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Study of Canopy Gap Size in Relation to Beech Saplings in Caspian Forests

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Abstract. Effect of gap size on survival, growth and vitality of potted beech saplings was studied in mountain forests of Northern Iran located on 1400 m from sea level. For this reason, three gaps were selected with 100, 200 and 700 m^2 area and a gap in a completely open space so that posts were established in four replication with 60 pots in each gap. Following one growth season, results indicate that survival of saplings grown in each 100 and 200 m^2 gaps is about 75% while this rate decreases to about 10% in both 700 m^2 gaps and in completely open spaces. Total height of saplings were 70mm and 100 mm in 100 and 200 m^2 gaps and 50mm and 40 mm in 700 m^2 and in completely open spaces respectively. Most saplings of 100 and 200 m^2 gaps are fresh and in 700 m^2 gaps and in completely open spaces are mainly weathered and less paled. Generally it is concluded from present study that beech potted saplings state in first growing season is more desirable in either of two smaller gaps than in two bigger one. So that their natural regeneration training in gaps provided through marking (shelter wood system and single – selection system) as their sapling production in more than 200 m^2 area will result to their qualitative and qualitative loss.

Keywords: canopy layer gap, Beech, growth, survival, vitality, and sapling.

1. Introduction

It is more than several decades that study on beech sapling specifically regarding to survival and growth of different light treatments has been taken into account by many researchers [Watt ,1923;, Burschel etal.,1965;Madsen ,1994 ; Larsen etal.,1995)..In this respect most studies have been performed on western beech sapling (*Fagus sylvatica L.*) and less studies on eastern beech saplings (*Fagus orientalis Lipsky*) and Japanese beech (*Fagus crenata Blume*). Most reports demonstrate that beech saplings survival decreases with increased gap area[Giannini,1971; Peltier etal.,1997).

So that compared to bigger gaps, highest survival rate is observed in small 200 m^2 gaps (Johnson ,1997; Yamamoto ,1996). Different reports have been provided on longitudinal growth of beech saplings in the gaps. While some author's reports greatest height growth of beech saplings in small gaps (Kharitonenko etal.,1972). Results of other studies indicate increased height growth with increased gap area (Suner etal.,1980; Tabari etal.,1998).In respect of freshness , most authors report its increase in smaller gaps which it may be due to the sciophilous nature of this species saplings(Kharitonenko etal.,1972). In Iran, however, some studies have been performed on survival and status of beech seedlings and saplings .While yet no specific report has not been provided on saplings of this species in different levels of canopy layer gaps. In fact, present study by measurement and defining survival, growth and shininess state of beech saplings in first growing season attempts to find suitable canopy layer sizes to favorable marking and training of this species in this growth stage (Sapling) to arrive in next growth stages (sapling and sprouts).Additionally, results of this study may recommend suitable size of gap surface to produce seedlings of this species in sapling growing stage for producers of this species.

2. Material and Methods

In present study in 2009 (Sep) in mountain area in west of Guilan province in north of Iran with altitude about 1400 m ^{2} from sea level with slope of 30-40% ,3gaps (approximately oval shaped)were selected close to each other with 100,200,700 m ^{2} areas and completely open space gap . It should be mentioned that measurement of gap areas shape achieved according to the picture of trees canopy around the gap on the ground and mapping their sides in millimeter paper. Approximate relative light could adjust to 15%-20%, 35%-40%, 75%-80% and 100% from small to big gaps respectively, simultaneously, beech seeds were gathered from parents trees foot. After isolation intact seeds were treated with Menkazeb and they hanged in same place in sack, so that they could pass cold treatment .Then in late February, treated seeds were placed in plastic pots (25 cm height, 8 cm head diameter) containing a combination of 80 % soil of nursery, 15 % tea residues and 5 % bran and disinfected by mentioned fungicide (Table.1).Then immediately preparation work was performed including clearance of cutting residues, setting aside leaf litters and removal of troublous under storey plants in gaps. Afterwards, in central part of each gap, four rows were digger with length and width of 1 meter and 25 cm depth with 2 meters distance from each other .Then 60 pots were established in each row beside each other.

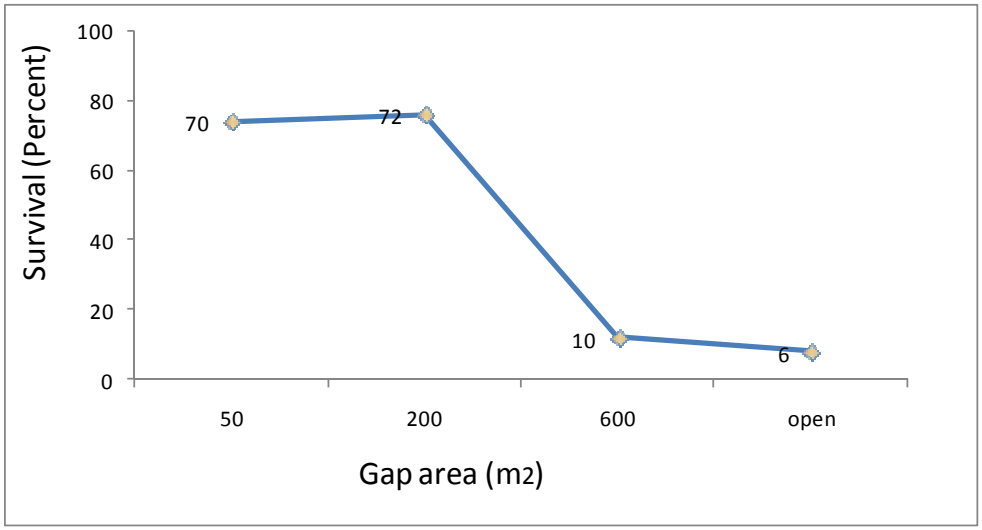

Figure .1 Sapling survival rate in open space gape significantly decrease compared to smaller gaps

Counting sapling grown in the pot was performed in mid-April . The number of survived sapling and their length (in mm precision) was recorded in late-October and their vitality (divisions : shiny , relative shiny , wilted , dried) was recorded in late-August . To measure sapling lengths in conditions when germination length or young branches were sunburned, length of burned section was subtracted from total length to find actual growth rate. Additionally no weeding operation was performed to remove weeds grown in pots during growth period. Using SPSS software, data normality and consistence was perfumed through K.S tests .Mean differences and their significant was defined by using one-way variance analysis (ANOVA) and Duncan tests with 5 % level. Since survival data was un-normal after different transformations, then this data was analyzed by using non-parametric tests of Kruskal-Wallis and Mann-Whitney. Significant of saplings shininess quality in different gap areas was defined by using Chi-square test.

3. Results

3.1. Survival

Results obtained by using non-parametric tests of Kruskal-Wallis and Mann-Whitney indicated that in late growth season , sapling survival rate in open space gape significantly decrease compared to smaller gaps (Figure 1) . This rate is 70% and 72 % in small 100 and 200 m^2 gaps respectively , and it decrease 10% and 6 % in large 700 m^2 gaps and open space respectively .In fact there is no significant difference in survival rate between two small gaps or in two large gaps . But this difference is obvious between either two small gap groups or between two large gaps.

3.2. Height

Analysis using one-way variance analysis (ANOVA) and Duncan indicates that beech saplings height varies in different gaps. So that, height in 100 and 200 m^2 gaps is larger than 700 m^2 gaps or open spaces (Figure 2). In fact heights similar to survival both in two small gaps and in two large gaps don't show significant difference.

3.3. Shininess

Results of chi-square test indicates that saplings shininess quality varies in different gaps (p=0.03, d.f=3,x^2= 11.35). According to table 2, 75% of saplings in 100 m^2 gaps are shiny and 25 percent are relatively shiny and 60% of saplings in 200 m^2 gap are shiny, 20% are relatively shiny and 10% are paled. 10% of saplings in 700 m^2 gaps are paled, 90% are dried and in completely open spaces, 5% of saplings are paled and 95% are dried. In other word, most of beech saplings in two small gaps are shiny and most of them in two large gaps are dried and less paled. So that in 700 m^2 gaps and in open spaces open spaces, no shiny or relative shiny sapling can't be observed.

Table 1 Physical –chemical traits of pod soil to produce beech sapling.

Sand	clay	soil texture	Saturation rate	Electric conductivity	total saturation	Organic materials	Organic carbon	Adorable phosphorous
70	8	Sand-loam	90	1.2	6.1	12.9	7.89	254

Table 2 : Frequency (%) of beech potted saplings shininess quality in different gap area .

	Gap area (m^2)			
	100	200	700	Open space
Completely shiny	75	60	-	-
Relatively shiny	25	20	-	-
Paled	-	10	10	5
Dried	-	10	90	95

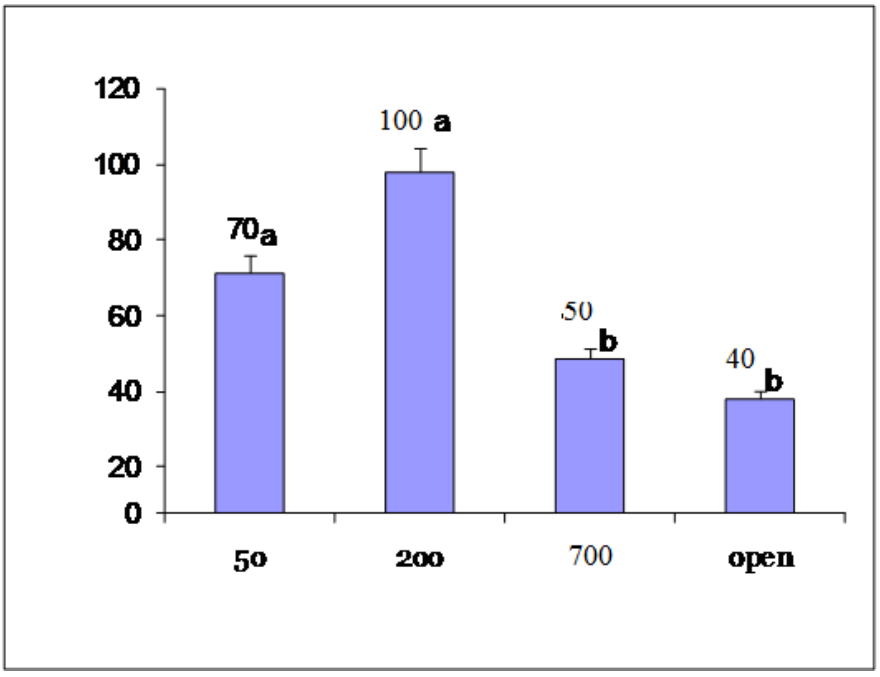

Figure 2.Beech saplings height in 100 and 200 m^2 gaps is larger than 700 m^2 gaps or open spaces

Present study demonstrates that while saplings survival is similar in 100 and 200 m^2 gaps but survival rate decreases with increased gap area. Some studies reported greatest *Fagus sylvatica* Saplings survival beneath semi-closed canopy layer with 20% light and greatest number of seedlings younger than 4 years old in this species beneath semi-closed canopy lager and in semi-shaded conditions(Giannini ,1971; Peltier etal.,1997)most mortality of beech potted saplings (containing mineral and organic soil) occurs in closed gaps(Johnson , 1997).

In this study , height or growth of potted saplings doesn't show significant decrease with increased gap area up to 200 m^2. But its rate decreased in larger gaps. indicating that heights of *Fagus sylvatica* saplings and seedlings increase with increase of shadow(Grosse , 1983; Allgaier, ,1991).

4. Discussion

Study on *Fagus sylvatica* and *Quercus robur* saplings grown in climatic greenhouse under various light conditions determine that length growth in saplings will decrease with increased shadow rate (Tabari etal.,1998). In fact, culturing conditions for beech and chestnut saplings in a study by mentioned authors is different from beech saplings condition studied in the study area of present study. So that temperature doesn't exceed from 18 $^{\circ}c$ in afore mentioned green house conditions. While ambient temperature in studied gaps exceeds to 40 $^{\circ}c$. Leading to increased evaporate transportation rate and occurrence of drought tension in plant, thus plant growth decreases or halts. In this study beech saplings are shiny or relatively shiny in 100 and 200 m^2 gaps but in 700 m^2 gaps and in completely open spaces they seem wilted or dried. In fact, this represent that saplings shininess decreases with increase gap area. so that sapling grown in larger gaps suffer drought tension, thus shininess rate decreases as growth and survival .The best regeneration quality and quantity in stands with relatively high density (0.7 density coefficient) (Kharitonenko,1972).

Generally it could be concluded from results of this study that survival , growth and shininess of beech potted saplings in small 100 and 200 m^2 gaps is more desirable than that of 700 m^2 gaps and completely open spaces . This result indicates that first marking gap area whether in shelter wood or single selection system is recommendable to beech regeneration and culturing its natural saplings in Northern forests in area smaller than 200 m^2. Obviously improvement in growth of saplings existing in these gaps will be possible in future years by cautiously removal of some brush wood and foliages around the gap to supply required light. Additionally this study reveals that desirable gap area size to produce beech saplings is possible in lower than 200m^2 area by trainers of this species. This may be provided through adjusting light conditions by using woody shelters supplying light requirements according to same area.

Finally it is recommended that similar studies , preferentially on beech seeding accompanying preparation of ground and soil inside the non-regenerated or destroyed beach gaps to achieve more suitable results as well as providing more precise recommendations .

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