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Correlation Coefficient and Variability Studies for Physico-Chemical Characteristics of Candidate Plus Trees of *Acacia nilotica* (L.) Willd

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ABSTRACT

The physico–chemical properties of wood are important parameters of the preliminary characterization of cellulose raw material and its potentiality for fuel wood, timber and for other non-timber products for their related use. This species becomes a material of paramount importance to be worked upon especially for its future benefits owing to its diverse uses. In the present investigation, physico-chemical characteristics of different CPT's of *Acacia nilotica* were quantitatively measured for correlation and variability studies. The correlation studies revealed that there was strong positive correlation between diameter and bark percentage. Highly significant and negative correlation was recorded with hot water and alcohol-benzene solubility. Genetic variability of *A. nilotica* were quantitatively measured for grain angle, bark percentage of sapwood, specific gravity of sapwood, fiber length of sapwood, cold Water soluble extractives of sapwood, hot water soluble extractives of sapwood, alcohol-benzene soluble extractives of sapwood, lignin and holocellulose percentage of sapwood. The highest value for phenotypic and genotypic coefficients of variability was observed for lignin. The lowest value for phenotypic and genotypic coefficients of variability was observed for specific gravity of sapwood.

Keywords:

Acacia nilotica, candidate plus trees, correlation, variability

INTRODUCTION

The expression of a particular character is an aggregate of complex contribution of so many other characters. In tree improvement programme, a clear understanding of the nature and degree of association among different traits is of great importance because the choice of one character can favour the appearance or disappearance of the other. Correlation, an important statistical tool, helps in determining such associations among different factors under consideration.

Acacia are established as very important economic plants since early times as source of tannins, gums, timber, fuel and fodder. They have significant pharmacological and toxicological effects in Africa and the Indian subcontinent; *A. nilotica* is extensively used as timber, fodder and firewood species. The bark and seeds are used as source of tannins. The species is also used for medicinal purpose. Bark of *A. nilotica* has been used for treating hemorrhages, colds, diarrhea tuberculosis and leprosy while the roots have been used as an aphrodisiac and the flowers for treating syphilis lesions (Bargali and Bargali, 2009).

This species therefore becomes a

material of paramount importance to be worked upon especially for its future benefits owing to its diverse uses. For this, the number of promising candidate plus trees at different locations were identified and evaluated for different parameters.

In the present investigations, the relationship of height, diameter, grain angle, specific gravity, bark percentage, fiber length, coldwater soluble extractive, hot water soluble extractive, alcohol-benzene soluble extractive, lignin percentage and holocellulose percentage have been studied. A wide range of variability present in species, always provide a better chance of selecting desirable type (Vavilov, 1951). Presence of vast natural variability is a characteristic feature of forest tree species. Thus, the present study was, therefore, undertaken to assess the genetic variability with candidate plus trees contributing characters and the degree of their transmission by estimating genetic variability in this economically very valuable tree species.

MATERIALS AND METHODS

The study was conducted on twenty candidate plus trees of *Acacia nilotica* marked at different locations in Akola district during the year 2011-12. The wood samples were collected from these marked trees and analyzed for different wood characteristics in the departmental laboratory of Forest Products and Utilization, Department of Forestry, Dr. P.D.K.V., Akola. The data for eleven parameters, viz., height (m), diameter (cm), grain angle (degrees), specific gravity of sapwood, bark percentage of wood, fiber length (mm), cold water soluble extractives (%), hot water soluble extractives (%), alcohol-benzene extractives (%), lignin percentage of sapwood and holocellulose percentage of sapwood were studied to work out the correlations. The observation for genetic variability were recorded for nine parameters, viz., grain angle, bark percentage of sapwood, specific gravity of sapwood, fiber length of sapwood, cold water soluble extractives of sapwood, hot water soluble extractives of sapwood, alcohol-benzene soluble extractives of sapwood, lignin and holocellulose percentage of sapwood.

Grain angle of the trees were measured by drawing straight line perpendicular to the base of the tree trunk and the deviation of the grain was measured with the help of protractor after shaving the bark. Bark thickness of the tree was measured in centimeters at breast height with the help of Swedish bark gauge. The recorded bark thickness was expressed as percentage. The specific gravity of wood was determined by the maximum moisture method (Smith, 1954). Tracheid length was determined by macerating the shavings of wood in Jeffery's fluid i.e. 10 per cent chromic acid and 10 per cent nitric acid for 48 hours (Pandey et al.1968). The cold and hot water soluble extractives were determined by employing the T_1m 59 method (Anonymous, 1959a), Alcohol-benzene extractives, klason-lignin content and holocellulose were determined by using T_6m 59 (Anonymous, 1959b), T_{12}m 59 (Anonymous, 1959c) and T_9m 54 (Anonymous, 1954) methods, respectively.

The data obtained for these traits were statistically analyzed by using randomized block design and completely randomized design in three replicates for each treatment as described by Panse and Sukhatme (1967) and Chandel (1984) and subjected for correlation coefficient analysis as per the method suggested by Panse and Sukhatme (1978) and Gupta (1984). The significance at 5 per cent level of probabilitywas tested as per the formula given by Gosset (1908). Phenotypic and genotypic coefficients of variation were worked out as per the formula suggested by Burton and DeVane (1953), Allard (1960) and Johnson et al. (1955).

RESULTS AND DISCUSSION

The correlation coefficients study was worked out for all the 11 character combinations. Out of 55 combinations of simple correlation, 26combinations were found to be positive and significant and 29 combinations were negative and significant. The values for simple correlation coefficient between physico-chemical characteristics of sapwood of CPTs of *A. nilotica* are presented in Table 1. The significant positive correlation to the tune of 0.652 was observed between diameter and bark percentage followed by alcohol-benzene percentage and lignin percentage (0.645), grain angle and bark percentage (0.642),

Table 1: Simple correlation coefficients between physico-chemical characteristics of sapwood of CPTs of *A.nilotica*

Character	1	2	3	4	5	6	7	8	9	10	11
Height	1.000										
Diameter	0.638	1.000									
Grain angle	0.178	-0.228	1.000								
Bark percentage	0.622	0.652	0.642	1.000							
Specific gravity	-0.648	-0.022	-0.139	-0.678	1.000						
Fiber length	-0.652	0.095	-0.702	-0.321	0.313	1.000					
Cold water	0.051	0.236	-0.024	-0.053	0.158	0.097	1.000				
Hot water	-0.464	-0.001	0.617	0.074	-0.095	0.057	0.092	1.000			
Alcohol-benzene	0.625	0.627	-0.080	0.392	-0.193	-0.319	-0.161	-0.687	1.000		
Lignin	0.244	-0.641	-0.007	-0.106	-0.092	0.411	-0.276	-0.154	0.645	1.000	
Holocellulose	-0.444	-0.091	-0.219	-0.031	0.052	0.183	-0.273	0.475	0.062	0.130	1.000

*Significant at 5 per cent level of significance (r=0.602)

1. Height
2. Diameter
3. Grain angle
4. Bark percentage
5. Specific gravity
6. Fiber length
7. Cold water
8. Hot water
9. Alcohol-benzene
10. Lignin
11. Holocellulose

Table 2: Estimate of variability for physico-chemical characteristics of sapwood of CPTs of *A. nilotica*.

Sr. No.	Character	Variability	
		PCV (%)	GCV (%)
1	Grain angle	2.18	2.10
2	Bark percentage	4.79	4.79
3	Specific gravity	0.63	0.56
4	Fiber length	1.10	0.95
5	Cold water soluble extractives	3.52	3.30
6	Hot water soluble extractives	4.91	4.88
7	Alcohol -benzene soluble extractives	2.24	2.08
8	Lignin	5.53	5.44
9	Holocellulose	5.20	5.16

diameter and height (0.638), Diameter and alcohol-benzene (0.627), height and bark percentage of sapwood (0.622), and grain angle and hot water soluble extractives (0.617). The significant negative correlation value of -0.687 was found between hot water soluble extractives and alcohol-benzene followed by bark percentage and specific gravity of sapwood (-0.678), height and fiber length of sapwood (-0.652) and diameter vs. lignin percentage of sapwood (-0.641). Similar type of relationship has been worked out by Sharma (2000) in *Dendrocalamus strictus*, Kumar (2000) in *Dalbergia sissoo* and Nimkar et al. (2007) in *Pinus roxburghii*.

For the proper utilization of observed variation in a species, it is prerequisite to know the extent of variation and also that whether, it is due to the genetic or the environmental factors. Hence, information on variation in the desired parameters and their correlation is vital for any breeding programme (Johnson et al. 1955). Therefore, a species exhibiting a wide range of variability (in term of wide range of parameters value and high standard deviation, variance and genotypic and phenotypic coefficients of variation) offer ample scope for undertaking screening for the desired traits.

In the present studies, the results obtained for the different characters with regard to variability parameters indicate that values have a wide range depicting the presence of good amount of variation. The values of phenotypic coefficient of variability (PCV) and genotypic coefficient of variability (GCV) ranged from 0.63 to 5.53 and 0.56 to 5.44, respectively (Table 2). The PCV was more than the GCV among the different wood attributes which showed the environmental effect on these characters. However, low differences between PCV and GCV indicate the lesser influence of environment and reflect on the reliability of selection based on phenotypic performance.

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