

# *Effect Of Mechanical Site Preparation Methods In Growth Of Pinus Brutia Afforestation*

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**Abstract** – Mechanical site preparation by mini excavator (ME) and crawler tractor by ripper (CTR) were compared for seed height and root-collar diameter, and survival in one year *Pinus brutia* afforestation. CTR had higher seedling height (16.6 cm) and root-collar diameter (3.44 mm), and survival (27%) than ME (15.2 cm and 3.21 mm, and 22%), while the methods were similar ( $p>0.05$ ) according to results of analysis of variance. Results of analysis of correlation showed statistically significant ( $p<0.01$ ) and positive relations between seed height and root-collar diameter in both methods. The results had first year data at the areas. New studies could be concluded for future years.

**Keywords** – Diameter, Growth, Height, Plantation, Soil.

## I. INTRODUCTION

According to the last national forest inventory, Turkey has 23.1 million hectares forest area of which 42% of the area (9.6 million ha) is unproductive [1]. Unproductive forest area decreased from 56% (11.3 million ha) of Turkey by forestry practices such as afforestation practices to 42% of the area (9.6 million ha) from 1973 to 2021. In the forest area, Brutian pine (*Pinus brutia* Ten.) has the largest natural distribution by 5.3 million ha which 34.1% of the area (1.8 million ha) is unproductive [1]. Forest establishment is the most important way in conversion of unproductive forest to productive or increasing of forest land by afforestation, reforestation, artificial regeneration and rehabilitation practices [2]. However, these practices have many stages from seed harvesting, site preparation to re-establishment by planting or sowing. There could be many environmental and biological factors [3-8] effective on these stages for successful forest establishment. Site preparation is one of the main stages in these establishments to be effective economical and success of the establishment practices. Mechanical site preparation methods were examined based on growth in Brutian pine afforestation to contribute future forest establishment practices in the species.

## II. MATERIAL AND METHODS

### 2.1. Studied areas

The studied areas were sampled from afforestation, which was 500 m<sup>2</sup> (50x10 m) each, established in 2021 at southern part of Turkey (Table 1, Figure 1). Mini excavators (ME) and ripper of crawler tractor (CTR) were used for site preparation method in the areas established by 2 years bare-root seedlings of a seed stand (Latitude (N): 37°21'00'', Longitude (E): 30°54'45'', 400 m asl.) at spacing 3x2 m (3333 seedlings/ha) at sandy-slip soil. Soil depth was about 35 cm in the humid areas according to Erinc's Aridity Index [9].

Table 1. Geographic details of the areas

Methods	Latitude (N)	Longitude (E)	Altitude (m)
CTR	37°37'11"	30°45'48"	682
ME	37°37'13"	30°45'47"	686



Figure 1. Sampled areas from CTR (left side) and ME (right side)

## 2.2. Studied characteristics and data analysis

Seedling height (**SH**) and root-collar diameter (**RCD**) were measured at end of growth period of 2022 (Figure 2). Survivals of the areas were estimated by ratio of spacing (3x2 m=3333 seedlings/ha) and number of measured seedlings.



Figure 2. Height and diameter measurements in the seedlings

One-way linear model of analysis of variance (ANOVA) was performed for comparison of the methods at SPSS package [10]. Relations between seedling height and root-collar diameter was estimated by Pearson' phenotypic correlation at the package.

### III. RESULTS AND DISCUSSION

Area prepared by ripper of crawler tractor (CTR) had higher seedling height (SH, 16.6 cm) and root-collar diameter (RCD, 3.44 mm) than area prepared by Mini excavator (ME, 15.2 cm, and 3.21 mm) (Table 2, Figure 3).

Table 2. Average and coefficient of variations (CV%) for the characteristics at methods

	CTR (44)*		ME (37)		Total (81)	
	H (cm)	RCD (mm)	H (cm)	RCD (mm)	H (cm)	RCD (mm)
<b>Average</b>	16.6	3.44	15.2	3.21	16.0	3.33
<b>CV%</b>	24.7	29.9	25.0	29.3	25.0	27.3

\*; Number of seedlings in parenthesis.

As seen from Table 2, survival of CTR area (27%, 880/ha) was also 20% higher than ME area (22%, 740/ha). It was reported that soil preparation methods had effective on survival of different forest tree seedlings [4; 8]. Root-collar diameter had higher variation than seedling height in both methods (Table 2).

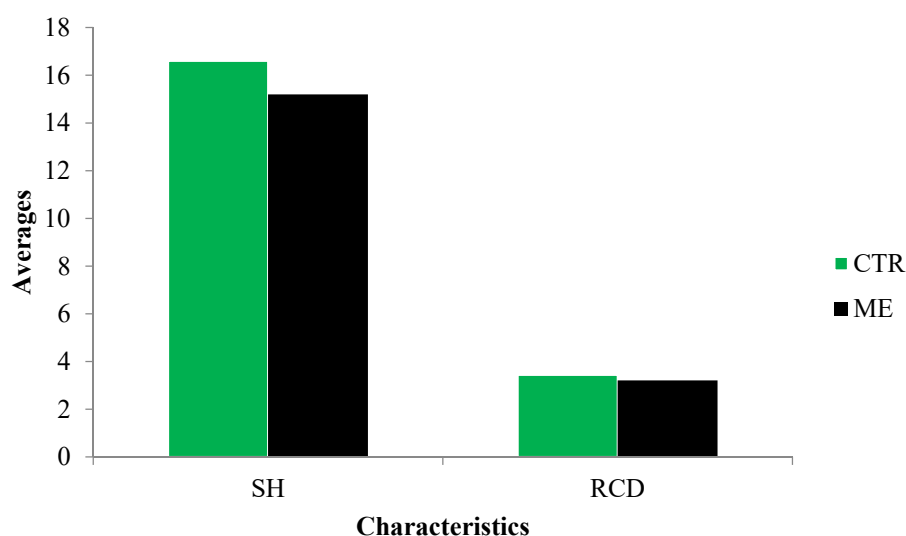


Figure 3. Averages of height and diameter for the methods

Methods were similar ( $p>0.05$ ) based on results of analysis of variance (Table 3). [11] indicated that mechanical site preparation treatment had a significant effect on soil, therefore may play an important role in afforestation success. [4] reported that soil preparation methods were positive effective on seedling morphology in Anatolian black pine (*Pinus nigra* Arnold subsp. *pallasiana* (Lamb.) Holmboe) and other forest tree species [8]. [12] suggested that use of mini-excavators with high productivity and not harming the ecosystem should be encouraged in terrace plantations on the steep terrain. However, the present study included first year data. The results could change in future years especially because of planting shock.

Table 3. Results of variance analysis for the characteristics for the methods

Characters	Source of variation	Sum of squares	Degrees of freedom	Mean of squares	F value	P
<b>H</b>	Between groups	36.503	1	36.503	2.301	.133
	Within group	1253.447	79	15.866		



	Total	1289.951	80			
<b>RCD</b>	Between groups	1.102	1	1.102	1.123	.292
	Within group	77.482	79	.981		
	Total	78.583	80			

Positive and significant ( $p < 0.05$ ) correlations were estimated between seedling height and root-collar diameter for both methods ( $r = 0.775$  and  $0.669$ ), and their combinations ( $r = 0.735$ ) (Figure 4). The results well accordance with early studies in regeneration [6-7], afforestation [5] and nursery stages [13-15] of Brutian pine.

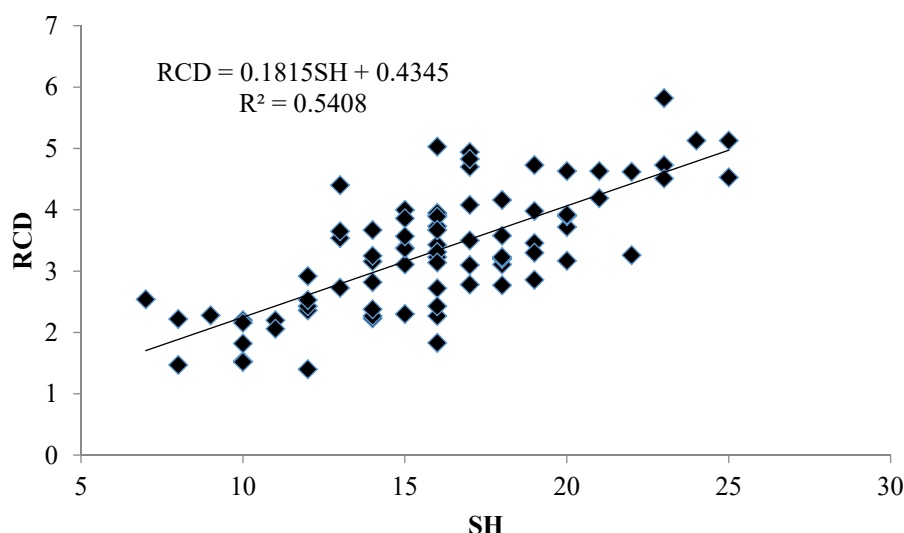


Figure 4. Relation between height and diameter for the combined methods

#### IV. CONCLUSIONS

The present study had first year data of the afforestation areas. New studies should be carried out to give accurate conclusions in future years. Relations between characteristics could be used in forest tending practices in the species. Cheaper method could be preferred in future practices in site preparations.

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