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Studies on growth performance parameters of *Cedrus deodara* populations under field conditions in temperate zone of Himachal Pradesh

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ABSTRACT

Studies on growth performance parameters of *Cedrus deodara* populations were conducted under field trial laid at Temperate Horticultural and Forestry Research Station, Kotkhai, Shimla, Himachal Pradesh situated at an elevation of 1800 m amsl. The saplings of deodar belonged to different populations occurring in six districts of Himachal Pradesh viz Chamba, Lahaul and Spiti, Kullu, Shimla, Kinnaur and Sirmaur. Populations were coded as P_1 to P_{20}. The plants were planted at a spacing of 3 x 3 m in the pits of size 60 x 60 x 60 cm where regular watering was done and uniform cultural practices were employed to screen out the best genotypes and best families growing under similar conditions at Kotkhai. Study concluded that the family and population P_{13} (Kufri), P_{15} (Hatu Peak) and P_{11} (Manali) were superior over other families and populations in respect of growth parameters viz height, diameter, number of primary branches and needle length at initial stage of growth indicating that these populations and families were genetically superior and could be taken for further breeding potentials and programmes which have shown eye-catching growth performance in the open field conditions. Study also showed that geographic diversity may not be related with the genetic diversity.

Keywords: Deodar; growth performance; populations; field conditions; genetic diversity

INTRODUCTION

Deodar (*Cedrus deodara*) belonging to family Pinaceae is one of the most important timbers of the western Himalayas. The species is distributed from Afganistan to Garhwal extending up to the valley of Dhauli river below the Niti pass with an altitude range of 1800 to 3000 m amsl. Deodar is a large evergreen tree usually 40 to 50 m high; branches are horizontal or slightly ascending or descending arising irregularly from the stem. The needles are dark green but morphological variation in needles also occurs. The light green foliage trees often referred to as having silvery foliage are met in ravines. Tree bark is grayish brown with vertical and diagonal cracks (Nazim 1982)

Variation is the occurrence of differences among individuals due to differences in their genetic composition and the environment in which they are reared. Therefore the study of variation is the first step for any breeding and/or improvement programme. The effectiveness of such programmes depends upon the understanding of tree variation in nature and preserving it intact for future use (Khosla et al 1980).

The studies pertaining to variation help in analyzing fully the natural pattern of variation and group the organisms into species, genera and families (Bagchi et al 1990). These studies help in the comparison of superior and inferior characters which have a great importance in breeding and/or improvement programmes (Dogra 1992).

The species is of high economic importance to the northern states being one of the chief timbers of export (Troup 1921). The genetic improvement of the

species has not been attempted because of its easy regeneration in managed stands. Today in spite of its ecological and economic importance limited information concerning the amount and pattern of its genetic variability is available. Hence the present study was undertaken to find out the growth performance pattern at the time of planting of two year old nursery raised seedlings and after one year growth in field conditions planted at a spacing of 3 x 3 m at an altitude of 1800 m amsl.

MATERIAL and METHODS

Seed sources/provenances/populations from different parts of Himachal Pradesh were identified and selected from districts Chamba, Lahaul and Spiti, Kullu, Shimla, Kinnaur and Sirmour and their populations were coded as P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}, P_{15}, P_{16}, P_{17}, P_{18}, P_{19}, P_{20}. At initial stage only few selective morphological parameters were considered and taken under study. The seed sources were selected to represent five altitude ranges which are 1700-2000 m (A_1), 2000-2300 m (A_2), 2300-2600 m (A_3) and 2600-2900 m (A_4) amsl. Seeds were collected from these populations from the selected individual plus trees which fulfilled the minimum standard requirements during October to November and are depicted in Table 1 .

The mean values of the data recorded for these characters were subjected to statistical analysis by employing the following statistical methods. In order to find out whether significant differences existed in different sites, the data collected for different sites with respect to the different phenotypic characters were subjected to analysis of variance by using family block design (FBD) taking one sapling as replication as one tree as suggested by Panse and Sukhatme (1978).

RESULTS and DISCUSSION

The desired genetic improvement cannot be achieved unless the variation in the species of interest is properly understood. The assessment of natural variation with regard to important character is of prime consideration. Hence genetically-based habitat-correlated variation is found within the wild populations of a species from the base material for selection and improvement work. Variation with populations and between the individuals of the populations is very important for any breeding programme.

It is clear from the Table 2 that maximum height was obtained in population P_2 (Kalatop, 60.80 cm) which was statistically at par with P_9 (Palchan, 60.50 cm). Collar diameter was found maximum in P_{18} (Sangla,13.90 mm) and P_1 (Dalhousie, 13.90 mm) populations. Number of branches was found maximum 8 in P_{19} (Nauradhar) followed by 7 in P_2 (Kalatop), P_5 (Bharmour), P_8 (Naggar) and P_{14} (Narkanda) which were statistically at par with P_{19} (Nauradhar). Needle length was found maximum (18 mm) in P_{19} (Nauradhar) and P_2 (Kalatop) which were statistically significantly different than other populations under study.

After one year growth after planting which is otherwise considered second year growth, maximum height was found in P_{16} (Nichar, 90.90 cm) followed by P_{15} (Hatu Peak, 90.50 cm) and P_{18} (Sangla, 90.50 cm) whereas collar diameter was found maximum in P_{15} (Hatu Peak 20.90 mm) followed by P_{13} (Kufri, 20.30 mm). Number of branches was observed maximum (13) in P_{13} (Kufri), P_{15} (Hatu-Peak) and P_{19} (Nauradhar) which were statistically different than other populations. Maximum needle length was observed in P_{15} (Hatu Peak, 28 mm) followed by P_5 (Bharmour, 27 mm) which were statistically and significantly different over other populations.

Table 3 depicts significant differences between various populations and sites and the maximum sapling height was observed in P_{15} (Hatu Peak, 60.40 cm) population followed by P_{11} (Manali, 60.00 cm). Growth (diameter) which is reliable indicator for growth performance was observed maximum in P_{13} (Kufri, 6.90 mm) population followed by P_{14} (Narkanda, 6.00 mm). Number of branches/ formation of branches to bear a canopy-shaped structure is also best indicator and desirable trait in growth performance studies. Number of primary branches was maximum (7) in P_{15} (Hatu Peak), P_{13} (Kufri), P_{10} (Solang Nala) and P_{11} (Manali) populations. Needle length was maximum (12 mm) in P_{15} (Hatu Peak). Effective size in populations reveals and concludes that geographic diversity may not be related with genetic diversity.

The result findings are in conformity with the findings of Mahadevan et al (1999) in *Casurina equiestifolia*, Mathur et al (1984) in *Acacia nilotica*, Matziuris (1998) in Aleppo pine, Mungar (1947) in ponderosa pine, Silen and Osterhaus (1979) in Douglas fir and Singh and Chaudhary (1992) in wild apricot.

Table 1. Location of populations of *Cedrus deodara* in different parts of Himachal Pradesh

Location	Code used	District	Altitude (m)	Latitude (N)	Longitude (E)
Dalhousie	P_1	Chamba	1900	30°32′	75°59′
Kalatop	P_2	Chamba	2150	32°32′	76°03′
Khajiar	P_3	Chamba	2300	30°38′	76°03′
Chhatra	P_4	Chamba	2600	32°41′	76°07′
Bharmour	P_5	Chamba	2875	32°26′	76°28′
Udaipur	P_6	Lahaul and Spiti	2600	32°45′	76°35′
Kullu	P_7	Kullu	1800	31°51′	77°02′
Naggar	P_8	Kullu	2100	32°04′	77°02′
Palchan	P_9	Kullu	2300	32°14′	77°05′
Solang Nala	P_{10}	Kullu	2880	32°15′	77°05′
Manali	P_{11}	Kullu	2580	32°09′	77°05′
Shimla	P_{12}	Shimla	2200	31°03′	77°01
Kufri	P_{13}	Shimla	2475	31°08′	77°15′
Narkanda	P_{14}	Shimla	2700	31°11′	77°24′
Hatu Peak	P_{15}	Shimla	2950	31°11′	77°24′
Nichar	P_{16}	Kinnaur	1950	31°31′	77°57′
Kalpa	P_{17}	Kinnaur	2500	31°30′	78°14′
Sangla	P_{18}	Kinnaur	2700	31°31′	78°15′
Nauradhar	P_{19}	Sirmour	2875	30°36′	77°19′
Churdhar	P_{20}	Sirmour	1975	30°37′	77°16′

Table 2. Studies on growth performance of *Cedrus deodara* populations in temperate zone of Himachal Pradesh

Population	I year (at the time of planting)				II year (after one year growth period)			
	Height (cm)	Diameter (mm)	Number of primary branches	Needle length (mm)	Height (cm)	Diameter (mm)	Number of branches	Needle length (mm)
P_1	60.00	13.90	6	17	60.90	16.40	10	25
P_2	60.80	12.60	7	18	90.00	16.10	11	26
P_3	60.20	13.70	6	16	90.30	19.70	10	25
P_4	60.00	13.10	5	16	60.80	17.10	9	24
P_5	60.30	11.90	7	17	60.90	16.20	10	27
P_6	60.20	13.40	6	15	90.00	16.00	10	25
P_7	60.00	11.10	6	17	60.50	13.60	11	24
P_8	60.20	13.80	7	17	60.70	15.30	12	26
P_9	60.50	12.50	5	15	60.60	16.10	11	25
P_{10}	30.50	13.70	4	17	60.30	16.70	11	25
P_{11}	30.10	10.10	4	14	90.10	16.10	11	23
P_{12}	30.90	12.70	5	16	60.20	16.60	10	25
P_{13}	30.80	13.40	6	14	90.20	20.30	13	25
P_{14}	30.60	11.60	7	16	90.20	17.60	12	25
P_{15}	30.10	14.10	6	16	90.50	20.90	13	28
P_{16}	60.50	11.50	5	16	90.90	16.80	10	26
P_{17}	30.70	10.70	5	17	90.20	16.50	10	24
P_{18}	60.30	13.90	6	16	90.50	18.30	11	23
P_{19}	60.00	13.50	8	18	60.10	16.10	13	23
P_{20}	30.10	12.50	4	14	60.20	17.50	08	24
$CD_{0.05}$	10.15	1.08	1	0.92	10.10	1.06	0.94	1.42

P_{13} (Kufri), P_{15} (Hatu Peak) and P_{11} (Manali) families were found similar and at par for growth pattern. These families and populations showed best results in field and can be taken for further breeding programmes and used for production and multiplication of genetically superior planting stock.

Table 3. Mean effective growth pattern analysis at one year growth period in *Cedrus deodara* populations under field conditions in temperate zone of Himachal Pradesh

Population	Height (cm)	Diameter (mm)	Number of primary Branches	Needle length (mm)
P_1	00.90	2.50	4	8
P_2	29.20	4.50	4	8
P_3	30.10	6.00	4	9
P_4	00.80	4.00	4	8
P_5	00.60	4.30	3	10
P_6	29.80	2.60	4	10
P_7	00.50	2.50	5	10
P_8	00.50	1.50	5	9
P_9	00.10	3.60	6	9
P_{10}	29.80	3.00	7	10
P_{11}	60.00	6.00	7	8
P_{12}	29.30	3.90	5	9
P_{13}	59.40	6.90	7	11
P_{14}	59.60	6.00	5	7
P_{15}	60.40	6.80	7	12
P_{16}	30.40	5.30	4	10
P_{17}	59.30	5.80	5	7
P_{18}	30.20	4.40	5	7
P_{19}	00.10	2.60	5	5
P_{20}	30.10	5.00	4	10
$CD_{0.05}$	10.35	1.10	1.00	1.50

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