

Effect Of Aspect On Growth Performance Of Natural Regenerations In Brutian Pine

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Abstract: The study was carried out for aspectual comparison of growth performances in natural regenerations of Brutian pine (*Pinus brutia*) to contribute natural regeneration and other forestry practices in the species. For the purpose, aspectual height (SH) and root-collar diameter (RCD) data of juvenile seedlings sampled from two years old natural regeneration areas was collected at end of growth period of 2020.

Averages of seedling height were ranged from 20.28 cm (east aspect) to 28.77 cm (west), while root-collar diameter varied between 22.36 mm (west) and 22.46 mm (north and west). The results showed that west aspect had higher growth performance than others. There were large differences within aspect for both SH and RCD, while aspects had statistically significant ($p < 0.05$) differences for SH opposite to RCD ($p > 0.05$) according to results of analysis of variance. Positive and significant ($p < 0.05$) relations ($r > 0.58$) between SH and RCD were found in each aspect and polled aspects.

Keywords: Diameter, growth, height, regeneration, seedling

I. INTRODUCTION

Brutian pine (*Pinus brutia* Ten.) is one of the most important forest tree species and subjected to forestry practices because of its commercial wood production of Turkey by 5.85 million ha natural distributions of which 45.2% (2.7 million ha) to be unproductive (Anonymous, 2015). Natural regeneration practices are one of common ways in conversion of unproductive forest to productive forest. Growth performance is a criterion in decision of success of the natural regeneration in forestry. It is known that there could be many environmental and biological factors could be effective on success of natural regeneration. However, limited studies were carried out on growth performance of natural regeneration (e.g., Sirlak, 1987; Catal *et al.*, 2017; Cetinkaya, 2019). It could be also said that aspectual growth performance of natural regeneration has not been studied in the species, yet.

In this study it was aimed to determine aspectual growth performance of natural regeneration, and to compare the performance for aspects to contribute silvicultural such as natural regeneration and other forestry practices in Brutian pine.

II. MATERIAL AND METHOD

A. MATERIAL

Aspectual populations, regenerated 2 years ago, was sampled at the same location to minimize effect of other factors on studied characteristics from southern part of Turkey of Brutian pine (Figure 1). Some location details of sampled populations were given in Table 1.

Aspect	Latitude (N)	Longitude (E)	Altitude (m)
North (N)	37°36'54"	30°47'07"	1307
South (S)	37°36'54"	30°47'08"	1313
East (E)	37°36'56"	30°47'06"	1307
West (W)	37°36'53"	30°47'06"	1300

Table 1: Location details of studied populations



Figure 1: Sampled populations in the study

B. METHOD

100 m² (10x10 m) area was sampled chosen randomly from each aspect. Height (SH) and root-collar diameter (RCD) of natural regeneration called also juvenile seedling which was 2 years old in the study was measured at each sampled area at end of growth period of 2020.

One-way analysis of variance (ANOVA) was used for comparison of growth characteristics based on aspects. Aspects were also grouped by Duncan's multiple range test (Duncan, 1955) for the characteristics.

Correlation between SH and RCD was estimated by Pearson's correlation using SPSS statistical package program in each and polled aspects.

III. RESULTS AND DISCUSSION

A. GROWTH CHARACTERISTICS

There were large differences within aspect and among the aspects for SH, while RCD was similar (Table 2). Large differences were also reported in one year natural regenerations in Brutian pine by Cetinkaya (2019). Averages of seedling height were 21.52 cm, 23.24 cm, 20.28 cm, and 28.77 cm in N, S, E and W aspects, respectively, while they were 22.46 mm, 22.45 mm, 22.36 mm and 22.46 mm for root-collar diameter in the aspects (Table 2, Figure 2).

Aspects	Characteristics							
	Average	SH (cm)			RCD (mm)			
		Min.	Max.	St. Dev.	Average	Min.	Max.	St. Dev.
N (71)*	21.52	12.00	43.00	6.90	22.46	22.00	24.20	.39
S (54)	23.24	12.00	56.00	9.13	22.45	22.00	24.00	.34
E (76)	20.28	12.00	44.00	6.39	22.36	22.00	23.10	.23
W (60)	28.77	18.00	59.00	8.52	22.46	22.00	23.30	.26
Total	23.18	12.00	59.00	8.27	22.43	22.00	24.20	.31

*; Number of seedlings measured per sampled area in the parenthesis.

Table 2: Averages, ranges, and standard deviation of SH and RCD in the aspects

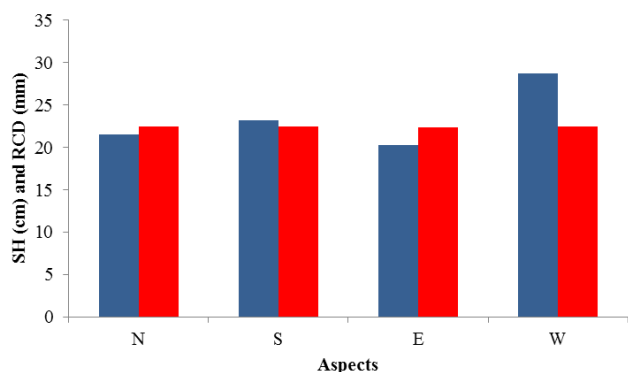


Figure 2: Averages of SH and RCD in the aspects

Averages of seedling height and root-collar diameter were found 23.18 cm and 22.43 mm in polled aspects, respectively (Table 2). They were found 8.9 cm and 1.68 mm in one year seedling in natural populations in the species (Cetinkaya, 2019). Averages of SH and RCD were found 8.2 cm and 3.97 mm in one year bare-root seedlings of Brutian pine, respectively (Bilir, 2019), while averages of seedling height and root-collar diameter were reported 12.5 cm and 2.74 mm in polled one year bare-root containerized seedlings in Brutian pine (Dilaver *et al.*, 2015). They were 18.4 cm and 4.86 mm in one year bare-root seedlings, and 14.79 cm and 4.56 mm in one year containerized seedlings of the species, respectively (Yilmazer & Bilir, 2016). It is known that there could be many environmental (i.e., aspect, rainfall, soil characteristics) and biological factors (i.e., genetic structure of seed/mother tree) could be effective on growth performances in natural regeneration and produced seedlings. For instance, number of survival seedlings varied between 5400/ha (South) and 7600/ha (East) (Table 2). It could be important for early practices forest tending such as artificial seed sowing.

Variations were the lowest in east aspect for both SH and RCD (6.39&.23) based on standard deviation (Table 2). Results of analysis of variance showed statistically significant ($p < 0.05$) differences among the aspects for SH, while they were similar ($p > 0.05$) for RCD. West and east aspect had evident differences from other aspects for SH based on Duncan's multiple range test.

B. CORRELATION

Positive and significant ($p < 0.05$) relations ($r > 0.58$) between SH and RCD were found in each aspect and polled aspects ($r = .612$) (Table 3, Figure 3).

Aspects	<i>r</i>
N	.756
S	.602
E	.624
W	.588
Total	.612

Table 3: Correlation coefficient between SH and RCD in the aspects and polled aspects

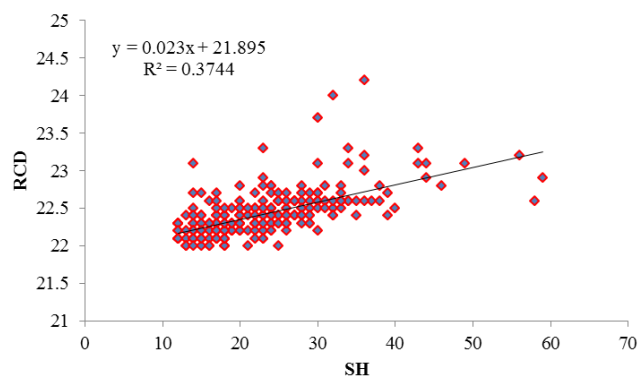


Figure 3: Relation between SH and RCD in polled aspects

Positive and significant correlations between SH and RCD were also reported in natural regeneration (Cetinkaya, 2019) and produced seedlings (Bilir, 2019; Dilaver *et al.*, 2015; Dilaver *et al.*, 2015) of the species.

IV. CONCLUSION

Variation of SH and RCD within aspect emphasized importance of selection of mother tree. New selection criterions should be improved for success of natural regeneration.

Significant differences among aspects for SH showed importance of aspect in silvicultural practices in forestry. Variations within aspect and among aspect could be used for different purposes in forestry practices.

Correlation between SH and RCD could be used in thinning out practices in the species.

This study was carried out to estimate effect of aspect on growth performance in the species. New studies should be organized for different ecological factors such as temperature, rainfall, altitude, and their interactions.

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