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Assessing Productivity of Eucalyptus Clones Under Different Edaphic Conditions

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ABSTRACT

Eucalypts are recognized as one of the fastest growing trees and they are preferred because of high growth rate, short rotation length (10 years) and favorable pulpwood properties.For most fast growing species growth rates are highest with favorable temperatures and where there is high soil water-storage capacity and good fertility. However, sustaining tree productivity in the future will depend on maintaining soil fertility levels in subsequent plantation rotations. Four compartment study at Dhimri, Tanda , Barakoli and Kotkharra south were selected for study to analyze the growth of Eucalyptus clones under different soil and ecological conditions. Clonal eucalyptus plantations were analyzed for productivity in three clones viz. K25, K28 and A.P. 10.Correlation of diameter and volume between different clones in a plantation area and CTA indicates that AP 10 shows better growth as compared to others.

KEYWORDS Productivity, Plantations, Eucalyptus , clones.

Introduction

Currently, eucalypts and pines are the most commonly used species in tropical timber plantations (Evans 1992). Together, they account for 43 percent of all tropical plantation area (FAO 1999). Eucalypts are recognized as one of the fastest growing trees and they are preferred because of high growth rate, short rotation length (10 years) and favorable pulpwood properties.

For most fast growing species growth rates are highest with favorable temperatures and where there is high soil water-storage capacity and good fertility. However, sustaining tree productivity in the future will depend on maintaining soil fertility levels in subsequent plantation rotations. Jacobs (1981) suggested that a Mean annual increment (MAI) of 10-15 m^3 ha^{-1} yr^{-1} was commonly obtained from the large scale plantations, but more recent experience suggests that on many sites faster growth rates are possible. Growth rates tend to be lower in India. The productivity of eucalyptus plantations in Kerala, for example, are estimated to be 5-10 m^3 $ha^{-1}yr^{-1}$. The causes are climate, soils, species used, (e.g. *E. tereticornis*) and silvicultural. Another possible cause of the poor productivity is soil fertility deterioration from successive crop rotations (Sankaran 1998).

In India, *Eucalyptus* was first introduced around 1790, when a number of species were planted in the erstwhile State palace garden at Nandi Hill near Mysore. Regular trials were started in 1843 at Willington in the Nilgiri Hills when Captain Cotton of the Madras Engineers successfully introduced *E. globulus*. Among the species tried so far in India, the Nandi grown *E. tereticornis*, popularly known as 'Eucalyptus hybrid' or 'Mysore gum' has been the most widely used for raising plantations in the varying climatic zones of the country. The species was first raised on a plantation scale in Karnataka in 1952. Since then extensive plantations have been done throughout the country to meet the needs of fuelwood, small timber and pulpwood.

Clonal plantation of *Eucalyptus* has revolutionized the pulp and paper wood industry. M/s Bhadrachalam Paper Boards Ltd. in Andhra Pradesh in 1997 were successful in developing clones like 71,99,128 etc. through clonal technology which have a productivity 17 to 24 cumt/ha/yr at six years of age .

In Uttarakhand, the forest department had earmarked about 24,500 hectare area in the tarai belt for production forestry purposes. In the year 1998-99 a five year World Bank Aided Forestry Project was started with one of its objectives being to develop genetically improved, uniform, fast growing, high yielding and disease resistant locality specific clones of *Eucalyptus* and to test the suitability of Eucalyptus clones developed outside the region. In view of the above objectives clonal testing trials were set up in the tarai forests of Uttarakhand. The study focuses on the results of the traits set up under the project. The purpose of the study was to analyze the growth of *Eucalyptus* clones under different soil and ecological conditions.

Materials and Methods:

Study area: The study area is located between 192-283m elevations in Uttarakhand Himalaya. A total of four compartment in Tarai belt of Uttarakhand were selected for study at Dhimri, Tanda , Barakoli and Kotkharra south. All these plantations were sampled with 0.1% sampling intensity. The plantations was established in the year 2005. Three clones of eucalyptus having two replicated each has been tried. Each clone was planted in 0.5 ha area at 2 x 2 m spacing. 3 year after the plantation the planted area was surveyed. The height and diameter of all the trees falling within the plot was measured with Ravi multimeter and Diameter by a tree caliper.

The soil samples from all these sites were analyzed for some physical and chemical properties of the soil. For the determination of soil pH, soil reaction was assessed by glass electrodes using 1:2 proportions of soil and water. Organic carbon was determined by wet oxidation method (Piper 1944) and Nitrogen was analyzed by Kjel Auto-analyzer and phosphorus by following Jackson 1958 at silviculturist sal laboratory haldwani. Volume per tree for 3 year old trees was estimated by using the equation developed for this region by Chaturvedi (1983). Clonal eucalyptus plantations were analyzed for productivity in relation to soil and other ecological factors. Three clones were selected for study viz. K25, K28 and A.P. 10. Out of these K25 and K28 were brought from Kerela and A.P.10 from Andhra Pradesh and introduced in tarai and bhabhar regions of Uttarakhand. All these clones were initially marked as the best performing clones of this region. Biomass was esti-

mated following equation developed by Bargali et. al. 1992.

Results and discussion

Soil parameters:

The properties of soil are given in table 1. Bulk density of the soil varied from 1.11 to 1.31 gm/cm^3, which was highest for Tarai central, barakoli and lowest for Tarai central Dhimri . Porosity ranged from 36.90 to 48.60%. Across all the sites, pH of soil varied from 6.18 (Tarai central Dhimri 57) to 7.88 (Kotkhrra south), Available nitrogen varied from 144.250 (Tarai central, barakoli) to 268.190 kg/ha. (Kotkhrra south), organic Carbon from 0.39 (Tarai central, barakoli) to 2.13 (Tarai central Dhimri) and soil potassium varies form .007 (Tarai central, barakoli) to .014 % (Tarai central Dhimri).

Table 1- Soil analysis detail of plots:

Location	pH	Available N(kg/ ha)	P_2O_5 (%)	K_2O (%)	Org.C (%)	Bulk Density (gm/ cm3)	Porosity %
Tarai central, barakoli (a) p.no. 52	6.370	144.250	0.011	0.007	0.390	1.310	46.650
Tarai central Dhimri 57 (a)	6.185	203.200	0.005	0.014	2.135	1.110	36.900
Kotkhrra south (a) p. no. 51	7.880	268.190	0.005	0.008	0.555	1.290	48.600
Kotkhrra south (a) p. no. 56	7.032	265.695	0.005	0.011	1.345	1.200	42.750

Data analysis- Data on plant height and diameter recorded at 3 years age was used for statistical analysis. The clonal plantation of A.P.10 at an age of 4 years showed an average diameter of 11cm., while in CTA (Clonal Testing Area) it showed an average diameter of 7 cm. K28 showed an average diameter of 8 cm and K25 7cm. in plantation area. The differences for height between various clones for different areas are not very significant.

The significant differences between clones were observed for per tree volume (Table 2) which can be attributed as individual genetic trait. K 28 showed maximum variation in per tree volume, with difference in locality. This can be very well related to the soil conditions existing in those areas. (Table 2). As can be inferred from the table, the areas with higher nitrogen content show lesser growth. Thus nitrogen content of soil has an inverse correlation with productivity. Biomass was not significantly varied between CTA . while it was higher for AP10 clone in a plantation area.

Table 2- Comparative growth in different clones at different sites:

S. No	Clone Name	Area / Current age	Dia(m)	height(m)	Per tree volume (Cumt.)	Mai (Cumt.)	Above ground biomass
1	AP 10	CTA dhimri 57 a/ 3	0.078	15.394	0.021	5.083	11.66
		Barakoli a 52 /3	0.111	14.86	0.042	13.269	16.04
2	K28	CTA dhimri 57 a /3	0.0676	9.894	.0095	4.52	10.19
		Kotkhara south a 51/3	0.0787	9.00	0.012	3.714	11.65
3	K25	CTA dhimri 57 a /3	0.082	12.662	0.019	9.06	11.66
		Kotkhara south a 56/ 3	0.0742	9.102	0.011	3.29	10.19

Discussion

The data computed was validated for per tree volume. The per tree volume was computed by using volume equation , (0.0015+0.2401*dia*dia*h) as well as using the volume table developed by A.N. Chaturvedi (1983).The results obtained are almost similar, except for minor variations, which shows that the data is highly significant.

The higher volume of clones may be attributed to their genetic potential. Differences in volume among the same clone at different sites can be attributed to different edaphic and ecological factors prevalent in those areas. The above ground biomass (10.19-16.04) recorded for the present study is comparable with that of Chaturvedi and Singh 1987 for early successional pine forest (1.2-17.6) but it is higher than those reported by Rogers and Westman 1980 for Eucalyptus forests (6.8) in Australia. Correlation of diameter and volume between different clones in a plantation area and CTA indicates that AP 10 shows better growth as compared to others (Fig 1and 2).

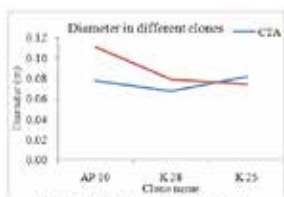


Fig. 1. Diameter of different clones

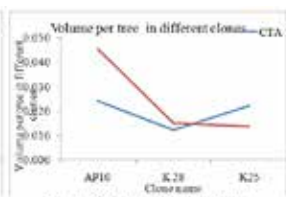


Fig. 1. Volume of different clones

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