

## RESEARCH ON THE GROWTH OF THE HUNGARIAN AND TURKEY OAK SEEDLINGS IN OPEN GROUP CUTS OF VARIOUS SIZES IN THE WOODLANDS OF THE WESTERN PART OF THE GETIC PLATEAU

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**Abstract.** The climatic changes of the last decades have impacted dramatically on the Hungarian oak (*Quercus frainetto* TEN) and Turkey oak (*Q. cerris* L.), which are widely spread (76%) in the western part of the Getic Plateau. In addition to the mass drying of these two species, the natural regeneration process underlying forest sustainability was also affected. The Hungarian oak and the Turkey oak are the only forest species to take full advantage of the fertile clay, heavy, compact soils (Preluvissols, Luvisols -74,5%) prevailing in the sample area (BERCEA & COJOACĂ, 2012). Research has shown that fixation of Hungarian oak seedlings is different being influenced by climatic changes, therefore, there is need for new forestry approaches to the two species covering this area since time immemorial. Like wise, the regeneration process of the Turkey oak takes place under normal circumstances, whereas the Hungarian oak is dramatically affected by the climatic changes and its regeneration is more difficult. The intervention of foresters in the regeneration process of the two species is determined by the higher economic value of the Hungarian oak as compared to the Turkey oak. The research carried out show the intervention mode in the woodlands containing Hungarian oak trees in order to maintain the right proportions of Hungarian and Turkey oak or to secure the natural regeneration of single species. The research findings show that the average heights, the average crown diameters and the smallest average values of the annual growth of the Hungarian oak are recorded in the group cuts of 0.5 H; the highest average height values, average crown diameters and average annual growth of the Hungarian oak seedlings are recorded in the group cuts of 1.5 H. In the first year, following the good fructification of the Hungarian oak, the highest average height are recorded, average crown diameters in the group cuts of 1.0 H, and the highest annual growth is in the group cuts of 1.5 H.

**Keywords:** *Quercus frainetto* TEN, *Quercus cerris* L., growth, seedlings.

**Rezumat. Cercetări privind dezvoltarea semințișului în ochiurile de diferite mărimi deschise în arboretele de gărnită și cer din partea vestică a Podișului Getic.** Speciile forestiere cele mai afectate de schimbările climatice din ultimele decenii au fost gărnita (*Quercus frainetto* TEN) și cerul (*Q. cerris* L.), specii ce au o răspândire foarte mare (76%) în partea vestică a Podișului Getic. Pe lângă uscarea în masă a exemplarelor acestor specii, a fost afectat procesul de regenerare naturală care stă la baza continuității pădurii. Gărnita și cerul sunt singurele specii forestiere care valorifică superior potențialul productiv al solurilor argiloase, grele, compacte (prelivosoluri, luvosoluri -74,5%) predominante în acest teritoriu. Din cercetări rezultă că instalarea semințișurilor de gărnită este diferită în condițiile schimbărilor climatice față de modul în care se face în condiții normale, fiind necesară o nouă abordare și diferențiere a silviculturii celor două specii care au ocupat acest teritoriu dintotdeauna. De asemenea, se observă că procesul de regenerare a cerului se desfășoară în condițiile cunoscute, iar gărnita este specia cea mai afectată de schimbările climatice, regenerarea se produce cu dificultate față de cer. Intervenția silvicultorilor în procesul de regenerare a celor două specii este determinată de valoarea economică mai mare a lemnului de gărnita comparativ cu lemnul de cer. Cercetările efectuate arată modul de intervenție în arboretele ce au în compoziție gărnită, astfel încât să poată fi menținută în proporții corespunzătoare în amestecurile cu cerul sau asigurată regenerarea naturală în arboretele pure. Rezultatul cercetărilor arată că înălțimile medii, diametrele medii la colet și creșterile medii anuale cele mai mici ale puieților de gărnită se înregistrează în ochiurile cu mărimea 0,5 H; cele mai mari înălțimi medii, diametre medii la colet și creșterii medii anuale în înălțime la puieții de gărnită se înregistrează în ochiurile cu mărimea 1,5 H. În primul an, după o fructificație bună la gărnită, se înregistrează cele mai mari înălțimi medii, diametre medii la colet în ochiurile cu mărimea 1,0 H, iar cele mai mari creșteri anuale se înregistrează tot în ochiurile cu mărimea 1,5 H.

**Cuvinte cheie:** *Q. frainetto*, *Q. cerris*, creșteri, puieți.

### INTRODUCTION

The cultivated forests, highly anthropized and populated in the western part of the Getic Plateau in the hydrographic basin of the Jiu river, include a high percentage - 43 % (72,151 ha) - of Hungarian and Turkey oak (BERCEA, 2007). Among the forest species, Hungarian and Turkey oak are the only ones taking full advantage of the hard compact clay soils (Preluvissols, Luvisols) which prevail in the area (74,5%) (BERCEA & COJOACĂ, 2012). The climatic changes in the area had a strong impact on these two species and, more particularly, the Hungarian oak in the extremely dry season leading to the mass wilting of trees (BADEA & TĂNASE, 2002) and compromising the regeneration process on long and very long term. Accordingly, long-term research and observation of the natural regeneration of the two species were conducted as well as deciding on the necessary actions to take with the fully-grown seedlings, which were to be naturally regenerated, according to weather conditions. The lack of rainfall for several consecutive years resulted in the severe edaphic drought negatively impacting on the Hungarian oak which depends on the suction force of the roots as a physiological mechanism to adjust to the dry conditions, unlike the Turkey oak, which depends on the earlier closure of stomata in daytime, reducing transpiration. The high frequency of fructification in the case of the Hungarian oak caused the imbalance of the regeneration process that should be compensated for through forestry measures of monitoring and regeneration of seedlings containing Hungarian oak trees. To this end, research was carried out to well ground and manage the natural regeneration process of the two species, according to the climatic changes.

## MATERIALS AND RESEARCH METHODS

The sample area covers the parts where The Hungarian and Turkey oak are widely spread, namely, in the south - Bucovăț and Seaca de Pădure belonging to the Woodland of Craiova, in the centre and north - Argetoiaia, Războinicu, Șușița, Motru, Cărbunești, Murgești, belonging to the woodlands of Filiași, Strehaia, Motru, Turceni and Cărbunești.

Observation was conducted in the following woodlands: Segarcea, Craiova, Filiași, Șimian, Corcova, Strehaia, Motru, Tarnița, Târgu-Jiu, Peșteana, Cărbunești, Turceni, Hurezani and Amaradia in 49 Production Units.

These woodlands were selected because of the Hungarian and Turkey oak are widely spread here and so as to determine the average conditions enhancing this type of vegetation, eliminating any generalisations for the whole sample area. In order to investigate the diversity of conditions enhancing the natural regeneration of the Hungarian and Turkey oak, 55 sample areas were selected to determine the height of the seedlings, the crown diameter and the increase of height and diameter. Two research methods were chosen: observation and experimentation, and analysis and synthesis of research findings. Experiments were conducted to determine the most effective methods of the Hungarian and Turkey oak regeneration, with respect to the natural conditions of vegetation as well as to the high variation of the most important ecological factors. Experiments mainly envisage the study of progressive cuts - permanent sample areas were chosen for this purpose. Group cuts of various sizes were placed in these areas in different types of forests where the Hungarian and Turkey oak are widely spread. The diameters of the group cuts were established by measuring the distance from the lowest part of the trees to the direction of the cardinal points, where permanent sample areas were placed. In the sample areas all the Hungarian and Turkey oak seedlings were measured, irrespective of their age, on account of lack of fructification, more particularly in the case of the Hungarian oak, up to 2003.

Within the group cuts to the direction of the cardinal points, permanent sample areas were established at equal distances (1 m), and measurements of the above mentioned characteristics were performed on a regular basis. The complex influence of the ecological factors on the seedlings in the regeneration areas was determined through the average height of the seedlings and the annual average increase in height and diameter.

## RESULTS AND DISCUSSIONS

The research findings are centralised in Tables 1 and 2.

Table 1. Growth of the Hungarian oak seedlings in group cuts of various sizes.

Size of group cuts	Species	Average height (cm)		Average diameter of seedlings (mm)		Average increase of height (cm)	
		2003	2004	2003	2004	2003	2004
0.5 H	Hungarian oak	37.52	28.76	7.5	4.34	10.0	11.08
0.75 H		65.84	42.97	11.86	7.38	15.79	10.56
1.0 H		49.29	49.67	9.86	9.0	13.43	14.67
1.5 H		94.94	45.22	15.38	7.04	38.65	15.83
2.0 H		60.02	52.35	7.90	7.66	16.09	13.57
0.5 H	%	100	100	100	100	100	100
0.75 H		175	149	158	170	157	95
1.0 H		131	173	131	207	134	132
1.5 H		253	157	205	162	386	142
2.0 H		160	182	105	176	160	122

Table 2. Growth of the Turkey oak seedlings in group cuts of various sizes.

Size of group cuts	Species	Average height (cm)		Average diameter of seedlings (mm)		Average increase of height (cm)	
		2003	2004	2003	2004	2003	2004
0.5 H	Turkey oak	22.13	26.77	3.24	5.14	13.78	8.13
0.75 H		47.99	30.15	7.33	5.58	14.57	8.57
1.0 H		34.67	68.84	6.52	11.16	15.86	17.52
1.5 H		51.23	59.33	7.73	8.08	22.39	15.21
2.0 H		57.98	67.19	8.58	9.46	31.0	21.33
0.5 H	%	100	100	100	100	100	100
0.75 H		217	113	226	109	106	105
1.0 H		157	257	201	217	115	215
1.5 H		231	222	239	157	162	187
2.0 H		262	251	265	184	225	262

Table 1 indicates that, as a rule, the smallest values of heights are associated with group cuts of 0.5 H in 2003 and 2004. The highest values of heights are recorded in the group cuts with the diameter of 1.5 H (94.94 cm) and of 0.75 H (65.84 cm) in 2003, whereas in 2004, the highest values of heights are associated with group cuts of 2.0 H (52.35 cm) and of 1.0 H (49.67 cm).

The differences of the average heights in 2003 and 2004 are motivated by the fact that the 1-year-old seedlings were also measured in the extremely good fructification of the Hungarian oak in 2003, which influenced the value of

the average height in the group cuts of various sizes through the smaller or larger number of seedlings. More than the 1-year-old seedlings were placed in the small-sized group cuts as compared to the large-sized group cuts, where they are farther away from the end of the plateau and large numbers of 1-year-old seedlings could not be placed within the group cut. Consequently, the average height recorded higher values in 2004 in group cuts of 2.0 H.

The average diameter of the seedlings at the level of the crown has the same distribution as the average height both in 2003 and in 2004.

The smallest values of the average increase of height were in the group cuts of 0.5 H in 2003, and the largest value in group cuts of 1.5 H, followed by group cuts of 2.0 H and very closely in group cuts of 0.75 H. In 2004, the smallest increase of height was recorded in group cuts of 0.75 H and 0.5 H, and the highest increase in group cuts of 1.5 H.

The average value of the height of Hungarian oak seedlings is higher in group cuts of larger size, ranging from 31% to 153% in 2003, and from 49% to 82 % in 2004.

The average diameter is larger in group cuts of larger size, ranging from 31% to 105 % in 2003, and from 62% to 107% in 2004.

The annual increase was higher in group cuts of larger size as compared to group cuts smaller than 0.5 H, ranging from 57% and 267% in 2003, and from 22% and 42% in 2004, except group cuts of 0.75 H, where smaller values, as compared to group cuts of 0.5 H, were recorded.

The interpretation of data in Table 1 shows that:

- average heights, average crown diameters and the smallest values of the annual increase of the Hungarian oak seedlings are recorded in group cuts of 0.5 H;
- the highest values of average height, average crown diameters and the annual increase of the Hungarian oak seedlings are recorded in group cuts of 1.5 H;
- in the first year, following the good fructification of the Hungarian oak, the highest values of average height, average crown diameters are recorded in group cuts of 1.0 H, and the annual increase is recorded in group cuts of 1.5 H.

Table 1 indicates that:

- the smallest heights of the Turkey oak seedlings are recorded in group cuts of 0.5 H in 2003 (22.13 cm) and in 2004 (26.77 cm);
- the highest values of the height of the Turkey oak seedlings are associated with group cuts of 2.0 H in 2003 (57.98 cm) and of 1.0 H in 2004 (68.84 cm). In percentages, the differences between the heights in group cuts of 0.5 H range from 57% to 162% in 2003 and from 13% to 157% in 2004;
- the average crown diameter of the Turkey oak seedlings closely follows the height values, the smallest diameters are recorded in group cuts of 0.5 H, and the largest in group cuts of 2.0 H in 2003 and in group cuts of 1.0 H in 2004. In percentages, the differences between the diameters of small-sized group cuts (0.5 H) as compared to group cuts larger than 0.5 H range from 101% to 165 % in 2003, and from 9% to 117% in 2004;
- the smallest values of the annual increase of the Turkey oak seedlings are recorded in group cuts of 0.5 H (13.78 cm in 2003 and 8.13 cm in 2004), and the highest values in group cuts of 2.0 H (31.0 cm in 2003 and 21.33 cm in 2004);
- extremely small values of the increase in height are recorded in group cuts of 0.75 H. In percentages, the differences between the heights in group cuts of 0.5 H as compared to group cuts larger than 0.5 H range from 6% to 125% in 2003, and from 5% to 162% in 2004.

The interpretation of data in Table 2 shows that:

- average heights, average crown diameters and the smallest values of the annual increase of the Turkey oak seedlings are recorded in group cuts of 0.5 H;
- the highest values of average height, average crown diameters and the annual increase of the Turkey oak seedlings are recorded in group cuts of 2.0 H;
- the larger the size of the group cut, the higher the annual average increase of the Turkey oak seedlings.

The comparison of the Hungarian and Turkey oak seedlings highlights that:

- the smallest values of height, diameters and annual increase are recorded in case of both species in group cuts of 0.5 H;
- the highest values of average height, average crown diameters and the annual increase are associated with group cuts of 1.5 H in the case of Hungarian oak seedlings and with group cuts of 2.0 H in the case of Turkey oak seedlings;
- in group cuts of 0.75 H, there is a sharp difference between the seedlings, as compared to seedlings in group cuts of 0.5 H, due to heights and diameters that secure their solid growth in the next years, more particularly, in the case of Hungarian oak seedlings, planted in weak or medium fructification years.

## CONCLUSIONS

The research carried out indicates that:

In small-sized group cuts of 0.5 H, Hungarian and Turkey oak seedlings have the smallest values of the height, diameter, height and diameter annual and aggregated increase, whereas in the large-sized group cuts (2.0 H) the highest values of the height, diameter, height and diameter annual and aggregated increase are recorded.

The average diameters and the highest average aggregated increase of diameters of Hungarian and Turkey oak seedlings are recorded in medium-sized group cuts (1.5 H; 1.0 H) westwards (W) and southwards (S) in the central parts (C) and at the midpoint (m) of the group cuts, whereas the smallest values are associated with small-sized group cuts (0.5 H; 0.75 H).

The evolution of the characteristics of seedlings according to the size of the group cuts points to the idea that the treatment of gradual cuts is the most effective with respect to the natural regeneration of the Hungarian and Turkey oak seedlings.

The optimal size of the group cuts is determined with respect to the compromise between securing the highest size and growth possible in the first years since the upshot and the right density for full growth as soon as possible.

The optimal size to secure the balance between the size and growth, on the one hand, and their density, on the other hand, ranges from 0.75 to 1.0 of the average height of the regeneration seedlings in the case of the Hungarian oak and from 1.0 to 1.5 of the regeneration seedlings in the case of the Turkey oak.

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