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INFLUENCE OF METHOD OF PLANTATION ESTABLISHMENT ON ENGLISH OAK (*QUERCUS ROBUR* L.) GROWTH AND DEVELOPMENT

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Biometrical characteristics in 1–6-year old English oak plantations in maiden oak-hornbeam forest on the southern part of the Right-Bank Forest-Steppe Zone are researched. Results of survival rate and increment of sowed and planted English oak plantations are given. A dependence of productivity of English oak plantations from the method of its establishment is presented.

Introduction. Method of establishment of artificial plantations depends on forest site types, biological features of tree and shrub species, state of reafforesting area and economical peculiarities of a region. First of all, an effectiveness of plantation establishment depends on optimal combination of such ecological factors as warm, moisture and ground aeration, term and norm of sowing, deep and ways of seed sowing, and, of course, carefulness of care about ground and plantations [3, 4]. There is a necessity of two ecological factors presence after emerging of sprouts – light and ground nutrients. The presence of two factors mentioned above in needed quantity is quite difficult task. The plantations which are established by sowing in first years of its life very hardly bear weather and climate factors, suffer from herbaceous plants competition and, in result, demand

long being and careful care [7]. The sowing method is close to natural reafforestation – the forest established by seed sowing is more long-lived than that which established by planting. First of all, it is explained by absence of root system deformation and other damages of seedlings which appear inevitably during digging, transportation and planting. Moroz G. F. [7] said that, at first, success of seed sowing depends on whether this method of plantation establishment is up to forest site types, ways of sowing, ground preparation, time of sowing, seed quality.

Planting of forest has some advantages on sowing. As usual seed costs are 5–7 times lower, seedlings (saplings) are not almost damaged by rodents and birds, there is its even placement and high survival rate, and they are less depressed by herbaceous plants and shoots of other woody species. Number of cares of plantations are less and term of its canopy density is shorter [2, 3]. At the same time plantation established by planting get closed later than seedlings, slowly and badly clean from branch stubs, gave less full-boled stems, and its wood usually has worse technical quality [7].

When sowing of English oak (*Quercus robur* L.) acorns on permanent place, as I. B. Logginov, S. T. Tychonov et al. [1, 4, 8, 10] said, young oaks in sprouts stage and 1-year old seedlings adapt for environmental conditions better than seedlings which were grown in nursery and replanted in couple of years on reafforesting area. As K. B. Losyts'kyi [5] said, having acorns we must give an advantage to sowing. Gordienko M. I. [2] said that oak plantation establishment in time when there is a little of atmospheric precipitation it is reasonable to give and advantage to sowing of acorns on permanent place. Establish plantations by this way we can form biologically firm stands.

According to data of many researches the method of plantation establishment also influence on damage of plantations from pests and diseases. According to D. F. Rudniev [6, 9] damage from cancer disease is 61 % in young oak plantations, which are established by planting, and in plantations established by sowing – 45 %. Oak plantations established by planting are weak because of major root damage after replanting from nursery. It is known that major root

intensively grow at first years. In result, root system became more lateral and oak stands – less tolerant [6]. As G. F. Morozov thought, neither planting nor sowing is an universal way of forestation, both of them are needed but in dependence of many circumstances, the main ones of those are forest site types (climate, ground, cover), species and economical reasonability.

Aim of research was to determine a growth insensitivity of oak plantations and stock influence on plantations productivity established by sowing of acorns and 2-years old seedlings planting.

Objects and methods of research. The research of oak plantations established by seed sowing was conducted in Synyts'ke, Sobkivs'ke and Jyrkivs'ke forest enterprises of government enterprise "Umans'ke forest enterprise". Temporary sample plots, where forest plantations were established by planting, were established in Man'kivs'ke and Potas'ke forest enterprises of government enterprise "Umans'ke forest enterprise" and Torgovyts'ke forest enterprise of government enterprise "Onykiivs'ke forest enterprise". The research of 1–6-year old oak plantations were conducted using the method of height of young oaks measurement with 1 cm accuracy and stem diameter by trammel with 1 mm pinpoint accuracy on root collar height. On every test-plot not less than 300 oaks were taken into account. There were made measurements of oak height, its diameter on root collar height, survival rate and increment during last year. The research was conducted at the end of August and the beginning of September and thrice repeated. For establishments of sample plots were chosen forest plantations established on spring on maiden and not turfed wood cutting area. Ground preparation included handmade cleaning of belts, lowering stumps and disking by cultivator KLB-1,7. During planting a planting system was 6,0 x 0,7 m, and 6,0 x 0,5 m during seed sowing. The sowing of acorns was hand hoed – 2–3 acorns were dropped in every hole, and 2-year old seedlings were used for planting. Cares of plantations were analogical and consisted of inter-row hoeing during first three years and cutting of oak plantations during second-fourth years.

Result of research. Analyzing sample plots one can conclude that there is a

difference between oak plantations made by seed sowing and seedlings planting at first year (Table 1, 2, Figure 1). First of all, it concerns plants survival rate. One-year old oak plantations established by sowing on test-plots number 1, 51, 52 had survival rate in range of 94–97 % and did not need a complement. Plantations on test-plots number 68, 69, 70 had the survival rate in range of 81–87 % which is lower from planned survival rate at forestry enterprises in Cherkasy region (not less than 86 %). When analyzing 1-year old oak plantations it is seen that average height of seedlings conclude 19,2 cm, and saplings – 36,9 cm, which is bigger on 17,7 cm (48 %).

Table 1. The measurements of height of 1–6-year old oak plantations established by sowing of acorns

Number of test-plot	Year of plantation establishment	Compartment / allotment	Age of plantation, years	Indexes of height measurements			
				the average height, years	difference according to heights, cm		the average height according to age, cm
					max.	min.	
1	2011	93/3	1	20 ±0,6	56	5	19,2
51	2011	18/4	1	18 ±0,5	53	5	
52	2011	6/2,5	1	19 ± 0,5	56	5	
2	2010	91/4	2	76 ±1,7	159	30	67,9
53	2010	34/11	2	57 ±1,4	128	24	
54	2010	33/2	2	71 ±1,4	135	30	
3	2009	18/5	3	106 ±2,1	228	49	105,9
55	2009	16/7	3	103 ±1,8	185	44	
56	2009	17/1	3	108 ±2,0	195	40	
4	2008	90/4,5,6	4	148±3,0	324	42	152,3
57	2008	93/1,3	4	159±3,0	343	48	
58	2008	69/4	4	149±3,1	339	48	
5	2007	87/8	5	167±3,8	331	56	168,6
59	2007	61/1,2	5	167±3,2	314	52	
60	2007	67/1	5	172±3,6	346	62	
6	2006	93/2	6	182±4,7	322	39	184,1
61	2006	67/1	6	185±4,8	378	41	
62	2006	63/2,3	6	185±3,6	339	72	

It should be noted that planted oaks have two years bigger biological age. By the way, difference according to height conclude 5–56 cm, planted – 11–72 cm.

An increment of planted plantations fluctuates in range of 3–16 cm. As for diameters within root collar it can be concluded that after 2 years of growing at

forest nursery the seedlings are completely formed. It worth to note that after oak replanting on reafforesting area the diameter does not increase because a plant as usual lose its strength on survival rate and forming of assimilating organs.

Table 2. The measurements of height of 1–6-year old oak plantations established by planting

Number of test-plot	Year of plantation establishment	Compartment / allotment	Age of plantation, years	Indexes of height measurements			
				the average height, years	difference according to heights, cm		the average height according to age, cm
					max.	min.	
68	2012	95/3	1	38±0,9	72	13	36,9
69	2012	94/4	1	36±0,6	61	11	
70	2012	17/7	1	37±0,8	71	12	
71	2011	96/17	2	61±1,7	141	18	51,9
72	2011	140/5	2	41±0,7	73	21	
73	2011	37/4	2	54±1,5	126	19	
74	2010	84/4	3	82±1,7	178	31	92,0
75	2010	62/2	3	96±1,9	193	44	
76	2010	28/3	3	98±1,9	188	31	
77	2009	139/5	4	132±2,7	286	30	133,0
78	2009	62/4	4	129±2,5	273	35	
79	2009	60/2	4	136±2,8	291	58	
80	2008	84/2	5	162±3,2	302	74	160,9
81	2008	6/15	5	167±3,2	314	52	
82	2008	37/6	5	154±2,9	301	47	
63	2007	140/9	6	183±3,4	324	72	179,5
64	2007	137/12	6	179±4,0	397	51	
65	2007	136/7	6	177±3,5	311	58	

The average diameter of planted plantations within root collar concludes 5,8 mm, seedlings – 3,4 mm what is 2,4 mm or on 41 % bigger (Table 3, 4, Figure 2). In 2-year old cultures established by seed sowing a prevailing in height is seen. The average height of seedlings concludes 67,9 cm with difference in heights – 24–159 cm. Planted cultures have the average height 51,9 cm with the difference in heights 18–141 cm. As a result of research one can conclude that 2-year old oak seedlings are 16,0 cm long or 23,6 % higher than planted oaks. Conversely the diameter of root collar of planted oaks is bigger and conclude 9,0 mm, at the same time sowed oak has the diameter 7,2 mm what is less on 20 %.

The survival rate of 2-year old oak plantations made by sowing fluctuates in range of 88–94 %, and planted plantations – 82–87 %. It indicates on complement necessity of planted plantations.

Table 3. The measurements of diameter of 1–6-year old oak cultures made by sowing of acorns

Number of test-plot	Year of plantation establishment	Compartment / allotment	Age of plantation, years	Indexes of diameter measurements			
				the average diameter, years	difference according to diameters, mm		the average diameter according to age, mm
					max.	min.	
1	2011	93/3	1	3±0,1	9	1	3,4
51	2011	18/4	1	3±0,1	11	1	
52	2011	6/2,5	1	3±0,1	12	1	
2	2010	91/4	2	8±0,2	21	3	7,2
53	2010	34/11	2	6±0,1	13	2	
54	2010	33 / 2	2	8±0,2	17	3	
3	2009	18 /5	3	15±0,3	33	8	15,1
55	2009	16 / 7	3	15±0,3	31	6	
56	2009	17 / 1	3	15±0,3	31	8	
4	2008	90 / 4,5,6	4	16±0,3	32	9	15, 9
57	2008	93 / 3,1	4	16±0,3	31	6	
58	2008	69 / 4	4	16±0,3	32	8	
5	2007	87 / 8	5	17±0,3	36	9	17,2
59	2007	61 / 1,2	5	18±0,4	41	10	
60	2007	67 / 1	5	17±0,3	33	8	
6	2006	93 / 2	6	23±0,6	47	9	23,9
61	2006	67 / 1	6	21±0,6	62	8	
62	2006	63 / 2,3	6	25±0,6	52	10	

Three-year old oak plantations established by seed sowing (test-plots number 3, 55, 56) have the average height 105,9 cm. The biggest height of seedlings in this age was 228 cm, the smallest – 44 cm. Plantations made by plantings have the average height 92,0 cm with fluctuating from 31 to 193 cm and the average increment during last year in range of 32–79 cm long. According to the average height this plantations are 13,8 cm longer or 9 % lower than sowed. The survival rate of 3-year old plantations established by sowing is in range of 86–91 % which is higher that standard survival rate. The survival rate of planted plantations is less and is in range of 76–84 %.

Table 4. The measurements of diameter of 1–6-year old oak cultures made by planting

Number of test-plot	Year of plantation establishment	Compartment / allotment	Age of plantation, years	Indexes of diameter measurements			
				the average diameter, years	difference according to diameters, mm		the average diameter according to age, mm
					max.	min.	
68	2012	95/3	1	5,7±0,1	12	2	5,8
69	2012	94/4	1	5,7±0,1	13	3	
70	2012	17/7	1	5,9±0,1	14	2	
71	2011	96/17	2	9,2±0,2	29	3	9,0
72	2011	140/5	2	8,8±0,2	16	4	
73	2011	37/4	2	8,9±0,2	20	3	
74	2010	84/4	3	13,8±0,3	28	6	14,7
75	2010	62/2	3	14,5±0,3	30	6	
76	2010	28/3	3	15,7±0,3	35	8	
77	2009	139/5	4	22,6±0,5	46	8	20,8
78	2009	62/4	4	20,0±0,5	52	6	
79	2009	60/2	4	19,7±0,5	47	8	
80	2008	84/2	5	24,2±0,6	52	7	22,9
81	2008	6/15	5	19,4±0,4	47	10	
82	2008	37/6	5	24,9±0,6	54	9	
63	2007	140/9	6	24,4±0,6	47	6	23,9
64	2007	137/12	6	24,8±0, 6	48	8	
65	2007	136/7	6	22,5±0,6	62	8	

Four-year old oak plantations characterize of further height increment of sowed oaks. There is a significant difference of height of sowed oaks which is in range of 42–343 cm long and planted oak – 30–291cm long. The oak increment is nearly equal and fluctuates in range of 49–89 cm long. The average height of planted oaks is 152,3 cm long, planted – 133,0 cm long which is less on 13 %. Oak saplings according to their diameter still prevail the seedlings. The diameter within root collar of plants in plantations made by planting concludes 20,8 mm, and made by sowing – 15,9 mm or bigger on 4,88 mm (23 %).

It should be noted that 5-year old oak plantations trend to have a difference between height and diameter. The average height of sowed oak concludes 168,6 cm, planted – 160,9 what is 5 % higher. The difference between heights fluctuates in range of 52–346 cm. Oak plantations established by planting have the

increment in range of 48–94 cm long. Despite of that the diameter of planted oak is bigger and is 22,9 mm long (comparing with dropped it is 17,2 mm what is 5,7 mm or 25 % bigger).

It should be noted that the average stem diameter is getting equal in 6-year old oak plantations which are established by planting and sowing. It is 23,9 mm. As for the average oak height it trend to differ. In plantations made by sowing the average height is 184,1 cm long, and in planted – 179,5 cm. In this age in plantation regardless the planting method a strict differentiation of oak tree heights is seen which fluctuates from 39 to 397 cm long. It can be explained by thickening of sowed plantation, unsuccessful complement of planted plantations and non cutting of dwarfed oaks during liberation cutting.

Conclusions

1. The way of oak plantation establishment influence on forest features of plantations. One-year old plantations established by seed sowing have the survival rate in range of 94–97 % and don't need the complement. The plantations established by stock planting have the survival rate in range of 81–87 % what is less than the standard survival rate.

2. The average height of one-year old sprouts is 19,2 cm, seedlings – 36,9 cm what is 17,7 cm (48,0 %) bigger. The seedlings have the diameter bigger on 42 %, taking into consideration that the plantations established by planting are two years older.

3. Starting from the second year we've seen the dominance in height in cultures established by seed sowing. The average height of seedlings is 67,9 cm, and the average height of planted plantations is 51,9 cm, oak seedlings are 16,0 cm or 24 % higher than planted oaks.

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