RESEARCH ARTICLE **(Open Access)**

Eco-Physiologic studies an important tool for the adaptation of forestry to global changes.

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Abstract

Forests are the dominant land use in Albania, occupying almost 1.5 million hectares [11], but c.a. 70% of the forest area belong coppices and shrub forests, as the results of unsustainable practices, intensive cutting and overgrazing. Forest ecosystems serve many ecological roles, including regulation of the planet's carbon and water cycles. Forests are also important components of economic systems. Research in the Forest Ecophysiology studies on the Faculty of Forestry Sciences is intended to produce biological knowledge that can be used to better manage forest resources for sustainable production of economic and non-economic values and aims to improve the understanding of past and current dynamics of Mediterranean and temperate forests. The overarching goal is to quantify the influence of genetics, climate, environmental stresses, and forest management inputs on forest productivity and carbon sequestration, and to understand the physiological mechanisms underlying these responses.Process-based models open the way to useful predictions of the future growth rate of forests and provide a means of assessing the probable effects of variations in climate and management on forest productivity. As such they have the potential to overcome the limitations of conventional forest growth and yield models. This paper discusses the basic physiological processes that determine the growth of plants, the way they are affected by environmental factors and how we can improve processes that are well-understood such as growth from leaf to stand level and productivity. The study trays to show a clear relationship between temperature and water relations and other factors affecting forest plant germination and growth that are often looked at separately. This integrated approach will provide the most comprehensive source for process-based modelling, which is valuable to ecologists, plant physiologists, forest planners and environmental scientists [10].

Actually the Albanian vegetation is presented in two different appearances:

- on one hand the existence of the virgin forests, generally located far from dwelling centres, because the lack of the infrastructure and,
- on the other hand the existence of degraded forests, located near dwelling centres because of intensive harvesting, abusive cutting and growing.

By the consequences the degraded ecosystems are under an ecological stress and their rehabilitation is very difficult. To develop low cost methodologies for improving vegetation which will result in functional ecosystems in far degraded Mediterranean areas by means of physiological studies is very important and a new scientific field in Albanian forestry.

The study is focused on seed germination physiology and seedling stress selection of some native evergreen and broadleaves oak species in order to determine the seed germination dependency on temperature and humidity, methods releasing germination beanies in species candidate for improving vegetation, the sensitivity of the germinating seeds and the seedlings on extreme temperatures, and the selection of drought and cold resistant seedling among populations of different geographical origin.

Keywords: Ecophytosiology, forestry adaptation, regeneration, ecological stress, oaks

1. Introduction

Forests are the most dominant land use in Albania, occupying almost 1.5 million hectares [12], but c.a. 70% of the forest area belong coppice and shrub forests, result of unsustainable practices, intensive cutting and overgrazing. In addition there are degraded areas and abandoned agriculture land, a big potential for afforestation's and reforestations to be done. Forest ecosystems serve many ecological roles, including regulation of the planet's carbon and water cycles. Forests are also important components of productive economic systems.

Understanding the ecological processes that drive structure and dynamics in plant communities and predicting the extent to which the alteration of environmental conditions affect these processes are major challenges in plant ecology research [4].

Developments and accomplishments, mostly since the 1970s, in forest tree seeds are reviewed. What remains unknown, and recommended directions for research during the early years of the new millennium, are discussed. The main focus is on seed production, storage and longevity and seed quality testing and nursery performance [5].

Research in the Forest Ecophysiology studies on the Faculty of Forestry Sciences is intended to produce biological knowledge that can be used to better manage forest resources for sustainable production of economic and non-economic values and aims to improve the understanding of past and current dynamics of Mediterranean and temperate forests. The overarching goal is to quantify the influence of genetics, climate, environmental stresses, and forest management inputs on forest productivity and carbon sequestration, and to understand the physiological mechanisms underlying these responses.

Process-based models open the way to useful predictions of the future growth rate of forests and provide a means of assessing the probable effects of variations in climate and management on forest productivity. As such they have the potential to overcome the limitations of conventional forest growth and yield models.

The significance of seed stage capacity has long been recognized as one of the critical steps in the species spatial and temporal establishment success [6]. The response pattern of seed germination is also regarded as a key characteristic in plant lifehistory strategy. The germination season, and the temperature requirements for germination, might be crucial for plant survival. To test the germination capacity and its temperature dependence in Mediterranean plants thirteen species representative of a diversity of habitats of Albanian vegetation were selected.

This paper discusses the basic physiological processes that determine the growth of plants, the way they are affected by environmental factors and how we can improve processes that are well-understood such as growth from leaf to stand level and productivity. The study trays to show a clear relationship between temperature and water relations and other factors affecting forest plant germination and growth that are often looked at separately. This integrated approach will provide the most comprehensive source for process-based modelling, which is valuable to ecologists, plant physiologists, forest planners and environmental scientists [10]. Seed germination can be regulated not only through genotypic characteristics [7], but also by environmental conditions, being soil temperature the most important environmental factor controlling seed germination.

To develop low cost methodologies for improving vegetation which will result in functional ecosystems in far degraded Mediterranean areas by means of physiological studies is very important and a new scientific field in Albanian forestry.This study assessed the effects of pre-treatment techniques on germination of seeds of some forest species, dedicated for the reforestation of degraded areas and is focused on seed germination physiology and seedling stress selection of some native evergreen and broadleaves oak species in order to determine the seed germination dependency on temperature and humidity, methods releasing germination beanies in species candidate for improving vegetation, the sensitivity of the germinating seeds and the seedlings on extreme temperatures, and the selection of drought and cold resistant seedling among populations of different geographical origin [2].

2. Material and methods

The evergreen Mediterranean's clerophyte vegetation is one of the most degraded vegetation. On the other hand the Mediterranean climate is characterised by its seasonality in temperature and precipitation, which leads to a hot drought period in summer and a cool wet period in winter [8]. This peculiarity of the Mediterranean climate has important implications on plant germination physiology, since dry summer conditions limit water availability and thus germination and growth, while cool winter temperatures also limit germination during the season with high water availability [14].

Progressive deforestation, due to wild fire, intensive cutting and over greasing, including habitat disruption rapidly, lead to a transformation of the ecosystem from their native state [15]. Actually we can be meet advanced degraded stages, even bare zones, and dedicated strong erosion desertification phenomenon, causing important damages in crop and human activities. The rehabilitation of these vegetation types is one of the most important objectives of the European global strategy and, at the sometime, very difficult because of climate change

and adverse ecological condition. This is, as well, one of the scientific priorities for the Faculty of Forestry Sciences.

When artificial regeneration is performed the selection of the proper provenance is of greatest importance [9]. For three years we worked on the framework of the NATO "Science for stability" project: "New approaches for improving vegetation in far degraded Mediterranean Ecosystems".

The vision of this project was: "To develop low cost methodologies for improving vegetation, which will result in functional ecosystems in far degraded Mediterranean areas by means of physiological studies and application".The main objective was to compare thegermination capacity and the ability to germinate underdifferent temperature ranges, those typically occurringin the different seasons, of Mediterranean species, belonging to different taxonomic,evolutionary and life habit groups.

Thirteen Mediterranean species inhabiting in the southern Albania were selected according to their distribution and life habit. Seeds from at least 10 plants per species were collected in the field. Depending on the distribution of each species, one to three different populations were sampled for seed collection.

The germination of the candidate forest seeds, in different ecological condition, pre-treatment by worm water, temperature, moisture and planting time, is done on the laboratory of Botany on the Faculty of Forestry Sciences. There are planted seeds of forestry candidate species, below listed, on different ecological conditions, periods and treatment by water, with experimental and seedlings product intention [11]. Seeds were placed in 9 cm diameter Petri-dishes on two layers of filter paper (Whatman no.1) moistened to saturation with distilled water, so that germination was not limited by water. Additional water was added when needed. Care was taken not to inundate the seeds. Petri-dishes were covered with par film to minimise water loses. Germination tests were conducted in controlled environment chambers.

Regarding pre-treatment by water, there are used five variants of planting:

V_1 - Planting on the plastic pots without treatment

V_2 - Planting on the plastic pots after the treatment by water (5 days)

V_3 - Planting on the plastic pots after the treatment by water (10 days)

V_4 - Planting on the plastic pots after the treatment by water (15 days)

V_5 - Planting on the terrain without treatment of the seeds.

The candidate seeds of forestry species as: Carob Tree (*Ceratonia siliqua* L.), Prickly Juniper (*Juniperus oxycedrus*L. ssp. macrocarpa), Holm oak (*Quercus ilex* L.), Valonia oak (*Quercus macrolepis* Kotschy), Kermes oak (*Quercus coccifera* L.), Strawberry Tree (*Arbutus unedo* L.), White Heath (*Erica arborea* L.), Oriental Hornbeam (*Carpinus orientalus* Miller.), Oleander (*Nerium oleander* L.), Common Myrtle (*Myrtus communis* L.), Haleppo Pine (*Pinus halepensis* Miller), Flowering Ash (*Fraxinus ornus* L.), Lentisk (*Pistacia lentiscus* L.), are collected on the Albania's evergreen Mediterranean clerophyllous forests and shrubs, under stress selection, providing a small seeds genetic bank.

On the framework of seed germination physiology and seedling stress selection objective there are determined the following tasks: (i) the study of seed germination dependency by the temperature and humidity; (ii) the development of the methods to release germination beanies in species candidate to improve vegetation's; (iii) the study, in the some species, of the sensitivity of the germinating seeds and seedlings on extreme temperatures; (iv) the selection of drought and cold resistant seedling among populations of different geographical origin; (v) the study of the seeds germination and seedlings development in different lighting and darkness conditions.

Regarding the nursery and greenhouse organization objective to produce plant materials, the main planed tasks were: (i) the providing of GR-Revegetation (Albania) program with plant materials needed for out or indoors experiments, (ii) the providingof re-vegetation materials in disposition of governmental, municipal or private activities for upgrading Mediterranean ecosystems; (iii) theapplied and if is necessary the development of micro-propagation techniques, in order to possibly reduce the cost of forest seedlings, proper for re-vegetation activities; (iv) the propagation of the knowledge and experience gained, among governmental and municipal, as well as private enterprises.

On the framework of seedling germination or plantlet survival under ecosystem condition there are accomplished the following tasks: (i) the organization of the main experimental field within Agricultural University territory; (ii) adequately large, to allow the performance of experiments for a number of years;

(iii) the providing of the scientific instruments for the measuring of the climatologically parameters, as well as the water potential status of the growing plants; (iv) the organization of the experimental fields at selected geographical regions of Southern Albania; (vi) the finding out among the species of the local flora, the ones most proper for upgrading Mediterranean ecosystems. Also to develop methodologies and determine the intervention times for obtaining cost flowering and high survival rates for seedlings or pantalets; (vii) the accommodation of experiments for testing plant materials derived through clonally and stress selection.

Among the organizational work, much effortwas directed on the establishment of the nursery and greenhouse at the Agricultural University of Tirana, Faculty of Forestry Sciences.

3. Results and discussion

First we studied the seeds germination only on the environment temperature of the seeds of Common Myrtle (*Myrtus communis* L.), Lentisk (*Pistacia lentiscus* L.), Holm Oak (*Quercus ilex* L.), Valonia oak (*Quercus macrolepis* Kotschy), Carob Tree (*Ceratonia siliqua* L.), and Oleander (*Nerium oleander* L.), treated by worm water for different days (see variants experimented).

There are planted, on the glass pots with 5 mm distillate water, 25 seeds for each forestry species over mentioned. The results of germination were as follow:

Table 1. For Valonia (*Quercus macrolepis* Kotschy)

Planting 19.02.1998 No., (%)	*Starting of germination 06.03.1998 No. (%)*	*Ending of germination 06.04.1998 No. (%)*	*Desiccation 31.04.1998 No. (%)*	*Growing average mm*
250 (100)	30 (12)	220 (90)	220 (100)	15

Table 2. For Holm Oak (*Quercus ilex* L.)

Planting 11.02..1998 No., (%)	*Starting of germination 28.02.1998 No. (%)*	*Ending of germination 27.03.1998 No. (%)*	*Desiccation 15.04.1998 No. (%)*	*Growing (average) mm*
250 (100)	40 (16)	210 (87)	210 (100)	10

Table 3. For Oleander (*Nerium oleander* L.)

Planting 06.03..1998 No., (%)	*Starting of germination 20.03.1998 No. (%)*	*Ending of germination 20.04.1998 No. (%)*	*Desiccation 10.05.1998 No. (%)*	*Growing (average) mm*
250(100)	20 (6)	225 (90)	225 (100)	15

- We started with two oak species, very important for the Mediterranean zones, which occupied important areas, but unfortunately damaged by the human activities:
- Holm oak (*Quercus cerris* L.), which dominates many forests over large areas of the Mediterranean Basin. Besides itshigh agronomic and social impact, Holm oak forests harbour an enormous degree of biological diversity [1]. Holm oak (*Quercus ilex*L.) is considered a species well adapted to dry and high-temperature climates, but water deficit cause severe seedling mortality, and drought stress is considered one of the triggering causes of Holm oak (*Quercus ilex*L.) decline. Thus, the development of efficient regeneration and conservation strategies is a priority, and requires ecophysiological studies, in order to understand adaptation to changing environments, assisted by a better understanding of the molecular drought-tolerance mechanisms.
- Valonia oak (*Quercus macrolepis* Kotschy), decline, is a typical Mediterranean species, has been recorded in the past two decades [13]. It was extended on the south-owestern Albanian (Ionnian coastal belt). The triggers were mostly human influence and specifically illegal cutting, wildfire and overgrazing. Regeneration and future management of this specie is therefore questionable. It has been widely used on the past for dye production extracted from its acorn cups as well as fodder for its acorns (Baldacci). Nowadays only its acorns are used for feed to livestock whereas its low wood quality is generally used only for firewood [16]. In the past few years there has been a growing interest for the species to be included in reforestation as well as

in research projects. On the other hand there is extensive information on regeneration of oak forests and the factors that there are affecting it. The existing knowledge establishment and is circumstantial and not scientifically documented information is available. More important, there is no information on the factors that affect species establishment and growth.

This experimental work continued for other forest species, listed as candidate species, which are under the ecological stress.

The results of the germination's dependency by treatment with water were:

The germination dependency, by the time, of Valonia (*Quercus macrolepis* Kotschy), for five variants, were:

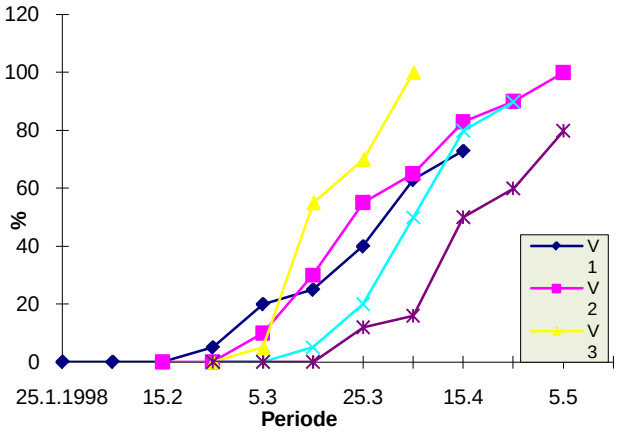

Figure 1. Germination dependency of Valonia seeds by the planting period

The seeds of Valonia (*Quercus macrolepis* L.) planted on November 05.1997 germinated after 45 days. The growing mm for this specie, shown in fig. 2:

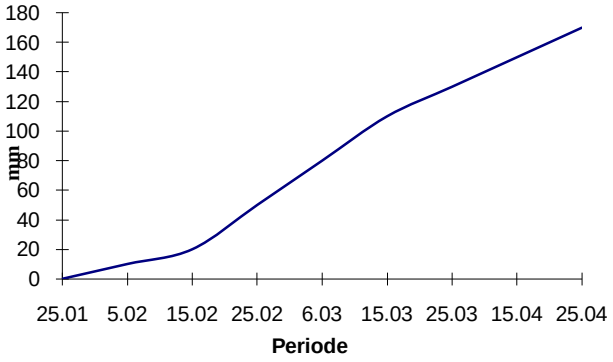

Figure 2. Growth dynamic in high of Valonia seedlings

The germination dependency, by the time, of Holm Oak (*Quercus ilex* L.), for five variants, shown in fig. 3,4:

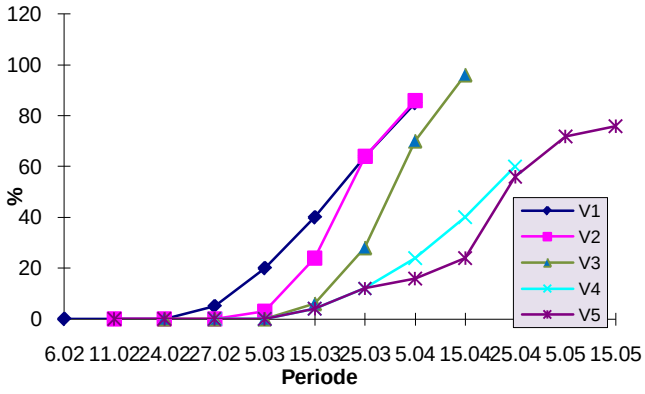

Figure 3. Germination dependency Holm Oak seeds by the planting period

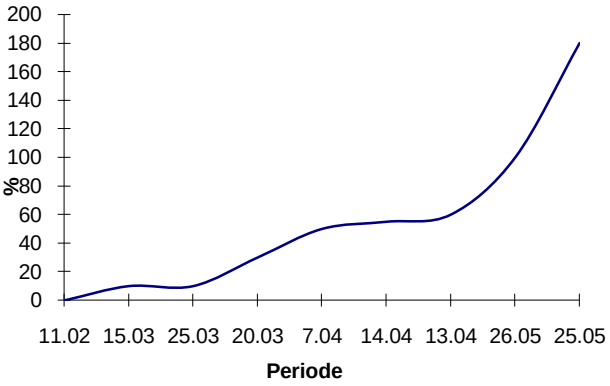

Figure 4. Growth dynamic in high of Holm Oak seedlings

We have identified the experimental field within Agricultural University territory where, for the first year, are planted only Oleander (*Nerium oleander* L.), seeds and pantalets. For the next three years we planted: Valonia oak (*Quercus macrolepis* Kotschy), Holm oak (*Quercus ilex* L.), Lentisk (*Pistacia lentiscus* L.), Carob Tree (*Ceratonia siliqua* L.), Strawberry Tree (*Arbutus unedo* L.), White Heath (*Erica arborea* L.), Common Myrtle (*Myrtus communis* L.), Prickly Juniper (*Juniperus oxycedrus* L. ssp. macrocarpa), Black Poplar (*Populus nigra* L.) etc.

Below, after 14-15 years we have analysed the growth dynamics for the oak and poplar trees, planted on the ecosystem conditions. The relationships of the trees volumes with diameter and highness and related exponential equations are represented on the fig.5; fig. 6; fig.7; fig. 8:

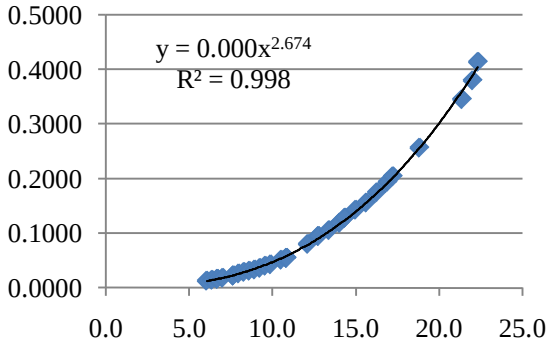

Figure 5. The relationship between volume and diameter per Poplar trees

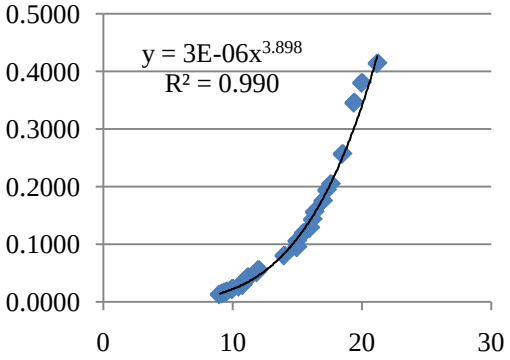

Figure 6. The relationship between volume and highness per Poplar trees

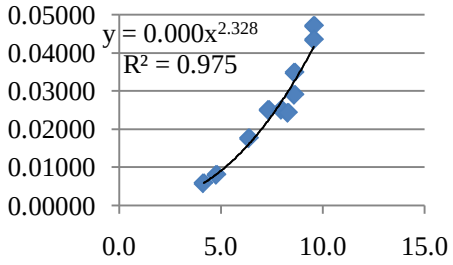

Figure 7. The relationship between volume and diameter per Oak trees

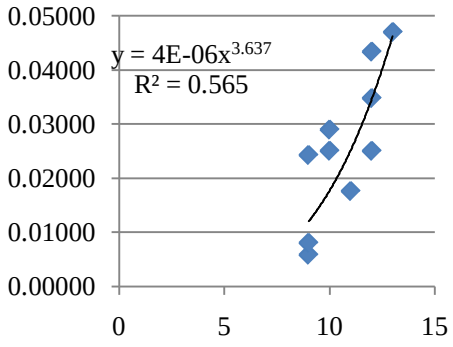

Figure 8. The relationship between volume and highness per Oak trees

4. Conclusion

For forest regeneration in general, seeds remain the method of necessity and the choice, object of eco-physiologic studies. Whereas other methods of propagating stock for new forests, such as rooting of vegetative cuttings, and micro propagation techniques, have been and are being developed,during the last decade at least, natural regeneration has regained priority over artificial regeneration.

Pre-treatment of seeds, before planting, is an important factor for the germination percentage and further development of seedlings. The experiments shown that best alternative is the third variants for both species (10 days pre-treatment on worm water), but the intensive growth is different [after 10 days per Valonia (*Quercus macrolepis Kotschy*)].

Here is a strong relationship between the development in volume of planted trees and diameter and highness for poplar trees and a weak one of volume and highness per oak trees. This is related with the different provenances and genetic differences per oak species.

As expected for Mediterranean ecosystems, where many species have been related to present different types and degrees of dormancy [2], large differences in germination, were found between species and for the same species planted in different period. This wide range of variation could be partly explained by intraspecific differences, between populations and years, as already observed in some species, due to both environmental and genetic causes.

On the other hand, since the Mediterranean climateis characterized by highly episodic and unpredictable rainy events [17], and therefore water availability in soil, it could be argued that rapid and massive germination would constitute a positive adaptation to such environment.

In conclusion, this study shows a wide range of diversity in the temperature influences on the germination capacity of Mediterranean species, which might be related to different strategies adopted by these species as a consequence of the heterogeneity of habitats and climatic seasonality intrinsic to the Mediterranean ecosystems.

The first seedlings produced on the nursery are panted first on the territory of Agricultural University of Tirana. In addition we have negotiated with General Directory of Forestry Service in Albania, to provide the experimental field on the Southern Albania, Forestry project of World Bank, to provide the next year a financial support, and American

Agency of Private Forest to provide the market for the selling of the plant materials, product by our program.

There are produced, in plastic bags and in terrain the forestry species as follow: Quercus ilex (800), Quercus macrolepis (950), Nerum oleander (500), Laurus nobilis(250), Fraxinus ornus (200), Cercis siliquastrum (90), Pinus halepensis (235), Populus Canadensis (900), Populus nigra var. piramidalis (100), Cupresus sempervirens (30), and Aesculus hipocastanum (50).

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