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GENETIC VARIATION, HERITABILITY, CORRELATION AND PATH ANALYSIS IN MULBERRY

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ABSTRACT

Twelve genotypes of mulberry (*Morus* spp.), exhibited genetic variation for plant height, number of primary branches, number of nodes per metre length of a branch, total number of leaves per plant, weight of 100 leaves, leaf area and leaf yield per plant. Heritability estimates were high (>70) for number of nodes per metre length of a branch, leaf area, weight of 100 leaves and leaf yield per plant ; moderate (> 50 and <70) for plant height and number of primary branches ; and low (>50) for total number of leaves per plant. Genotypic correlations of leaf yield per plant were highly significant and positive with plant height, number of primary branches, total number of leaves per plant weight of 100 leaves and leaf area. Maximum direct contribution to leaf yield per plant was made by number of primary branches, followed by plant height, number of nodes per metre length of a branch and weight of 100 leaves. Total number of leaves per plant and leaf area made sizeable indirect effects via number of primary branches, plant height and weight of 100 leaves.

KEY WORDS : Mulberry, *Morus* spp., correlation, path analysis, variation.

Mulberry (*Morus alba* L.), the sole food plant of silkworm (*Bombyx mori* L.) is cultivated in 3.13 lakh ha under different agro-climatic conditions in India. In all, there are 559 genotypes, comprising of 363 indigenous and 136 exotic strains being maintained in India (Dandin, 1989). Evaluation of genepool for important agronomic traits is the pre-requisite for mulberry improvement. A breeder is always concerned with the selection of superior genotype which perforce is dependent on the phenotypic expression. Often selection based on phenotypic performance does not lead to expected genetic advance mainly due to the presence of genotype (g) x environment (e) interactions as well as due to undesirable association between the complex characters at the genotypic level. Thus, knowledge of complex characters like leaf yield and its component characters, which show less susceptibility to environmental conditions, and are, therefore, capable of being measured with great precision, can obviously be of considerable use for a rational approach to the improvement of leaf yield. With the exception of a few earlier works (Das and Krishnaswamy, 1969; Sarkar *et al.*, 1987; Susheelamma *et al.* 1988 no work has been done on mulberry. Therefore, an attempt has been made to study the magnitude of genetic variability, heritability, genetic advance, nature and degree of inter-relationship between different characters and also to test the suitability of various traits for making direct and indirect selection with reference to the mulberry genotypes raised in hill tracts.

MATERIALS AND METHODS

Twelve promising genotypes of mulberry (*Morus* spp.). of which, 10 indigenous strains *viz.*, C-776, Cuckpilla, K-2, MS-2, S-13, S-34, S-1301, TR-4, TR-8, TR-10 and 2 exotic strains *viz.*, China White and English Black brought from the germplasm collection of Central Sericultural Research and Training Institute, Mysore and raised under pit system with a spacing of 120 cm x 90 cm in a randomised rod row design with three replications during May, 1991 at the Regional Sericultural Research Station, Coonoor. The station is located in the Western ghats of South India between 11° and 22° North latitude and 76°, 15' and 77° East latitude at an altitude of 1850 m above MSL. After the establishment of plants, the crown height was fixed at 50 cm from the ground level. Ten competitive plants were randomly selected and tagged for 90 days' (crop duration) growth observation. Standard cultural operations for mulberry raised under rainfed condition were followed. The observations were made on plant height (PH), number of primary branches NPBP, number of nodes per metre length (NNML) of a branch, total number of leaves per plant (TNLP), weight of 100 leaves, leaf area (LA) and leaf yield per plant (LYP) in three seasons *viz.*, spring, summer and autumn for the year 1993-95. Data were averaged to single plant basis for the purpose of statistical analysis.

The phenotypic and genotypic co-efficients of variation, broad sense heritability, genetic advance, phenotypic and genotypic correlations and path co-efficients were calculated as per normal methods.

RESULTS AND DISCUSSION

Genetic variation

The estimates of the components of variance, phenotypic and genetic co-efficient of variation (PCV and GCV), broad sense heritability and genetic advance are shown in Table 1. Genotypic differences in all characters were significant at 1 per cent level of probability. The PCV was generally higher than the GCV for all cases but in some cases the two values differed only slightly. The highest values were shown by LYP followed by NPB and weight of 100 leaves. The heritability estimates ranged from 48.42 to 94.09 per cent High heritability (>70) estimates were shown by NNML, LA, weight of 100 leaves and LYP. Moderate estimates (>50 and <70) were shown for PH and NPBP Low heritability (<50) was found in TNLP. The expected genetic advance, expressed as percentage of the mean varied from 13.65 to 66.54. Relatively very low values were recorded for PH, TNLP and NPBP. Comparatively high expected genetic advances were observed for LYP, NNML, weight of 100 leaves and LA.

The variation exhibited by the 12 genotypes in 7 quantitative characters indicates that selection for several of these characters may be effective. However, selection efficiency is related to the magnitude of heritability and genetic advance. According to Panse (1957), if heritability is chiefly due to additive gene effects, a high genetic advance may be expected. Hence high heritability in conjunction with high genetic advance is considered more useful than the heritability estimates alone in predicting the resultant effect in selection programme. NNML, weight of 100 leaves, LA and LYP can be considered highly reliable characters, and selection of the characters will be effective as they have high heritability estimates and high magnitude of genetic advance. The heritability estimates of NNML is higher than other characters which suggest that environmental effect constitute minor portion of the total phenotypic variation in this character. Thus selection for superior genotype based on NNML *per se* would be effective. For more efficient approach towards improvement of LY selection should be made on its components. The association of quantitative characters with LY, thus assumes special importance as the basis for selecting better genotypes for breeding programme.

Correlation between characters

The phenotypic and genetic correlations among the various characters are presented in Table 2. In most instances, there was a close agreement between phenotypic and genetic correlations while in other cases, the differences were high, signifying the importance of the environmental effect in estimating these parameters. Throughout the remainder of the section, reference will be made only to genetic correlations between various characters. All the

Table 1. Phenotypic and genetic co-efficient of variation, components of variance, heritability (H) and genetic adance (GA) of 7 characters of mulberry (*Morus* spp.)

Characters	Mean	F value	Phenotypic variance	Genotypic variance	PCV (%)	GCV (%)	H %	GA as % of mean
Plant height (cm)	209.5	5.94**	501.30	311.80	10.69	6.57	62.20	13.65
No. of primary branches	20.6	5.22**	60.18	35.16	37.73	28.84	58.42	45.43
No. of nodes/m length of a branch	16.0	48.62**	23.01	21.65	29.98	29.08	94.09	58.13
Total number of leaves/plant	423.4	3.82**	16514	7996	30.35	21.12	48.42	30.27
Weight of 100 leaves (g	260.2	15.94**	7249.9	6037.3	32.72	29.86	83.27	56.13
Leaf area (Sq. cm.)	146.4	20.05**	877.9	758.5	20.24	18.82	86.39	52.68
Leaf yield/plant (g)	865.0	10.99**	131963	101497	42.00	36.83	76.91	66.54

All the characters were significant at 1 % level

Table 2. Phenotypic (rp) and Genotypic (rg) correlation co-efficients among seven agronomic characters of mulberry

Correlated characters		Correlation co-efficients					
		Leaf yield	Plant height	No.of branch	No.of nodes / m length of a branch	Total No. of leaves / plant	Leaf area
Plant height	rp	0.709					
	rg	0.933**					
No. of primary	rp	0.634	0.294				
branches	rg	0.854**	0.800**				
No of nodes/m	rp	-0.522	-0.415	-0.359			
length of a branch	rg	-0.586**	-0.553**	-0.407*			
Total No. of	rp	0.567	0.510	0.744	-0.001		
leaves/plant	rg	0.813**	0.922**	0.911**	-0.135		
Leaf area	rp	0.322	0.071	0.247	-0.699	-0.052	
	rg	0.415*	0.201	0.262	-0.792**	-0.065	
Wt. of 100	rp	0.653	0.395	0.065	-0.507	0.055	0.509
leaves	rg	0.776**	0.578**	0.204	-0.550**	0.073	0.554**

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

characters, except NNML were found high significant positive association with LYP. NNML had significant negative correlation with all characters except TNLP. LA had poor correlation with PH and NPBP. Weight of 100 leaves also had poor correlation with NPBP and TNLP. LA had high significant positive correlation with weight of 100 leaves. In this study, LY has positive and significant correlation with all characters studied except NNML. The present result confirms the earlier investigation made by Das and Krishnaswamy (1969) and Sarkar *et al.* (1987).

Path co-efficient analysis

While correlation co-efficients generally described between the characters in statistical terms, they are inadequate in interpreting the cause and effect relationship. The correlation co-efficients between various characters could be partitioned into direct and indirect relationship by the path analysis technique. Leaf yield being the complex outcome of different characters was considered the resultant variable and PH, NPBP, NNML, TNLP, LA and weight of 100 leaves as caused variables. The direct and indirect effects of six associated characters are shown in Table 3. Of these, four characters *viz.*, PH, NPBP, NNML and weight of 100 leaves showed positive direct effect on LY. TNLP and LA which have shown significant positive correlation with LY exerted negative direct effect on LY. In contrast, NNML which has significant negative correlation with LY showed positive direct effect on LY. The indirect effect of PH via NPBP is higher than its direct

Table 3. Direct and indirect genetic effects via various paths of six agronomic characters on the leaf yield in mulberry

Characters	Indirect effect via						Genetic correlation with leaf yield/plant
	Plant height	No.of primary branches	No.of nodes/m length of a branch	Total No.of leaves	Leaf area	Wt. of 100 leaves	
Plant height	(0.529)	0.650	-0.129	-0.385	-0.001	0.269	0.933
No. of Primary branches	0.423	(0.813)	-0.095	-0.381	-0.001	0.095	0.854
No. of nodes/m length of a branch	-0.292	-0.330	(0.234)	0.057	0.001	-0.256	-0.586
Total No. of leaves	0.488	0.741	-0.032	(-0.419)	0.001	0.034	0.813
Leaf area	0.106	0.213	-0.185	0.027	(-0.005)	0.259	0.415
Wt. of 100 leaves	0.306	0.169	-0.129	-0.032	-0.004	(0.466)	0.776

Figures in parentheses denote the direct effects

Residual effect = 0.005

effect. LA influenced the LY via weight of 100 leaves, NPBP and PH. The result obtained by path analysis technique helps in direct and indirect selection of traits for genetic improvement of LY. It allowed us to detect those components which exhibit the highest effect on LY expression. Character *viz.*, PH, NPBP, NNML and weight of 100 leaves had positive direct effect on LY which should be paid close attention by breeders and direct selection of thesetraits will be rewarding for LY improvement. However, TNLP and LA influence the LY indirectly via PH, NPBP and weight of 100 leaves, indirect selection through such traits will be effective. The results obtained in this technique are in agreement with the earlier reports, of Susheelamma *et al.*, (1988).

An understanding of the nature of association of yield with their agronomic traits would give appropriate suggestions in the selection pocedure for breeding programme. The component traits which are strongly correlated with leaf yield as the basis of selection would minimise the effect of epistasis, then linkage will not influence the progeny mean for any trait.

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VARIABILITY, HERITABILITY AND GENETIC ADVANCE FOR YIELD AND QUALITY PARAMETERS IN *Aestivum* WHEAT

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ABSTRACT

Studies on variability, heritability and genetic advance for yield and quality parameters were carried out in *aestivum* wheat by using 64 entries. The study revealed the existence of wide range of variation for almost all the characters studied, showing a lot of scope for selection. The highest level of variability was found for tryptophan content and lowest for number of days to maturity. High heritability estimates together with high genetic advance were observed for plant height and pelshenke value. Grain yield per plant, tryptophan content and DBC value showed low heritability and low genetic advance, indicating high influence of environment on the expression of these characters.

KEY WORDS : Wheat, variability, heritability, genetic advance, yield, quality

The success in any breeding programme depends on the amount of variability present for different characters in a population and its efficient management and utilisation. In order to exploit different types of gene actions in the population, information on the relative magnitude of genetic variability in the population, heritability and genetic advance of important agronomic and quality traits is essential. Though, extensive work has been done to understand the heritability and