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The Influence of Species and Fertilizations on the Maintenance of Seedlings on Degraded Lands in the Transylvanian Plain

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Abstract. In order to establish the influence of species and fertilization on the maintenance of seedlings planted on degraded lands by superficial erosion in the Transylvanian Plain we used black pine (*Pinus nigra*), ash-tree (*Fraxinus excelsior*) and red dogwood (*Cornus sanguinea*). The fertilization has been done with nitrogen (active substance) in dozes of 10 and 20 grams per pit planting. We established the maintenance degree of seedlings in the first and the second year after planting.

Keywords: ecological reconstruction, land erosion, experimental plots, afforestation, seedlings, fertilization.

INTRODUCTION

In our country, according to the last statistics, the soil erosion and torrential processes affect approximatley 7.3 mil. hectars, out of which approximatley 5.3 mil. hectars with serious erosion proceses which call control, and the rest, approximately 2 mil. hectars, need prevention agricultural-pedologycal improvement measures. One way to combat the degradation processes and make the ecological reconstruction is afforestrations. The difficult environmental conditions of the superficial erosion degraded lands (superficial soil or without soil, low humidity, sunny exposition, precipitous slope, the absence of grass cover) make difficult the settling of the forestry vegetations, the maintenance of planted seedlings being the lowest. The experiment was installed on very hard superficial erosion degraded lands in the Transylvanian Plain (Teaca amelioration perimeter, near Teaca locality, Bistrita-Nasaud county) and we tried to estabilish how species and fertilizations affect the seedlings maintaince in the first two years after planting.

MATERIALS AND METHODS

The experimental area Teaca 2 was placed on a degraded area affected by very strong or excessive erosion (e3-e4) (environmental group of degraded lands 11* and presents the following specific features: altitude 400 m, SV exposition, 25^{o} slope, carbonatic erodo-soil very strongly eroded, substratum of clays and marls.

*Note - The environmental group of degraded lands 11 – Lands with a very strong or excessive erosion (e3-e4), prevailing pseudo-endzinic and typical erodo-soils or Regosoils low to moderate developed, having a clayey loamy or clayey texture, without a skeleton of with a little skeleton, 21-50 cm thick (sometimes up to 75 cm), formed on marls, clays or marl complexes, limestone and sandstone (according to *Norme tehnice privind compoziţii, scheme şi tehnologii de regenerare a pădurilor şi de împădurire a terenurilor degradate* (Technical norms regarding compositions, schemes and technologies of forest regeneration and degraded lands afforestration), Ministerul apelor, pădurilor şi protecţiei mediului, 2000.

The experimental area is represented by 3 repetitions with 9 variants each, having an area of 810 m^2, the surface of one variant is 30 m^2, and that of a repetition is 270 m^2. Each variant is represented by 15 seedlings, the planting scheme is 2.0/1.0 m. The planting was done in the spring of 2007, in normal pits of 30x30x30 cm in pit plantings of 60x80 cm. The fertilization (factor b) was done mannualy, at the beginning of June 2007, in the pit-plantings, around the seedlings at 10-15 cm from them, without covering the fertilizer. Every year has made one loosening of the soil around the seedling.

The variants were as follows:

a1b1 – unfertilized black pine
a1b2 – black pine + fertilization with N 10g/pit-planting
a1b3 - black pine + fertilization with N 20g/pit-planting
a2b1 –unfertilized ash-tree
a2b2 – ash-tree + fertilization with N 10g/pit-planting
a2b3 - ash-tree + fertilization with N 20g/pit-planting
a3b1 – unfertilized red dogwood
a3b2 – red dogwood + fertilization with N 10g/pit-planting
a3b3 - red dogwood + fertilization with N 20g/pit-planting

In order to establish the seedlings settling percentage we did observations in May 2007 and to establish the seedlings maintenance in the autumn of 2007 and 2008.

We applied the test F and the test Tuckey (Duncan) in order to provide statistic conclusions regarding the results obtained when using the species: black pine, ash-tree and red dogwood and the fertilization with nitrogen, and their influence on the settling and maintenance of the seedlings in the first two years from planting.

RESULTS AND DISCUSSION

It is obvious that the settling percentage of different forestry species seedlings is radically different due to their morpho-phisyological and ecological features. These specific features reveal into the exact way of striking the main and secondary roots, the number of roots and their capacity to absorbe the water and nutrients. Beside these specific features that regard strictly the biology of the studied species, the seedlings settling degree is influenced by other unfavourable factors as the incorrect application of some working technologies chains (from taking out the seedlings from nurseries to their planting).

In our experiment, the seedlings settling percentage was obviously influenced by the two experimental factors (the species and the treatment applied to the soil where the seedlings were planted) and also by the interaction between them. This is obvious when reading the table of variances (Tab. 1).

Tab. 1

The table of variances for the bifactorial experience (3x3) with forestry species and soil treatment (fertilization). Observations in May 2007

The cause of variability	SPA	GL	s^2	Sample F compared to s^2_e	Sample F compared to s^2 S x T
Total	2865.80	26			
Blocks	26.08	2			
Species A	549.50	2	274.75	9.48 >3.63 ; 6.23	0.76 <6.94 ; 18.00
Soil treatment B	387.74	2	193.87	6.69 > 3.63 ; 6.23	0.53 < 6.94 ; 18.00
Species x Treatment	1438.88	4	359.72	12.41> 3.01 ; 4.77	
Error	463.60	16	28.97		

In the table of variances we can notice that the values F calculated on the basis of s^2_e (the variance of the error) are much bigger than the values F tabular for F 5% and F1%. When the values F are calculated on the basis of s^2_{SxT} (interaction between factors) they are much smaller than F theoretical for the probability 5% and 1%, a thing that suggests that the interaction between the two factors is less important in the total variability of the data.

The synthesis of the experimental results is presented in Tab. 2.

Tab. 2

The influence of the species, fertilization, and the interaction species x fertilization on the seedlings settling in the first year after planting

Species/fertilization	Without fertilization	10 g N/pit	20gN/pit	Mean species
Black pine	66.6 d*	91.6 ab	93.3 ab	83.8 B
Ash-tree	86.7 bc	93.3 ab	80.0 c	86.7 B
Red dogwood	100.0 a	95.5 ab	88.0 bc	94.5 A
Mean fertilization	84.4 N	93.5 M	87.1 N	

DS5% for two means effect species (A)=5.63 %
DS5% for two means effect treatment (B)=5.38-5.63%
DS5% for two means effect interaction (AxB)=9.3-10.6%
* The difference between any two variants, followed by at least one common letter is insignificant

We preferred the model of the bilateral synthesis table as this allows both the pointing out of the effect of each factor and also the effect of the interaction between the factors.

The data in Tab. 2 show clearly that the differences between the species are significant when talking about seedlings settling, the highest value of the settling percentage is obtained by the red dogwood (94,5%), while the other two species tested (ash-tree and black pine) obtained significantly lower settling percentages than the red dogwood (83,8-86,7%).

The same variation model is represented by the mean of the treatment effects. The highest value of settling is obtained at the treatment variant with 10 g N/pit (93,5%), significantly different from the variants without treatment, and with 20 g N/pit. We have to mention that although at first sight the results do not seem to coincide with the biological reality, yet it is very possible that 20 g N/pit, in the conditions of the droughty summer of year 2007 to have disturbed the quite fragile radicle system of the seedlings or to have manifested a toxic effect of the nitrogen excess (in conditions of low humidity of the soil, the soil solution is very concentrated even at 20 g N/pit)

Regarding the effect of the interaction between the two factors on the seedlings settling percentage, the data in the synthesis table broadly confirm what we noticed in the variances table. Concretely, a number of 7 variants are practically identical, the significant differences are only between the variants with extreme values. Thus, the highest seedling settling percentage was registered for red dogwood without any treatment, followed by the same species fertilized with 10 g N/pit. The lowest seedlings settling percentages were registered for ash-tree fertilized with 20 g N/pit (80%) and for the black pine without fertilization (66,6%).

After one season of vegetation from planting (September 2007) the seedlings maintenance degree was not significantly influenced by the two factors, as we can see in Tab. 3 (the variances table)

Tab. 3

The table of variances for the bifactorial experience (3x3) with forestry species and soil treatment (fertilization), observations done in september 2007

The cause of variability	SPA	GL	s^2	Sample F compared to s^2_e	Sample F compared to s^2 S x T
Total	691.10	26			
Blocks	225.16	2			
Species A	17.30	2	8.65	0.38 <3.63;6.23	0.87 <6.94 ; 18.00
Soil treatment B	47.08	2	23.54	1.04 <3.63;6.23	2.38 <6.94 ; 18.00
Species x Treatment	39.45	4	9.86	0.43 <3.01;4.77	
Error	362.10	16	22.63		

Here we can notice that the values F calculated on the basis s^2_e and s^2_{SxT} are smaller than the values F theoretical. The synthesis of the experimental results is presented in Tab. 4.

Tab. 4

The influence of species, fertilization and of the interaction species x fertilization on the seedlings settling in the first year after planting (September 2007)

Species/fertilization	Without fertilization	10 g N/pit	20gN/pit	Mean Species
Black pine	93.3 a	92.2 a	95.5 a	93.7 A
Ash tree	91.1 a	93.3 a	97.8 a	94.1 A
Red dogwood	95.5 a	95.5 a	95.5 a	95.5 A
Mean fertilization	93.3 M	93.7 M	96.3 M	

DS5% for two means effect species (A)= 4.98 %
DS5% for two means effect treatment (B)= 4.76-4.98 %
DS5% for two means effect interaction (AxB)= 9.3-10.6 %
* The differnce between any two variants, followed by at least one common letter is insignificant

Analyzing the results, we can notice that the differences between the species, as regarding the maintenance, are insignificant and the fertilization does not significantly influence the maintenance of the seedlings. In Tab. 2 and 4 we can notice that for ash-tree and the black pine (and also the red dogwood) the seedlings maintenance percentage was higher (with 1-9,8%) in the spring of 2007 than in autumn, which can be explained by the fact that when observing the seedlings settling (May 2007), not all of them were vegetating, suffering after the shock of planting, especially the black pine, and for the the ash-tree and the red dogwood, a high percentage of them self-cut back, sprouting during the vegetation season 2007, thus, at the observations in September 2007, the number of the maintained seedelings was bigger. From the data in synthesis table (Tab. 4), the effect of the interaction between the two factors on the seedlings maintenance degree is insignificant, all the 9 variants beeing identical. The highest maintenance percentage was registered for ash-tree, fertilized with 20 g N/pit (97,8%), followed by the red dogwood (95,5%) in all the treatment variants.

After two years from planting (September 2008) only the factor species significantly influenced the seedlings maintenance degree, as we can notice in Tab. 5, the value F calculated on the error variance, for the factor species, it is higher than the tabular F values for F 5% and 1%.

Tab. 5

Table of the variances for the bifactorial experience (3x3) with forestry species and soil treatment (fertilization), observations done after two years from planting

Cause of the variability	SPA	GL	s^2	Sample F compared to s^2_e	Sample F compared to s^2 S x T
Total	4624.20	26			
Blocks	720.49	2			
Species A	1796.27	2	898.13	9.37 >3.63;6.23	19.31 >6.94; 18.00
Soil treatment B	388.27	2	194.13	2.02 <3.63;6.23	4.17 <6.94 ; 18.00
Species x Treatment	185.97	4	46.49	0.48 <3.01;4.77	
Error	1533.20	16	95.82		

The effect of the interaction between the two factors on the seedlings maintenance degree is significant, the factor species being more important, a fact that is emphasized through value F calculated on the basis of s^2_{SxT}, which is higher.

The synthesis of the experiment results is presented in Tab. 6.

Tab. 6

The influence of species, fertilization and of the interaction species x fertilization on the seedlings maintenance after two years from planting

Species/fertilization	Without fertilization	10 g N/pit	20gN/pit	Mean species
Black pine	91.1 ab	91.1 ab	94.4 ab	92.2 A
Ash-tree	88.9 ac	86.6 acd	95.5 a	90.3 A
Red dogwood	77.7 d	64.4 e	80.0 cd	74.0 B
Mean fertilization	85.9 M	80.7 M	90.0 M	
DS5% for two means effect species (A)= 10,25 % DS5% for two means effect treatment (B)= 9.79-10.25 % DS5% for two means effect interaction (AxB)= 9.3-10.6 % * The differnce between any two variants, followed by at least one common letter is insignificant				

In Tab. 6 we can see clearly that the differences between species as regards the seedlings maintenance are significant, the highest value is obtained for the black pine (92,2%) and ash-tree (90,3), while the red dogwood obtained a significantly lower maintenance degree (74%) as compared to the other two. The influence of the fertilization on the seedlings maintenance degree, after two years from planting proved insignificant, though we can notice differences between the fertilization variants. The combined effect of the two factors on the seedlings maintenance degree proved to be significant only for the variants with extreme values, 7 of the variants being identical. The highest maintenance percentage was registered for the ash-tree and the black pine fertilized with 20 g N/pit (95,5% and 94,4%) and the lowest maintenance percentage was obtained by the red dogwood for all the fertilization variants (64,4-79,9%).

CONCLUSIONS

If after one year from planting there weren't significant differences between species as regards the seedlings maintenance degree, after two years from planting, we can conclude that the factor species significantly influences the seedlings maintenance degree. The species with the best results was the black pine, followed by the ash-tree. This proves that the black pine

resists the best on degraded lands by very strong superficial erosion and it is less pretentious as regards the pedological conditions (nutrients, water). The ash tree obtained good results and succeeded to adapt well to the degraded land conditions, as it is well-known its great adapting capacity and plasticity to the environmental conditions. The red dogwood had the lowest maintenance degree, as it is more pretentious to the environmental conditions. Nitrogen fertilization, although not significantly affect the maintenance of seedlings after two years of planting, its effect was positive.

In the conditions of degraded lands by very strong sheet erosion (group 11 of environmental degraded lands), regarding the seedlings maintenance degree after two years from planting, very good results were obtained by the black pine, the ash-tree and the red dogwood, which recommend them as reference species in establishing the afforestration compositions for these categories of degraded lands. The black pine could be used as a main reference species in a proportion of 60-70%, the ash-tree as a main mix species (20-30%) and the red dogwood in a lower proportion (10-20%).

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