SELF-THINNING FOR HUNGARIAN AND TURKEY OAK WILDLINGS

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Abstract. Some conclusions arise from the research: The Hungarian oak has the capacity to grow under the crown, given certain light intensity restrictions, powerfully correlated with the crown loosening; Within forest areas where light intensity is lower than 5% of that in open field, crown loosening is needed during seed year or during first year of vegetation in order to insure the regeneration; In brushes under 0.8 consistency, the crown loosening can be done up until the third year of vegetation at the latest; The powerful self-thinning during the first year took place within small seedling felling (0.5 H), while under the dense stand the powerful self-thinning took place where the crown density of the stand was higher; Climatic changes, manifested through very dry years, with high temperatures for a long time and very large amplitudes in a short period of time, have resulted in changing the intensity of natural self-thinning for the Hungarian and Turkey oak, for the brush overall, but also within the areas where exploitation-regeneration works were carried out through progressive cuttings, which determines differentiated carrying out of the cuttings for rejuvenation and approaching a new strategy to maintain an d perpetuate Hungarian oak on its territories.

Keywords: *Quercus frainetto* TEN., *Quercus cerris* L., climatic changes, self-thinning.

Rezumat. Eliminarea naturală în semințișurile de gârniță şi cer. Scopul cercetărilor s-a concentrat pe stabilirea intensității de eliminare naturală în semințișurile naturale de gârniță şi cer în condițiile schimbărilor climatice actuale. Din cercetări efectuate, am constatat următoarele: gârnița are capacitatea de a se instala sub masiv în anumite limite ale intensității luminii aflată în corelație directă cu deschiderea arboretului; în porțiunile de pădure în care intensitatea luminii este sub 5% din cea în terenul descoperit este necesară deschiderea masivului în anul de sămânță sau în primul an de vegetație pentru asigurarea regenerării; în arboretele cu consistența sub 0,8 deschiderea masivului se poate face până cel mai târziu în anul al treilea de vegetație; eliminarea mai puternică în primul an, s-a produs în ochiurile cu dimensiuni mici (0,5 H), iar sub masiv eliminarea mai puternică s-a produs acolo unde consistența arboretului este mai mare. Schimbările climatice care se manifestă prin anii foarte secetoşi, cu temperaturi ridicate o perioadă îndelungată de timp şi amplitudini foarte mari în intervale scurte de timp au condus la modificarea ritmului eliminării naturale în semințișurile de gârniță şi cer, atât pe ansamblul arboretelor cât şi în suprafețele parcurse cu lucrări de exploatare-regenerare prin tratamentul tăierilor progresive, fapt ce determină aplicarea diferențiată a tratamentelor cu tăieri de regenerare şi abordarea unei noi strategii pentru menținerea şi perpetuarea gârniței în teritoriile ocupate.

Cuvinte cheie: *Quercus frainetto* TEN., *Quercus cerris* L., schimbări climatice, eliminare naturală.

INTRODUCTION

The Hungarian oak (*Quercus frainetto* TEN.) and Turkey oak (*Quercus cerris* L.) ecosystem formed stable structures along the time, but they were seriously affected by the long drought followed by a mass drying between 1989 and 1994.

The intensity of the drying phenomenon manifested differently for the two species being more intense for Hungarian oak in stands with diverse ages (BADEA & TĂNASE, 2002).

The shown decline for Hungarian oak and Turkey oak determined to start research activities which had an extensive evolution character of stands condition and affectation degree of the trees. The drying phenomenon affected the exploitable stands in different stages of regeneration works application, and through the extraction of the dried trees from the stands, it was produced a disordered state of the works and of course of the regenerations (BERCEA, 2005; BERCEA & SĂRARU, 2008). The behaviour of the two species was different especially during the process of fructification, the Hungarian oak did not fructify but the Turkey oak continued to fructify in a normal way. From the exploitable stands where there were made regeneration cuttings, there were not extracted trees in order for the works to be continued normally, because the annual possibility is harvested from the accidental products appeared because of the drying phenomenon. The drought affected the installed seedlings as well and the Hungarian oak stands regeneration had a hard period.

The very large areas occupied by Hungarian oak and Turkey oak within the studied territory and especially in the south part of it, do not allow to recover the forests through plantations and the substitution of these species is impossible. Because of the climate and physical-geographical conditions of this territory, the Hungarian oak and the Turkey oak are the single species which can form forests and valorize in a superior way the existent resorts.

This way, it appeared the necesity to adapt the known solutions for the regeneration of Hungarian oak and Turkey oak stands to the new conditions and to find the optimal solutions in order to straighten out the regeneration process of the two species.

The researches about the natural selection in Hungarian oak and Turkey oak seedlings in different real conditions will lead to scientifical solutions about the possibilities of Hungarian oak and turkey oak regeneration which can be appliable in production.

The researches were performed between 2000 and 2006. During the researches, we had difficulties because of the lack of the necesarry apparatus and skilled personnel to perform the simultaneous determinations of the temperature

and brightness in all experimental blocks, as well as the appeared difficulties caused by the lack of Hungarian oak fructification, in the first years since the researches start.

For our researches, it is very important the way of natural selection of the seedlings under the mountain, at certain lighting intensities, within the different dimensions eyes, at the edge of the mountains or eyes, as well as in the conditions appeared because of uncontrolled opening of the stands as a result of Hungarian oak and Turkey oak stands drying phenomena.

MATERIAL AND METHODS

In order to reach the objective, there were placed 40 permanent trial areas in which there were performed evaluations in the autumn of every year, being determined the number of the seedlings on species.

The study of the natural selection in Turkey oak seedlings was performed within the trial areas placed in u.a. 46B in U.P. II Bucovăț, 124A in U.P. Seaca de Pădure in Craiova Forest District, u.a. 44B in U.P. I Gogoşu, 66C in U.P. III Filiaşi, 80H, 81D, 82M in U.P. II Argetoaia in Filiași Forest District, u.a. 117C in U.P. I Războinicu, 47 C in U.P. IV Şuşița in Strehaia Forest District, u.a. 1A in U.P. III Cărbuneşti. The determinations were performed in 2003, 2004 and 2005 for the planted seedlings from the 2002 fructification.

For the Hungarian oak, the lack of the fructification, before 2003, did not allow to watch the evolution of seedlings number at the end of the vegetation season for a certain age seedlings. These elements could be determined only for different ages seedlings, planted as a result of a low fructification.

The evolution of the seedlings number provided by a very good fructification could be done only after the Hungarian oak fructification in 2003, being performed evaluations in 2004, 2005 and 2006.

The very high intensity of the fructification in 2003 was determined by us in July 2003 and because of that we started to place trial areas for the Hungarian oak stands in the autumn of 2003 and as a result we could watch the seedling installation and then its selection in its first year, beginning with the spring of 2004, in 52 trail areas placed in U.P. II Argetoaia, u.a. 112B, C; 99F, 88K, Filiaşi Forest District.

The light intensity was determined with a luxmeter. There were performed a lot of observations about the Hungarian oak and Turkey oak natural regenerations in Jiu area in a very long period of time (over 20 years) through the performed production work and acquired results.

RESULTS AND DISSCUTIONS

1. The natural selection of Turkey oak seedlings.

One year after eyes opening, the natural selection in the eyes is between 21% and 59% and under the mountain is between 47% and 72%. The higher selection was produced in the first year, in the eyes of smaller dimensions (0.5H), and under the mountain the higher selection was produced where the stand's consistency is full or almost full. In sufficient humidity years, the light is the main factor in the natural selection of the seedlings, the more light is, and the less eliminated seedlings are.

In the second vegetation year, the Turkey oak natural selection is between 15% and 29% (Table 1), the differences being made by the lighting degree of the seedling, the forest type, the slope exposure, etc.

Table 1. Natural selection of Turkey oak seedlings in the first years of establishment.
Tabel 1. Eliminarea naturală a puieților de cer în primii ani de la instalare.

The researches place	The size of the eyes raported to the hight of the trees	The analyzed period from the autumn of till the autumn of	The eliminated seedlings from the fructification of 2002 (%)		
			In vegetation year	In the eye	Under the mountain
1	2	3	4	5	6
u.a. 46 B, 124 A	Eyes of 0.5 to 1.5H opened in the autumn of 2002. In the situations "in the eye" and "under mountain" the consistency 0.6 to 1.0.	2002 - 2003	I	59	72
		2003 – 2004	II	29	33
		2004 – 2005	III	12	36
44 B, 1 A	Eyes of 0.5 to 2.0H opened in the autumn of 2002. In the situations "in the eye" and "under mountain" the consistency 0.6 to 1.0.	2003 – 2004	II	22	34
		2004 - 2005	III	12	36
66 C, 80 H, 82 M	Eyes of 0.5 to 1.5H. In the situations "in the eye" and "under mountain" the consistency 0.5 to 0.8.	2003 - 2004	II	19	28
		2004 – 2005	III	11	27
81 D, 117 C, 47 C, 55 C	Eyes of 1.0H. In the situations "in the eye" and "under mountain" the consistency 0.5 to 0.8.	2002 - 2003	I	21	47
		2003 – 2004	II	15	33
		2004 - 2005	III	10	29

Legend: u.a. = working unit; U.P. = working section; H = mean height/of the tree.
Legendă: u.a. = unitate amenajistică; U.P. = Unitate de Producție; H = înălțimea copacilor.

In the third vegetation year, the natural selection is still high under the mountain (between 29% and 36%) being permanently higher than that from the eyes (between 10% and 12%). The seedlings can still be observed within the mountain, in the areas where the light intensity overtakes 15% from the light intensity in the open field and at the edge of the eyes where they use the lateral light.

2. Natural selection of Hungarian oak seedlings.

Hungarian oak stands which reached the exploitation age and being caught in a full process of regeneration by the intense drying between 1990 and 2001, the natural selection of the seedling can be watched in the open eyes for a long time. In these eyes, on some central parts, the stage of massif is closed and it began the phenomena of natural selection because of the intraspecific and interspecific competition. Our objective was to establish the determinant factors of the natural selection within the individual development period of the seedlings with effects on the natural regeneration establishment.

In the trail areas in which it was determined the proportion of the natural selection of the seedlings in the first year, it resulted different percentages between 20% and 70%, being differentiated through: the number of plantlets which appear in a certain area, the evolution of the climate factors during the vegetation season, the conditions of seedlings development (under the mountain laterally protected by the parental mountain, open ground), the size of the acorn from which it appears, the genetic information received from the parental trees, the adaptation to the environment conditions of the area etc.

The plantlets density on area unit, can become from the first year a restrictive factor, through the big number of plantlets on a square meter (over 160).

The natural selection of the seedlings is produced through the competition of the roots for water and, later, on a smaller scale, together with the trunk development and leaves growing, through the competition of the underground part. The selection proportion in the first year is the same, both for the seedlings under the mountain and for those in the other areas of the eye, in the stands placed on the plane fields. For the stands placed on the southern slopes, the natural selection is higher under the mountain by 34%.

In the period August - September, after the appearance of the humidity deficit in the soil together with the daily medium temperature raising and insolation, the seedlings dry in a percentage of 40% - 60%. From the performed researches resulted that to the end of September, the leaves dry, making the impression of entering earlier in the vegetative rest (checking the leaves colour) but, analyzing the situation of the trunk and root, it is observed that the seedlings dried.

In the second year of vegetation the natural selection for the Hungarian oak is between 18% and 36% (Table 2), the differences being made by the lighting degree of the seedling, the forest type, the slope exposure, etc.

In the third year of vegetation, the natural selection is still high under the mountain being permanently higher than that one in the eyes. The seedlings within the mountain, in the areas in which the light intensity exceeds 15% from the light intensity in open ground and at the edge of the eyes where the seedlings can use the lateral light.

The natural selection of the sapling is produced under the strong influence of the ecological external factors. The establishment of Hungarian oak saplings in a year with a very good fructification, its density on a square meter, growth strength and its resistance to the action of the preservative ecological factors are the result of the ecological factors which are favourable to the species.

The study of the establishment of Hungarian oak sapling in a year with a very good fructification creates the possibility of watching the result of the ecological factors which are favourable to this process. The observation of their manifestation during a vegetation season shows us the limits in which Hungarian oak seedlings can establish and develop normally, helping us to determine the level from which they become limitative, as well as the proportion of these factors which can be compensated in a way in which the result of their action to be favourable to the establishment and keeping the Hungarian oak sapling.

One year after the eyes opening, the natural selection in the eyes is between 20% and 63% and under the mountain round the eyes is between 54% and 70%. The stronger selection in the first year produced in small dimensions eyes (0.5H), and under the mountain the stronger selection produced in the place where the stand's consistency is full or almost full. It must be said that 2004 was reach in precipitations uniformly distributed during the vegetation season except August when it was very hot. We can draw a conclusion that in years with sufficient humidity, the light is the main factor in the seedlings natural selection, the more light is, the less eliminated seedlings are. Within the studied territory, there is enough heat in order to establish the Hungarian oak seedlings; it becomes limitative only during the drought periods, as it happened in August 2004 when it could be observed the drying of the seedlings in the areas with a high exposure to the sun.

The natural selection of the Hungarian oak and Turkey oak seedling is a complex process which manifests differently based on the unfavourable result of the determinant ecological factors like light, soil humidity and heat, which are specific to both species. To these, there are added the seedlings density in the area as well as the genetic adaptation variability of the species which appears especially at the extreme amplitudes of limitative manifestation of one of the ecological factors. If for the compensation of the humidity lack, the Hungarian oak adapted developing a very strong root, the lack of light cannot be compensated and becomes the limitative factor which mainly determines the natural selection of the seedlings.

Table 2. Natural removal of Hungarian oak seeds in the first years of establishment.
Tabel 2. Eliminarea naturală a semințișului de gârniță în primii ani de la instalare.

The researches place	The diameter of the eyes reported to the height of the trees	The analyzed period from the autumn of till the autumn of	The eliminated seedling from the fructification of 2003 (%)		
			In vegetation year	In the eye	Under the mountain
1	2	3	4	5	6
U.P. II Argetoaia, u.a. 112 C	Eyes of 0.5 to 1.5H opened in the autumn of 2003. In the situations under the mountain with the consistency of 0.6 to 1.0.	2003 - 2004	I	63	70
		2004 – 2005	II	33	35
		2005 – 2006	III	15	40
u.a. 112 B	Eyes of 0.5 to 2.0H opened in the autumn of 2003. In the situations under the mountain with the consistency of 0.6 to 1.0.	2004 – 2005	II	19	36
		2005 - 2006	III	12	38
u.a. 99 F	Eyes of 0.5 to 1.5H. In the situations under the mountain with the consistency of 0.5 to 0.8.	2004 - 2005	II	18	22
		2005 – 2006	III	11	26
u.a. 88 K	Eyes of 1.0H. In the situations under the mountain with the consistency of 0.5 to 0.8.	2003 - 2004	I	20	54
		2004 – 2005	II	14	32
		2005 - 2006	III	12	36

Legend: u.a. = working unit; U.P. = working section; H = mean height/of the tree.
Legendă: u.a. = unitate amenajistică; U.P. = Unitate de Producție; H = înălțimea copacilor.

In the pure stands of Hungarian oak with ages of over 40 years there are saplings with bush aspect of which origin has not been established yet in the scientific works. The researches showed that all patterns came from seeds and present the following features:

- at a depth soil between 5 and 15 cm, the root starts with a strong tap root which enters in depth;
- from the same level of the root, the trunk ramifies in two, three patterns which reach the soil surface, in an inclined position under an angle between 150 and 200^0;
- all patterns which start from the same root have on all aerial part, branches which cover the trunk completely and because of the lateral branches development, the trunk is not evidently differentiated;
- the trunks and the lateral branches develop horizontally and because of that they have a bush aspect and cover the soil on an area between $1m^2$ to $4m^2$;
- the trunks of these patterns have a bush aspect because the repeated self cutting back of the seedlings in a long period of time from 4 to 10 years;
- the level establishment of the pre-existent saplings with bush aspect appears in over 40 years old stands which are capable to fructify, in which because of different reasons the consistency reduced under 0.8;
- the establishment of these types of saplings under the mountain with a high resistance against the shadowing is specific only to the Hungarian oak;
- in the pure stands of Hungarian oak, with a consistency under 0.7, this type of manifestation and establishment of the saplings forms a sublevel with a height of no more than 2.5 meters which cover the soil in a percentage of 30% - 70%;
- the light intensity in areas covered with pre-existent bush aspect patterns is between 15% to 35% from the light intensity in the open ground;
- the growth of the empty space in the superior ceiling of the maternal stands leads to the activation of height growth of the patterns established in the light, favourising the correction of only one trunk but with limited effects for the trunk rectitude and further growths.

The age of the bush aspect patterns is between 3 and 40 years.

CONCLUSIONS

The development way of the Hungarian oak seedlings in their first years of life shows the high degree of species adaptability to develop in extreme conditions of humidity and temperature. Because of the reduced density of the seedlings, they self cut back beginning with the second year and they develop their branches from the base almost parallel with the ground, the growth in height are small and after a sufficient approaching to the nearby seedlings garland and the creation of the forest microclimate, through which it is kept easily the soil humidity, it starts the height vigorous growth.

The Hungarian oak has the capacity to establish under the mountain in certain limits of light intensity which is in direct correlation with stand's opening. At full consistency of the maternal stand, the light intensity is only 4% from that one in the open ground, there were kept 27% from the number of established seedlings. At the light intensity of 5% to 8% from that one in open ground, there were 30% to 32% from the number of established seedlings. At an intensity of 30% to 35% from that one in the open ground, there were kept 64% to 65% from the total number of established seedlings.

In the stands with full o5r almost full consistency, in which the light intensity is 4% to 5% from the light intensity in the open ground, there are kept between 4 and 15 seedlings on a square meter, in the first year of life, enough for regeneration. In the second year of vegetation, the number of seedlings reduces between 1 and 4 seedlings on a square meter, insufficient for regeneration. In those parts of the forest in which the light intensity is under 5% from that one in the open ground, it is necessary to open the massif in the first year of vegetation for regeneration.

In the stands with under 0.8 consistency, the massif opening can be done till the third year of vegetation.

One year after the eyes opening, the natural selection in the eyes between 20% and 63% and under the massif, round the eyes, it is between 54% and 70%. The stronger selection in the first year produced in a smaller dimensions eyes (0.5H) and under the mountain the stronger selection produced where the stand's consistency is higher. In years with sufficient humidity, the light is the main factor in the natural selection of the seedlings. So, the more light is, the less eliminated seedlings are.

The natural selection of Hungarian oak and Turkey oak sapling is a complex process which manifests differently based on the unfavourable result of the determinant ecological factors like light, soil humidity and heat, which are specific to both species to whom it is added the seedlings density in that area as well as the genetic adaptation variability of the species which manifests in the extreme amplitudes parts of limitative manifestation of one of the ecological factors. The main factor which influences the natural selection is light, followed by the soil humidity and extreme, very high temperatures.

In the Hungarian oak stands which began to fructify and have the consistency under 0.8, it is an established seedling with bush aspect making a sublevel which participates to forest microclimate keeping.

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