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Auxological research concerning *Robinia pseudoacacia L.* from the sterile dump Cocoreni (Rovinari Basin)

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Abstract Black locust in a species from North America which found in Romania another home.. This species was used not only for afforestation and reforestation on sandy soil but also on degraded land. Fourteen years ago, on sterile dump Cocoreni from Rovinari Basin, forest culture with black locust has been installed. In order to put in evidence the growth of this species three tree from different crown class were selected. Trees were cut down and measurements were made on the cross sections. Then the sections area, the volume and factor form have been calculated. The research shows the rate of growth for the black locust on very difficult site condition.

Key words

Robinia pseudoacacia, auxology, increment

Black locust is a species native to North America. In our country, especially in Oltenia, it found a second home. The species grows well on sandy soil, but is also used successfully for afforestation on degraded soil, superficial soil, and eroded soil [1]. In Rovinari Basin, as son as dumps has been formed, forestry cultures have been installed. Black locust was one of the specie commonly used. Research aimed to highlight the growth rate of black locust installed on the sterile dumps Cocoreni.

Materials and Methods

A 14 years old pure black locust (*Robinia pseudacacia*) forest culture is found on the sterile dump Cocoreni (Fig. 1). It is found on a deposit consist by sandy fraction (80%) gravel (10%) and clay (10%).

Fig. 1 Forest culture from Cocoreni sterile dump

Biological material is represented by 14 years old black locust trees. There has been selected tree from different crown class: dominant, codominant and intermediate. The trees were cut down and cross sections were made for each 1 m on the tree trunk (fig. 2).

Fig. 2 Preparing biological material

On every cross section annual rings were counted and diameter were measured for ages multiple of five years. There has been established tree height, tree top length, diameter at the base of the top tree and diameter at the middle of the stump. It was determined cross section areas, the volume and form factor using relations:

$$\gamma = \frac{\pi}{4} d^2;$$

$$v_a = v_{stump} + l\sum \gamma_i + v_{top};$$

$$v_{stump} = \gamma_{0,15} * 0,30;$$

$$v_{top} = \frac{1}{3} gl;$$

$$f_{1,3} = \frac{v_a}{w_{1,3}}.$$

Where: d – diameter (cm);

l – segment length (1m);

γ_i – section area at the middle of the segment lenght

$\gamma_{0.15}$ – section area on the middle of the stump;

g – section area from the base of the top tree;

l – tree top length (m);

v_{stump} – stump volume (dm^3);

v_{top} – top tree volume (dm^3)

v_a – tree volume (dm^3);

$w_{1.3}$ – cylinder volume (a cylinder with the same height and the same basal area like a tree);

$f_{1.3}$ – form factor.

Basal diameter increment (i_d), basal area increment (i_g), height increment (i_h) and volume (i_v) increment were calculated. The mean annual increment, the periodic increment and the mean periodic increment were calculated for each item. The percentage increment in basal diameter, in basal area, in height and volume were determined [2, 3].

$$p_y = \frac{y_{(t+n)} - y_t}{y_{(t+n)} + y_t} * \frac{200}{n}.$$

Where: p_y – the percentage increament;

$y_{(t+n)}$ – the item value at the end of the period;

y_t – the item value at the beginning of the period;

n – number of years for a period.

Results and Discussion

Based on the measurement made at the ages of 5, 10 and 14 years, the longitudinal profile of the tree was built. Then, tree height, tree top length, diameter at the base of the top and diameter at the middle of the stump have been established. These items are necessary to calculate the section areas, volumes and form factors (table 1)

Table 1

Cross-section area, volume and factor form

Section		Dominante tree			Codominante tree			Intermediate tree		
No.	height	Cross-section area (cm^2) at the age of ... years								
		14	10	5	14	10	5	14	10	5
1.	0,80	160	120	54	116	83	39	39	31	14
2.	1,80	143	111	45	89	68	25	33	26	10
3.	2,80	132	102	41	79	49	12	29	21	5
4.	3,80	117	87	34	74	36	6	26	16	2
5.	4,80	107	75	25	67	35	3	24	13	1
6.	5,80	100	72	21	62	34	1	21	11	1
7.	6,80	92	65	14	56	28		17	6	
8.	7,80	81	57	8	50	23		13	3	
9.	8,80	74	49	6	46	21				
10.	9,80	66	41	3	40	17				
11.	10,80	225	131	3	127	51				
12.	11,80	38	20		24	10				
13.	12,80	19	9		19	7				
14.	13,80	10								
15.	14,80	4								
	$\Sigma\gamma$	1367	938	254	849	460	86	218	129	33
Volume (dm^3)										
Trunk volume ($l x \Sigma\gamma$) dm^3		137	94	25	84,9	46,0	8,6	21,9	12,9	3,2
Stump volume (Vc) dm^3		6	4	2	4,4	3,0	1,3	1,4	1,1	0,6
Top volume (Vf)		0	0	0	0,2	0,0	0,0	0,1	0,0	0,0
Tree volume (Va)		143	98	28	89,4	49,0	9,9	23,4	14,0	3,9
Cylinder volume ($W_{1,3}$) dm^3		232	175	56	147,5	107,6	23.1	38,1	28,7	7,1
Form factor										
$F_{1.3} = v_a / w_{1.3}$		0,615	0,561	0,497	0,607	0,455	0,623	0,615	0,487	0,547

Dominant tree reached high heights and diameters since the first years of life. At the age of 5 it attain about 11m high. Large differences are observed in terms of cross-section area and volume at age of 5 years comparative with codominant and intermediate tree. This highlights the top position of that tree since the first years of life.

In terms of form factor there are no significant differences. This can be explained by the youth of trees. Their social position only now is differenced.

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The analyses of the dynamics of tree increment shows that there are differences between the dominant, codominnat and intermediate tree (table 2 and 3).

A special position has codominant tree where there is a more pronounced increment in the range of 5 to 10 years,. This tree probably benefit from more favorable site conditions or lack of competing neighboring trees. Although in the first years of life we can notice low value for their biometric characteristics after that it activates their growts reaching values close to values of dominant tree

Table 2

Increment items at different ages

age	Basal diameter				Basal area				Height			
At the age of ..ye	Basal diameter (mm)	Mean annual increment	Periodic increment	Mean periodic increment	Basal area (mm^2)	Mean annual increment	Periodic increment	Mean periodic increment	Height (m)	Mean annual increment	Periodic increment	Mean periodic increment
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Dominant tree												
5	77,76	15,55	77,76	15,55	4746	949	4746	949	11,7	2,34	11,7	2,34
			42,43	8,49			6593	1319			3,7	0,74
10	120,19	12,02			11339	1134			15,4	1,54		
			14,99	3,75			3005	751			0,8	0,20
14	135,18	10,40			14344	1103			16,2	1,25		
Codominant tree												
5	67,22	13,44	67,22	13,44	3547	709	3547	709	6,5	1,30	6,5	1,30
			30,00	6,00			3872	774			8,0	1,60
10	97,22	9,72			7419	742			14,5	1,45		
			14,33	3,58			2347	587			0,6	0,15
14	111,54	7,97			9766	698			15,1	1,08		
Intermediate tree												
5	36,64	7,33	36,64	7,33	1054	211	1054	211	6,7	1,34	6,7	1,34
			22,35	4,47			1677	335			3,8	0,76
10	58,98	5,90			2731	273			10,5	1,05		
			7,44	1,86			732	183			0,5	0,13
14	66,42	4,74			3463	247			11,0	0,79		

(Table 2 below)

age	Volume				Form factor			
0	13	14	15	16	17	18	19	20
Dominant tree								
5	27,6	5,52	27,6	5,52	0,50	0,099	0,497	0,099
			70,7	14,15			0,066	0,013
10	98,4	9,84			0,563	0,113		
			44,5	11,12			0,052	0,013
14	142,8	10,99			0,615	0,123		
Codominant tree								
5	9,9	1,99	9,9	1,99	0,43	0,086	0,431	0,086
			39,0	7,81			0,024	0,005
10	49,0	4,90			0,455	0,091		
			40,5	10,12			0,152	0,038
14	89,4	6,39			0,607	0,121		
Intermediate tree								
5	3,9	0,77	3,9	0,77	0,55	0,109	0,547	0,109
			10,1	2,02			-0,060	-0,012
10	14,0	1,40			0,487	0,097		
			9,5	2,37			0,128	0,032
14	23,4	1,67			0,615	0,123		

Table 3

Percentage increment items at different ages

Age	Basal diameter		Basal area		Height		Volume	
years	$d_{1.3}$ (mm)	% p_{id}	g (mm^2)	% p_{ig}	h (m)	% p_{ih}	v (dm^3)	% p_{iv}
Dominante tree								
5	77,76	40	4746	40	11,7	40	27,6	40
10	120,19	8,57	11339	16,4	15,4	5,46	97,9	22,41
14	135,18	2,35	14344	4,68	16,2	1,01	142,8	7,46
Codominante tree								
5	67,22	40	3547,00	40	6,5	40	9,9	40
10	97,22	7,3	7419,00	14,12	14,5	15.24	49,0	26,59
14	111,54	2,74	9766,00	5,46	15,1	0,81	89,4	11,69
Intermediate tree								
5	36,64	40	1054	40	6,7	40	3,9	40
10	58,98	9,35	2731	17,72	10,5	8,84	14,0	22,67
14	66,42	2,37	3463	4,73	11,0	0,93	23,4	10,15

Conclusions

1. The basal area, the volume and the increment items put in evidence the evolution of the tree in the forest culture.
2. The highest percent of height increment for the codominant tree showed that favorable site condition or maybe lack of competion permit passage from one class to another
3. High values of items increment register to the overstory trees trees that benefit from favorable light conditions.

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