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Growth Performance of Eucalyptus Clones in Tarai Region of Uttar Pradesh, India

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Abstract

The experimental trial for assessment of suitable clones was established in KVK, Beliparin Gorakhpurdistrict of Tarai region. The trial was conducted under statistical design of Randomized Blocks with 3 replicates and 3 x 2 m spacing for all 26 clones of Pragati Biotech, Punjab, IFGTB , Coimbatore and FRI, Dehradun - IFGTB 1-10, FRI 104, 110, and 124 & Punjab clones 413,07,526, 04, K-25, 2070, 2136, 3018, 3021, P-14, P-45, 2013 and P-66 of two eucalyptus species (*E. tereticornis* and *E. camaldulensis*) along with control for all 27 treatments. Overall, on the basis of growth performance, clones- IFGTB -4, 1,6, 9 , 10 , in FRI series - 104, 124 and in Punjab series- P-14, P-45, 07, K-25, 526, 2136, 2013 performed superior over other treatments. On the basis of growth performance of clones for height, girth at basal height, basal area and tree volume, in IFGTB series, the clones IFGTB 4, IFGTB 1, IFGTB 6, IFGTB 9, IFGTB 10, in FRI series, FRI 104, and FRI 124 and in Punjab series, P-14, P-45, 07, K-25, 526, 2136 and 2013 performed superior over other treatments in Gorakhpur district.

Key words : Eucalyptus clones, growth performance, tarai region, suitability, agroforestry.

Eucalyptus is the most suitable species for agroforestry plantations owing to its unpalatable characteristic, rapid growth rate, adaptation to extreme ecological situations including saline-alkali soil environment and drought. It is distributed worldwide in various agro-ecological environments, from deserts to rainforests. *Eucalyptus* has the ability to withstand the salinity, drought and water logging conditions and also acts as recreational areas, windbreaks, shelterbelts etc. Production of genetically improved clonal plantation stocks of Eucalyptus can improve the quality of produces such as wood for paper and pulp, leaves for oil extraction and other medicinal value [6]. It is found that farmers are easily adopt and grow the Eucalyptus species due to its fast growing nature and wide demand by the pulp and paper industries as well as pole for building construction. Eucalyptus plantations can also improve degraded lands by stabilizing soils, improving soil nutrient status and increasing soil organic matter through enhancement of above ground litter production [9]. Among five important trees outside forests in the state of Uttar Pradesh, the relative abundance percent of Eucalyptus trees in rural area is 15.86 and in urban area, it is 8.87. stated that Eucalyptus *hybrid* and *E. tereticornis* are the two most widely planted Eucalyptus trees in India. As a short rotation and fast growing nature, Eucalyptus is widely preferred by farmers for pulp and paper industries as well as in local market for pole [8]. In eastern part of Uttar Pradesh state of India, Eucalypts are in improving stage for adoption at larger level and choice of suitable clones in plantations is still a big challenge for them. Therefore, with an aim to evaluate the growth performance of Eucalyptus clones in Gorakhpur district of Tarai region of Eastern Uttar Pradesh, this study has been undertaken for identification of suitable clones of Eucalyptus in the region.

Material and methods

Study area : The districtGorakhpur lies under Tarai region of Eastern Uttar Pradesh.The forest area is only 2.78 % of total geographic area of the district [10]. The present district of Gorakhpur lies between latitude 26° 13' N and 27° 29' N and longitude 83° 05' E and 83° 56' E. The total geographical area of Gorakhpur is about 3483.8 sq km whereas total population is 37,69,456. Gorakhpur forest division is situated in the Tarai region of U.P. and comprises of the districts Gorakhpur and parts of Maharajganj. Gorakhpur forests are rich in biodiversity and are endowed with variety of plant species. Gorakhpur is the headquarters of Gorakhpur Division and District. Gorakhpur division comprises of four districts, Gorakhpur, Deoria, Mahrajganj and Kushinagar. It is divided into seven Tehsils and further subdivided into 19 Development Blocks (Fig. 1).

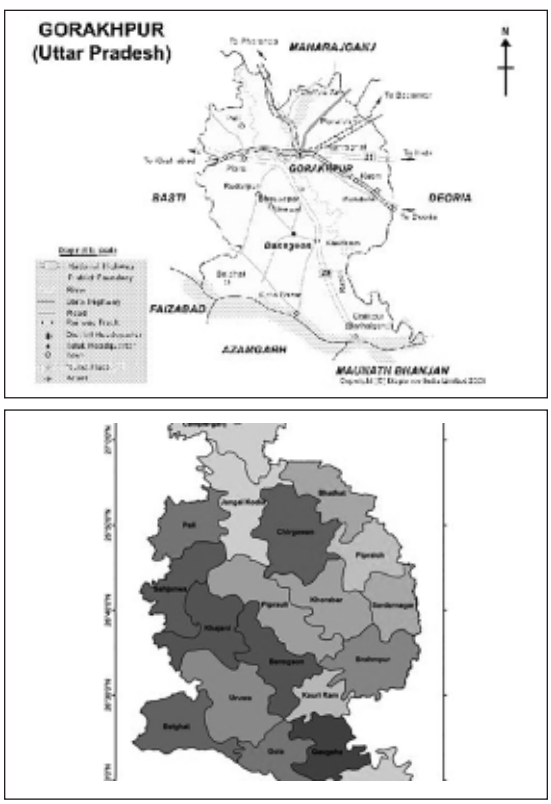


Fig. 1. Map of district Gorakhpur

Establishment of experimental trial : Theexperimental trial for assessment of suitable clones was established in Krishivigyankendra, Belipar in Gorakhpurdistrict of Tarai region. The trial was conducted under statistical design of Randomized Blocks with 3 replicates and 3 x 2 m spacing for all 26 clones of Pragati Biotech, Punjab, IFGTB, Coimbatore and FRI, Dehradun - IFGTB 1-10, FRI 104, 110, and 124 and Punjab clones 413,07,526, 04, K-25, 2070, 2136, 3018, 3021, P-14, P-45, 2013 and P-66 of two eucalyptus species (*E. tereticornis* and *E. camaldulensis*) along with control for all 27 treatments. The mixture of 100 g of NPK (3:2:1) fertilizer and FYM (1.0 kg per plant) were applied at onset of monsoon during planting to assist establishment of growth. The irrigation was also done twice a month normally and in hot summers once in a week. The annual increment of each clone was calculated using all the growth parameters (girth at breast height; gbh and height) for consecutive five years. The basal area in m^2 (BA =0.00007854 x DBH in cm) and volume of trees in cum ($V= \pi r^2 x h$) / tree (r and h in m), (1667 trees / ha in 3x2 spacing)were also calculated [12]. The data analysed statistically by standard ANOVA technique using RBD. The statistical analysis was done by data analysis tool package of OPSTAT prepared by Statistical Software Package for Agricultural Research Workers. CCS HAU, Hisar, Haryana [13].

Results and discussion

The results of growth performance evaluation of these clones were recorded for mean annual increments of height (m) and girth at basal height; gbh (cm) for all the four years and are depicted in Table 1, 2 and Fig 2, 3. The highest value of increment in gbh belonged to clones IFGTB 4 (40.00 cm) followed by IFGTB 1 (38.33 cm), IFGTB 6 (37.40 cm), IFGTB 9 (35.00 cm) and IFGTB 10 (33.95 cm) amongst IFGTB series whereas in FRI clones, clone FRI

104 performed superior with 33.65 cm increment in girth after four year of planting In Punjab clone series, P-14 (42.80 cm) showed highest value followed by P- 45 (42.03 cm), 07 (41.35 cm), K 25 (40.73 cm), 526 (38.55 cm), 2136 (37.40 cm), 2013 (36.53 cm). The lowest values belonged to clone IFGTB 5 (26.75 cm) andDDN-100 (29.34 cm). The clones with superior annual increment in height were IFGTB 4 (15.69 m) followed by IFGTB 6 (14.59 m) and IFGTB 1 (14.55 m) in IFGTB series whereas in FRI series, FRI 124 (13.59 m) performed superior over other two clones. The clones of species *E. camaldulensisin* IFGTB series performed superior over FRI clones /species of *E. terreticorni*s. The results of the analysis of variance (ANOVA) for mean height increments showed high levels of significance. The mean girth increments were also analysed significantly using ANOVA.The results of growth performance indicated that out of 27 clones, all clones gave superior results for growth indicators in comparison to control. The clones of species *E. camaldulensis* performed superior over other *E. tereticornis* and *E. hybri*d. The results of the analysis of variance for annual mean increment in height and girth showed in Table 3,4.Overall, on the basis of growth performance, clones- IFGTB -4, 1,6, 9 , 10 , in FRI series - 104, 124, in Punjab series- P-14, P-45, 07, K-25, 526, 2136, 2013 performed superior over other treatments. Here, only clone 07 of Punjab series, belonged to *E. tereticornis* whereas all other clones were of *E. camaldulensis*. On the basis of growth performance of clones for height, girth at basal height, basal area and tree volume (Fig. 4) , in IFGTB series, the clones IFGTB 4, IFGTB 1, IFGTB 6, IFGTB 9, IFGTB 10, in FRI series, FRI 104, and FRI 124 and in Punjab series, P-14, P-45, 07, K-25, 526, 2136 and 2013 performed superior over other treatments in Gorakhpur district.

These results are in confirmation with results of Dhillon and Singh, Lal *et al.* [15] and Singh and Dhillon where they discovered that clones tested under the same conditions responded differently, which may be attributed to their genetic make-up. Earlier research has documented the eucalyptus clones performance and those research' findings indicate that, considerable changes in growth and yield among eucalyptus clones may be attributed due to environmental and genetic variables. Red Gum (*Eucalyptus camaldulensis* L.) is renowned globally for its fast growth, high levels of drought tolerance and adaptability to diverse climatic conditions and soils, which makes it popular among eucalypt tree growers [18].Some clones which were inferior to the best provenance seedlot demonstrates that clonal selections should not be transferred to contrasting environments without thorough testing.

The variation among clones in growth parameter may be due to genetic make-up and interactions with the environmental factors. Similarly, [20] also found difference in diameter growth among clones of *E. tereticornisat* the age of 3.5 years. It was identified best clones out of 36 *viz*., clone 2070, 285, 316, 288, 498, 286 and 2045 for Punjab ecological condition [21]. It was studied the growth performance of 12 clones of Eucalyptus at Ludhiana [22]. The clone no. 413 and 2070 recorded significantly higher height growth as compared to other clones. In south Gujrat, clonal variation for growth parameters such as DBH, mid- diameter, height, form quotient and volume was significantly different among 20 clones of Eucalyptus and DBH varied between 11.47 and 16.07 cm with an overall mean of 13.28 cm [8]. It is also established that *E. camaldulensisas* a pure species is adapted to low-to intermediate rainfall environments. The identified clones of *E. camaldulensis* are well suited for Tarai region of Uttar Pradesh in India.

Table 1. Annual increment in height (m) in 4 years

Clones	Year 1	Year 2	Year 3	Year 4
IFGTB-1	3.61	4.93	5.71	14.55
IFGTB-2	3.1	4.5	4.7	11.24
IFGTB-3	3.65	5.5	5.07	12.95
IFGTB-4	3.87	5.75	5.41	15.69
IFGTB-5	3.08	4.8	5.34	10.48
IFGTB-6	3.56	4.58	6.32	14.59
IFGTB-7	3.31	4.88	5.14	10.68
IFGTB-8	3.14	4.68	5.07	13.38
IFGTB-9	4.46	6.43	6.39	14.37
IFGTB-10	4.33	6.48	6.3	12.79
DDN-100	2.97	4.7	5.62	11.89
DDN-104	2.82	4.5	4.74	13.18
DDN-124	3.27	5.48	5.09	13.59
2136	5.11	8.33	7.91	15.72
2070	3.42	5.2	7.01	15.89
413	3.55	5.55	6.25	13.94
P-66	2.61	4.4	5.67	14.99
3021	4.51	7.53	7.91	14.75
P-45	4.69	7.18	8.03	15.75
2013	7.35	11.68	10.51	15.56
0-4	4.41	7.85	7.58	16.70
K-25	4.39	7.58	7.45	17.45
3018	3.51	5.4	6.26	14.55
526	4	7.73	7.89	15.57
P-14	5.8	9.65	8.74	16.11
0-7	4.94	7.7	8.17	15.44
Control	1.63	2.55	3.4	9.39
C.D.	0.23	4.44	2.70	4.20
SE(m)	0.08	1.52	0.92	1.44
SE(d)	0.11	2.15	1.30	2.03
C.V.	16.64	32.30	20.83	14.27

Table 2. Annual increment in girth (cm) in 4 years

Clones	Year 1	Year 2	Year 3	Year 4
IFGTB-1	1.13	10.9	10.55	38.33
IFGTB-2	0.95	6.9	19.35	29.20
IFGTB-3	1.65	10.9	19.53	29.15
IFGTB-4	3.25	15.6	19.65	40.00
IFGTB-5	1.88	6.9	19.68	26.75
IFGTB-6	2.5	13.4	21.23	37.40
IFGTB-7	0.88	6.1	19.03	28.60
IFGTB-8	1.35	11.1	28.83	31.60
IFGTB-9	2.73	11.6	21.5	35.00
IFGTB-10	2.33	10.9	20.5	33.95
DDN-100	1.85	8.6	19.95	29.35
DDN-104	1.73	11.2	18.55	33.65
DDN-124	2.8	9.3	19.8	32.75
2136	2.63	19.4	27.53	37.40
2070	4.6	14.4	21.98	33.63
413	1.85	17	20.93	36.00
P-66	2.73	13	20.15	31.95
3021	3.78	19.8	23.45	41.40
P-45	2.45	22.7	14.28	42.03
2013	4.45	13.9	17.83	36.53
04	5.05	10.6	18.25	32.60
K-25	2.95	20.3	33.56	40.73
3018	3.03	14.5	19.35	36.65
526	1.93	15	23.73	38.55
P-14	5.23	19.7	20.38	42.80
0-7	5.00	15.9	20.2	41.35
Control	1.12	8.45	12.25	28.75
C.D.	0.49	3.15	10.11	N/A
SE(m)	0.17	1.08	3.46	3.74
SE(d)	0.24	1.53	4.89	5.29
C.V.	16.49	36.36	27.79	15.35

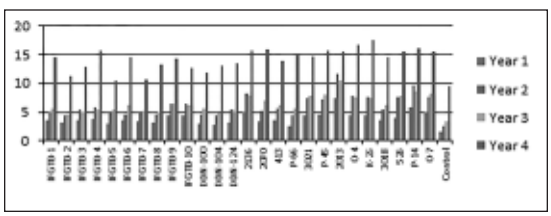


Fig. 2. Annual increment in height (m) in 4 years

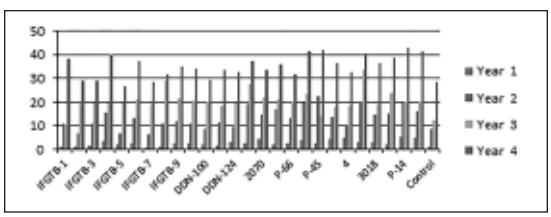
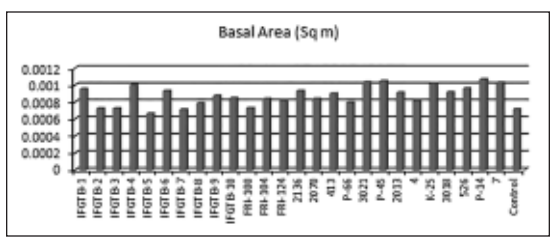


Fig. 3. Annual increment in girth (cm) in 4 years



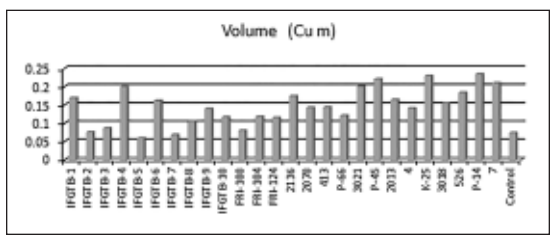


Fig. 4. Performance of clones for basal are(sq m) and tree volume(cu m)

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