSR-Leaf shoot ratio, LYL-Leaf yield/plant

Table 2: Estimation of phenotypic, genotypic and error variances and phenotypic (PCV) and genotypic (GCV) co-efficient of variations, heritability (h^2) and genetic advance (GA) for thirteen different characters in mulberry.

Traits	σ^2P	σ^2g	σ^2e	PCV (%)	GCV (%)	H^2 (%)	GA (% of mean)
Leaf length (cm)	3.763	3.664	0.099	12.71	12.54	0.97	25.50
Leaf width (cm)	10.106	9.952	0.153	23.84	23.66	0.98	48.36
Petiole length (cm)	0.974	0.962	0.012	24.97	24.81	0.99	50.80
Petiole width (cm)	0.123	0.001	0.122	96.18	6.92	0.01	1.03
Leaf thickness(µm)	373.864	373.061	0.803	12.67	12.66	1.00	26.05
No. of branches / plant	148.518	143.762	4.756	45.64	44.90	0.97	91.01
Longest shoot length (cm)	698.789	696.051	2.739	19.38	19.35	1.00	39.78
Total shoot length (cm)	931647.250	893595.625	380051.641	40.33	39.49	0.96	79.68
Inter-nodal distance (cm)	0.344	0.219	0.125	11.12	8.87	0.64	14.56
Hundred leaf weight (gm)	9364.627	8424.614	940.012	32.05	30.40	0.90	59.40
Leaf area (sq.m)	7754.544	7257.456	497.088	32.71	31.65	0.94	63.07
Leaf shoot ratio	0.866	0.748	0.118	49.31	45.84	0.86	87.78
Leaf yield/Plant (kg)	0.341	0.310	0.031	40.76	38.85	0.91	76.27