COMPARATIVE ANALYSIS OF THE ANNUAL GROWTH OF BLACK PINE AND SCOTS PINE SAPLINGS PLANTED IN 2023 ON THE DEGRADED LAND IN RECEA QUARRY, SUNCUIUS, BIHOR COUNTY

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RESEARCH ARTICLE

Abstract
In this paper is analyzed the introduction and testing of ecological reconstruction in the area of Recea quarry, place. Bihor, Romania, with the help of two species: Black Pine (Pinus nigra) and Silvestru Pine (Pinus sylvestris). The growth, acclimatization and manifestation of the two species were followed during the installation period and the subsequent period. Concretely, the evaluation of the behavior of the black pine and the silvester pine under the pedoclimatic conditions of the quarry area was pursued. Two Sample areas of 50m² were planted each, one for each species. It was planted with a scheme of 2x1m, with 25 saplings in each surface. The influence of species and age of saplings on increases in diameter and height was analysed.

Keywords: *Ecological restoration, medium diameter, annual growth, experimental field*
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INTRODUCTION

Ecological reconstruction is a complex process through which degraded or destroyed ecosystems are rehabilitated or recreated, in order to restore ecological functions, biodiversity and natural balance. This involves active interventions such as reintroduction of native species, restoration of vegetation structure or rehabilitation of physical characteristics of habitat (Pimm et al, 2014; Hobbs, Harris, 2001; Hobbs, Cramer, 2008). The term "ecological reconstruction" is defined and refined in scientific papers and by international organizations such as the Society for ecological Restoration (SER), a reference organization in the field. Thus, according to

International Principles and Standards for the Ecological Restoration and Recovery of Mine Sites: "Biological processes and exchanges are reinstated in the context of the surrounding ecosystem, with interventions undertaken when and where required to compensate for the loss of natural recovery potential" . (S1)

Reforestation of degraded land is also done when excessive deforestation of forests has led to habitat loss for many plant and animal species, as well as degradation of soil and air quality. Ecological reconstruction may include initiatives to reforest these lands by planting trees and promoting natural regeneration of vegetation.

In the case of native species, the local origin (provenance) is always preferred, as they develop in optimal conditions and more efficiently capitalize on the productive potential of the resorts. Where the bioecological requirements of a forest or provenance species do not readily align with the characteristics of the stational conditions, it is more prudent to carry out experimental crops using the results obtained from these tests (S2) as a species selection criterion.

The Şuncuiuş refractory clay and clay shale deposit is located in Bihor County, in the northern part of the Pădurea Craiului Mountains. It is part of the village of Şuncuiuş and includes several mineral perimeters, located in the areas of Balnaca, Dealul Simionului, Dumbrava and Recea (S3).

According to ORDER no. 2533/2022, Art. 10:
(5) the codification of degraded land resort types (TSD) shall be made using the following symbols:
(a) the nature of the degradation and, respectively, the category of degraded land shall be noted with:
Y - Haldate land;

(b) the phytoclimatic position of the place shall be noted with:
D - Hill region - FD1, FD2 and FD3 ...

The symbols corresponding to the criteria for classification and station classification for determining the type of resort of haldate land are as follows:

i) the nature of the degradation and the category of degraded land – respectively

Y – Haldate land;

ii) the phytoclimatic position of the land

D – Hill region – FD1, FD2 and FD3;

iii) intensity/form of degradation (given by land physiognomy)

1 = crude sterile dumps or terigenarising from mining, geological exploration, excavation or various excavations

B - anthropogenic protosol consisting of small (coarse or fine) solidifiable material (sand, gravel, loess, clays)

Thus, according to Table 1 key for determining the types of Haldate Land Resort (Y) (Annex 2, OM 2533/2022), the method of formulating the type of Haldate Land Resort in the given case is as follows: YD1B – hilly (FD3) dummy, sterile from mining with anthropogenic protosol consisting of solified (coarse) small material (sand, gravel).

MATERIALS AND METHODS

For this study, an experimental field with 8 sample surfaces of 50 m2 (figure 1) was created in MARCH-APRIL 2023, in which 1 year old black pine saplings and 3 year old silvester pine saplings were planted.

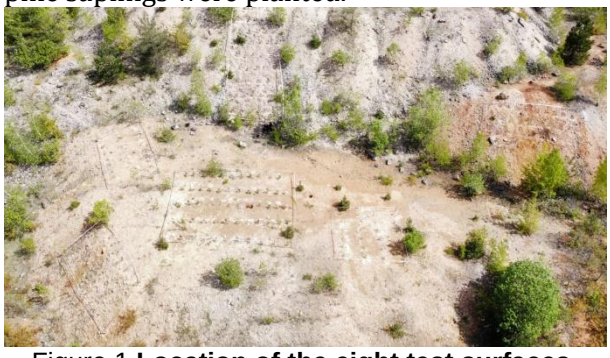

Figure 1 **Location of the eight test surfaces**

For this study, two of the sample surfaces, with two pine species, on a small slope, of 50m^2 each were chosen. The biological material for black pine comes from Austria, St. Martin im Innkreis,. The age of the saplings was 1 year, produced in containers with a diameter of 70 mm and a height of 100 mm. Number of saplings: 25.

For the silvester pine, the biological material comes from a local nursery, Şuncuiuş locality, jud. Bihor. The age of the saplings was 3 years Number of saplings: 25.

The choice of the afforestation composition was made according to the Edaphic and climatic conditions (Enescu et al., 2016), but also to the naturally regenerated species on sterile dumps (Bodea et al., 2022). Thus, the silvester pine has regenerated well on some portions, but is missing in areas with dry soil and where the slope of the land is very large. For this reason, for the experiment we also chose the black pine (Bodea et al., 2023), which is recommended for such arid lands.

The installation of pine saplings in experimental batches was done by planting in pits of 40x40x40 cm, with the use of vegetable soil. The adopted planting scheme was 2x1m, and the planting device applied was in rectangle on flat lands (Florescu, 1994).

The digging of the pits was done manually with the casmaua and the tarnacop, used to remove the boulders. On the bottom of the pit was introduced loan soil, then the saplings were placed, after which the ballot was introduced in alternate layers vegetal soil, acid peat but also sterile, which is high clay content, being beneficial for reducing the evaporation of water from the soil during dry periods, but also to get used as early as possible to the new Edaphic conditions (Donita et al., 2004; Clinovschi, 2005).

In the third decade of April, at the beginning of the first year of vegetation in the plantation, the notes regarding the start in vegetation of the saplings (the degree of attachment to planting) were made.

Measurements of the following characteristics have been performed:

- the degree of attachment after planting in the field, expressed in %;
- The degree of maintenance of the saplings, noted at the end of the growing season in year I, expressed in %;
- the height of the saplings (cm) from the ground level to the top of the shaft;
- the diameter of the saplings at the parcel (mm), at the end of the year of vegetation in the field;
- number of verticals;
- number of branches per vertical.

Some of the measurements made on the 50m^2 sample surfaces for each species, with 25 saplings each, were noted in Table 1. Images of the 2 surfaces are given in fig.2 and fig.3.

Table 1

Notations used for the two sample surfaces

No crt.	Variant	Species	Slope, degrees	Fertilization at planting	Experimental field code
1	A	*Pinus nigra* Black Pin	P1 ≤ 10°	NF (unfertilized)	A - Pi.n. S1P1N
5	E	*Pinus sylvestris* Silvester Pin	P1 ≤ 10°	NF (unfertilized)	E - Pi.s. S1P1N

Figure 2 **Sample surface A - Black Pin, Slope <10°, unfertilized**

Figure 3 **Sample surface E - Silvester Pin, Slope <10°, unfertilized**

The diameter of the trunk at the parcel was measured with the caliper (fig. 4), and the height with a roulette for measuring heights (fig. 5).

Figure 4 **Measuring the height of seedlings with roulette**

Figure 5 **Measurement of the diameter of the saplings with the electronic caliper**

In most of the analyzed characters (including the height of the saplings and the diameter) it was possible to calculate the arithmetic mean using the well-known formula $x = \sum x/n$.

The results obtained from biometric determinations on the mentioned characters, in the two species taken in the study, were statistically processed by variance analysis, specific to monofactorial experiences executed in randomized blocks, the significance of the differences between the two varieties tested being established using the DL test or the multiple comparison test (DS5%). For certain characteristics, the test 't' (student) was also used (Ardelean et al., 2005; Ardelean, 2011).

The measured values in the 2 black pin sample surfaces have been tabulated:

Tabel 2

Data measured in experimental field A, code A-Pi.n. S1P1N, slope<10º, unfertilized, Black Pin, 25 saplings

No crt.	Spring		Autumn		Increases in 2023	
	At planting 03.2023		11.2023			
	Diameter, mm	Height, cm	Diameter, mm	Height, cm	Diameter, mm	Height, cm
1	9.85	7.80	10.05	24.50	0.20	16.70
2	11.95	10.00	13.00	32.00	1.05	22.00
3	7.60	7.00	8.20	28.80	0.60	21.80
4	10.12	8.50	10.38	33.50	0.26	25.00
5	9.10	7.80	9.40	26.00	0.30	18.20
6	8.04	9.00	8.36	33.00	0.32	24.00
7	9.00	8.80	9.28	29.00	0.28	20.20
8	9.20	11.00	9.60	38.50	0.40	27.50
9	10.10	10.30	10.43	33.00	0.33	22.70
10	11.12	7.60	11.52	28.00	0.40	20.40
11	8.07	7.80	8.27	27.30	0.20	19.50
12	8.10	8.90	8.48	28.50	0.38	19.60
13	9.12	10.60	9.52	37.00	0.40	26.40
14	9.36	7.30	9.78	22.00	0.42	14.70
15	7.90	9.40	8.10	32.80	0.20	23.40
16	7.89	10.00	8.10	32.60	0.21	22.60
17	12.14	9.80	12.56	30.00	0.42	20.20
18	8.36	11.00	8.76	33.60	0.40	22.60
19	9.10	8.20	9.38	27.30	0.28	19.10
20	10.50	8.00	10.86	26.50	0.36	18.50
21	10.00	11.20	10.30	31.80	0.30	20.60
22	14.15	11.80	14.40	42.00	0.25	30.20
23	10.02	11.60	10.28	35.60	0.26	24.00
24	7.06	10.60	8.18	29.50	1.12	18.90
25	10.45	8.00	10.86	27.00	0.41	19.00

Tabel 3

Data measured in experimental field E, code E - Pi.s. S1P1N, slope<10º, unfertilized, Silvester Pin, 25 saplings

No crt.	Spring		Autumn		Increases in 2023	
	At planting 03.2023		11.2023			
	Diameter, mm	Height, cm	Diameter, mm	Height, cm	Diameter, mm	Height, cm
1	5,74	10,00	5,94	29,00	0,20	19,00
2	19,70	30,00	19,94	55,00	0,24	25,00
3	11,20	30,00	11,53	41,00	0,33	11,00
4	18,15	30,00	18,53	52,50	0,38	22,50
5	10,56	30,00	10,86	43,50	0,30	13,50
6	11,30	25,00	11,55	32,50	0,25	7,50
7	14,25	38,00	14,55	56,00	0,30	18,00
8	16,43	34,00	16,83	56,50	0,40	22,50
9	12,40	25,00	12,68	41,00	0,28	16,00
10	12,00	24,00	12,26	36,00	0,26	12,00
11	13,25	24,50	13,50	44,50	0,25	20,00
12	9,80	35,00	10,07	55,00	0,27	20,00
13	12,40	30,00	12,68	48,50	0,28	18,50
14	13,42	30,00	13,65	55,00	0,23	25,00
15	10,30	30,00	10,57	48,50	0,27	18,50
16	10,80	29,00	11,08	39,00	0,28	10,00
17	18,80	39,00	19,21	67,50	0,41	28,50
18	11,60	29,00	11,85	40,00	0,25	11,00
19	14,04	28,00	14,44	49,00	0,40	21,00
20	11,80	25,00	12,10	30,50	0,30	5,50
21	9,85	24,00	10,11	33,00	0,26	9,00
22	11,40	28,00	11,63	47,50	0,23	19,50
23	14,55	39,00	14,85	61,50	0,30	22,50
24	13,60	36,00	13,82	52,40	0,22	16,40
25	9,25	20,00	9,46	25,00	0,21	5,00

RESULTS AND CONCLUSIONS

The concrete results of these measurements are presented in Table 4, and the significance of the differences between the two tested species is determined using the test 't' (student), (Ardelean, 2010).

Tabel 4

The average diameter and height of the saplings measured in the spring and autumn of 2023, annual increases for the 2 species

CODE	Variant	The diameter on the date of…, mm		Growth in diameter, mm	The height on the date of…, cm		Increase in height, cm
		03.2023	11.2023		03.2023	11.2023	
Pi.n. - S1P1N	A	9.53	9.92	0.39	9.28	30.79	21.51
Pi.s. - S1P1N	E	12.66	12.95	0.28	28.90	45.60	16.70

The influence of the species and age of saplings on annual increases:

The calculated annual increases in diameter and height are shown in Table 5.

Tabel 5

Centralization of data on increases in diameter and height for the 2 species

No crt.	Increases in diameter, cm		Increases in height, cm	
	Pi.n.	Pi.s.	Pi.n.	Pi.s.
1	0.20	0.20	16.70	19.00
2	1.05	0.24	22.00	25.00
3	0.60	0.33	21.80	11.00
4	0.26	0.38	25.00	22.50
5	0.30	0.30	18.20	13.50
6	0.32	0.25	24.00	7.50
7	0.28	0.30	20.20	18.00
8	0.40	0.40	27.50	22.50
9	0.33	0.28	22.70	16.00
10	0.40	0.26	20.40	12.00
11	0.20	0.25	19.50	20.00
12	0.38	0.27	19.60	20.00
13	0.40	0.28	26.40	18.50
14	0.42	0.23	14.70	25.00
15	0.20	0.27	23.40	18.50
16	0.21	0.28	22.60	10.00
17	0.42	0.41	20.20	28.50
18	0.40	0.25	22.60	11.00
19	0.28	0.40	19.10	21.00
20	0.36	0.30	18.50	5.50
21	0.30	0.26	20.60	9.00
22	0.25	0.23	30.20	19.50
23	0.26	0.30	24.00	22.50
24	1.12	0.22	18.90	16.40
25	0.41	0.21	19.00	5.00

The influence of the species and the age of the saplings on the growth in height:

Tabel 6

Centralization of the helpful table for calculating variances and "t" values

Elements of calculation	Pi.n.	Pi.s.
n	25	25
$\sum x$	537.80	417.40
$\bar{x}$	21.51	16.70
C	11569.15	6968.91
$\sum x^2$	11858.36	7957.46
SPA	289.21	988.55
GL	24.00	24.00
s^2	12.05	41.19
s_x	0.69	1.28
s_d	-	8.58
±d	-	-4.82
t	-	-0.56

Table 7

Summary of the experimental results (test t) for the annual height increases for the two species

No Var.	Species	Increase in height, mm $\bar{x} \pm sx$	± d, cm	t	Sign the difference
A	Pi.n.	21.51 ± 0.69	-	-	-
E	Pi.s.	16.70 ± 1.28	-4.82	-0.56	n.s.

$t_{calc} < t_{P5\%} = 1.9$

According to Table 7, it is confirmed that there are no significant differences between the 2 species in terms of annual increases in diameter.

The influence of species and age of saplings on growth in height:

Tabel 8

Calculation of variances and "t" values

Elements of calculation	Pi.n.	Pi.s.
n	25	25
$\sum x$	9.75	7.10
$\bar{x}$	0.39	0.28
C	3.80	2.02
$\sum x^2$	5.06	2.10
SPA	1.26	0.08
GL	24.00	24
s^2	0.05	0.00
s_x	0.05	0.01
s_d	-	4.80
±d	-	-6.82
t	-	-1.42

Table 9

Summary of the experimental results (test t) for the annual increases in diameter for the two species

No Var.	Species	Increase in diameter, cm $\bar{x} \pm sx$	± d, cm	t	Sign the difference
A	Pi.n.	0.39 ± 0.05	-	-	-
E	Pi.s.	0.28 ± 0.01	-6.82	-1.42	n.s.

$t_{calc} < t_{P5\%} = 1.9$

According to Table 9, it is confirmed that there are no significant differences between the 2 species in terms of annual increases in height.

In conclusion, there are no significant differences between the 2 Pine species analyzed, neither in terms of the influence of the species nor the age of the juvenates, on the increases in diameter or height in 2023, on this degraded land. These results are also due to the fact that the saplings were planted with bale and loan soil, and the survival rate was 100% for both species.

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