Effect of Species and Land Preparation method on the Maintenance of Saplings on Eroded Lands in Frata Perimeter, in the First Year After Planting

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Abstract

In order to establish the influence of species and land preparation method on the maintenance of saplings planted on degraded lands due to sheet erosion in Frata amelioration perimeter (Cluj county, Romania) we used black locust (Robinia pseudoacacia) and manna ash (Fraxinus ornus). The land preparation methods used were terraces and pits. We established the saplings maintenance degree in the first year after planting. To establish the influence of species and antierosional land preparation on the maintenance of saplings planted and which struck roots, we placed two experiment (bifactorial). The significance of the differences between the tested variants was shown using Duncan (Tuckey) test of multiple comparisons, considering significant differences DS5%. As compared to manna ash, the black locust provided the highest saplings maintenance degree, at an insignificant difference. Terracing, as antierosional land preparation provides the highest maintenance degree at an insignificant difference as compared to the pits, no matter the species involved. The variants which provided the highest maintenance degree were manna ash x wattle fence terraces and black locust x wattle fence terraces and the lowest maintenance degree was registered by the manna ash planted in pits.

Keywords: afforestation, antierosional land preparation, Fraxinus ornus, Robinia pseudoacacia, saplings

INTRODUCTION

One way to combat the erosion processes and make the ecological reconstruction is afforestation. Until 2009 approximately 355000.0 ha of degraded lands were aforested (the figure resulted by summing up the aforested areas along different periods, as follows: 1881-1930 - 5000.0 ha (Gaspar et. al, 1995); 1930-1948 -100000.0 ha (Gürgü, 2006); 1952-1990 - 219232.0 ha (Oprea et. al, 2003); 1990-2009 - 30586.0 ha (http://mmareu.ro/file/17.11.2010_Programul-National-Impadurire.pdf). During these aforestation works there were done some researches on the methods and technologies for installing forestry vegetation on different degraded lands conditions. There also have been tested different types of works for consolidation and preparing the lands used for aforestation, different planting procedures, species and aforestation compositions and the installed cultures were observed in the first years after planting (Traci, 1966, 1970, 1975, 1985, 1986; Untaru, 1975, 1982, 1986, 1988; Constandache, 2002, 2004, 2006). The consolidation of the eroded slopes by terraces is recommended in afforestation of the eroded lands in oak, beech and spruce areas, in subalpine and forest steppe (Traci, 1966, 1985), but also in the case of some slopes and waste heaps (Untaru et al., 1988). Ciortuz et al. (2004) underlined the increase of the percentage of saplings striking roots and maintenance of saplings planted on terraces. More recent researches regarding the increase of the maintenance of saplings planted on lands affected by sheet erosion, in first years after planting, have been done in the Transylvanian Plain (Vlasin, 2012, 2013).
The experiment was installed on very hard superficial erosion degraded lands (in the Transylvanian Plain (Frata amelioration perimeter, near Frata locality, Cluj county, Romania) and we tried to establish how species and antierosional land preparation affect the saplings maintenance in first year after planting.

**MATERIALS AND METHODS**

In order to establish if the species, antierosional land preparation and the interaction species x antierosional land preparation affects saplings maintenance in first year after planting and how it is affected, we placed two experiments in Frata amelioration perimeter (Frata 1 and Frata 2). The place of the experiment, the material used, the experiments placing mode and data processing are described below.

The experiments were placed in Frata amelioration perimeter, near Frata locality, in the southern part of Transylvanian Plain, Cluj county, Romania. Frata perimeter has two units: Frata 1 (Oaș) of 9.33 ha and Frata 2 (Cerci) of 20.93 ha. According to the geomorphological delimitation in „The geographical Monography of Romanian Popular Republic“, the territory subjected to the study belongs to Alpine-Carpathian Geosinclinal, Transylvanian Depression sub-province, Mureș Plain district, Sărmaș Plain sub-district. The main land configuration form is south and south-western slope and the land configuration microforms are represented by 1-4 m wide terraces that served for vines cultivation in the past. From the altitude point of view, Frata is situated between 380 m and 500 m. The type of soil is cambic erodosoil. From the climatic point of view, according to Koppen, the perimeter belongs to the climatic province D.f.b.k. The average annual temperature is 8.2 °C and the average annual precipitation is 613 mm. The potential evapo-transpiration is 620 mm, thus it exceeds the precipitation value.

The land degradation process is severe to extreme sheet erosion (IRISILVA, 2011). The identified degraded land site type constituted of sheet erosion degraded lands, with very severe to excessive eroded lands on slopes having 12-30 degrees, with soils of 20-50 cm thick, loamy-sandy to loamy texture and less than 5% skeleton, oligo to mesotrophic (ES18), from common oak altitudinal plant belt (MAPPMÎ, 1995). The identified site group of degraded land is GS10 – Lands with very severe to excessive erosion (e3-e4), mostly with cambic erodisols, clayey-illuvial, feri-illuvial or typical and slow to moderate developed regosols, of 21–50 cm thick, rarely up to 75 cm thick, sandy-loamy to loamy, without skeleton or with little skeleton (up to 25%), rarely with more skeleton (26–50%), formed on loess, loams, sands, gravels with sand, sandstones and marl complexes or on hard rocks, without outcrops at surface (IRISILVA, 2011 according with MAPPM, 2000).

Installation technology: nude root saplings planted in normal holes of 30 x 30 x 30 cm in pits of 60 x 80 cm, planting scheme 2.0 x 1.0 m (5000 saplings/ha) and nude root saplings in normal holes of 30 x 30 x 30 cm, on wattle-fence terraces of 0.75 m wide, placed on the contour line, at 2.0 m distance between terraces, planting scheme 2.0 x 1.0 m (5000 saplings/ha). The wattle-fence terraces were placed on whole surface of perimeter alternating with pits areas.

The experiment factors were:

Factor A – species, with two elements:
- a1 – black locust
- a2 – manna ash

Factor B – antierosional land preparation, with two elements:
- b1 – pits
- b2 – wattle-fence terraces

We placed two bifactorial experiments, thus resulting 4 experimental variants, as follows:
- v1 - a1b1 - black locust, pits
- v2 - a1b2 - black locust, wattle-fence terraces
- v3 - a2b1 - manna ash, pits land
- v4 - a2b2 - manna ash, wattle-fence terraces
We formed the experiments by placing annual control areas for regenerations in Frata 1 and 2 amelioration perimeter (Fig.1). The sample forming was done by randomly choosing the annual control areas. The placing of regeneration annual control areas was done according to the technical sylvicultural standards in operation (MAPPM, 2000). We systematically placed the areas of regeneration annuals control areas related to the first annual control area which had been placed in a corner of the regenerated area (unit). This placing mode determined that a part of the annual control areas to be on terraces and the others on pits. Their surface was 200 m² per each and their form was circular. The total surface was calculated such as, taken together, to be minimum 4% of Frata 1 unit and minimum 2% of Frata 2 unit (MAPPM, 2000). In unit Frata 1 (Oaş) we randomly chose 6 annual control areas (3 for terraces and 3 for pits) and in unit Frata 2 we chose 12 annual control areas (6 for terraces and 6 for pits, grouped in two).

In every annual control area we did the inventory of the viable saplings, for each species, and we established the saplings maintenance percentages. The inventories were done in September 2013 in order to establish the saplings maintenance degree after one year from planting. The value of saplings maintenance percentage, for each species and repetition, was calculated in relation to the initial number of planted saplings in every annual control area. For this experiment we studied the influence of the species, of antieresional land preparation and of the combination species x antieresional land preparation on the saplings maintenance degree in first year after planting.

RESULTS AND DISCUSSIONS

1. Experiment Frata 1 (Oaş)

During 2013, in first year after planting, as we can see in the variance table (Tab. 1), both species and antieresional land preparation factors and the interaction between them do not really influence the maintenance degree of saplings planted and which stroke roots in the first year after planting (value F calculated for species, antieresional land preparation and interaction species x antieresional land preparation is inferior to value F theoretical, for P5%).

If we refer to species, the highest maintenance degree of saplings in first year after planting belongs to the black locust (92,7%) followed, at a insignificant difference, by the manna ash (91,7%) (Fig.2). If we refer to antieresional land

Fig. 1. Antieresional land preparation (wattle-fence terraces) in Frata amelioration perimeter
preparation, there were no significant differences between the two preparation methods (pits and terraces), wattle-fence terraces land preparation providing a 3.2% higher maintenance degree for black locust and manna ash saplings.

The interaction between the two factors (species x antierosional land preparation) does not really influence the saplings maintenance degree in the first year after planting. In the synthesis table (Tab. 2) we can see that the highest maintenance degree was obtained by the manna ash planted on wattle-fence terraces (94.8%), followed, at an insignificant difference, by the combinations *black locust x wattle-fence terraces* (92.8%) and *black locust x pits* (92.6%), and last were *manna ash x wattle-fence terraces* (88.6%).

**Tab. 1.** Variance table for bifactorial experiment 2x2, in 2013 in Frata amelioration perimeter

<table>
<thead>
<tr>
<th>Variability cause</th>
<th>SPA</th>
<th>GL</th>
<th>$s^2$</th>
<th>Test F calculated</th>
<th>theoretical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>638.18</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blocks</td>
<td>174.98</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Species A</td>
<td>2.80</td>
<td>1</td>
<td>2.80</td>
<td>0.04</td>
<td>&lt;5.99;13.75</td>
</tr>
<tr>
<td>Land preparation B</td>
<td>30.72</td>
<td>1</td>
<td>30.72</td>
<td>0.46</td>
<td>&lt;5.99;13.75</td>
</tr>
<tr>
<td>Species x land preparation</td>
<td>27.00</td>
<td>1</td>
<td>27.00</td>
<td>0.40</td>
<td>&lt;5.99;13.75</td>
</tr>
<tr>
<td>Error</td>
<td>402.67</td>
<td>6</td>
<td>67.11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tab. 2.** Influence of species, antierosional land preparation and interaction species x antierosional land preparation on saplings maintenance degree (%) in first year after planting

<table>
<thead>
<tr>
<th>Species/Antierosional land preparation</th>
<th>pits</th>
<th>terraces</th>
<th>Mean per species (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black locust</td>
<td>92.6 a</td>
<td>92.8 a</td>
<td>92.7 A</td>
</tr>
<tr>
<td>Manna ash</td>
<td>88.6 a</td>
<td>94.8 a</td>
<td>91.7 A</td>
</tr>
<tr>
<td>Mean per antierosional land preparation (%)</td>
<td>90.6 M</td>
<td>93.8 M</td>
<td></td>
</tr>
</tbody>
</table>

**DS5% for two means species effect (A) = 11.57%**
**DS5% for two means land preparation effect (B) = 11.57%**
**DS5% for two means interaction effect (AxB) = 16.6-17.3%**

**Note:** Difference between any two values, followed by at least one common letter is insignificant

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Fig. 2. Manna ash planted in pits and wattle-fence terraces, Frata 1 perimeter, first year after planting (2013).
For the first year, the statistic calculations for the two experiments show that the species, antierosional land preparation mode and interaction between the two factors do not have a real influence on saplings maintenance degree, the differences between the variants being caused by other factors (climate conditions, micro-site conditions, quality of planting works, etc.). The black locust has the highest maintenance degree (92.5–92.7%), followed, at an insignificant difference, by the manna ash (89.2–91.7%) in both experiments. If we refer to the antierosional land preparation, the two methods (pits and wattle-fence terraces) do not significantly differ. The interaction between the two factors (species x antierosional land preparation method) does not really influence the saplings maintenance degree in the first year after planting. Yet, during this period, the combinations which provided the saplings highest maintenance degree are those with wattle-fence terraces for both species. The combinations manna ash x wattle-fence terraces provided the highest saplings maintenance degree in both experiments. The lowest maintenance degree was registered for combination manna ash x pits in both experiments.

2. Experiment Frata 2 (Cerci)

During the 2013, in first year after planting, as we can see in the variance table (Tab. 3), both species and antierosional land preparation factors and the interaction between them do not really influence the maintenance degree of saplings planted and which stroke roots (value F calculated for species, antierosional land preparation and interaction species x antierosional land preparation is inferior to value F theoretical, for P5%).

If we refer to species, the highest saplings maintenance degree in first year after planting, belongs to the black locust (92.5%) (Tab. 4, Fig.3) followed, at an insignificant difference, by the manna ash (89.2%). If we refer to antierosional land preparation, there were no significant differences between the two preparation methods (pits and terraces), wattle-fence terraces antierosional land preparation providing a 6.7 % higher maintenance degree.

The interaction between the two factors (species x antierosional land preparation) does not really influence the saplings maintenance degree in the first year after planting. Yet, during this period, the combinations which provided the saplings highest maintenance degree are those with wattle-fence terraces for both species. The combinations manna ash x wattle-fence terraces provided the highest saplings maintenance degree in both experiments. The lowest maintenance degree was registered for combination manna ash x pits in both experiments.

**Tab. 3. Variance table for bifactorial experiment 2x2, in 2013 in Frata amelioration perimeter**

<table>
<thead>
<tr>
<th>Variability cause</th>
<th>SPA</th>
<th>GL</th>
<th>$s^2$</th>
<th>Test F calculated</th>
<th>Test F theoretical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>590.97</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blocks</td>
<td>121.67</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Species A</td>
<td>32.34</td>
<td>1</td>
<td>32.34</td>
<td>1.04</td>
<td>&lt;5.99;13.75</td>
</tr>
<tr>
<td>Land preparation B</td>
<td>136.69</td>
<td>1</td>
<td>136.69</td>
<td>4.39</td>
<td>&lt;5.99;13.75</td>
</tr>
<tr>
<td>Species x land preparation</td>
<td>113.47</td>
<td>1</td>
<td>113.47</td>
<td>3.64</td>
<td>&lt;5.99;13.75</td>
</tr>
<tr>
<td>Error</td>
<td>186.80</td>
<td>6</td>
<td>31.13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tab. 4. Influence of species, antierosional land preparation and interaction species x antierosional land preparation on saplings maintenance degree (%) in first year after planting**

<table>
<thead>
<tr>
<th>Species/Antierosional land preparation</th>
<th>pits</th>
<th>terraces</th>
<th>Mean per species (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black locust</td>
<td>92.2 ab</td>
<td>92.8 ab</td>
<td>92.5 A</td>
</tr>
<tr>
<td>Manna ash</td>
<td>82.8 b</td>
<td>95.7 a</td>
<td>89.2 A</td>
</tr>
<tr>
<td>Mean per antierosional land preparation (%)</td>
<td>87.5 M</td>
<td>94.2 M</td>
<td></td>
</tr>
</tbody>
</table>

DS5% for two means species effect (A)= 7.88 %; DS5% for two means land preparation effect (B)= 7.88 %; DS5% for two means interaction effect (AxB)= 11.1-11.8 %

Note: Difference between any two values, followed by at least one common letter is insignificant
maintenance degree was obtained by the manna ash planted on wattle-fence terraces (95,7%), followed, at an insignificant difference, by the combinations black locust x wattle-fence terraces (92,8%) and black locust x pits (92,2%), and last (at a significant difference from the combination manna ash x wattle-fence terraces) were manna ash x terraces (82,8%).

CONCLUSIONS
In Frata degraded lands amelioration perimeter, characterized by strong to very strong superficial erosion (GS10 site group of degraded lands) the black locust provided the saplings highest maintenance degree, followed at an insignificant difference by manna ash, thus the two species are recommended to be included in the afforestation formula, the black locust as a main base species and the manna ash as a mixture main species. The antierosional land preparation in wattle-fence terraces and planting black locust and manna ash saplings on these terraces provide in the first year after planting a higher degree of saplings maintenance – a fact that reduces the completion expenses and hastens the definitive success, the close crop, stops the erosion processes and improves the vegetation conditions.

REFERENCES
8. MAPPM (2000). Technical standards regarding compositions, schemes and technologies of forest
regeneration and degraded land afforestation 1, Bucharest.


