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ESTIMATION OF VARIOUS PHENOTYPIC AND GENOTYPIC VARIABLES IN SOME CLONES OF *POPULUS DELTOIDES* IN ALLUVIAL SOIL

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ABSTRACT

Forty clones of *Populus deltoides* were grown in the new alluvial soil of Kalyani, West Bengal, India to assess the phenotypic variability with genotypic co-efficient of variation(GCV), phenotypic co-efficient of variation(PCV) and environmental co-efficient of variation(ECV) in respect of nine characters. The heritability (in broad sense) and genetic advance were also estimated. It revealed that a further scope of selection of genotypes is possible in such agro-climatic area. Such further studies may enhance the possibility of selection and growing best genotype.

Key words: Poplar, ETP (Entire transplant), Taper (Height/Collar diameter), phenotypic variability, environmental coefficient of variations.

Introduction

Considering *Populus deltoides* as one of the fast growing species for agro-forestry purposes, the growth performance of 40 different clones of *Populus deltoides* were calculated. Particularly the phenotypic variability, heritability (in broad sense) and genetic advance, GCV, PCV and ECV in percentage were calculated to select and recommend a few suitable clones for growing ETPs in West Bengal (Fig 2).

As it is well established that Poplar is grown in large scale in agricultural fields in Uttar Pradesh, Punjab, Hariana and other states as one of the fast growing species for plywood, matchwood, paper pulp and packing case industries. The farmers of above said states are earning a lot of money by growing this species so it was assumed that this species may also be tested in the state of West Bengal and that is why the variations in growth pattern were also evaluated.

Poplar can also play an important role in increasing the productivity of land in aforestation programmes and in the conservation of soil due to horizontal massive growth of root system in the sub upper layer of the soil (Josline and Schoenholtz, 1997). Due to their specific photoperiods, one of the most promising species of Poplar, *Populus deltoides* although an exotic from North America, is currently the choice of species for agroforestry in different parts of India.

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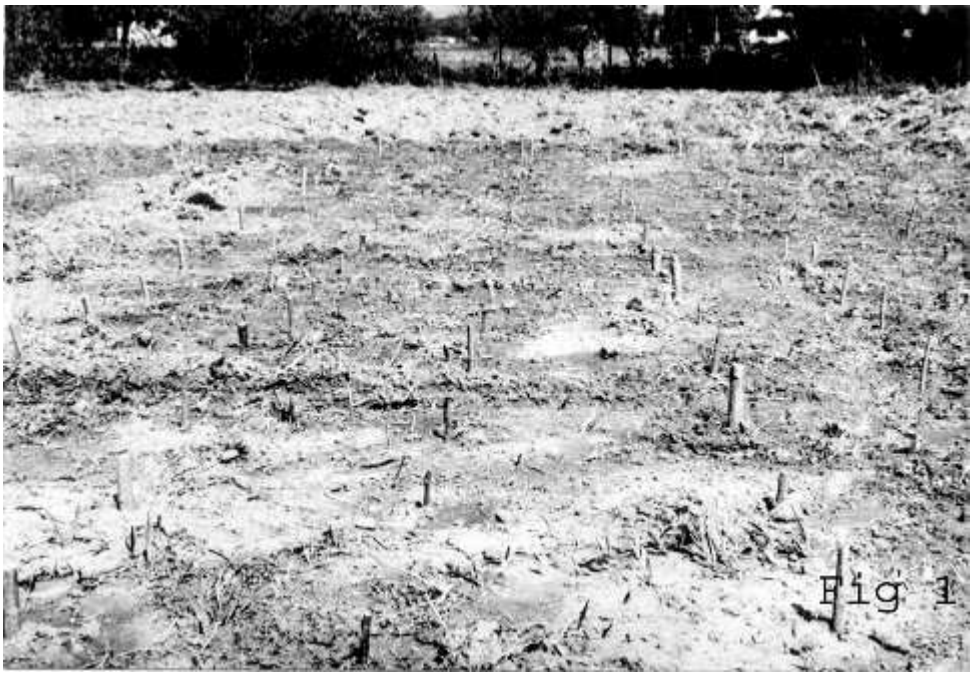

Fig 1. Showing stem cuttings planted in the field.

Fig 2. Showing nursery plants of six months age.

Materials and Methods

The investigation consisting of 40 clones of Poplar (*Populus deltoides*) was carried out for two years. Stem cuttings of 40 clones were planted in Randomized Block Design with four replications in a five-row plot for each genotype (Fig 1). Spacing was given as 90 cm between row to row and 60 cm between cutting to cutting. Fifteen days before planting the stem cuttings, pits of 1ft. X 1ft. X 1ft. size were prepared with 1 kg of farmyard manure mixing with the soil.

The observations were made for nine characters (plant height, collar diameter, number of branches per plant, internodal length, length of branches, diameter of branches and number of leaf per plant, leaf area and taper). The standard formulae of Hanson *et al.* (1956) were used for statistical analysis to find out the heritability. Genetic advance was calculated by the formulae suggested by Lush (1949).

Result & Discussion

Previous studies indicate that, while considerable wealth of information is available on the phenotypic variability, relatively less information is available on the range of phenotypic variation present in respect of the quantitative characters of poplar ETPs. Range, Mean, Standard Error of the Mean and the Critical Difference (CD) for each of the nine characters calculated by the method of analysis of variance are presented in the Table 1. The table shows that there were wide ranges of phenotypic variations for all the characters studied, but in case of internodal length the phenotypic variability ranged from 3.37 to 5.7 cm in 1st year and 4.0 to 5.87cm in 2nd year. This was lowest range of variability amongst all the characters. Wide range of variations in the expression of phenotype was also reported by Zhang *et al.* in 1999. The maximum range of phenotypic variability was found with respect to branches per plant,

TABLE-1: PHENOTYPIC VARIABILITY AND CO-EFFICIENT OF VARIABILITY FOR NINE CHARACTERS IN 40 CLONES IN DIFFERENT YEARS

Characters	December, 1st year				December, 2nd year			
	Range	Mean±S.Em	CD*	CV**	Range	Mean±S.Em	CD*	CV**
Plant height(cm)	250-590	388.91±9.90	27.96	5.13	295-612	480.00±23.87	66.86	9.93
Collar diameter(cm)	1.87-4.20	3.27±0.04	0.11	2.52	2.07-4.15	3.16±0.19	0.5	12.08
Branches/plant	0.0-11.25	5.55±0.44	1.23	15.88	0.0-7.0	4.02±0.31	0.88	15.75
Internodal length(cm)	3.37-5.70	4.56±0.07	0.20	3.27	4.00-5.87	4.68±0.13	0.36	5.62
Length of branches(cm)	56.5-160.25	106.30±9.74	27.28	18.33	72.5-167	100.96±11.01	30.85	21.82
Diameter of branches(cm)	0.45-1.6	0.88±0.19	0.53	43.29	0.6-2.05	0.97±0.23	0.66	48.75
No. of leaf/plant	38.50-79.50	57.81±2.76	7.75	9.57	45.00-90.00	72.18±4.81	13.49	13.34
Leaf area(Sq.cm)	198.00-396.00	307.98±6.95	19.48	4.5	210.00-396.00	308.68±10.42	29.21	6.7
Taper (height/diameter)	95.45-186.00	120.65±3.08	8.64	5.11	95.00-177.20	153.43±5.23	14.65	6.82

*$p \leq 0.05$ ** Expressed in percentage.

followed by the length of branches, diameter of branches and plant height. In these characters large differences between the mean value and highest value were recorded.

The careful study of CD (critical difference) values at 5% level of significance revealed that most of the clones varied significantly among themselves. The maximum CD value (27.96) was recorded in case of plant height, while the minimum of CD value at 5% level of significance was found with respect to collar diameter (0.11) after one year. But in the 2nd year, the maximum and minimum CD values were recorded in case of plant height (66.86) and internodal length (0.36) respectively. The careful review on coefficient of variability (CV) expressed in percentage, indicated the highest CV for the trait diameter of branches in both the years. However, the lowest CV was recorded for collar diameter (2.52) in the 1st year and for internodal length (5.62) in the 2nd year respectively.

The range of phenotypic variability in respect of all the characters revealed that the environmental condition of the site was favourable for better expression of variation. The only character-plant height having highest CD value in both the years (environments) - indicated intrinsic differences between the genotypes (treatments) associated with uncontrolled variation.

Since many of the quantitative plant characters, which are of economic value, are highly influenced by environmental conditions, the improvements in such a population is primarily conditioned by the magnitude, nature and interactions of genotypic and non-genotypic variations in the various plant characters. This suggests the imperative need of partitioning the overall variability into its heritable and non-heritable components with the help of suitable genetic parameters, such as genetic co-efficient of variation, heritability estimates and genetic advance (Gandhi *et al.*, 1964).

The present part of investigation was therefore, undertaken on a collection of exotic *Populus deltoides* clones to explore the genotypic variability by determining the magnitude of heritability of different characters and their phenotypic and genotypic coefficient of variations.

The highest GCV was observed for the character branches per plant. The lowest GCV was recorded in respect of intermodal length in the 1st year. Similarly, in the 2nd year the highest GCV was found for the character branches per plant, followed by the characters length of branches and diameter of branches. The lowest GCV was recorded in case of taper. So, it was observed (Table 3) that all the characters selected for study had high genetic variability in both years. It was also to be noted that GCV for same character showed high variability in different years indicating the strong control of genotype on the character.

A comparative study of genotypic, phenotypic and environmental coefficient of variations for different growth parameters was made (Table 3). It is revealed that all the characters showed large variability in genotypic, phenotypic and environmental coefficient of variations depending on different seasons and different years respectively. The highest variability was recorded in case of branch characters. The same character showed different variability in different seasons in different years.

TABLE 2: HERITABILITY IN BROAD SENSE (H^2), GENETIC ADVANCE (GA) OF NINE CHARACTERS IN 40 CLONES IN DIFFERENT YEARS

Characters	December, 1st year			December, 2nd year		
	$h^{2(\%)}$	GA	GA in % of mean	$h^{2(\%)}$	GA	GA in % of mean
Plant height(cm)	0.98	179.11	46.05	0.87	121.80	25.34
Collar diameter(cm)	0.99	1.17	36.00	0.83	0.79	25.24
Branches/plant	0.98	6.40	115.25	0.95	3.10	77.07
Internodal length(cm)	0.98	1.19	26.11	0.93	0.97	20.69
Length of branches(cm)	0.93	71.69	67.44	0.88	60.44	59.86
Diameter of branches(cm)	0.67	0.45	52.04	0.53	0.38	38.95
No. of leaf/plant	0.93	21.54	37.25	0.81	18.90	26.18
Leaf area(Sq.cm)	0.98	105.79	34.35	0.95	102.43	33.18
Taper (plant height/collar diameter)	0.98	53.93	44.70	0.85	24.60	16.03

TABLE 3: ESTIMATES OF GENOTYPIC, PHENOTYPIC AND ENVIRONMENTAL CO-EFFICIENT OF VARIATIONS FOR DIFFERENT GROWTH PARAMETERS.

Characters	GCV%				PCV%				ECV%			
	June,1st year	Dec.,1st year	June,2nd year	Dec,2nd year	June,1st year	Dec.,1st year	June,2nd year	Dec,2nd year	June,1st year	Dec.,1st year	June,2nd year	Dec,2nd year
Plant height(cm)	19.62	22.5	12.83	13.55	19.67	22.64	14.46	14.05	2.86	5.13	13.33	9.93
Collar diameter(cm)	20.63	17.52	20.15	13.43	21.03	17.56	21.28	14.73	8.19	2.52	13.66	12.08
Number of branches/plant	62.58	56.49	50.66	38.2	63.23	57.05	52.15	39.00	18.07	15.80	24.74	15.75
Internodal length(cm)	13.21	12.77	12.95	10.5	13.35	12.88	13.19	10.70	3.72	3.27	4.99	5.62
Length of branches(cm)	35.74	33.91	36.52	30.82	36.82	35.13	37.77	32.70	17.76	18.33	19.32	21.82
Diameter of branches(cm)	32.28	30.86	35.21	25.94	38.32	37.69	38.02	35.60	41.40	43.39	28.67	48.70
No. of leaf/plant	26.43	18.67	18.03	14.00	26.59	19.27	19.57	15.57	5.81	9.57	15.19	13.34
Leaf area(Sq cm)	17.11	16.82	16.24	16.44	17.31	16.97	17.05	16.78	5.18	4.50	10.40	6.75
Taper (Height/ Collar diameter)	26.78	21.84	15.91	8.40	27.19	21.99	17.12	9.00	9.42	5.11	12.66	6.82

A careful study on genotypic (GCV), phenotypic (PCV) and environmental coefficient of variation (ECV) revealed that PCV percentage were slightly higher than the GCV percentage in both the years (Table 3) with respect to plant height. ECVs were of negligible amount except during June of 2nd year. It was evident that both the GCV and PCV values increased in the second half of the years i.e. in December of 1st year and December of 2nd year which clearly indicated that coefficients of variability for this character could be predicted at the end of growth phase.

In case of collar diameter also, there were little differences in GCV% and PCV% indicating the lesser influence of environment on the expression of trait. But a remarkable feature was that both GCV and PCV decreased in the letter stage of growth in both the years indicating the dominance of height growth in compare to collar diameter growth. In respect to taper both GCV and PCV decreased in the second half of both the years in greater amount indicating the uniformity in the expression of characters in letter stage of growth. In case of taper also PCV was recorded slightly greater than the GCV indicating the minor environmental influence.

The characters branches per plant, internodal length, length of branches, diameter of branches, leaves per plant and leaf area all showed higher GCV and PCV in the first half of both the years. In all these characters PCV were found higher than the GCV manifesting the role of environment on the expression of characters, Li *et al.*, (1996) also reported that the genetic variability may change with the age.

Differences among heritabilities (Table 2) of the nine characters studied were relatively large, ranging from 0.67 percent for diameter of branches to 0.99 percent for collar diameter in the 1st year. However, in the 2nd year the lowest and highest heritability were recorded in case of diameter of branches (0.53) and leaf area (0.95) respectively. The same heritability percentage was recorded with respect to branches per plant. However, the high heritability was recorded in all the traits except the diameter of branches.

The expected genetic advance expressed as the percentage of mean was estimated with respect to all the nine characters in both the years (Table 2). It was clearly revealed that excluding the branch characters other traits had relatively small differences. The highest genetic advance in percentage of mean was recorded for branches per plant followed by length of branches. The lowest value was found in respect to internodal length in both the years. The trait internodal length also had lower genotypic coefficient of variation during both the years.

The large genetic variability associated with high heritability was also reported by Joshi and Singh in 1996. Similar results were also found by Pandey *et al., (1993)* and Rajora *et al.*, (1994). Misra et al. (1995) also reported high genetic variances for different growth parameters.

The main objective of present study was to assess the variations in different clones of *P. deltoids* for various quantitative characters in new agro-climatic area. Taking up these characters individually, the data indicated that branches per plant, length of branches, diameter of branches and plant height had high genetic coefficient of variation, which

suggested high degree of genetic variability in these characters. However, with the help of genetic coefficient of variation alone it was not possible to determine the amount of variation that was heritable. The heritable portion of the variation could be predicted with the help of heritability estimates and genetic gain (Swarup and Chaugale, 1962).

High heritability values have been obtained in characters, collar diameter, plant height, internodal length, leaves per plant, leaf area, taper and length of branch.

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