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Research Article

GENETIC ESTIMATES OF GROWTH AND WOOD ANATOMICAL PROPERTIES IN EUCALYPTS CLONES

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Abstract- Eighteen eucalypt clones were studied for growth and wood anatomical and physical properties at four years age. The analyzed data was used for further estimation of genetic parameters for growth and wood anatomical properties. Genotypic and phenotypic coefficient of variation values were in the range of low to medium (GCV =4.4 to 39.3%; PCV=7.8 to 49.5 %). Tree height, diameter, volume, biomass, basic density, fibre cell wall thickness and vessel density recorded higher heritability values i.e., 59.98%, 51.18%, 63.08, 59.67%, 51.94%, 51.64% and 51.73 %, respectively. Volume, total biomass and carbon content recorded about 60 per cent genetic gain.

Key words- genetic estimates, growth parameters, wood anatomical parameters, eucalyptus

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Introduction

With increasing population and industrialization the demand for wood and wood products is also increasing phenomenally. Contrarily the land availability for cultivation is decreasing day by day. In this situation, the only solution is improving the site specific clones with higher productivity and quality of end use. Traditionally, the tree selection for improvement programmes highlight growth traits, *viz*., height, diameter, volume or biomass as top priority of improvement, contrarily, quality parameters such as wood quality are generally considered as secondary parameter. However, for successful improvement of any species, the both productivity and parameters determining the quality of end use must invariably be given equal priority. The most important agroforestry tree species grown for pulp and plywood is Eucalyptus, which is extensively cultivated by Indian farmers due its fast growth, high pulp yield and wood anatomical properties. The major determinants of pulp-wood quality are the wood fibre properties including fibre dimensions [1]. Hence, while improving eucalypts, selection of clones should not only be based on the growth and productivity but the wood anatomical properties must also be emphasized as characters of equal importance [11,16,22,23]. Genetic parameters support the studies of genetic evaluation and selection of site specific clones for specific end use. Study of different genetic parameters is not only important for formulations of breeding programmes aimed for increasing the productivity with enhanced quality, but also for successful exploitation of the genetic variability inherent in the germplasm [11,17,18,22,23]. Therefore to formulate selection strategy for Eucalyptus improvement, present study was undertaken and genetic parameters were estimated on growth, physical and anatomical traits.

Materials and Methods

The location of experiment belongs to the tropical climate characterized by fairly hot summer, moderately cold winter and more humid and warm monsoon with heavy rainfall. The average annual precipitation is 1355 mm. A clonal evaluation trial of Eucalyptus was established in the year 2011 in the campus of College of Forestry, Navsari Agricultural University, Navsari, Gujarat [200 55°21.18°N latitude, 720 54°29.24°E longitude and at an altitude of 12 meters above mean Sea Level]. The trial composed of 18 Eucalyptus clones (named as EC-1, EC-2…EC-18), planted at 2 x 2 m spacing with three replications following randomized block design. Various growth parameters *viz*., tree height, diameter at breast height, tree volume, stem biomass and carbon sequestration potential were recorded were recorded from total six ramets (trees) per clone in the study as per the standard procedures. Tree volume is calculated by using formula as suggested by [2,3]. Carbon sequestration potential of different clones was estimated using following formula: Carbon content (kg tree^{-1}) = Stem biomass (kg) x 0.363. The value of 0.363 represents the carbon content (g)/ dry wood biomass (g) estimated using gravimetric method. Here, dry wood samples were collected from different clones and used in the assessment of carbon content. Average carbon value was used in the estimation. Anatomical parameters including fibre parameters *viz*., fibre proportion, length, width, fibre lumen width and cell wall thickness and vessel parameters like vessel proportion, length, diameter and density were recorded following maceration process of Schultz's method [4]. Fibre length and vessel parameters were recorded according to International Association of Wood Anatomists (IAWA) committee guidelines [5]. Genetic parameters were estimated by using standard formulas as suggested by various authors *viz*., GCV and PCV [24, 25], heritability and Genetic advance [24, 26] and genetic gain [26]. Further details of the materials and methods are available at [22].

Results

In the present study important growth and biomass parameters as well as wood anatomical properties were used for estimation of genotypic and phenotypic coefficient of variability as well as genetic parameters such as heritability (broad sense), genetic advance and genetic gain. The data pertaining to all the genetic parameters is given in [Table-1].

Among 14 studied parameters, phenotypic coefficient of variation (PCV) ranged from 7.81 to 49.50 percent. Tree volume, stem biomass and carbon content recorded maximum PCV values; however, fibre length and fibre width resulted in lower PCV values. Whereas, genotypic coefficient of variation (GCV) also ranged between 4.45 and 39.31 percent, for the studied parameters. As seen in PCV, GCV values also higher for tree volume stem biomass and carbon content. In contrast, all the physical and anatomical properties along with tree height recorded lesser values of GCV. Broad sense heritability (H^2; %) values are considered as one of the important genetic parameters that help in traits selection. In the study, broad sense heritability values ranged from 25.94 to 63.08 percent. Out of 14 parameters, all the growth and physical parameters of wood along with vessel diameter and its length showed higher heritability values than other anatomical parameters. In the study, basic density (66.91), vessel length (56.09) and fibre length (54.33), followed by stem biomass (36.04) recorded higher values of genetic advance and all other parameters recorded the least genetic advance values [Table-1]. Genetic gain as percent of mean varied from 5.23 percent in fibre length to 64.32 percent in volume. Maximum gain was recorded for volume, stem biomass and carbon content, however, DBH, height, basic density, vessel density, vessel length, wood moisture content and cell wall thickness recorded relatively moderate genetic gain between 10 to 25 percent. Remaining parameters recorded with less than 10 percent genetic gain [Table-1].

Table-1 Genetic parameter estimates using 4th year data for growth and wood anatomical properties in 18 Eucalypt clones

Properties	PCV (%)	GCV (%)	H^2 (%)	GA	GG (%)
Height (m)	10.78	8.35	59.98	2.18	13.32
DBH (cm)	21.58	15.44	51.18	2.60	22.75
Volume (m^3/tree)	49.50	39.31	63.08	0.08	64.32
Biomass (kg/tree)	47.64	36.80	59.67	36.04	58.56
Carbon content (kg/tree)	47.64	36.80	59.67	13.08	58.56
Basic density (kg/m^3)	12.05	8.68	51.94	66.91	12.89
Moisture content (%)	10.28	7.30	50.36	6.91	10.67
Fibre length (µm)	7.81	4.45	32.52	54.33	5.23
Fibre width (µm)	9.38	5.13	29.88	0.94	5.77
Fibre lumen width (µm)	13.54	7.93	34.32	0.90	9.57
Cell wall thickness (µm)	10.56	7.59	51.64	0.39	11.23
Vessel density (No./mm^2)	19.34	13.91	51.73	2.82	20.61
Vessel length (µm)	12.83	8.66	45.56	56.09	12.04
Vessel diameter (µm)	10.59	5.39	25.94	7.76	5.66

Note: PCV: Phenotypic Coefficient of Variations; GCV= Genotypic Coefficient of Variations; H^2= Heritability (Broad Sense); GA =Genetic Advance and GG = Genetic Gain

Discussion

Variation among trees of the same age and of the same species that are growing on the same site is of great importance to tree breeder for selection, multiplication and further breeding programme [6]. Identification of traits of interest, which is controlled by gene, plays a vital role for tree breeder while selecting genotypes. Some of the genetic parameters such as heritability and genetic gain having higher values are greatly used in tree improvement programme. The tree breeder can influence gain from selection in essential two ways, *i.e.*, the heritability of the trait and through the selection differential [6]. Therefore, understating genetic parameters for various traits are essential. In the present study, phenotypic and genotypic co-efficient of variation, broad sense heritability, genetic advance and genetic gain have been worked out for growth, physical and anatomical properties of wood. The overall range of variation was found to be low to medium for phenotypic co-efficient of variation (PCV; 7.8 to 49.5%) and genotypic co-efficient of variation (GCV; 4.45 and 39.31%) among 18 clones of eucalypt. Lesser values of PCV and GCV for growth traits among progenies of *E. camaldulensis* is reported by [7]. Such trend is also reported in many species or clones of Eucalyptus species for growth and anatomical attributes [8-11]. Heritability values express the proportion of variation in the population that is attributable to genetic differences among individuals. Further, heritability is of key importance in estimating gains that can be obtained from selection programs. If the values near to the 100 percent, then the variation in a population was found to be highly influenced by genetics; in contrast, if the value is near to the zero, then the variation is not attributable to genetics [6]. In the study, broad sense heritability values ranged from 25.94 to 63.08 percent and most of the traits such as tree height, diameter, volume, biomass, basic density, fibre cell wall thickness and vessel density recorded higher heritability values > 50 and limited to 63 percent. Since tree height, DBH and basic density attributed to higher heritability values, these traits may be used in selection of clones for better quality and quantity of pulp in eucalypts. Further, genetic gain values also ranged from as low as 5.23 to as high as 64.32 percent. Volume and its associated traits such as tree biomass and carbon content recorded about 60 percent gain. This clearly indicates that either biomass or volume can be used while selection of genotypes in Eucalyptus along with other parameters that has recorded maximum heritability. Many researchers also worked out heritability and genetic gain for various growth and anatomical properties [11-15]. The range of values recorded for growth and anatomical properties including basic density in the study were found to be at par with values quoted by several researchers in several species of Eucalyptus [7, 9-10, 16-21], however, lower values of broad sense heritability for growth parameters *viz*., DBH (31.00 %), height (34.00 %) and volume (37.00%) were recorded by [22] in full sib hybrids of *E. grandis x E. urophylla* studied at 8 years age. Tree height, DBH, volume, stem biomass, basic density, fibre cell wall thickness and vessel density recorded higher heritability values; whereas, volume and its associated traits such as tree biomass and carbon content also recorded about 60 percent genetic gain.

Application of research: The traits *viz*., volume, biomass and carbon content, which showed higher heritability and genetic gain, may be used while selection of clones for commercial use and further breeding program.

Research Category: Forestry

Abbreviations:
PCV: Phenotypic Coefficient of Variations
GCV: Genotypic Coefficient of Variations
GA: Genetic Advance
GG: Genetic Gain
H^2: Broad Sense Heritability

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References

[1] Ramirez M., Rodrıguez J., Peredo M., Valenzuela S. and Mendonca R. (2009) *Wood Science and Technology*, 43, 131-141.
[2] Panwar P. and Bhardwaj S.D. (2005) *Agrobios (India), Jodhpur, India*.
[3] Qunekham K. (2009) *M.Sc. (Forestry) thesis. University of Canterbury, New Zealand*.
[4] Jane F.W. (1956) *Adam & Charles Black Ltd., London*.
[5] Wheeler E.A., Bass P. & Gasson P.E. (1989) *IAWA bulletin new series*, 10(3), 218-359.

[6] Zobel B. J. & Talbert J. (1984) *New York, John Wiley*.
[7] Singh A.; Toky O.P. and Dhillon G.P.S. (2011) *Ann. For*., 19(1), 27-33.
[8] Malan F.S. (1991) *South Afri.For. J*., 157, 16 - 23.
[9] Sundararaju R., Bharathi R.K. and Chinnathurai A.K. (1995) *Ind. For*., 121(2), 96-102.
[10] Kube P.D., Raymond C.A. and Banham P.W. (2001) *For. Genet*., 8(4), 285 - 294.
[11] Behera L. K. (2015) *Ph.D. (Forestry) Thesis. Navsari Agricultural University, Navsari.*
[12] Luna R.K. and Singh B. (2009) *Ind. For*., 135(2), 147-160.
[13] Kumar R. and Bangarwa K.S. (2010) *Ind. J. For*., 33(2), 161-165.
[14] Thakur A. and Sidhu D.S. (2010) *Ind. For*., 136(2), 198-204.
[15] Verma S.K. and Sharma S.K. (2011) *Ind. For*., 137(6), 732-738.
[16] Vennila S., Parthiban K.T., Seenivasan R., Saravanan V., Anbu P.V., Kanna S.U. and Durairasu P. (2011) *Ind. J. Ecology, 38(Special Issue),* 84-90.
[17] Peter D.K., Carolyn A.R. and Paul W.B. (2001) *For. Genet.,* 8(4), 285-294.
[18] Ginwal H.S., Kumar P., Sharma V.K. and Mandal A.K. (2004a) *Silvae Genet*. 53(4), 148-153.
[19] Ginwal H.S., Kumar P., Sharma V.K. and Mandal A.K. (2004b) *Silvae Genet*. 53(4), 182-186.
[20] Indira E.P. (2007) *Ind.J.Agrofor.,* 30(2), 199-207.
[21] Dhillon G.P.S. and Singh A. (2010) *Ind.J.Agrofor*., 12(1), 91-94.
[22] Huse S.A. (2018) *Ph.D. (Forestry) Thesis. Navsari Agricultural University, Navsari.*
[23] Kulkarni H.D. (2014) *In, Bhojvaid P.P., Kaushik S., Singh Y.P., Kumar D., Thapliyal M. and Barthwal S., Eds., ENVIS Centre on Forestry, Forest Research Institute, Dehradun, India*.
[24] Burton G.W. and DeVane E.W. (1953) *Agronomy Journal*, 1,78-81.
[25] Pillai S.K. and Sinha H.C. (1968) *Ram Prasad and Sons, Agra,* 241 - 245.
[26] Johnson H.W., Robinson H.F. and Comstock R.E. (1955) *Agronomy* Journal, 47, 314-318.