GERMINATION, UPSHOT AND GROWTH OF HUNGARIAN AND TURKEY OAK SEEDLINGS IN THE WOODLANDS OF THE WESTERN PART OF THE GETIC PLATEAU

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Abstract. The climatic changes of the last decades have affected the forest ecosystems. Among these species, the most affected have been the Hungarian oak (*Quercus frainetto* TEN) and the Turkey oak (*Quercus cerris* L.), which are widespread (76%) in the sample area (BERCEA, 2007; BERCEA & COJOACĂ, 2012). In addition to the mass drying of these two species, the natural regeneration process underlying forest sustainability and perpetuation of species in the areas occupied was also affected. In order to adjust the regeneration process to the climatic changes, intensive research was carried out on the germination, upshot and growth of seedlings in the envisaged areas. The Hungarian oak and the Turkey oak are the only forest species to take full advantage of the fertile clay, heavy, compact soils (Preluvisols, Luvisols -74.5%) prevailing in the Getic Plateau (BERCEA, 2007; BERCEA & COJOACĂ, 2012). Research has shown that Hungarian oak acorns germinate much faster than Turkey oak acorns, even from the autumn when fructification occurs. As a rule, the germination of the Turkey oak takes place in the spring following the fructification year and starts by a 2-week gap as compared to the Hungarian oak acorn since it is less affected by the late freezing, which justifies the existence of the Turkey oak seedlings on the northern shadowy slopes and at the foot of the plateau. The higher multiannual average temperatures and the poorer multiannual average rainfall in the area enhance germination with the first sufficient humidity values. The enhanced germination of the Hungarian oak acorn makes it possible to have seedlings during years of low fructification as such acorns also spring up from *Balaninus glandium*. The enabling of natural regeneration, the establishment of the optimal period for the land work in the microproduction units will take place according to the germination period and the germination characteristics in the case of the Hungarian oak and the Turkey oak. Likewise, there is need to determine the moment to cease the exploitation of the fully-grown oak trees and to clean the woodlands, before the upshot of stems, and, exceptionally, to postpone the cut works for a year when the germination has extensively taken place in the fructification year.

Keywords: *Quercus frainetto* TEN*, Q. cerris* L.*,* germination, upshot, seedlings.

Rezumat. Germinaţia, răsărirea şi dezvoltarea plantulelor de gârniţă şi cer în pădurile din partea vestică a Podişului Getic. Schimbările climatice la care asistăm în ultimele decenii an influenţat şi ecosistemele forestiere. Dintre toate speciile forestiere cele mai afectate au fost gârniţa (*Q. frainetto* TEN) şi cerul (*Q. cerris* L.), specii ce au o răspândire foarte mare (76%) în teritoriul luat în studiu (BERCEA, 2007; BERCEA & COJOACĂ, 2012). Pe lângă uscarea în masă a exemplarelor acestor specii, a fost afectat procesul de regenerare naturală care stă la baza continuităţii pădurilor şi perpetuarea speciilor în teritoriile ocupate dintotdeauna. Pentru a se adapta procesul de regenerare la schimbările climatice produse s-au iniţiat numeroase cercetări şi cu privire la germinaţia, răsărirea şi dezvoltarea plantulelor celor două specii în teritoriile ocupate. Gârniţa şi cerul sunt singurele specii forestiere care valorifică superior potenţialul productiv al solurilor argiloase, grele, compacte (preluvosoluri, luvosoluri -74,5%) predominante în Podişul Getic (BERCEA, 2007; BERCEA & COJOACĂ, 2012). Din cercetări rezultă că ghinda de gârniţă germinează mult mai repede decât a cerului, chiar din toamna anului cu fructificaţie. Germinaţia la cer se produce, de regulă, primăvara următoare anului de fructificaţie şi începe cu un decalaj de circa două săptămâni, mai târziu faţă de ghinda de gârniţă, fiind mai puţin afectată de îngheţurile târzii, fapt ce explică instalarea seminţişurilor de cer cu mai mare uşurinţă pe versanţii nordici, umbriţi, sau la baza versanţilor. Temperaturile medii multianuale mai mari şi precipitaţiile medii multianuale mai reduse din acest areal, determină începerea germinaţiei de la primele semne de umiditate suficientă pentru declanşarea procesului. Germinaţia mai uşoară a ghindei de gârniţă favorizează instalarea seminţişurilor şi în anii cu fructificaţii slabe, prin răsărirea puieţilor şi din ghinda cu atacuri slabe de *B. glandium*. Efectuarea lucrărilor de ajutorare a regenerării naturale, stabilirea perioadei optime de execuţie a lucrărilor pe microstaţiuni se vor face luând în calcul perioada de germinare şi modul cum decurge aceasta diferenţiat pentru gârniţă şi cer. De asemenea, se va stabili concret momentul opririi exploatării arborilor maturi şi al efectuării lucrărilor de curăţire a parchetelor, înainte de începerea apariţiei tulpinilor, iar în mod excepţional, amânarea tăierilor cu un an în cazul în care germinarea seminţelor s-a produs în proporţie foarte mare în toamna anului de fructificaţie.

Cuvinte cheie: *Q. frainetto* TEN, *Q. cerris* L., germinare, răsărire, plantule.

INTRODUCTION

Across Romania, the climatic changes manifest in the long-term dry periods and high temperatures succeeding at short intervals followed, generally, by years of heavy rainfall over short periods of time. The Getic Plateau is situated in the south of the Carpathians, characterised by a warm climate and lack of rainfall, which triggers even poorer rainfall that is not uniformly distributed over the year. In summertime, the warm and dry air advections are more numerous and longer, coming from North Africa, which lead to higher evapotranspiration, impeding on the adjustment of species to the dry atmospheric and edaphic conditions. The climatic pressure put on the forest species caused the mass wilting of trees and, more particularly, the low fructification and high frequency fructification, compromising the natural regeneration process. The most affected species was the Hungarian oak, out of which more than 45% trees were affected during the dry period of 1988-2004 (BADEA & TĂNASE, 2002). The woodlands of the Hungarian oak and the Turkey oak cover a surface area of 72,151 ha (43%) out of the total area of 167,248 ha of the woodland in the Jiu river basin to the south of the Carpathians (BERCEA, 2007). The poor rainfall for several consecutive years resulted in severe edaphic dry weather 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 the Hungarian oak. To this end, research was carried out to study and manage the natural regeneration process, as well as the germination, upshot and growth of the seedlings of the two species.

MATERIALS AND RESEARCH METHODS

The sample area covers the western part of the Getic Plateau in 6 woodlands of pure and mixed seedlings of the Hungarian oak and Turkey oak in the hydrographic basin of the Jiu river.

To determine the distance and the number of the seedlings at the end of the plateau and in the group cuts, both for the Hungarian oak and for the Turkey oak, sample areas were chosen, where analyses of the 1-year-old seeds, not heavily influenced by the microclimatic conditions at the extremity of the plateau and in group cuts of various sizes, were made. The research identified both similarities and dissimilarities of the two species depending on the weather conditions, the forest type, the woodland and the seedlings condition. In 2003, 2004, 2005 and 2006, periodic observation and inventory targeted the sample areas in the woodlands of Craiova, Filiaşi, Strehaia, Motru, Turceni and Cărbuneşti.

RESULTS AND DISCUSSION

Characteristics of the Hungarian oak. The observation and research highlighted the following:

In early November 2003, which was a high fructification year for the Hungarian oak, 33% of the healthy disseminated acorns had seedlings (Table 1), and the length of the roots ranged between 0.5 cm and 10 cm.

In early winter, on December 6, 2003, 92 % of the healthy disseminated acorns had seedlings (Table 1), and the average length of the radicle was 11 cm (0.5 - 22 cm).

Seedlings of the Hungarian oak acorns were found before dissemination.

The very high percentage of the acorns germinating in dissemination autumn was due to weather conditions. In September and October 2003, there was heavy rainfall in the sample area – between 91.1 - 174 mm at the three weather forecast stations of Craiova, Bâcleş and Târgu Jiu, and the average monthly temperatures in September, October and November ranged between 6.2 and 16.3^0 C (Table 2).

The germination of the Hungarian oak acorn was faster in the sample areas with no grass and bedding plants, or with a thin 2-3-year-old bedding plants rotting layer, where the seeds had contact with the wet soil on more than 20% of the surface of the acorn.

Table 1. Percentage of germinated acorns in the dissemination autumn.

Species	Sample area u.a.	Number of healthy acorns (items/m^2)				
		Total (items/m^2)	out of which, seedlings at …		percentage at ….	
			01.11.2003 (items /m^2)	06.12.2003 (items /m^2)	01.11. 2003 (%)	06.12. 2003 (%)
1	2	3	4	5	6	7
Hungarian oak	124 A	142	39	128	27	90
	82 M	180	67	170	37	94
	112 B	206	81	193	39	94
	112 C	196	52	175	26	89
Average		181	60	167	32	92

Table 2. Variation of rainfall and autumn temperatures.

Weather forecast station	Year	Average monthly rainfall					Average monthly temperatures				
		08	09	10	11	12	08	09	10	11	12
1	2	3	4	5	6	7	8	9	10	11	12
Craiova	2003	9.2	121,.0	132.1	39.0	51.8	24.9	16.3	9.2	6.7	-0.4
	2004	27.6	55.6	17.5	99.2	35.7	21.9	17.1	12.6	6.5	1.3
Bâcleş	2003	4.3	91.1	114.5	43.6	23.4	24.3	15.3	8.0	6.4	-0.6
	2004	60.8	39.2	33.5	90.4	11.6	21.1	16.0	11.9	5.8	1.0
Târgu Jiu	2003	26.6	128.8	174.1	49.7	33.2	23.6	16.0	8.9	6.2	0.1
	2004	85.9	67.5	40.4	131.8	35.2	20.8	15.7	11.7	6.2	1.3

The smallest number of germinated acorns (11%) with a radicle up to 0.5 cm, were found in the sample areas of dry hard soil. In early December in 2003, the radicles of some germinated acorns fallen on the grassy land did not touch the soil that should have fixed them, they entered a decay process during the dry period through the dehydration of the cotyledons, of the radicle and its drying, thus, interrupting the germination process.

The germination of the Hungarian oak acorn attacked by *Balaninus glandium* takes place only when the embryo is not destroyed or when the hypocotyl is not cut in the early growth stage. With 80% of the attacked acorns, by a maximum of two larvae, only the cotyledons are eaten up, the embryo being eaten up only in the cases of heavy attacks.

In the early spring of 2004, germination was activated in the second decade of March following the heavy rainfall of 9–10 March and the subsequent high temperatures. Thus, on April 10, 2004, the healthy acorn and not heavily attacked by *B. glandium,* germinated in a very (high) percentage - 99%. The average length of the radicle was of 1.0 - 22 cm.

Germination can be compromised only when the acorn is dehydrated before the beginning of the process. Research showed that with 70% of the acorns where the germination process had reached the emergence stage, the radicle having penetrated the skin and being less than 0.5 cm long, water scarcity or lack of water during the growth of the radicle stopped the process and resulted in the death of the embryo. The phenomenon is readily noticeable in the sample areas on the dry hard soil, where the acorns had the necessary water to start the germination process. The vegetation process of the plants changed the acorns initial stage enabling the process; practically, they were lifted, thus, reducing the contact area with the soil and eliminating the contact with the wet soil and the water supply necessary for the on-going germination. In 30% of the ceased germination cases, the radicle reaches about 3.0 cm, not being able to fix in the soil, either because of the grass or of the thick dry plant bedding. The thick and partly wet plant bedding enhances the horizontal growth of the radicle due to the need for a wet area allowing its fixation in the soil.

The alternation of wet and dry seasons at extremely large intervals causes the acorn germination to stop at different stages; consequently, it compromises their germination. The constant sufficient humidity of the soil hosting the germinating acorns is crucial to the Hungarian oak seedlings. This is secured only in the woodlands with no grassy soil, with thin rotting plant bedding, which keeps wet and which is covered by a plant bedding layer dating from the fructification year, partly covering the acorns, preventing the rapid evaporation of the humidity of the soil and maintaining a wet microclimate in the acorn layer.

The penetration of the radicle in the soil takes place only in the sufficiently wet areas and it is a prerequisite for the successful germination process and the emergence of seedlings, through the rapid growth of the root and its deep fixation in the soil in a short period of time, as well as through the development of a fascicle of side roots absorbing the water and securing the physiological processes triggered by germination.

The high temperatures in late February 2004, followed by a wet and warm period starting from the second decade of March, favoured the emergence of the stems. It happened after the penetration of the roots in the soil and the extension of the hypocotyl axis, followed by the unfolding of cotyledons in two symmetrical parts and the emergence of the epicotyl axis in between, giving rise to the main stem and the first leaves (protophyls) which grow very fast.

The growth of the stems also started in the second decade of March, with reference to the acorns having germinated in the previous autumn and having their roots already fixed in the soil.

Temperatures above 10^0 C in daytime for more than 5 days at the level of the soil causes the upshot of the stem and coincides with the next period of vegetation of the vernal plants (*Viola silvestris, Corydalis cava*).

On 31 March, 60 % of the stems had already sprung, and on 15 April - 98 %.

The growth of the stems is fast during the first 10 days, depending on the temperature in daytime and being enhanced by high temperatures at the level of the soil in the woodland. Nevertheless, on July 3, 2004, newly sprouted stems were found in u.a. 99 F, U.P. II Argetoaia under a very thick layer of plant bedding made up of last year leaves, gathered in a pool. The upshot of stems was due to the rainfall that took place two days before drawing up the inventory list, resulting in a pool where the 11 acorns were found, and the stems had already reached 4 cm and become wilted because of darkness, striving to penetrate the thick plant bedding (Figure 1). The soil temperature reached 28 ^{0}C. Hence, the upshot of the stem depends not only on temperature, but also on the soil humidity.

The vertical growth of the stems is fast in the first weeks, and the growth of leaves is very slow; after stems stop growing, leaves grow fast. Each seedling has 3-5 leaves (80 % have 5 leaves, 10 % 4 leaves and 10 % 3 leaves) and the best developed leaves go to the top of the seedlings.

On May 30, the seedlings stopped growing, the average height was of 11 cm (3 cm - 18 cm), the average length of the root was of 19 cm (12 cm - 36 cm), and the average diameter of the root crown is of 3 mm (1 - 5 mm).

On rare occasions (in less than 0.1% of the cases), two stems sprang out of the same root and grew similarly, having the same height when they stopped growing.

The mechanically affected stems are able to recover through drying, even if this mechanical action took place in the first days of the stem growth.

During the first vegetation year, a second growth was extremely rare in the sample areas - only in 0.3% of the total number of seedlings, irrespective of the position of the sample areas.

Research on upshot of the Hungarian oak seedlings was also carried in U.P. II Argetoaia, u.a. 99 F, on flat area of low inclination, with sample areas of 1 m^2, at 1 m from one another, to the north, south, east and west. One year after the high fructification of the Hungarian oak in the autumn of 2003, i.e. in November 2004, the seeds belonging to the sample areas in 4 group cuts of 1/2 of the average height of the seedlings (0.5 H), to 3 group cuts of the average height of the seedlings (1.0 H) and 4 group cuts of 1.5 of the average height of the seedlings (1.5 H) were examined – see table 3.

Figure 1. Upshot of Hungarian oak seedlings in July 2004 (BERCEA, 2004).

Table 3 indicates that the fixation of the Hungarian oak seedlings in a flat area or in an area of low inclination took place up to 5 m from the end to the centre of the group cut, and outwards, uniformly below the regeneration trees, their number increasing from the end of the group cut to the centre.

In the small-sized group cuts, of ½ of the average height of the regeneration trees (9.5 m), the fixation of the seedlings covered the whole surface area, the average number of seedlings/m^2 ranging between 12.5 and 14.7.

Table 3. Emergence of Hungarian oak seedlings at the end of the woodland.

Size of group cuts vs. the height of seedlings (H)	Maximum emergence distance to the centre of the group cuts	**Average no. of 1-year seedlings/m^2, sprung at a distance of… m**										
		1	2	3	4	5	6	1	2	3	4	5
		From the end to the centre of the group cut						From the end of the group cut outwards				
1	2	3	4	5	6	7	8	9	10	11	12	13
0.5 H	5	14.7	15.1	13.1	12.9	12.5	0	9.5	12.8	16.5	19.7	20.1
1.0 H	5	14.3	14.5	12.3	9.8	4.5	0	7.5	12.5	16.3	19.5	20.1
1.5 H	5	13.6	13.8	11.7	9.1	3.9	0	7.3	12.4	16.4	19.7	19.9

In the group cuts of the same size of the height equal to the height of the regeneration trees (18.5 m), the average number of seedlings/m^2 ranged between 4.5 – 14.3, whereas there were no seedlings in the centre of the group cut.

It is also the case of the group cuts of 1.5 H, where the average number of seedlings/m^2 ranged between 3.9 – 13.6, and where there were no seedlings in the centre of the group cut.

Table 3 also shows that the highest number of seedlings/year was in the group cuts of small diameter. Admittedly, in the group cuts with the diameter equal to ½ of the height of the seedlings, the average number of seedlings/m^2 ranged between 14.7 – 12.5, almost uniformly distributed in the centre of the group cut and outside the group cut, recording only a slight decrease in the first m^2 towards the centre of the regeneration trees area. In the group cuts with the diameter equal to the height of the seedling, the number of seedlings/m^2 at the end of the group cut to the centre of the group cut decreases from 14.3 to 4.5, whereas outside the group cut it increases from the end of the regeneration group cut to the centre, from 7.5 to 20.1 seedlings/m^2.

Furthermore, the average number of seedlings in the group cuts of 1.5 H of the seedlings is smaller, decreasing from the end of the group cut to the centre, while it increases outwards from 7.3 to 19.9 as in the case of the group cut equal to the height of the seedlings.

The research carried out in the sample areas belonging to the group cuts with central regeneration trees or with regeneration in u.a. 153 B, U.P. II Argetoaia, Ocolul Filiaşi and in u.a. 50 D, U.P. IV Şuşiţa, Ocolul Strehaia indicates that the Hungarian oak acorns were sufficiently disseminated in the centre of the group cuts.

Characteristics of the Turkey oak. 2002 and 2004 were good fructification years for the Turkey oak, while 2005 was extremely good in this respect. Periodic observation, inventory lists and growth measurements targeted the very good and good fructification years as well as some other years. The research carried out with Turkey oak group cuts, with Turkey oak and Hungarian group cuts and with Sessile oak, Turkey oak and Hungarian oak group cuts showed that:

- the germination of the healthy Turkey oak acorns reached 8% up to December 5 in the fructification year, and it ranged between 5.7% in 2005 and 9.4 % in 2002, according to the weather conditions, condition of the seedlings, the size of the group cut and the spread of the grass on the soil (Tables 4, 5);
- the radicle of the germinated acorns is of 1.0 cm (0.3 – 1.5 cm);
- in the early spring of 2003 and 2006, germination was activated gradually starting from March 20 in 2003 and March 25 in 2006, respectively, according to the weather conditions, exposure, thickness of the plant bedding in the fructification year, condition of the seedlings, and the spread of the grass on the soil;
- germination may be considered complete on April 30 in 2002 and on May 5 in 2006;
- the radicle penetrates the skin slowlier as compared to the Hungarian oak acorn, requiring a longer period of water absorption;

Table 4. Percentage of germinated Turkey oak acorns in the autumn of dissemination in 2002.

Species	Sample area u.a.	Number of healthy acorns (items/ m^2)				
		Total items/m^2	out of which, seedlings at …		percentage at ….	
			31.10.2002	02.12.2002	31.10. 2002	02.12. 2002
1	2	3	4	5	6	7
Turkey oak	80 H	3.9	0	0	0	0
	81 D	12.7	1	2	7.9	15.7
	82 A	11.8	1	1	8.5	8.5
	153 B	15.0	1	2	6.7	13.3
Average		10.9	0.8	1.3	7.5	9.4

Table 5. Proportion of germinated Turkey oak acorns in the autumn of dissemination in 2005.

Species	Sample area u.a.	Number of healthy acorns (items/ m^2)				
		Total items/m^2	out of which, seedlings at …		percentage at ….	
			09.11.2005	05.12.2005	09. 11. 2005	05.12. 2005
1	2	3	4	5	6	7
Turkey oak	153 B	84	3	5	3.6	6.0
	124 A	53	2	3	3.8	5.7
	81 D	141	4	7	2.8	5.0
	44 B	67	2	4	3.0	6.0
Average		86.3	2.8	4.8	3.3	5.7

- the radicle penetrates the soil fast and deeply, developing fascicular side roots through which it absorbs the water and maintains the cotyledons alive;
- the average growth of the root in the first year reaches 17 cm (10 - 34 cm);
- the hypocotyl gets longer, it splits up into two symmetrical parts, and the stem springs from its end;
- the stem grows fast, reaching an average height of 15 cm (5 - 26 cm), followed by leaves growing - from 3 to 5 (in number);
- like the Hungarian oak, the Turkey oak rarely witnesses 2 stems from the same acorn;
- the 1-year seedlings rarely undergo a second growing process.

The germination of the two oak species indicates similarities and dissimilarities. Thus, the Hungarian oak acorn germinates faster than the Turkey oak one, from the very autumn of the fructification year, although the research could not be conducted in parallel because of the lack of fructification of the two species in the same year. The germination of the Turkey oak generally takes place in the spring following the fructification year and is marked by a 2-week gap as compared to the Hungarian oak acorn, being less affected by the late frost, which justifies the easier upshot of the Turkey oak seedlings on the north shadowy slopes or at the foot of the slopes. The early germination of the Hungarian oak acorn, as well as the high germination rate in the autumn of the fructification year justifies the spread of this species to the south. The higher multiannual average temperatures and the poorer multiannual average rainfall in this area cause the germination to start as soon as humidity allows it.

The easier germination of the Hungarian oak acorn favours the dissemination of seeds in the years of low fructification through the upshot of seedlings even from the acorns attacked by *B. glandium*.

The enhancement of natural regeneration, the establishment of the optimal period for microproduction units will take into consideration the germination period and the characteristics of the process with the Hungarian oak and the Turkey oak.

Also, there is need to establish when to stop the exploitation of the fully grown trees and to clean the woodlands, before the upshots of stems, and, exceptionally, to postpone the cuts for the next year when the germination was high in the fructification year. Losses can be severe when the acorns are moved away from the germination area (as it happened in 2003).

CONCLUSIONS

1. The Hungarian oak acorn germinates several times starting from the autumn of dissemination year in proportions of more than 90% of the number of healthy acorns, according to the amount of rainfall and the temperature during the whole period, while roots can be up to 22 long. A small part may germinate before dissemination.

2. The germination of the Hungarian oak acorn is faster in the areas where the soil is not grassy or covered by a plant bedding or by a 2-3 year-old rotting plant bedding, where seeds come into contact with the wet soil, the contact area being larger than 20% of the total surface of the acorn.

3. The smallest number of acorns where germination involves the growth of the radicle up to 0.5 cm are found in the dry hard soil. In the case of some acorns germinating on the grassy soil, the radicles do not come into contact with the soil to be able to fix, they start decaying in the dry season and due to the dehydration of the cotyledons, of the radicles and through its drying, germination is interrupted.

4. The germination of the Hungarian oak acorn attacked by *Balaninus glandium* takes place only when the embryo has not been eaten up or the hypocotyl was not cut in the early growth stage. In 80% of the cases, when the acorns are attacked by a maximum of 2 larvae, only the cotyledons are eaten up, the embryo being eaten up in heavier attacks.

5. In early spring, germination is activated starting from the second decade of March, following the heavy rainfall and high temperature. The average length of the radicle reaches 11 cm (1.0 to 22 cm).

6. Germination can be compromised only when the acorns become dehydrated after germination has started. The constant soil humidity that the acorns need after germination has started depends on the fixation of the Hungarian oak seedlings.

7. The penetration of the roots in the soil and the extension of the hypocotyl axis are followed by the unfolding of cotyledons in two symmetrical parts and the emergence of the epicotyl axis in between, giving rise to the main stem and the first leaves (protophyls) which grow very fast.

8. The growth of stems begins with the acorns having germinated in the previous autumn and having the roots already fixed in the soil in the second decade of March.

9. Warmth triggers the growth of the stems. Temperatures above 10 ^{0}C in the soil in daytime for more than five consecutive days cause germination to start.

10. The growth of the stem is fast during the first 10 days since its upshot, according to the temperature values in daytime, being enhanced by high temperatures of the soil in the woodland and by the soil humidity.

11. With the Turkey oak, germination takes place up 8% of the healthy acorns until December 5 in the fructification year, and, according to the weather conditions, condition of the seedlings, size of the group cut and spread of grass in the soil, the radicle of the germinated acorns is 1.0 cm long (0.3 – 1.5 cm).

12. In early spring, germination is activated gradually starting from the third decade of March, according to the weather conditions, exposure, thickness of the plant bedding in the fructification year, condition of the seedlings, spread of grass in the soil.

13. The radicle of the Turkey oak penetrates the skin slowlier than that of the Hungarian oak, requiring a longer period of water absorption.

14. The radicle penetrates the soil fast and deeply and it develops side roots through which water is absorbed and cotyledons are kept alive.

15. The root can reach 17 cm in the first year (10 - 34 cm).

16. The hypocotyl gets longer, cotyledons split up into two symmetrical parts, and the stem springs from its end. The stem grows fast, reaching an average height of 15 cm (5 - 26 cm), followed by leaves growing - from 3 to 5 (in number).

17. Like the Hungarian oak, the Turkey oak rarely witnesses 2 stems from the same acorn.

18. The 1-year seedlings rarely undergo a second growing process.

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