Bulletin of the *Transilvania* University of Braşov
Series II: Forestry • Wood Industry • Agricultural Food Engineering • Vol. 4 (53) No. 2 - 2011

# RESEARCH REGARDING THE ARTIFICIAL REGENERATION BY SEEDING PEDONCULATE OAK ACORNS IN MANAGEMENT UNIT II SNAGOV PARK, SNAGOV FOREST DISTRICT

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***Abstract:*** *The deficiency problems in natural regeneration in case of oak species from Snagov Park associated forests have to be corrected by artificial interventions in order to ensure the proportion of the main species as indicated in the management plans. A special problem is represented by the pedonculate oak (Quercus robur) natural regeneration. In this context, the present paper presents the results regarding the success of applied artificial regeneration operations into a compartment from the mentioned area.*

***Key words:*** *artificial regeneration, success, oak, Snagov Forest District.*

## 1. Introduction

Despite the fact that the treatment methods provided by the management plans (in case of Management Unit II - Snagov Park) were applied according to the management plans prescriptions, there was no success in natural regeneration of the main and basic species in this management unit - pedonculate oak (*Q. robur*) [4].

In this context, in order to maintain the fundamental natural forest types in the future, it was necessary to carry out artificial regeneration activities in numerous compartments by considering techniques such as seedling in holes and in rows.

The outputs of these techniques as well as the success rate of the overall regeneration activities were investigated, and the results are presented in the current paper.

The direct seedling is the method according to which the seeds are directly incorporated in the soil of the ground intended for forest cultures. Given this technological particularity, the direct seedling method is considered to resemble the method of natural regeneration from the forest seed. It is true that, in both cases, the new generation results from seeds that come into direct contact with the mineral soil but this is only an apparent resemblance, as there are differences between the two ways of installing the forest vegetation [1].

A main argument is that the natural seedling is installed after the dissemination of the seeds, in the ratio and the composition permitted by the trees on the surface to be regenerated [3]. The direct seedling, on the other hand,

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involves human activity regarding artificial seedling of seeds belonging to species chosen and associated in the afforestation composition.

It is also known that in the case of the natural regeneration, a part of the disseminated seeds frequently disappear before or during germination due to biotic or abiotic deteriorating agents [1]. Even if the unharmed seeds (rarely being of superior quality) come into direct contact with the mineral soil due to the pressure exercised by the litter or the dense and compact layer of the live forest, so as to find the humidity and the heat necessary to the germination, and the alternation of these favourable conditions with the freezing and draught periods, they may die and even the resulted plantation may die [2].

On the other hand, the positive and the most important feature of the direct seedling is the fact that this is made directly in the soil of the land to be forested. The resulted saplings grow on the permanent spot, without suffering the consequences of the transplantation process, so that the roots of the saplings are not affected by any deformations or mechanical injuries and, as such, healthier crops are obtained compared to those resulting from plantations.

Apart from the multiple benefits of the direct seedling processes, the last ones present many disadvantages as they are exposing the seeds to the action of different biotic and abiotic deteriorating agents, whose negative actions are difficult to prevent and remedy [2].

The forest cultures installed by direct seedling need usually longer and more frequent care than other cultures. On the other hand, the direct seedling cannot complete the natural regeneration because the resulting saplings may be quickly overwhelmed and eliminated by the existing seeds [1].

## 2. An Overview on Direct Seedling

On the terrains to be afforested the direct seedlings can be executed in holes, rows or manual dispersion. Regardless the adopted procedure, the aspects to be considered in nursery cultures - quality and seed preparing, timing, depth and seedling norm are the same in case of artificial regeneration of forest through direct seedling method.

**Seedling in holes** - is the most applied procedure presenting the important advantage that it uses a small amount of seeds in comparison with the other procedures, and the afforestation schemas are easy to materialize in the field [1].

The hole is a cavity, commonly of circular shape, and small dimensions (diameters from 10 (12) cm up to 40 cm, in function of seeds dimensions) and with depths equivalent to certain species seedling depths. It is recommended to adopt a decreased depth from centre to exterior, and the seeds to be arranged on two perpendicular directions.

The holes are executed with specific tools being located in the middle of a panel. Frequently, in case of panels with 1.0x1.0 meters five holes are dug: four in corners direction and one in the centre.

The seedling norm expressed in pieces or gram/hole varies from double to four-five times the number of individuals that must be obtained from a hole. On terrains without grass, with medium texture, which generally ensure the regeneration conditions, the seedling can be done in small clefts located in the middle of the hole having the adequate depth according to the seedling season. In these conditions there can be used special devices like seedling tube or stick.

The seedling tube is a tool of 1.0-1.20 meters long, made from an easy, resistant material, having on one end a chuck with one or more holes through which the seeds are distributed in the soil. The seeds are introduced on the superior part of the tube.

The seedling stick presents a curved superior part and the inferior part of the tube presents an automatic clack. After seeds introduction the hole is covered with earth.

**Seedling in rows (lines) -** presupposes the seeds distribution in straight rows or lines having constant depth. The operation can be done both manually and mechanically. This procedure is applied, especially on terrains where the soil has been partially or totally prepared (strips) [1].

The rows can be continuous or interrupted (with lengths of 1-2 meters where the seeds are not distributed in case of interventions on plantations).

The rows can be equidistant (from 1.0 to 2.0 meters) or grouped two by two on distances of 0.7-1.0 meters according to the adopted afforestation schema.

In case of slopes the rows are disposed on the contour lines. On the plain zone (Snagov Park) the rows are oriented to north-south in cases such as mandatory protection of the plants against solar activity or on direction of the dominant wind in case this presents a threat.

In some countries from Eastern Europe, in case of the direct seedling method application for spruce the "Specht" procedure is adopted - on plantations without nursery consisting of direct growth of the plants on the terrain to be afforested (small surfaces). Thus, on relatively level terrain and profound soils with high humus content there are traced areas with widths of 0.6-0.8 meters on which the seeds are incorporated in channels. A part of the obtained plants are harvested and are used in closed surfaces regeneration and the remaining ones are left undisturbed in order to assure the terrain regeneration by direct seedling.

**Seedling by direct manual dispersion of the seeds -** presupposes the uniform distribution of seeds in the field sometimes even to its surface. The procedure leads to satisfying results in areas with sufficient precipitations, on terrains without herbaceous vegetation, on fluffy soils, with sufficient moisture, and a well represented humus layer in case of species of seeds with a short germination period [1].

Due to the fact that only a small part of the seeds attain favourable germination conditions, there are used increased seedling norms (3-4 times greater than in case of whole seedling or row seedling); in these conditions the procedure can be applied when high quantities of seeds are provided in an easy manner at reduced acquisition costs.

For the creation of favourable germination conditions and ulterior growth of the seedling plants, the seedling by direct manual dispersion of the seeds can be executed on a surface of a soil panel which was prepared according to this operation.

On large surfaces with favourable germination conditions, the direct seedling by direct manual dispersion of the seeds can be done by using planes or helicopters, as the procedure is practiced in countries such as Canada, United States, Russia and others.

In our country this procedure was applied in 1952 for spruce seeds, under forest cover, or on large surfaces resulted from clear cutting or wind falling, in some basinets like Dorna, Ialomiţa and Doftana rivers.

Because of the high costs associated with plane operation, high seed consumption, reduced efficiency of the cultures and small surfaces which are suitable for afforestation by using this method, in the last decades this procedure was aborted.

In these conditions, in Romania there are applied the first two procedures and in the studied area (Snagov Park), these procedures were applied for artificial regeneration with respect to specific and zone characteristics (regenerated areas, plain conditions, basic species represented by species form Quercus taxa, adequate seedling schemas).

## 3. Research Location and Methodology

The research was conducted in compartments no. 51 and 52. In the first one the seedling has been carried out in 2001, using 4-5 acorns per hole. During the first annual control, the number of seedlings per hole exceeded 2 individuals - as prescribed by the enforced standards, and, in 2011 the crops were closed.

The height of the seedlings, the collar and crown diameter were measured in the field. The height of the samples varied between 105 and 425 cm, and in the neighbouring sampled areas there were found individuals with heights between 30 and 50 cm. The diameter varied between 2 and 10 cm, the crown diameter was between 70 and 150 cm, and overall vegetation state was good.

In compartment 52 the artificial regeneration activities were carried out in 2005. In this case there was used the row-sowing technique and, the first annual control showed the presence of more than two individuals per linear meter of row as prescribed by the standards. After six years, the individuals' heights varied between 25 and 160 cm, the collar diameter was between 2 and 6 cm and the crown diameter (the average value of two perpendicular measured diameters) was between 30 and 105 cm in conditions in which the cultures were not closed.

## 4. Results and Discussion

Between 2001 and 2010, in Management Unit II Snagov-Park, the trees on 122.4 hectares were harvested for regeneration purposes, out of which 89.5 hectares were regenerated by under-planting pedonculate oak, and 31.9 hectares remained non-regenerated. The seedling was performed in stages through widening the gaps resulted from the application of the group shelterwood system; all the area was ploughed and the holes were placed on a grid with rows of 80 cm, and a seedling standard of 6-8 acorns per hole, in order to provide 4-5 seedlings and 20-25 acorns per meter of seed drill, in row seedling.

The care operations that followed performed the elimination of the invading agents all over the regenerated area.

In order to emphasize the comparative state of vegetation and growth of the pedonculate oak saplings, as installed by direct seedling in the Management Unit II Snagov-Park, compartment 52 = 2.5 ha (seedling in holes) and compartment 51 = 4.5 ha (seedling in rows) were selected. In order to emphasize the latest annual growth (2010-2011), the date of the last annual control, because the closing of the culture was achieved in the saplings sown in the spring of 2001, in compartment 51 on an area of 4.5 ha and in compartment 52 on an area of 2.5 ha, ten sampling areas were marked, in dimensions of 6 x 6 m and 5 x 4 m, respectively, where the saplings were inventoried per species and also the total height and the crown diameter was measured.

After the inventory of the cultures in the 19 compartments where direct seedling in holes and on rows was performed, the first annual control indicated a 70% rate of success having the following regeneration composition (naturally installed species and the oak resulting from direct seedling in holes and rows): 30% oak, 40% linden tree, 30% common ash.

According to the annual control of the cultures in 2011, the saplings resulting in the spring of 2005 had an average height between 0.5 m and 1.2 m (compartment no. 26), in case of the saplings resulted from the seedling in the spring of 2001, the cultures were closed and in compartment 21A they were up to 4 m high. The measurements taken in the above-mentioned sample areas are presented in Table 1, for compartment 51 and in Table 2 for compartment 52.

In analyzing the data from Table 1 the average number of saplings per square meter is confirmed to be between 4 and 5 pieces in each sampled area. For the whole sampled area (3…6 $m^2$) the number of the following saplings per species was inventoried: from 12 to 15 in oak, from 0 to 3 in common ash, from 0 to 6 saplings in linden. The height of the saplings, regardless of the species is between the measured minimum and maximum value, i.e. minimum values 50-30 cm (sample areas 2…4) and maximum values 400-425 cm (sample areas 5, 9, 10).

The collar diameter has values between 0.2 cm and 10 cm. As far as the crown diameter is concerned, the measured values are more homogenous (between 70 and 140 cm), regardless of the sample area.

Table 1

*Minimum and maximum dimensions of the height, collar diameter and crown diameter in 2011, when the crops were closed for the saplings resulting from the seedling of the acorns in holes, in the spring of 2001* (*compartment 51*)

| Sample area no. | No. of saplings/$m^2$ | Height *h* [cm] | Collar diameter | Species/$m^2$ | | | | Crown diameter [cm] |
|---|---|---|---|---|---|---|---|---|
| | | | | Pedonculate oak | Common ash | Linden | Dt. | |
| 1 | 5 | 250-350 | 5-7 | >15 | - | - | - | 100-130 |
| 2 | 5 | 50-200 | 3-5 | >15 | - | - | - | 80-100 |
| 3 | 4 | 30-120 | 2-5 | >13 | - | 6 | - | 70-90 |
| 4 | 5 | 50-150 | 5-9 | >15 | 2 | 3 | - | 80-110 |
| 5 | 5 | 400-410 | 5-9 | >14 | - | - | - | 110-150 |
| 6 | 4 | 300-350 | 4-8 | >15 | 3 | 2 | - | 100-130 |
| 7 | 5 | 205-210 | 5-7 | >14 | 1 | 1 | - | 90-110 |
| 8 | 5 | 105-175 | 4-6 | >12 | - | 2 | - | 85-105 |
| 9 | 5 | 404-425 | 5-10 | >15 | 1 | 1 | - | 100-140 |
| 10 | 5 | 205-425 | 5-10 | >15 | 1 | 1 | - | 90-140 |

Table 2

*Minimum and maximum dimensions for height, collar diameter and crown diameter in the saplings obtained from the seedling in 2005* (*compartment 52*)

| Sample area no. | No. of saplings/$m^2$ | Height *h* [cm] | Collar diameter | Species/$m^2$ | | | | Crown diameter [cm] |
|---|---|---|---|---|---|---|---|---|
| | | | | Pedonculate oak | Common ash | Linden | Dt. | |
| 1 | 4 | 30-150 | 2-4 | >12 | - | - | - | 55-90 |
| 2 | 5 | 25-130 | 2-4 | >15 | 1 | - | - | 60-100 |
| 3 | 5 | 30-130 | 3-5 | >15 | 1 | 1 | - | 30-90 |
| 4 | 4 | 25-150 | 2-4 | >14 | 2 | 3 | - | 60-80 |
| 5 | 4 | 30-160 | 3-6 | >15 | 4 | 4 | - | 55-90 |
| 6 | 5 | 30-140 | 3-5 | >15 | - | - | - | 60-80 |
| 7 | 5 | 25-150 | 2-5 | >15 | 2 | - | - | 70-100 |
| 8 | 4 | 30-150 | 2-6 | >15 | 2 | - | - | 70-100 |
| 9 | 4 | 40-150 | 3-4 | >14 | 1 | 3 | - | 60-100 |
| 10 | 5 | 50-160 | 4-6 | >12 | - | 2 | 1 | 60-105 |

The growth in the pedonculate oak (main basic species) in 2011 was an average of 40 cm, as the values obtained from the measurements were very close (between 35 and 50 cm).

In compartment 52 (Table 2) where the seedling was performed in 2005 and the inventory and measurements were performed at the end of August 2011, the following results were obtained:

- The number of saplings was between 4 and 5 pieces per square meter and per species the inventory showed 12-15 saplings on the test area of 20 square meters as compared to approximately the same number but on an almost double the size area (36 $m^2$), which means that the natural selection process was triggered and almost 50% of the saplings disappeared.
- The difference between the least increase and the most increase in height is more or less homogenous, the maximum difference being 130 cm (between 30 and 160 cm).

The difference between the smallest measured diameter (2 cm) and the largest measured diameter (6 cm) is smaller, of only 4 cm.

Also, there is a greater difference between the diameters of the crowns - 55 cm.

It is worth emphasizing the fact that in 2011, the average annual growth in the oak saplings was 20 cm, i.e. 50% of the annual growth in the saplings resulting from the seedling performed in the spring of 2005. These measurements confirm the data in the specific literature [1] on the growth of this species which are smaller in the first years of life.

## 5. Conclusions

In conclusion, the artificial establishment by direct seedling in rows may be applied with good results, when the natural regeneration is not performed pursuant to a long cycle between two full masts in the pedonculate oak.

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