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The Effect of Pruning and Thinning on The Growth of OAK Coppice Quercus aegilops L.

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Abstract

This study was performed on the eastern aspect facing Azmir Mountains that locating the northeast of Sulaimani City, during the growing seasons of 2005, 2006 and 2007. The coppices of the dominated oak *Quercus aegilops* were treated by silvicultural practices, included pruning and thinning, in four different levels. The objective of this study was to evaluate the effect of pruning and thinning on height and diameter growth of the oak species. Generally, the results showed that pruning to ½ of the coppice height P_3 was significantly superior on pruning to ¼ P_1 and pruning to one-third $^1/_3$ of the coppice height (P_2) on height growth parameter, while there were no significant differences between P_2 and P_3 on diameter growth. Regarding the thinning, the results generally revealed a significant increasing in the growth of height and diameter of the oak coppices of the three thinning levels in comparing to the un-thinned stump. Regarding the dual interactions, the results showed that P_3C_3 was significantly superior on the height growth parameter.

Introduction

The highest ridges of the Zagros Mountains contain Iraq's only forests, some of them quite extensive, preserved by the isolation and ruggedness of the area. Few areas in Iraq now have woodlands as well developed even as those in nearby Turkey *[1].*The indigenous mountain forests of Iraqi Kurdistan were estimated to be about 900,000 hectares of exploitable oak forest of the 1,700,000 to 1,900,000 ha of forests, mapped and divided into broad categories based on the quality and density of the stocking. The main value of these forests is for the fuel production *[2].* FAO survey of the forestry sub-sector in 1999 indicated that the forest area in northern Iraq covered about 36% of the region. The tree cover of the region's mountain slopes reaches elevations from 600m to 2400m and is dominantly made up of oak woodlands and mainly with *Quercus aegilops* the predominant species, holding medium-sized trees, often with a widespread crown *[3;4].*According to FAO *[5]*, it is estimated that the total yield from Kurdistan forests annually is about 10,000 tons of charcoal and 20,000 tons of wood fuel, which require the felling about 2,000 hectares of mature forest every year. Regulating the cutting of forests for fuel and charcoal and overgrazing has reduced some of these oak forests to scrubland; unfortunately, these problems still exist. Release from grazing alone is sufficient to secure a very marked improvement in erosion control, and since the forests are more or less heavily grazed, it would seem that the improved management of forest range is likely to become the most important aspect of future forest policy in the mountain catchments*[1; 2].* In recent years, the prevention of the cutting in many areas of the

Kurdistan region had resulted in the regeneration of these oaks by sprouts and coppices. Field observations show the ability of oak tree stocks to vegetative regeneration by producing more than one sprout, (may reach to more than 20 coppice sprouts per tree). This leads to slowing oak trees growth and losing its natural shape. This study comes to determine and compare the effect of different levels of pruning and thinning (cleaning) on the growth of oak shrubs represented by height and diameter growth of the coppices.

Materials and methods

A. Study site

The study site is located in the natural oak forests in Sulaimani Government, facing the north slope of Azmir Mountains, that at the border on the northeast side of Sulaimani city. The elevation of the area 1100-1170m. (amsl) 35° 38' 33'' N, 45° 29' 12'' E.

B. The experimental design

The experimental trial was carried out on a selected 0.5 ha on the dominated coppices of oak, and implemented according to randomized complete block design (RCBD) with two silvicultural factors (Pruning P and Thinning C. Treatments) included of:

1. Pruning (P): Pruning lower 1/4 of the coppice height (P_1), pruning lower 1/3 of the coppice height P_2, pruning lower 1/2 of the coppice height (P_3), and not pruned coppice (P_0).
2. Cleaning (C): Coppices cleaned to remain one dominate stump sprout (C_1), coppices cleaned to remain two dominate stump sprouts (C_2), coppice cleaned to remain three stump sprouts (C_3) or left as un-thinned (control or C_0).

C. Data collection and statistical analysis:

Data of growth parameters were collected from the entire coppice from early April, 2005 to the end of the growing season in early November; 2005 also during 2006 and 2007. For each sample, the diameter point was identified by a painted band at 1m from the ground level vertically to ensure accurate location for re-measurements, which taken by digital vernier in two sides for all coppices *[6].*The heights were also recorded for each sample by the ruler and at the end of the experiment considering the tallest coppice height and the thickest coppice diameter for comparing the results and for all of the other parameters. The means were tested by using Duncan's Multiple Range Test ($P \leq 0.05$).

D. Studied Parameters:

Evaluated parameters consisted of the following measurements:

1. Height growth (cm).
2. Diameter growth (mm).

Results and discussions

1. Growth height (cm):*

As shown in *Figure 1A*, there were significant differences between low pruning ½ of the coppice height P_3, and other levels, pruning ¼ of the coppice height P_1, pruning one-third P_2, and no pruning P_0, that achieved 24.24cm height growth. While there were no significant difference between the rest of the pruning levels 19.19, 19.43 and 19.56cm, respectively.

These results may be due to intensifying nutrient elements to these parts in place of that thinned. The data is an agreement with *[7]* who stated that this method involves removing trees from the lower crown classes speed up the increasing height growth. Also, agreed with *[8]* who observed increasing growth of individual trees by pruning. Regarding thinning C, *(Figure 1B), Quercus aegilops* showed a positive growth response to thinning, but there were no significant differences between C_1, C_2 and C_3 with values 36.57, 39.91and 39.54cm, respectively. The growth of large stumps was stimulated by thinning more than that of smaller stumps. Large stumps probably have a greater capacity for resource acquisition, and thus more able to take advantage of the increase of resources available that takes place after thinning, and to eventually using these resources for growth.

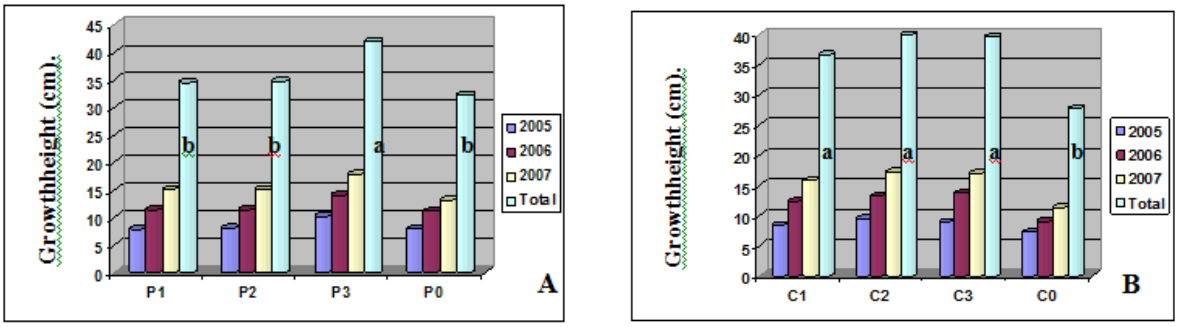

Figure-1*: (A, B); Effect of pruning and cleaning on the growth of oaks coppice height (cm).

These results agreed with *[9]* who showed that the thinning of Emory Oak stump sprouts influences the growth and volume of the residual coppices, it agreed also with *[10]* who suggested that thinning hardwoods would increase the height growth. Also, consistent with *[11]* who reported that the average growth of oak coppice is greatest when a thinning treatment leaves one residual sprout. However these data disagreed with *[12]* who observed that the growth and volume of the residual stump sprouts depend largely on the number of sprouts left after thinning.

As shown in *Table 1* there were significant differences in growth height due to the P_3C_3 interaction treatments with the other dual interactions, which gave a maximum value of 49.55 cm, while the minimum value of 21.83cm was recorded from the P_0C_0 interaction. However, P_3C_1, P_3C_2 and P_1C_2 were shown to be significant differences in height growth.

Table-1*: Interaction effects of pruning and cleaning on height growth (cm).

Interactions	*2005*	*2006*	*2007*	*height growth*	
P_1C_1	7.710	11.92	16.67	36.30	efg
P_1C_2	8.720	14.04	18.38	41.13	cd
P_1C_3	7.200	11.05	15.51	33.76	fgh
P_1C_0	7.930	9.160	10.25	27.33	i
P_2C_1	7.370	11.05	12.54	30.96	hi
P_2C_2	9.960	12.21	16.90	39.07	cde
P_2C_3	8.120	13.25	16.64	38.01	cde
P_2C_0	6.780	9.510	14.56	30.85	hi
P_3C_1	10.66	14.56	20.72	45.93	b
P_3C_2	10.28	14.68	17.05	42.01	bc
P_3C_3	11.92	16.96	20.67	49.55	a
P_3C_0	7.760	10.16	12.74	30.66	hi
P_0C_1	8.130	11.79	13.17	33.09	hi
P_0C_2	8.800	12.25	16.41	37.45	def
P_0C_3	8.530	13.31	15.02	36.86	efg
P_0C_0	6.480	7.480	7.880	21.83	j

*: Duncan's Multiple Range Test ($P \leq 0.05$) indicates that there was no significant difference between four columns respectively (in each group) conjoint by the same letter (s).

2. Diameter growth (mm):

Duncan's Multiple Range Test ($P \leq 0.05$) indicated that the differences between P_1, P_2 and P_3 were non-significant, but they were significantly different from P_0. The maximum value of growth diameter was 14.66mm with P_3, and the minimum growth was11.33mm recorded from P_0 *(Figure 2A).*

In *Figure 2B*, the results show that C_1 and C_2 did not differ significantly with each other, and C_2 did not differ significantly from C_3, while they differed from C_0, the highest value was 15.64 mm observed from C_1, but the lowest value of 10.11 mm was observed from C_0.

The effects of forest thinning and pruning on growth are complex. They are determined by many interacting factors, including changes in soil temperature, soil water, microbial respiration rate, root respiration rate and decomposition of leaf and branch litter. These factors are influenced both by thinning, as a result of changes in canopy structure and energy balance and by natural variability in microclimates such as precipitation and temperature. The findings obtained are in agreement with many previous studies; for example *[13]*who established that thinning increased the diameter growth by 31 to 69%, and by*[14]* with *[15]*which they observed that increases in diameter growth have been occurring in response to thinning in many hardwoods.

Also, Central hardwoods have responded to thinning treatments similarly, with diameter increases *[16],*and*[17]*.Furthermore, *[18]*noticed that the diameter (d.b.h.) growth of thinned sprouts of northern red oak was 1.5 times greater than control sprouts. However, some studies have shown no diameter response *[19],* which our data disagreed with such finding.

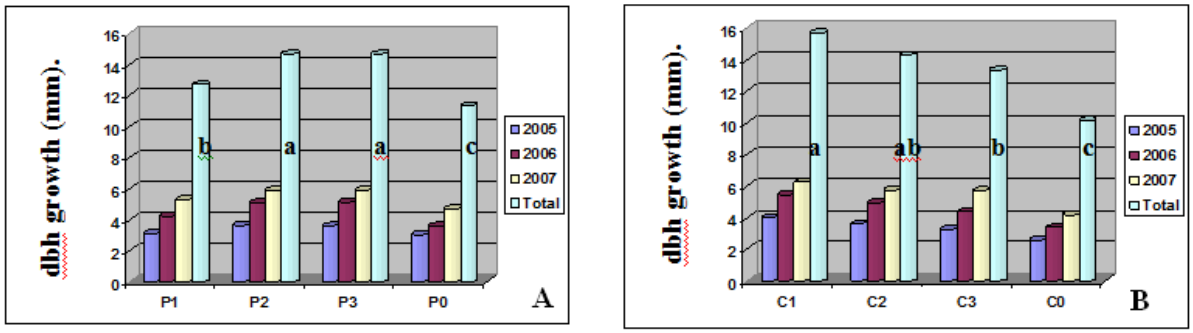

Figure-2*: (A, B); Effect of pruning and cleaning on dbh growth (mm).

P_1C_1 in the table *(2)* caused significant differences in diameter in comparisone to the rest of dual interactions. The maximum value of 16.31mm was recorded from P_1C_1 and a minimum value of 5.49mm was observed from P_0C_0.

Table-2*: Interaction effects of pruning and cleaning on the dbh growth (mm).

Interactions	*2005*	*2006*	*2007*	*Total Growth*	
P_1C_1	4.59	5.36	6.37	16.31	a
P_1C_2	3.46	5.34	5.92	14.72	bcd
P_1C_3	2.37	3.65	4.88	10.91	g
P_1C_0	2.12	2.68	4.00	8.790	h
P_2C_1	3.85	5.46	5.82	15.12	abcd
P_2C_2	4.24	5.50	6.40	16.14	ab
P_2C_3	3.40	5.32	6.28	15.00	abcd
P_2C_0	3.15	4.05	5.15	12.35	efg
P_3C_1	3.66	5.62	6.48	15.76	abc
P_3C_2	3.63	4.93	5.76	14.32	cd
P_3C_3	3.69	5.06	5.98	14.73	bcd
P_3C_0	3.40	4.97	5.46	13.83	de
P_0C_1	3.85	5.27	6.25	15.37	abc
P_0C_2	3.06	3.91	4.94	11.91	fg
P_0C_3	3.56	3.36	5.65	12.57	ef
P_0C_0	1.71	1.78	2.00	5.490	i

*: Duncan's Multiple Range Test ($P \leq 0.05$) indicates that there was no significant difference between four columns respectively (in each group) conjoint by the same letter (s).

Conclusions

1. Although, P_3 (pruning to ½ of the coppice height) has significant effect on all of the height, and diameter growth and there were no significant differences between P_2 (pruning to 1/3 of the coppice height) and P_3 (pruning to ½ of the coppice height) on the diameter growth, in this investigation we recommend P_3 (Pruning ½ of the coppice height).
2. Since there were no significant differences between C_1 thinning to remaining one dominant coppice, C_2 remains two dominant coppices and C_3 cleaning and thinning to remaining three dominant coppices on the height growth. Also, C_1 with C_2 on the diameter growth. This study recommends remaining one dominated coppice C_1.
3. Regarding the dual interactions, P_3C_3 is recommended for height growth.
4. The study recommends to carrying out synonymous experiments in other areas and in different aspects of Kurdistan to achieve more reliable results.

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