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Shikha Thakur
 Department of Tree
 Improvement, Rani Lakshmi Bai
 Central Agricultural University,
 Jhansi-Gwalior Road, Near
 Pahuj Dam, Jhansi,
 Uttar Pradesh, India

Sanjeev Thakur
 Department of Tree
 Improvement and Genetic
 Resources, College of Forestry,
 Dr. Y S Parmar UHF, Nauni,
 Solan, Himachal Pradesh, India

SK Jha
 Department of Forest Biology
 and Tree Improvement, College
 of Forestry, ACHF, Navsari
 Agricultural University, Navsari,
 Gujarat, India

Dushyant Sharma
 Department of Tree
 Improvement and Genetic
 Resources, College of
 Horticulture and Forestry, Neri,
 Hamirpur, Himachal Pradesh,
 India

Correspondence
Shikha Thakur
 Department of Tree
 Improvement, Rani Lakshmi Bai
 Central Agricultural University,
 Jhansi-Gwalior Road, Near
 Pahuj Dam, Jhansi,
 Uttar Pradesh, India

Variability for first year growth in forty nine international clones of *Populus deltoides*

Shikha Thakur, Sanjeev Thakur, SK Jha and Dushyant Sharma

Abstract

The present study was conducted to evaluate early growth performance of 49 international clones of *Populus deltoides* under mid hills conditions of Himachal Pradesh. The clones were procured from clonal selections from various sources of USA and planted under Randomized Block Design (RBD) in experimental farm of Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. One year growth was recorded and analyzed for height, diameter and genetic parameters. Significant variation was recorded for diameter and height growth among different clones. Both diameter and height growth traits showed moderate values for heritability and genetic advance indicating good scope of early selection for these traits in these clones. Clones 9000, 6503, 4400, 200 and T-81 were found best in terms of evaluated traits.

Keywords: *Populus deltoides*, heritability, genetic advance, clones

1. Introduction

Poplars (the genus *Populus*), belonging to the family Salicaceae, are trees with many valuable characteristics which have led to multiple beneficial uses for society and the environment since the dawn of history. Poplars are very useful and attracting lot of attention due to some characteristics which includes fast growth, ease of propagation, propensity to hybridize, pleasing appearance and many uses. While providing wood, fiber, fuel wood and other forest products, poplars also benefit society in the rehabilitation of degraded land, restoration of forest landscapes and mitigation of climate change. All of these benefits support rural livelihoods and contribute to sustainable development, particularly in developing countries.

The genus Poplar has relatively low species diversity compared to other tree genera, with only 30 to 40 species recognized by most taxonomists. One of the most familiar and silviculturally important poplars is *Populus deltoides* (commonly known as Eastern Cottonwood) which occurs throughout warm temperate to cool temperate regions of the world. It extends latitudinally from 28° to 36° N and longitudinally from 70° to 100° W.

Populus deltoides was introduced in India in 1952 by Forest Research Institute, Dehradun to increase the availability of raw material for plywood industries in the country (Chaturvedi and Rawat, 1994)^[2] as the wood is in demand for pulp and paper, plywood, matchwood, packing cases and light constructional timber all over the world (Rizvi *et al.* 2008)^[6]. The seed of the species was introduced initially during 1997 from Southeastern and Southwestern parts of United States of America and then cuttings were made from the resulting progeny. It is one of the most popular tree species in the agroforestry system as well as a principal species providing a number of hybrids and clones, which are being grown in irrigated plains of Western Uttar Pradesh, Uttarakhand, Punjab, Haryana, Himachal Pradesh and Jammu and Kashmir (Singh *et al.*, 1999)^[8]. As poplars provide us with wood, fiber, fuelwood and other forest products, along with rehabilitation of degraded land and mitigation of climate change. All of these benefits support rural livelihoods and contribute to sustainable development, particularly in developing countries.

Due to increasing popularity of the clones of *Populus deltoides* because of their short rotation and attractive price of wood, a large number of farmers have planted commonly known clones on their farm. The primary goal of this study was to study the genetic variability among growth parameters of these introduced international clones which are yet not been studied much. Variability studies in trees are very important for their survival, good growth as well as for adaptation (Sharma D *et al.*, 2018)^[7]. Keeping this in mind the present genetic variability study was carried out on different international clones of *Populus deltoides* in the main campus of the Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, India.

2. Material & Methods

A large germplasm bank of poplar is maintained at Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, India. Out of them selected hundred clones were grown in Randomized Complete Block design with three blocks for further study for suitability for local condition and wood quality studies. In the present investigation, forty nine clones developed from clonal selection from various sources of

United States of America have been selected for initial height and diameter variability study. The descriptions of the clones are given in table 1. The height and diameter were measure with the help of measuring tape and calipers, respectively. The analysis of data for ANOVA and variance component partitioning were carried out in JMP 9.0 software (SAS Institute Inc., Cary, NC)^[1].

Table 1: Description of *P. deltoides* clones used in the present study for assessing variability in initial growth and diameter

Sr. No.	Place and country	Number of clones	Clones
1	Louisiana, USA	11	8101, 5502, 7000, 6300, 6503, 6600, 6400, 57, 6500, 7001, 7002
2	Mississippi, USA	11	9002, 10200, 9800, 9607, 9000, 9501, T-6, T-95, T-7, T-100, 9606
3	Newberry, South Carolina, USA	7	T-41, T-35, T-77, T-44, T-45, T-36, T-40
4	North Carolina, USA	5	T-70, T-12, T-14, T-15, T-28
5	Tennessee, USA	3	T-81, T-93, T-78
6	Texas, USA	12	4400, 4709, 1400, 1001, 1100, 200, 4601, 4900, 700, 1008, 900, 1007

3. Results and Discussion

There was significant variation for first year height and diameter (Table 2). The clonal height ranged between 2.59 to 4.73 m with an average value of 3.41 m (Fig-2) and the basal diameter ranged between 17.62 to 35.98 mm with an average values of 28.46 mm (Fig-2).

Out of forty nine clones, twenty four clones showed higher value than overall mean and among those twenty four clone number 9000 from Mississippi, USA showed maximum value followed by clones 6503, T-81, 9607, 4400, 7000, 4709, 200, T-95, 1007, 5502 and 57 (Fig-1). For basal diameter, twenty five clones showed higher value as compared to average of all

clones under study. Clone T-93 recorded maximum value (35.98 mm) for basal diameter followed by 6600, 9000, T-45, 6503, 200, T-12, T-81, 4400, 4709 and 4900 (Fig-2). Clones 9000 from the Mississippi, 6503 from the Louisiana, 4400 and 200 from the Texas and T-81 from Tennessee were superior for both the characters.

Table 2: Analysis of variance table showing significance for the variation in height and diameter due to *P. deltoides* clones.

Characters	df	Mean Square	F Ratio	Prob > F
Height	48	0.680	1.646	0.020
Diameter	48	61.139	1.955	0.003

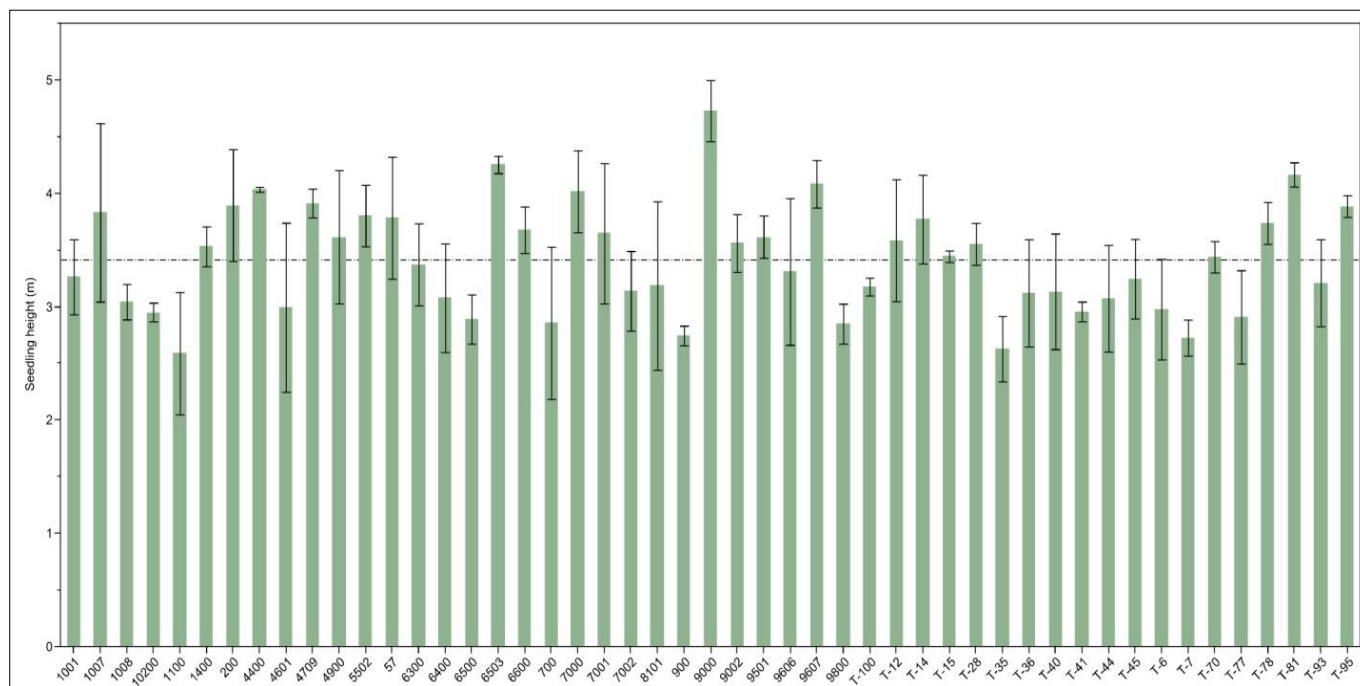


Fig 1: First year height variation in forty nine selected *P. deltoides* clones (dotted line shows overall mean of all forty nine clones).

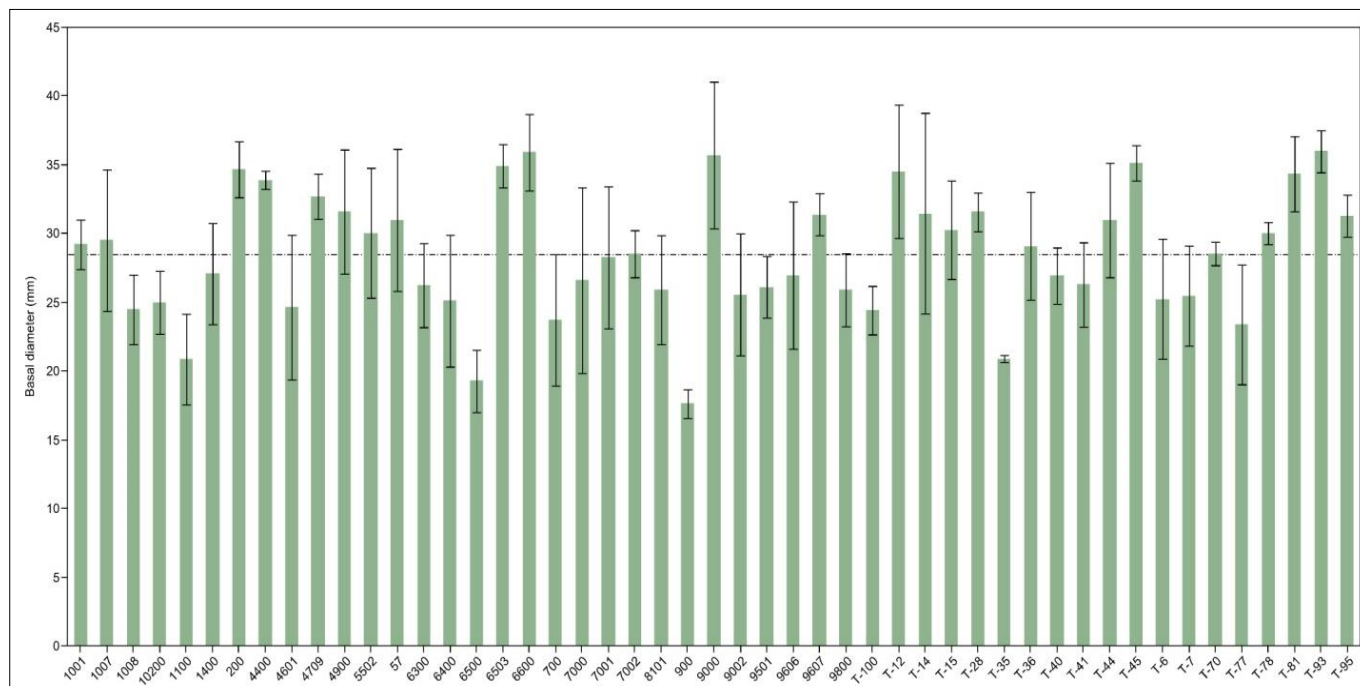


Fig 2: First year basal diameter variation in forty nine selected *P. deltoides* clones (dotted line shows overall mean of all forty nine clones).

Perusal to table shows that in initial years environment has much influence of height and diameter of selected clones. The environmental variance was higher as compared to genotypic variance for both the characters resulting in higher ECV as compared to GCV. The heritable value was observed lower in height as compare to diameter. Height is generally more influenced by environment however moderate genetic gain observed for both the characters. The variation in growth parameters has also been reported in tree species by Kumar *et al.* (2010) [4] in *Eucalyptus tereticornis*, Prasad *et al.* (2011) [5] in *Lucaena leucocephala* and by Jayraman and Rajan (1991) [3] in *Eucalyptus auriculiformis*.

Table 3: Genetic parameters for height and diameter in *P. deltoides* clones

Genetic parameters	Height (m)	Diameter (mm)
V _g	0.09	9.96
V _e	0.41	31.27
V _p	0.50	41.23
GCV (%)	2.61	34.98
ECV (%)	12.11	109.88
PCV (%)	14.72	144.86
Heritability	0.18	0.24
Genetic Gain	0.26	3.19
Genetic Advance (%)	7.58	11.22

4. Conclusions

Assessment of genetic variability is a key to progress in tree improvement programme (Zobel, 1981) [9] and is a useful tool in determining the strategies for tree improvement and breeding of any species. Significant variation among all genotypes was found for height as well as for diameter growth. The moderate value of heritability (h^2) and genetic advance (GA) for both height and diameter growth in evaluated genotypes suggest that early selection can be made for these traits in *P. deltoides*. In conclusion, clones 9000 from the Mississippi, 6503 from the Louisiana, 4400 and 200 from the Texas and T-81 from Tennessee can be selected for short rotation end uses like feedstock bioenergy however these clones need further site specific multilocational field trials for evaluation of growth parameters under different

agro-climatic conditions of low and mid hills of Himachal Pradesh.

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