UDK 630*232.329.6:582.632.2=111
Original scientific paper

EFFECT OF CONTAINER TYPE ON GROWTH AND DEVELOPMENT OF PEDUNCULATE OAK (*Quercus robur* L.) SEEDLINGS IN THE NURSERY

Vladan POPOVIĆ¹, Aleksandar LUČIĆ¹, Ljubinko RAKONJAC¹

Abstract: In this paper are presented the research results of effect of the container type on growth and morphological parameters of Pedunculate oak seedlings. In the experiment were used three types of containers Bosnaplast 18, Bosnaplast 12 and HIKO V265.

Seed collection was performed in the Pedunculate oak seed stand registration number RS-2-2-qro-12-197 which is managing by FE Kragujevac in autumn 2012 and seed sowing in containers was done in spring 2013 in the seedling nursery of Institute of Forestry in Belgrade.

The analysis of one-year-old seedlings was performed in autumn 2013. The parameters that were measured are height and root collar diameter.

Seedlings produced in containers Bosnaplast 18 with cell volume of 220 cm³ and HIKO V265 with cell volume of 265 cm³ have larger dimensions and they are more quality than seedlings produced in containers type Bosnaplast 12 that have cell volume of 120 cm³. Researches have shown that container volume has positive effect on morphological characteristics of Pedunculate oak seedlings in conditions of seedling nursery.

Key words: Pedunculate oak (*Quercus robur* L.), container, seedling, morphological parameters.

¹ Institut of Forestry, Kneza Visislava 3, Belgrade, Serbia. E-mail: vladanpop79@gmail.com

* **Acknowledgement:** The research is financed by the Ministry of Science and Technological Development of the Republic of Serbia, Project TR 31070 "The development of technological procedures in forestry with a view to an optimum forest cover realisation" (2011-2014).

Translation: Dragana Popović

УТИЦАЈ ТИПА КОНТЕЈНЕРА НА РАСТ И РАЗВОЈ ЈЕДНОГОДИШЊИХ САДНИЦА ЛУЖЊАКА (*Quercus robur* L.) У РАСАДНИКУ

Извод: У раду су приказани резултати истраживања утицаја типа контејнера на раст и морфолошке параметре садница лужњака. У огледу су коришћена три типа контејнера, Боснапласт 18 и Боснапласт 12 и НИКО V265.

Сакупљање семена обављено је у семенској састојини лужњака, регистарски број RS-2-2-qro-12-197 којом газдује ШГ Крагујевац у јесен 2012. године, а сетва семена у контејнере извршена је у пролеће 2013. године у расаднику Института за шумарство у Београду.

У јесен 2013. године извршена је анализа једногодишњих садница. Мерени су висина садница и пречник кореновог врата.

Саднице произведене у контејнерима Боснапласт 18 са запремином ћелија од 220 cm³ и НИКО V265 са запремином ћелија од 265 cm³ су већих димензија и квалитетније од садница произведених у контејнерима Боснапласт 12 са запремином ћелија од 120 cm³. Истраживањима је утврђено да запремина контејнера позитивно утиче на морфолошке карактеристике садница лужњака у расадничким условима.

Кључне речи: лужњак (*Quercus robur* L), контејнер, садница, морфолошки параметри.

1. INTRODUCTION

The dilemma between classical and container seedling production is constantly present in development of nursery production technology. Many scientists have dealt with production of container seedlings (Elam, W.W. 1981; Matic, S. et al. 1996; Ocvirek, M. 1997; Orlic, S. 2000). The seedlings produced in containers have many advantages compared to seedlings produced in the conventional manner: higher survival rate during production and later during replanting, seedlings suffer less replant shock, the period of planting is extended, the production is mechanized, the afforestation of degraded terrains. The main drawback of container production is abnormal development of the root system (Oreskovic, Z. et al. 2006).

For the production of forest species seedlings in our country and in the world are used smaller containers, because they are cheaper, they reduce substrate procurement costs, they are easier to handle and a higher number of plants per unit area can be produced in them. These containers are suitable for the production of species with smaller seed, species of slower growth and less developed root system. For species with larger seed, species of rapid growth and strong root system it is necessary to use larger containers.

The characteristics of containers, volume and size of cells have a major effect on the physiology and morphology of seedlings in the nursery and later in a forest culture. It is therefore important to determine how these characteristics affect the growth and development of seedlings in order to produce higher quality and more developed seedlings that will successfully be used for afforestation.

In this paper was studied the effect of containers on the growth and development of Pedunculate oak one-year-old seedlings in the nursery. The researches were performed in seedling nursery and laboratory of the Institute of Forestry in Belgrade.

2. MATERIAL AND METHOD

The trial was set in four replications in the spring 2012 in the seedling nursery of the Institute of Forestry in Belgrade. Seed of Pedunculate oak (*Quercus robur* L.) was collected in the first week of October 2012 in the seed stand with registration number RS-2-2-qro-12-197, FMU "Rogot", department 2a, Forest administration Kragujevac, FE Kragujevac. Germinated acorns were manually sown in containers in April 2012 in seedling nursery of the Institute of Forestry in Belgrade.

For the trial were used three types of containers that are commonly used in Serbia for seedling production: Bosnaplast 12 with dimensions 36x25, 5x12 cm, with 55 cells in the block and with volume of each cell of 120 cm³, Bosnaplast 18 with dimensions 32x21, 2x18 cm, with 33 cells in the block and with the volume of each cell of 220 cm³ and HIKO V265 with dimensions 35,2x21, 6x15 with 28 cells in the block and with volume of each cell of 265 cm³. The containers were filled with peat used in regular nursery production. Watering was performed regularly as well as protection with shade cloth and protection from diseases. At the end of the growing season in October 2013 was determined the survival rate and the seedling height and root collar diameter were parameters that were measured. Seedling height was measured by a ruler with an accuracy of 1 mm and root collar diameter was measured by a caliper with an accuracy of 0.01 mm.

For all analyzed variables were done descriptive statistics, analysis of variance and for all tests the error of 5% was considered as statistically significant. Statistical analyzes were done using the statistical package Statgraph 5.01.

3. RESULTS AND DISCUSSION

Fundamental laws of nutrition apply for all plants, and a good and healthy growth can only be achieved if all the factors that regulate growth are evenly distributed and in the correct ratio (Bala and Fricker, 1971). The amount of reserve nutrients in the soil (substrate) directly affects the nutritional status of plants (Ćirković-Mitrović, T. et al. 2012).

Growth of seedlings in the first year is particularly important for future survival and development of plants (Larsen, 2007). The studies (Walker and Hunt, 1999) have shown that the seedling height best forecasts the growth while the root collar diameter best forecasts the survival of seedlings after replanting.

The analysis of the survival rate has showed that the type of container did not affect the survival of Pedunculate oak seedlings. The survival rate of Pedunculate oak seedlings produced in containers Bosnaplast 12, Bosnaplast 18 and HIKO V265 ranged from 84.2 to 87.6%. From Table 1 it can be seen that the

seedlings produced in containers with a higher volume of cells have larger dimensions.

Table 1: *Summary statistics, analysis of variance and post-hoc test for root collar diameter and height of seedlings*

Container type	Root collar diameter	Heights of plants
	Average	Average
B12	3,22±0,51 ^a	21±4,72 ^a
B18	3,96±0,73 ^b	22,1±6,98 ^a
HIKO V265	4,06±0,63 ^b	21,6±4,92 ^a
P-value	0,0000	0,3428

In our studies root collar diameter of seedlings differs depending on the type of the container (Figure 1). The seedlings produced in the container type Bosnaplast 12 reach average root collar diameter of 3.22 mm, the seedlings produced in the container type Bosnaplast 18 reach average root collar diameter of 3.96 mm while the seedlings produced in the container type HIKO V265 reach average root collar diameter of 4.06 mm. The analysis of variance showed that there were statistically significant differences in root collar diameter depending on the type of container and this was confirmed by post-hoc test (Table 1).

The container type did not significantly affect the height of the seedlings. The highest mean height of 22.1 cm was measured in seedlings produced in the container type Bosnaplast 18 and the lowest mean height of 21 cm was measured in seedlings produced in the container type Bosnaplast 12. The mean height of 21.6 cm was measured in seedlings produced in containers HIKO V265. The analysis of variance showed that differences in reached mean height of seedlings depending on the type of container were not statistically significant (Table 1).

Similar conclusions that the cell volume of containers has a positive effect on morphometric characteristics of seedlings in their research got Seletković et.al 2011, in a trial with Austrian pine. The morphological parameters of one-year-old seedlings of Common cypress are directly dependent on the volume of container (Topić et.al 2009). In researches on Pedunculate oak and Sessile oak have been found that cell volume of container does not significantly affect the growth of seedlings, but definitely higher volume of container gives the seedlings of larger dimensions (Oreskovic, Z. et al. 2006). Volume of container directly affects the growth of Pinus pinea seedlings meaning that in containers with a maximum volume were produced the best developed seedlings (Topić et.al 2009). In trails on Bald cypress it was found that the volume of containers positively affects morphological parameters of the seedlings (Popovic, V. et al. 2013).

4. CONCLUSIONS

Based on the conducted researches and the obtained results in this paper the following conclusions can be made:

The physical characteristics of the containers did not affect the survival rate of Pedunculate oak seedlings in the nursery.

Researches carried out in this paper have showed that there is the effect of physical characteristics of containers on growth of Pedunculate oak one-year-old

seedlings in the seedling nursery. Seedlings produced in containers with the higher volume of cells Bosnaplast 18 and HIKO V265 reach greater values of height and root collar diameter compared to seedlings produced in containers type Bosnaplast 12, provided that the differences in the reached heights are not statistically significant.

According to our researches, it is recommended that in the production of Pedunculate oak seedlings have to be used containers of greater volume that will provide a sufficient amount of nutrients for plants so that they can have a higher starting height and root collar diameter during afforestation.

By monitoring development and measurement of seedlings in a field trial established from seedlings produced in containers, the data on survival, height increment and radial growth will be collected and this will provide guidelines and recommendations for the use of the appropriate type of container.

LITERATURE

Balue, H., Fricker, C. (1971): *Fertilization of forest trees*. Yugoslav agricultural forestry center, Documentation on techniques and technology in forestry No. 78.

Elam, W.W., 1981: *Production of containerized Southern Red Oaks and their performance after outplanting*. Proceedings of the Southern Containerised Forest Tree Seedling Conference, 25-27. 08. 1981. Savannah, Georgia.

Larsen J. Bo, 2007: *The influence of light, lime, and NPK-fertilizer on photosynthesis, respiration, transpiration and water use efficiency of different beech provenances (Fagus sylvatica L.)*. In: Improvement and Silviculture of Beech Proceedings from the 7th International Beech Symposium, IUFRO Research Group 1.10.00, 10–20 May 2004, Tehran, Iran.

Matić, S., N. Komlenović, S. Orlić, M. Oršanić, 1996: *Nursery production of Pedunculate oak*. In: D. Klepac (editor), Pedunculate oak (*Quercus robur* L.) in Croatia. Croatian Academy of Sciences and Arts, Hrvatske šume d.o.o. Zagreb, 159–166, Zagreb.

Ocvirek, M., 1997: *Effect of sowing period on the development of Pedunculate oak (Quercus robur L.) seedlings in three types of containers*. Papers of Institute of Forestry Jastrebarsko 32 (2): 55-72.

Orešković, Ž., A. Dokuš, M. Harapin, T. Jakovljević, R. Maradin, 2006: *Growing of seedlings Pedunculate oak (Quercus robur L.) and Sessile-flowered oak (Quercus petraea (Matt.) Liebl) in different types of containers*. Papers of Institute of Forestry, Special issue 9: 75–86.

Orlić, S., 2000: *Production of Pedunculate oak (Quercus robur L.) seedlings in Croatia, 1992–1998*. Papers of Institute of Forestry 35 (1): 83–90.

Popović, V., Čirković-Mitrović, T., Rakonjac, Lj., Lavadinović, V., Lučić, A. (2013): *Effect of container type on growth of seedlings of Bald cypress [Taxodium distichum (L.) Rich.]*, International scientific conference Forest research institute at the Bulgarian academy of sciences, 85th anniversary, p. 59.

Seletković, I., Potočić, N., Topić, V., Butorac, L., Jelić, G., Jazbec, A. (2011): *Influence of various container types and slow- release fertilizer doses on growth and physiological parameters of black Pine (Pinus nigra Arn.) seedlings*. Šumarski list (Forestry journal) – special issue, 90-102.

Topić, V., Butorac, L., Đurđević, Z., Kekelić, B., Jelić, G., (2009): *Effect of container type on growth and development of seedlings of Common Cypress (Cupressus sempervirens var. pyramidalis Nyman) in nursery and forest cultures*. Šumarski list (Forestry journal) No. 3–4, 121-134

Topić, V., Đurđević, Z., Butorac, L., Jelić, G. (2006): *Effect of container type on growth and development of Mediterranean stone pine (Pinus pinea L.) in the nurseries*. Paper of Croatian Forest Research Institute, special edition 9: 149–158, Jastrebarsko.

Ćirković-Mitrović, T., Popović, V., Brašanac-Bosanac, Lj., Rakonjac, Lj., Lučić, A. (2012): *THE EFFECT OF APPLICATION OF DIFFERENT NUTRITION PREPARATIONS ON HEIGHT INCREMENT OF WALNUT (Juglans regia L.) SEEDLINGS*. SUSTAINABLE FORESTRY, collection 65-66, pp: 73-82.

Walker, R. F., Hunt, C. D. (1999): *Growth and Nutrition of Containerized Singleleaf Pinyon Seedlings in Response to Controlled Release Fertilization*. Arid Soil Research and Rehabilitation, 13: 123–132.

EFFECT OF CONTAINER TYPE ON GROWTH AND DEVELOPMENT OF PEDUNCULATE OAK (*Quercus robur* L.) SEEDLINGS IN THE NURSERY

Vladan POPOVIĆ, Aleksandar LUČIĆ, Ljubinko RAKONJAC

Summary

The seedlings produced in containers have many advantages compared to seedlings produced in the conventional manner: higher survival rate during production and later during replanting, seedlings suffer less replant shock, the period of planting is extended, the production is mechanized and they are used for the afforestation of degraded terrains.

The characteristics of containers, volume and size of cells have a major effect on the physiology and morphology of seedlings in the nursery and later in a forest culture. It is therefore important to determine how these characteristics affect the growth and development of seedlings in order to produce more quality and more developed seedlings that will successfully be used for afforestation.

In this paper has been studied the effect of three types of containers on the growth and development of Pedunculate oak one-year-old seedlings in the nursery.

Based on the conducted researches and the obtained results in this paper it can be concluded that the type the containers did not affect the survival rate of Pedunculate oak seedlings. The physical characteristics of the containers affect the growth of one-year-old Pedunculate oak seedlings in the nursery. Seedlings produced in containers with the higher volume of cells Bosnaplast 18 and HIKO V265 reach greater values of height and root collar diameter compared to seedlings produced in containers type Bosnaplast 12, provided that the differences in the reached heights are not statistically significant.

According to our researches, it is recommended that in the production of Pedunculate oak seedlings have to be used containers of greater volume that will provide a sufficient amount of nutrients for plants so that they can have a higher starting height and root collar diameter during afforestation.

УТИЦАЈ ТИПА КОНТЕЈНЕРА НА РАСТ И РАЗВОЈ ЈЕДНОГОДИШЊИХ САДНИЦА ЛУЖЊАКА (*Quercus robur* L.) У РАСАДНИКУ

Владан ПОПОВИЋ, Александар ЛУЧИЋ, Љубинко РАКОЊАЦ

Резиме

Саднице произведене у контејнерима у односу на саднице произведене класичним путем имају низ предности: већи проценат преживљавања у току производње а и касније приликом пресађивања, мањи шок приликом пресађе, продужење периода садње, механизована производња, пошумљавање деградираних терена.

Карактеристике контејнера запремина, облик и димензије ћелија имају велики утицај на физиологију и морфологију садница у расаднику, а и касније у шумској култури. Због тога је важно утврдити колико ове особине утичу на раст и развој садница, како би се произвеле што квалитетније и развијеније саднице које ће моћи успешно да се искористе за пошумљавање.

У раду је истраживан утицај три типа контејнера на раст и развој једногодишњих садница лужњака у расаднику. На основу обављених истраживања и добијених резултата у овом раду може се закључити да тип контејнера није утицао на проценат преживљавања садница лужњака. На раст једногодишњих садница лужњака у расаднику утичу физичке карактеристике контејнера. Саднице произведене у контејнерима са већом запремином ћелија, Боснапласт 18 и НИКО V265 достижу веће вредности висине и пречника у кореновом врату у односу на саднице произведене у контејнерима типа Боснапласт 12, стим да резлике у достигнутим висинама нису статистички значајне.

Према нашим истраживањима препорука је да се за производњу садница лужњака користе контејнери веће запремине, који ће биљкама обезбедити довољну количину хранљивих материја, како би оне имале већу стартну висину и пречник у кореновом врату приликом пошумљавања.