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GENOTYPIC VARIABILITY AND CORRELATION STUDIES OF LEAF CHARACTERS IN *TERMINALIA* SPECIES

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ABSTRACT

Genetic variability, genotypic and phenotypic coefficient of variation, heritability, genetic advance and interrelationships of nine foliar characters in 39 genotypes of *Terminalia arjuna* and *T. tomentosa* were studied. Maximum variation was observed in leaf weight followed by leaf area, L x B and stomatal frequency. The small values of error variances for all nine foliar characters suggest that they are genetically controlled. High GCV and PCV were reported for leaf weight, leaf area, L x B, breadth and length of leaf and stomatal frequency in descending order. High heritability was associated with high genetic advance for L x B and leaf area which confirms that the additive gene effects are important in determining these characters. The low and moderate genetic advance with high heritability for other seven foliar characters, is possibly due to intra- and interallelic interaction. Leaf area, length, breadth, L x B, weight of leaf and stomatal length had significant positive correlation with each other while stomatal frequency had significant negative correlation with these characters.

Key words: Variability, heritability, genetic advance, correlation, *Terminalia*.

The genetic improvement of *Terminalia* species depends on variable germplasm, selection of plus genotypes (trees) from genepool and determination of elite genotypes (trees) from plus genotypes for utilizing them in hybridization programmes. In all these stages estimation of genetic variability, heritability, genetic advance and interrelationships of various desired characters are very essential. The aim of this study was to estimate the magnitude of genotypic and phenotypic variation, heritability, genetic advance and interrelationship of characters so as to select superior genotypes from among the 39 genotypes belonging to *T. arjuna* and *T. tomentosa* complexes. The importance of both species has been well recognized in tasar silk industry as the primary food plants of tasar silkworm

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Antheraea mylitta D. Besides, they have also been extensively utilized as multipurpose trees (MPT) in pharmaceutical, timber, tannin and leather industries [1].

MATERIALS AND METHODS

Thirty nine genotypes (plus trees) were selected and marked on the basis of leaf variation, texture and hair at Central Tasar Research and Training Institute, Piska Nagri Farm, Ranchi during 1990. The measurements for various foliar characters, viz. length, breadth, area, weight, stomatal frequency, stomatal length and breadth of stomata for each genotype were recorded taking 10 random leaves in each of three replications. Data were used to compute components of variance as described by Burton and Devane [2] and coefficient of variation as described by Burton [3]. Heritability in broad sense and expected genetic advance were estimated according to Lush [4]. The formulae suggested by Miller et al. [5] were used to calculate genotypic and phenotypic correlation coefficients.

RESULTS AND DISCUSSION

It is evident that all the nine foliar characters had significant differences between various genotypes of *T. arjuna* and *T. tomentosa* (Table 1). The extent of variabilities present in the characters has been depicted in Table 2. The maximum range of variation was observed for length x breadth (L x B), followed by leaf area, stomatal frequency, leaf weight, leaf length, leaf breadth, L/B ratio, length and breadth of stomata where 5.1, 6.5, 3.0, 11.0, 2.4, 2.8, 1.8, 1.6 and 1.8 times variation has been observed, respectively. Accordingly, maximum variation was observed in leaf weight followed by leaf area, L x B, stomatal frequency, leaf breadth, leaf length, L/B ratio, breadth of stomata and length of stomata. The phenotypic, geno- typic and environmental variances of nine foliar characters are presented in Table 3. A perusal of Table 3 indicates that the characters were greatly influenced by environment as the phenotypic variances were always greater than their genotypic variances. Further, these variances were high for L x B, leaf area and stomatal frequency while relatively lower variances were observed for leaf length, leaf weight, and leaf breadth. The lowest variances were observed for L/B ratio, stomatal length and stomatal breadth.

Table 1. Analysis of variance for foliar characters of *Terminalia*

Character	d.f.	Treatment MSS	F	P
Leaf area	38	58354.6	10.8***	0.0
Leaf length	38	126.1	6.1***	0.0
Leaf breadth	38	39.2	13.8***	0.0
L/B ratio	38	0.4	4.4***	0.0
L x B	38	92628.1	10.0***	0.0
Leaf weight	38	112.9	102.1***	0.0
Frequency of stomata	38	222.2	11.8***	0.0
Length of stomata	38	0.1	10.9***	0.0
Breadth of stomata	38	0.1	7.5***	0.0

***Highly significant at 0.1% level.

Table 2. Phenotypic variability in foliar characters in *Terminalia*

Character	Range	Mean	SE	CD at 5%
Leaf area (cm^2)	77.7-507.3	257.2	42.40	119.42
Leaf length (cm)	15.3-36.3	26.5	2.63	7.4
Leaf breadth (cm)	6.6-18.2	11.6	0.97	2.7
L/B ratio	1.6-3.0	2.3	0.17	0.5
L x B	127.1-654.6	328.7	55.71	156.3
Leaf weight (g)	2.3-25.4	8.4	0.60	1.7
Stomatal frequency	22.0-67.3	38.8	2.51	7.1
Stomatal length (μ)	0.9-1.5	1.3	0.05	0.1
Stomatal breadth (μ)	0.5-1.0	0.7	0.04	0.1

The efficacy of selection on the magnitude of variability present in the material depends on the extent to which the desirable characters are heritable. Burton [3] suggested that the study of genotypic coefficient of variation together with heritability estimate would give the best picture of progress to be achieved through selection. In the present study (Table 4) the phenotypic coefficients of variation (PCV) were higher than the corresponding genotypic coefficients of variation (GCV) for all nine foliar characters, indicating that all the characters had interacted with the environment to some degree. High PCV and GCV were observed for leaf weight, leaf area and L x B, hence selection may be effective for these characters.

Table 3. Estimates of phenotypic, genotypic and error variances for foliar characters in *Terminalia*

Character	Phenotypic variance	Genotypic variance	Error variance
Leaf area	19451.5	17653.8	1797.75
Leaf length	42.0	35.1	6.91
Leaf breadth	13.1	12.2	0.95
L/B ratio	0.1	0.1	0.03
L x B	30876.0	27795.9	3080.1
Leaf weight	37.6	37.3	0.37
Stomatal frequency	74.1	67.8	6.30
Stomatal length	0.1	0.02	0.002
Stomatal breadth	0.01	0.01	0.001

Heritability (broad sense) was high for all the characters studied. Highest heritability was reported for leaf weight, followed by leaf breadth, stomatal frequency, stomatal length, leaf area, L x B, stomatal breadth, leaf length and L/B ratio. Such high levels of heritability may be due to the control of additive gene action in expression of these characters [6]. Johnson et al. [7] pointed out that heritability estimates along with genetic gain is more

useful than heritability alone. Estimates of genetic advance in percentage of mean was highest for L x B and leaf area. Moderate genetic advance was noticed for stomatal frequency, leaf weight, leaf length and breadth. High heritability was associated with high genetic advance for L x B and leaf area which further confirmed that additive gene effects are important in the determination of these characters and would be effective in selection. The low/moderate genetic advance with high heritability shown by stomatal frequency, leaf weight, leaf length, leaf breadth, L/B ratio, stomatal length and breadth indicates that the expression of these characters is possibly controlled by intra- and interallelic interactions.

Table 4. Estimates of phenotypic (PCV) and genotypic coefficients of variation (GCV), heritability (h^2) and genetic advance (GA) for foliar characters

Character	PCV (%)	GCV (%)	h^2	GA
Leaf area	54.2	51.7	0.91	260.8
Leaf length	24.4	22.3	0.84	11.2
Leaf breadth	31.1	30.0	0.93	6.9
L/B ratio	15.2	13.4	0.77	0.6
L x B	53.5	50.7	0.90	325.9
Leaf weight	72.9	72.5	0.99	12.5
Stomatal frequency	22.2	21.2	0.91	16.2
Stomatal length	11.7	11.2	0.91	0.3
Stomatal breadth	13.4	12.5	0.87	0.2

The correlations among the nine foliar characters are presented in Table 5. Substantial differences between phenotypic and corresponding genotypic correlations in all pairs of characters were observed due to environmental effects. Further, the magnitude of genotypic correlations was always higher than their corresponding phenotypic correlations barring nonsignificant correlation between length and breadth of stomata. This suggests that there is strong inherent association between various characters. Significant positive correlations were observed between leaf area and leaf length, leaf breadth, L x B, weight of leaves and stomatal length. Significant negative correlation of leaf area was noticed with L/B ratio, stomatal frequency and stomatal breadth. While length of leaf was highly correlated with leaf breadth, L x B, leaf weight and stomatal length, it had significant negative correlation with L/B ratio, stomatal frequency and stomatal breadth. Leaf breadth was showed high positive correlation with L x B, leaf weight and stomatal length, but negative with L/B ratio, stomatal frequency and stomatal breadth. L/B ratio had significant positive correlation with stomatal frequency and negative correlation with L x B and leaf weight. While L x B had significant positive correlation with leaf weight and stomatal length, it was negatively correlated with stomatal frequency and stomatal breadth. Leaf weight showed high positive correlation with stomatal length and negative with stomatal frequency and stomatal breadth. Stomatal frequency exhibited significant positive correlation with stomatal breadth and negative correlation with stomatal length.

Table 5. Phenotypic and genotypic (within parentheses) correlation coefficients between various foliar characters in *Terminalia*

Characters	Leaf area	Leaf length (L)	Leaf breadth (B)	L/B ratio	L x B	Leaf weight	Stomatal frequency	Stomatal length	Stomatal breadth
Leaf area		0.96*** (0.99)***	0.96*** (0.98)***	–0.36** (–0.46)***	0.98*** (1.00)***	0.83*** (0.88)***	–0.38*** (–0.41)***	0.54*** (0.59)***	–0.60*** (–0.68)***
Leaf length			0.89*** (0.92)***	–0.13NS (–0.26)*	0.93*** (0.95)***	0.76*** (0.84)***	–0.33** (–0.36)**	0.56*** (0.63)***	–0.58*** (–0.68)***
Leaf breadth				–0.54*** (–0.61)***	0.98*** (0.99)***	0.83*** (0.88)***	–0.39*** (–0.42)***	0.57*** (0.62)***	–0.51*** (–0.76)***
L/B ratio					–0.43*** (–0.54)***	–0.41*** (–0.47)***	0.29* (0.38)***	–0.19NS (–0.26)*	0.11NS (0.16)NS
L x B						0.88*** (0.89)***	–0.37*** (–0.41)***	0.59*** (0.65)***	–0.54*** (–0.62)***
Leaf weight							–0.30* (–0.32)**	0.38*** (0.40)***	–0.58*** (–0.68)***
Stomatal frequency								–0.41*** (–0.44)***	0.36*** (0.43)***
Stomatal length									0.08NS (0.05)NS
Stomatal breadth									

*,**,***Significant at 5%, 1%, and 0.1% levels, respectively. NS—nonsignificant.

Summing up, these relationships indicate that leaf area, leaf length, leaf breadth, L x B, leaf weight and stomatal length had significant positive correlation with each other. Therefore, these characters should be considered as effective parameters for selection. Further, significant negative correlation of stomatal frequency with these characters is also desirable since it will help in the development of drought resistant and moisture retaining genotypes of the food plants for tasar culture.

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