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CURRENT AND FUTURE STATUS OF STANDS' REGENERATION THROUGH AFFORESTATION

Mihai DAIA[1], Constantin ROŞU[2], Gheorghe PÂRNUŢĂ[3], Marin TUDOROIU[3]

[1]University of Agronomic Sciences and Veterinary Medicine Bucharest, Faculty of Agriculture, 59 Mărăşti Blvd., Bucharest, code 011464, Phone: 021 318 0466; Fax: 021 318 0466, mihai.daia@rnp.rosilva.ro
[2]„Ştefan cel Mare" University of Suceava, Forestry Faculty, 13 Universităţii Street, Code 720229, Phone: 0230 216 147; Fax: 0230 520 080
[3]Forest Research and Management Institute, 128 Eroilor Blvd., Voluntari, code 077190, ILFOV, Romania, Phone: 021 3503238; Fax: 021 3503245; gh_parnuta@icas.ro; borys19@gmail.com

Corresponding author email: manajov@yahoo.com

Abstract

The stands' regeneration through afforestation does not represent the main modality for insuring the stands' regeneration, but it is used where the natural regeneration cannot be assured, and when the forests are extend or reintroduced. It may be appreciated that nowadays, the stand's status is mainly influenced by the climatic, pedo-hydrological and anthropical factors .In this context, we may witness the process of devitalization and trees' abnormal drying, especially in the arid areas of the country, respectively in the steppe and forest steppe regions, also in Danube meadow regions, in plane and other hilly territories, mainly during dry and extremely dry years. Statistics regarding the beating-up works and rehabilitation of affected plantations within the plantations realized between 2001-2010 by RNP-Romsilva reveal that there were established on a total surface ranged between 5621 and 9239 ha, and 18-25% were damaged and had to be remade. Concerning the supplying of forest reproductive materials, it may be mentioned that during 2001-2011 the seed stand and the seed orchard surfaces decreased, but the seed stands surface for the main scattered and other noble hard wood species increased. The ecological rehabilitation of the degraded forest is necessary and should be realized by promoting species more resistant to more and more dryer site conditions from forest steppe the plane forest and by extension of surfaces covered by Norway spruce in sub alpine region, Stone pine and Mountain pine in the alpine region. Related to the afforestation realized within the state owned forests, it may be noted that they were made in accordance with technical guidelines using the best genetically improved forest reproductive materials, with adapted provenances/ species in different site conditions. We consider that it is mandatory to update the technical guidelines in order to include a more intensive afforestation and forest management processes, conditions that are necessary for obtaining more stable and higher quality stands.

Key words: *afforestation, climate change, site condition, forest species*

INTRODUCTION

The stands' regeneration through afforestation does not represent the main modality for insuring the stands regeneration nor the guaranty of forests existence continuity. The afforestation is used where the natural regeneration cannot be assured, where the forest's frontiers extend or the forest is reintroduced.

Marin Drăcea [5], the initiator of Romanian research on silvicultural matters, mention very suggestively the importance of this domain "The forest is not a temporarily improvisation, but the result of hard and long battles between the blind forces of the nature which continuously corrode the earth's crust until the wooden vegetation, with strong patience and brilliant tactics, manages to conquer the soil, to calm down these blind forces and to give to the man kind peace, the safety of tomorrow and thus the will to live."

It may be appreciated that in the current days, the stand's status is mainly influenced by the climatic, pedo-hydrological and anthropic factors.

Taking into account the evaluations made by the Intergovernmental Panel on Climate Change [22] on global and regional level, we may acknowledge that the mean global air

temperature has increased by approximately 0.74°C in the period 1906-2005, and in Europe, during the same period, the mean temperature increased by 1° C; the precipitations volume has increased in North but decreased in South. I our country, in the period 1961-2007, the increase of the mean temperature was almost 1°C [2], [17]. It turns out that the rapid rhythm of the climatic changes surpasses the ecosystems' adaptability capacity (I.P/10 207/ European Commission Brussels, March 2010-[19]).

In this context, nowadays we may witness the process of devitalization and trees' abnormal drying, especially in the arid areas of the country, respectively in the steppe and forest steppe regions, Danube meadow regions, in plane and other hilly territories, mainly during dry and extremely dry years. This process is highlighted by the wood volume harvested through sanitary cuttings and as well by the results of the trees' health status monitoring evaluated through defoliation degree method [10], [11].

MATERIAL AND METHOD

The study materials for the present paper are "Forest reproductive materials" used in afforestation during the last decade (2001-2010). There are also tackled aspects concerning the update of the national catalogue of Basic Materials for Forest reproductive materials, in accordance with national and international regulations, and taking into account the climatic changes.

The methods used are represented by statistical analysis concerning the current status of stands' regeneration through afforestation and the assessment of climatic changes' impact on site conditions of the forest ecosystems. In order to realize the stands' regeneration through afforestation in the present changes of environmental conditions, the main activities that must be done were mentioned for each vegetation zone.

RESULTS AND DISCUSSIONS

Current status of stands' regeneration through afforestation

The general considerations are reflected by the degree of success of the afforestation works and by the status of natural regenerations (which appear mainly in the extra Carpathian regions form south, east and south-east of the country) and also by the high volume of works that must be done in order to consolidate the plantations until the establishment of close crop status.

Statistics [20] regarding the beating-up works and rehabilitation of affected plantations within the plantations realized between 2001-2010 in forest managed by RNP-Romsilva reveals that there were established on a total surface ranged between 5621 and 9239 ha, and 18-25% were damaged and had to be remade (Table 1).

The climatic changes specific to the current days in Romania are reflected also by the characteristics of the hydrological regime and the frequent floods, due to more and more frequent alternations of minimum and maximum hydrological values [8]. These phenomenons imply severe consequences especially in the Danube Delta and Danube Meadow regions. These types of situations impose the use of the most adequate afforestation technologies [9] and the establishment of an afforestation composition capable to resist these conditions.

The overflowed meadow region located along the Danube, the rivers and in the Danube Delta represents a distinguish silvicultural zone [6], where a limited number of forest tree species grow and the poplars and willows are the widest spread species.

The ecosystems established in steppe or forest steppe clime conditions are considered to be among the most unstable but productive ecosystems. The establishment and development of the forest vegetation through afforestation is difficult, expensive and completely different to the afforestation of any other forest zone from the country and is characterized by the following particularities: (i) the microclimate changes in short time intervals; (ii) the hydrological regime is unpredictable; (iii) the accessibility is hindered bay many little rivers; (iv) the floods produce heavy loses to the plantations.

Starting with the '60ies and until 1989, in the Danube Meadow and Delta regions, there were realized several land improvement works to many natural poplars and willows open woods,

levees and levees covered by palustrian vegetation; swamps and lakes were improved by damming in, draining and levelling; the new areas became silvicultural or agricultural lands.

Table 1. Situation of beating-up works and rehabilitation of damaged plantations

Specification / year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Current beating up works (ha)	5729	5211	6833	6486	5813	5868	4545	7022	6881	5177
Rehabilitation of plantations (ha)	1799	1344	2006	1589	544	112	1026	2217	1808	1047
Total (ha)	7528	6555	8838	8075	6357	6990	5621	9239	8689	6224

Table 2. Distribution of poplars and willows in natural or cultivated stands

Stand composition	**Natural stands**		**Cultivated stands**		**Total**	
	ha	%	ha	%	ha	%
Poplars stands	24.317	51,0	55.251	71,3	79.568	63,6
Willow stands	15.249	32,0	20.371	26,3	65.620	28,5
Mixed poplars and willow stands	8.074	16,9	1.823	2,4	9.897	7,9
Total	47.640	100	77.445	100	125.085	100

After the damming in, the Danube floodable land considerably decreased, especially in the meadow zone, but in the same time the interest for the Danube like ecosystems amplified from the economical point of view and especially from ecological point of view. Furthermore, taking into account he perspective when the available water becomes more and more limited, the sustainable management of all ecosystems, including the forest ones located in zones transited by many water flows (especially in the fluvial zones, including the Danube zone) will be a more and more important issue, offering new valences to the forest tree species.

After the damming in of the Danube, we can note the following distribution of different land categories: (i) the dam-margin zone; holms and the Small Brăila Pond (over 14 000 ha): (iii) impounded zones (over 10 000 ha, 7764 ha with silvicultural purpose).

The afforestation of these areas involves many difficulties like: (i) significant modification of site conditions and deterioration of the soil's humidity and trophicity; (ii) the bad condition of dams: the crest of wave was weatherworn and it even ceased to the water pressure in 2006 and 2010; (iii) poor development of the infrastructure the roadways being represented by the boundary dams and interior earth roads; (iv) the abusive pasturing of no owner animals which shelter in the silvicultural buildings; (v) the sustainable management manner or rehabilitation of natural habitats.

The modification of ownership heavily influenced the forest general condition but especially the stands' regeneration manner. During the forests' restitution process we may acknowledge that the regeneration process went on normally only within the state owned forests. The state owned forest surface decreased from 6. 341 million hectares in 1990 to 3.339 million hectares at the and of 2010, when 52.2% of the national forested was state owned forest, 19 % was natural persons owned forests, 11.5% legal persons owned forests, 2.2% forest owned by religious entities (churches, monasteries etc.), and 15.1% forests owned by town halls. In 1991 the forest regeneration was realized on a total surface of 23097 ha, 15 560 of those through afforestation, while in 2009 regeneration works were realized on a total surface of 22853 ha (10962 ha through afforestation).

In 1991 the afforestation works were realized completely in the state owned forests. In 2009, 77.2% of the total amount of the afforestation

works was realized in state owned forests, although the state owned forests represent only 53% of the total national forested area.

The increase of the national forested area through afforestation of 25551 degraded lands (the majority of planted lands are located in Oltenia and Dobrogea, according to (*** Law Nb. 46/2008 – Forest Code [22] and National strategy for Romanian sustainable development [21]) during 1990-2010 period varied according to the possibility of transfer of this type of land from the National State Domain Agency to RNP-ROMSILVA.

Lately, outside the national forested area, an afforestation campaign is in place, contributing this way to the increase of forested area by planting of trees on the lands unable to be used for agricultural purpose.

The creation of shelter-belt action doesn't occupy the necessary status, due to the difficulties generated by the convincing the land owners to agree to with the plantation of some their lands.

Related to the afforestation realized within the state owned forests, it may be noted that they were made in accordance with technical guidelines using the best genetically improved forest reproductive materials adapted species in different site conditions. The most suitable work technology and regeneration composition were used when special site conditions were encountered.

The future of stands' regeneration through afforestation

Concerning the insurance of forest reproductive materials, it may be mentioned that during 2001-2012 the seed stands' surface decreased from 58098 hectares to 46697 hectares and the seed orchard's surface also decreased from 828 hectares to 619 hectares.

Table 3. Dinamics of seed stands and seed orchards surfaces (ha)

Year	**Conifers**		**Broadleaves**		**TOTAL**	
	Seed stands	Seed orchards	Seed stands	Seed orchards	Seed stands	Seed orchards
1979	34 374		30915		65289	
1986	32891	576	37669	428	70561	1004
2001	25303	528	32795	300	58098 (44548*)	828
2011	17813		28884		46697	619

*) Initial surface was reduced by Ministerial Order Nb. 481/2002

If we analyze the evolution of seed stands and seed orchards surfaces we may notice that, during the last 30 years, it has decreased. In 2009-2010 National Forest Administration – ROMSILVA financed a project [15] meant to revise and update the National Catalogue [25] (approved by Ministerial Order Nb. 269/2001 [26]) and elaboration of the National Catalogue of Basic Materials, in accordance to national (***O.U.G. nr. 11/2004 [24], replaced by the Law 107/2011 [18]) and international regulations (***EU Directive 1999/105 [27]). The basic materials sources proposed within the National Catalogue of Basic Materials (which will finalize in 2012) are sufficient in order to cover the forest reproductive materials needs, for all important forest tree species.

In order to ensure necessary for the more increasing demand for scattered and noble hard wood species (Wild cherry, Ash, Sycamore maple, Black alder, Chestnut, Beam tree, Black walnut) there were established 167 seed stands on a total surface of 788 ha.

A novelty approach of the new National Catalogue is the introduction of 63 seed stands and 2 seed orchards included in the "Tested" category. These basic materials sources were approved by the national authority responsible for silvicultural matters taking into account the results of researches made by ICAS [14].

There were also proposed [15] source units for stands adaptation capacity to extreme site conditions, on species and regions of provenances [16], as it follows:

- superior altitude Norway spruce stands (ecological sector 1B), 8 seed stands totalizing 124 ha;
- high altitude beech stands (ecological sector 3A), 7 seed stands – 136 ha;
- thermophilic oak stands on sandy soils (ecological sector 6D), 5 seed stands -46 ha;
- mixed Turkey –Hungarian oak and pure Hungarian oak stands on soils with pseudogleyzation (sector 7A), 5 seed stands -76 ha;
- small forests in steppe region (sector 8A), composed with species like: Turkey oak, wild cherry, flowering ash, black pine, black locust, greyish oak, silver lime, 12 seed stands – 16 ha;
- greyish oak stands on sandy soils (sector 8B), 2 seed stands – 16ha;
- pedunculate oak stands on swampy soils (sector 9B), 9 seed stands totalizing 217 ha.

The National Catalogue of Basic Materials will include the nursery stool beds for obtaining forest reproductive material for the "Qualified" category for poplar selected clones and hybrids (31.55 ha) and for willows (10.89 ha) [7].

Considering the future of stands' regeneration through afforestation, we may admit that if the mean annual temperature modifies by approximately 1^{o}C very probable there will be a translation of the Romanian vegetation zones meaning a slight transition from steppe to semi desert conditions, from forest steppe to steppe conditions, form plain forest to forest steppe. There will be registered also an increase of the altitude of the vegetation layers: the sessile oak stands will move up to the beech stands layer, the beech stands layer will move up to the one of mixed beech and conifers stands, these will reach the Norway spruce stands level and finally the Norway spruce stands will go up to alpine zone, resulting in an increase of the superior altitudinal limit of forests [1], [3], [4], [12], [13].

As a result of the climatic changes, the most affected forests will be those which already have a reduced resistance to biotic and abiotic factors, mainly located in the plain region: the stands including pubescent oak, greyish oak, Hungarian oak, Turkey oak, pedunculate oak, black locust stands located in unfavourable conditions etc [11]. Less affected by the climatic changes will be the mixed stands including a rich spectre of species.

The species selected for afforestation must take into account the establishment of the forest compositions best suited to the actual climate conditions; the introduction of exotic species should be done only after convincing research studies.

It is necessary to rehabilitate the degraded forests and to promote the species more resistant to drier and drier conditions from forest steppe and plain forests, and, as well the broadening of the Norway spruce in the subalpine region, of the stone and mountain pines in the inferior alpine zone (Giurgiu, 2010).

In order to ensure the forests' stability it is necessary to avoid the mono species plantations and to promote the diversified regeneration compositions taking into account the conservation of genetic biodiversity.

In the plain region should be found an alternative to the black locust pure plantations by promoting other species like elms, flowering ash, xerophyte oaks, European nettle tree, European wild pear, beam tree.

Within the forest steppe and plain forest regions, the oaks will remain the main forest tree species but their proportion in the regeneration composition should not exceed 60% in order to include also secondary species.

In the hilly region, the mezo xerophyle species should be promoted as well as the pedunculate oak, according to the site conditions.

On medium and high altitude hills it is necessary to promote the three sessile oak subspecies: petrarea, policarpa and dalechampi, the first one in the cooler region of Moldavia, and the other two in the southern part of the country concurrently with introducing of the secondary species, keeping in mind that in some parts the existence of common hornbeam and limes is essential for ensuring the stands' stability.

Within the sessile oak subregion, especially on compact soils, as it is naturally distributed in Pătrăuţi region, the pedunculate oak should be introduced.

The beech stands will continue to be de main resistance belt of the Romanian forests; however where the natural regeneration must be helped, the silver fir should be reintroduced if from certain reasons it disappeared in regions where the site condition are favorable for it.
Within the beech stands mixed with conifers vegetation layer, the Norway spruce pure stands should be replaced in the future with mixed Norway spruce, beech and silver fir forests. In the Norway spruce stands vegetation sub zone in order to increase the stands' stability and to diminish the proportion of negative phenomenon (wind blows, snow brakes, insects' attacks etc) there should be reintroduced species like beech and silver fir and to promote the European mountain ash where the site conditions are suitable for its development. In order to fortify the stands from this region, it should be used forest reproductive materials from seed sources selected for their capacity to adapt to extreme site conditions.
In the future time the alpine zone will probably be the main zone of expansion and retaking of very important forest lands. Here we will find, the stone pine, the European larch, Norway spruce, mountain ash, green alder, mountain pine etc.
In the region of overflowed meadows, especially in the Danube Delta, in the conditions of a steppe or forest steppe climate, dry or semidry, the most labile but in the same time most productive ecosystems are established. The total surface covered by poplars and willows totalizes 125 085 ha representing 2% of the total national forested area. In order to realize a management that ensures a higher stands' stability, the hydrological (the duration and frequency of the floods and the underground water) and soil (soil texture and humus content) conditions must be taken into account.
In these areas there must be realized the rehabilitation and preservation of the natural habitats, to ensure the ecosystems' stability, but in the same time to obtain high value wood. It must be ensured the conservation of the forest genetic resources established for autochthonous species especially those of black and white poplars, white and crack willows. The ecological reconstruction of these areas should be made by replacing the poplar clonal plantations planted in improper conditions with plantations of indigenous poplars and some hardwood species (oak, ash and elm) compatible with the site conditions. The plantations with hybrid poplars and selected willows must be promoted only in very good site conditions in order to obtain vigorous stands. For accomplishing this objective the nursery stool beds network has been remade using all the clones attested for use in plantations. In order to prevent the losses from the young hybrid poplars plantations and to avoid the drying of the mature stands as a result of climate change and descending of the underground water, a new planting technology using large sizes poplar big slips.
In the regions where water flows produce shore fall, the regeneration works will have to consider the creation of a continuous forest belt composed by autochthonous species, with a multistage structure which to ensure the shores protection. For satisfying the increasing demand of wood in the plain region, an alternative that must be considered is the development of agro-forest plantations meaning the plantations of forest tree species in and agricultural lands, among the agricultural cultures. The best known combination between agricultural – forest plantation is that of the forest shelter belts, one of the best solutions for a sustainable management of de agricultural lands. A mandatory condition is to update de technical guidelines for a more intensive establishment and management of plantations in order to obtain more stable and better quality stands.

CONCLUSIONS

The current status of the stands' regeneration through afforestation was largely influenced by climatic, pedo – hydrological and antropic factors, leading to a percentage of 18-25% of damaged plantations.
As a result of the forests' restitution process, the afforestations' quantum decreased due to the fact that they were mainly realized in the state owned forest (more than 90%).
For the future afforestations, taking into account the climatic changes, the National

Catalogue of Basic Materials has been revised and updated in order to ensure forest reproductive materials genetically improved and adapted to various site conditions.
There were realized guidelines for afforestation works on vegetation zones.

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