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The Importance of Seed Stands in Broadleaved Forestry in Kosovo

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Abstract

The choice of seed source is decisive for the success of plantings. To avoid mistakes the consumer must know which seed sources are available and to what extent they will match the planting site and the purpose of the planting programmes. A project from FAO financed supports the implementation of Forest Strategy in Kosovo. According to this project from now to the year 2026, Kosovo must plant about 3,000 ha annually of forest with native tree species such as: beech (*F. silvatica*), oaks (*Quercus sp*.). Seed requirement for this planting plan is very great, but present capability of seed supply of the mentioned species from seed stands can't meet this requirement. Seed from appropriate provenances only should be used. Where possible home-collected seed from registered seed stands should be used and applicants in Kosovo are encouraged to ask for plants from Kosovo seed. Selected seed provides a reliable source of well-adapted plants at a modest cost. It is important that the best broadleaved stands are registered as future seed sources. This paper aims to set down establishment procedures for seed stands in the natural broadleaved forests of Kosovo. The high rate of cutting for industrial uses and fuel-wood in many parts of Kosovo has created a situation of severe dysgenic exploitation which can be mitigated by setting aside high quality stands for seed production. The location of the seed sources of beech and oaks, were described and the boundaries were demarcated in the field. In default of information on origin careful estimation of the adaptability, growth and reproductive ability of the stand were carried out. The first step taken in delineation was to produce an accurate map of the distribution of seed sources. The second step was to determine the original and large scale of populations. These main populations were then examined for lesser discontinuities resulting from soil types, mountain ridges and human interference. At the end 4 stands were selected of 5 ha area and necessary data were collected in the field. To realise this benefit detailed procedures for stand selection, mapping, inventory, thinning, isolation, registration and future management are required which are suitable for application in the unmanaged stands of broadleaved species..

Keywords: seed stands establishment; provenance; tree improvement; seed sources; seed orchards; improved genetic quality.

1. Introduction

Approximately 44.7% (481,000 ha) of Kosovo`s area is under forest cover (Kosovo National Fore-stry Inventory 2012) and the need to assess, mana-ge and develop this forestry estate to create both emp-loyment and investment opportunity is paramount. Within framework of a FAO project (Support for the implementation of the Forestry Strategy in Kosovo) an assessment and analysis of potential areas for afforestation has been carried out. This report provides important data regarding the num-ber of seedlings that should be produced, as well as the range of required species. The objectives of the National Afforestation/Reforestation Program can-not be achieved without the production of high quality forest seedlings of the appropriate species. The target for the forest nursery will be the produc-tion of forest seedlings suited to the site types pre-defined as being suitable for afforestation in Kosovo. Future production strategies should focus on the production of seedlings, from indigenous seeds, collected from national seed stands. The advantages of focusing on native species are:

1. The genetic profile of the indigenous trees and shrubs which are of local origin will compliment local growing conditions. The key principle should be the right tree in the right place.
2. Planting trees that are better adapted to local site conditions will lead to a better plant survival rate thus avoiding the significant cost of replacing.

3. Planting seedlings grown from imported seeds will affect the local genetic characteristics of cer-tain species. This can manifest itself through dela-yed sprouting, delayed flowering and fructifica-tion. This in turn can disrupt the balance between the indigenous species and the wild life.
4. Using native seedlings will reduce transport costs.
The selection and establishment of seed stands represents a quick inexpensive method of obtain-ning seed of improved genetic quality. Up to now all seed collection in Kosovo has been made in the form of general collections of provenance identi-fied material with control to avoid collection from particularly poor phenotypes. This paper aims to set down establishment procedures for seed stands in the beech and oak natural forests in Kosovo in terms of stand selection, inventory, stand treat-ment, isolation and their future management. A seed stand may be defined as a plus stand that is upgraded & opened by removal of undesirable individuals and then cultured for abundant seed production (Barner 1973). This description corres-ponds with the OECD (Organisation for Economic Cooperation & Development) category of "*selected reproductive material*" (OECD 1974) and it is intended that selected seed stands should follow these guidelines. A further important role of seed stands is the conservation of genetic resources. The high rate of cutting for industrial uses & fuel-wood in many parts of Kosovo has created a situation of severe dysgenic exploitation which can be mitiga-ted by setting aside high quality stands for seed production. General aspects of seed stand establi-shment have been frequently reviewed in literature (Barrett 1980). Main objectives of seed stand esta-blishment have been widely recognised and are:
1) Produce seed of improved genetic quality.
2) Increase the quantity & quality of seed produced
3) Concentrate seed collection in small areas thereby lowering costs and making control easier.

2. Material and Methods

In the natural beech forests of Kosovo, comprehen-sive surveys to locate the best stands are beyond the capacity of the KFA (Kosovo Forest Agency) staff. Thus for efficient stand selection the advice of local KFA staff was very important to locate a shortlist of possibilities which were visited and inventoried. The first step taken in delineation was to produce an accurate map of the distribution of seed sources in all Kosovo. It was important to select stands in which there is likely to be a signi-fycant genetic component in the phenotypic superiorrity. The second step was to determine the original, large scale populations that were present. These main populations were then examined for lesser discontinuities resulting from soil types, mountain ridges & human interference.

2.1. Selected stands

Definition

A selected stand is a stand of trees superior to the accepted mean for the prevailing ecological condi-tions when judged by the selection criteria (OECD 1974). The stands are selected because of their phenotypic superiority in specified important traits. It is important to select stands in which there is likely to be a significant genetic component in the phenotypic superiority, for instance, a stand should not be selected solely because it is growing well on an exceptionally good site. Selection criteria were limited to a few important traits. In many countries of temperate zone the following minimum require-ments used by the OECD Scheme for the Control of Forest Reproductive Material are recognised:
1. Uniformity: The stands must show normal deg-ree of individual variation in morphological chara-cters.
2. Volume production: Volume production of wo-od is normally an essential criterion for acceptan-ce of selected stands. Volume production of wood must normally be superior to the accepted mean.
3. Wood Quality shall be taken into account and in some cases, may become essential criterion.
4. Form & Growth Habit: The trees in selected stands must show particularly good morphological features, especially straightness and circularity of stem, favourable branching habit, small size bran-ches and good natural pruning. The proportion of forked trees and with spiral grain should be low.
5. Origin: The clear designation of the stands as material of indigenous and nonindigenous origin.
6. Location & Isolation: Stands need to be situa-ted at a sufficient distance from poor stands of the same species.

7. Effective size of population: Stands must con-sist of groups of trees, well distributed & sufficien-tly numerous to ensure adequate interpollination.

8. Age and development: Stands need to consist of trees of an age at which acceptance criteria can be clearly judged.

9. Health & Resistance: Trees in selected stands must in general be free from attack by damaging organisms & show resistance to adverse conditions of climate and site in the place.

10. Geographic history. The location of seed source must be described and the boundaries must be easily identifiable in the field, where necessary by demarcation. As regards origin, it must be care-fullly checked whether the stands are of local origin or introduced. Very often the information on origin is lacking.

11. Genetic history must be carefully checked.

Above all it is important to study the artificial selection to which the stands have been subjected & to clarify whether the stand had derived from a seed lot representing a few parent trees only or from a larger population. Measures must be taken to reduce the risk of contaminating pollen from foreign sources. Where isolation is difficult, a minimum size of 5 ha of the stand may be recom-mended & seed should not be collected along borderline of selected stand. Finally all available information on stand history in terms of regeneration, thinnings and fires served as a further guide for final selection. Stand selection involves the consideration of a complex factors & represents one of the most critical and proble-matical stages in seed stand establishment. Firstly, it was important to locate seed stands in the most important provenance regions and in situations which will be representative of a given provenance region in terms of altitude, climate & soil. Second-ly, the area of stand required to supply sufficient seed to meet likely demands should be estimated.

3. Results and Discussion

3.1. Stand Selection

Taking into account the above criteria, it became a site inspection of some forest stands, checking with a test to look at the conditions of the forest stands. Stands who did not fulfill one of the above criteria, were excluded from the list of candidates for seed stands. Stands who fulfilled these criteria at first glance, was accepted, but of course, there will be other measurements and observations, to make a final selection of seed stands. Below we give brief information on the inspected piles, providing the end of each description of the opinion, if accepted as seed stand.

Generaly it is preferable to locate stands on nation-nnnally owned land. Access must be adequate to allow entry of a 4-wheel drive vehicle for cone collection operations. Finally the ease of protection of the stand from serious fires or illegal cutting may also influence stand selection.

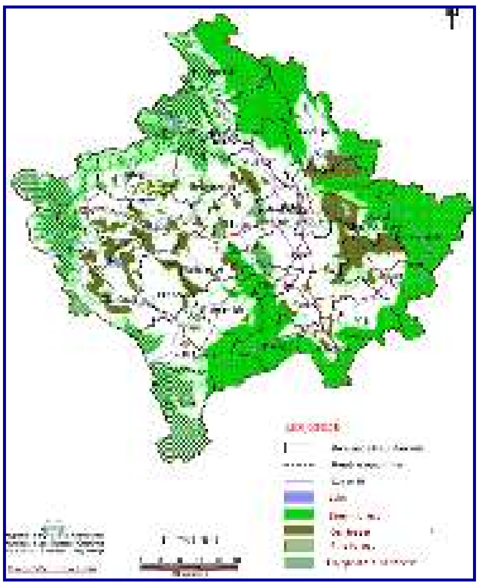

Figure 1. Forest Cover in Kosovo

Given such a large number of factors it may not be possible to satisfy all criteria and find the ideal stand. In Kosovo, the stand requirements can usually be met for 2 or more alternative locations within a given provenance region for *F. silvatica* and *Quercus sp*. and final selection can be based on the all impor-tant factors of access, sale of thinnings and protect-tion. These selected seeds stands, all within Kosovo, are presented in the following table, according to the species and their location:

Table 1. Selected Seed Stands in Kosovo

Nr	Management Unit	Plot Nr.	Species	Area plot Ha	Area of seed stand
1	Ahishte	31/1	*Fagus sylvatica* L.	15.20	5.53
2	Blinaja	33/1	*Quercus petrea* L	21.50	9.72
3	Blinaja	24/1	*Quercus cerris* L.	25.40	6.84

3.2. Mapping

A map at a scale between 1:5.000-1:10.000 was essential for defining seed stand boundaries, desi-gning inventory sampling, fixing isolation zones, control of thinning and for subsequent registration and control of seed collection. The map should outline roads, tracks, rivers, gullies, ridges and the stand limits and can be readily drawn from aerial photographs which also help in studying topogra-phy and stand distribution. Stand boundaries may be demarcated on the map and where possible sho-uld follow features such as tracks, rivers or ridges.

3.3. Inventory

The inventory of seed stands was required for se-veral reasons. Firstly 2 or more alternative stands may be compared as an aid to stand selection. Secondly the inventory results will form the basis for calculating selection intensities for thinning. The inventtory had the aim to yield information on both quantitative characters such as number of trees per ha, tree height and diameter, and basal area and quailtative traits such as stem forking, stem straightness, branch characters and natural pruning. These phenoltypic characteristics may be divided into quality classes to form a basis of the qualitative inventtory assessment and guidelines for marking thinnings.

3.2. Characteristics of seed stands

Table 2. Dendrometric parameters of the seed stands

Key Dendrometric characteristics	Ahishta *Fagus sylvatica*	Blinaja *Quercus petrea*	Gjilan *Quercus cerris*
Average diameter (cm)	34.1	21.9	24.1
Average height (m)	26.0	21.1	23.0
Trees number per ha	354	594	547
Basimetric area (m^2/ha)	32.3	22.3	25.1
Stand volumme (m^3/ha)	870	518	586
Age (years)	136	84	78

Seed Stand nr. 1 Ahishta (*Fagus sylvatica*)

Figure 2. Beech stand selected as seed stand

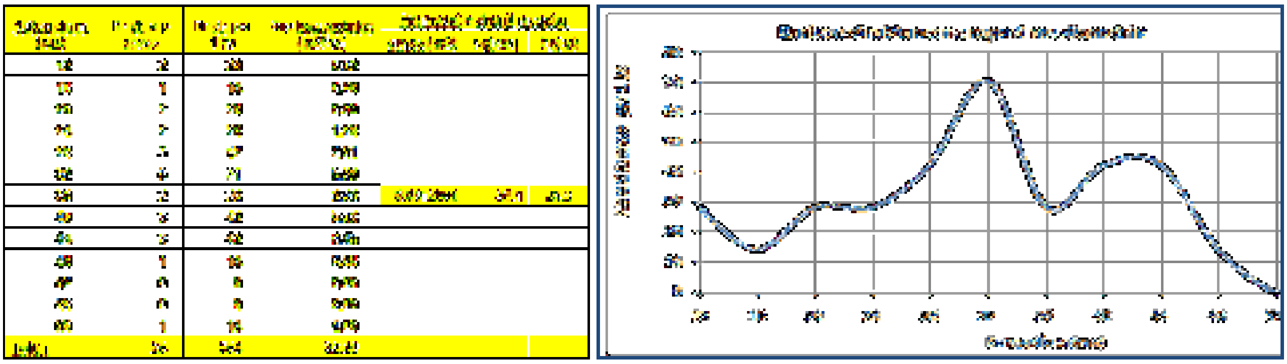

Figure 3. Structure of the beech stands

Seed Stand nr. 2 Blinaja (*Quercus petrea*) Bunga

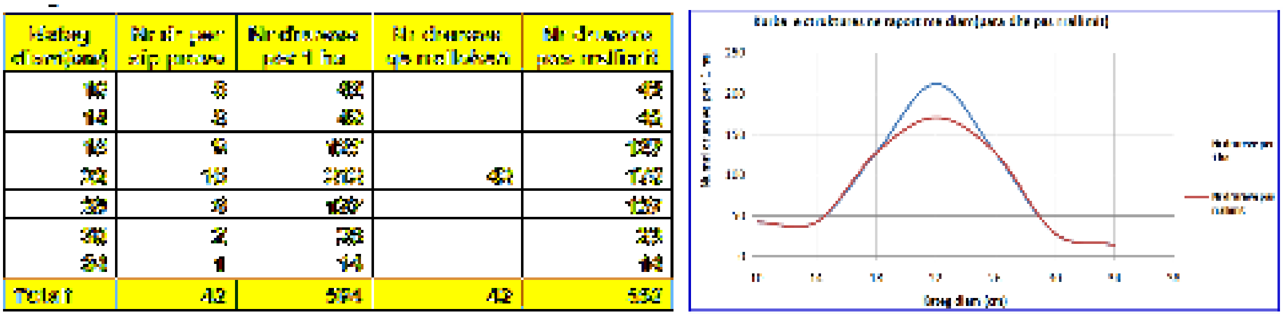

Figure 4. Structure of the oak stands (Q. petrea)

Figure 5. Oak stand Blinaja selected as seed stand

Seed Stand nr.3 Maja Gjelbert (Quercus cerris)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	2	[illegible]		[illegible]
12	2	[illegible]	7	7
[illegible]	5	[illegible]	7	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]
Shuma	[illegible]	[illegible]	[illegible]	[illegible]

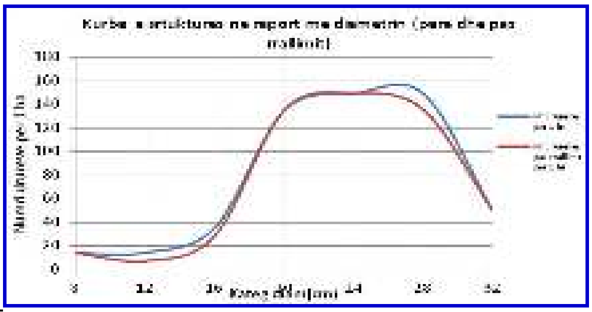

Figure 6. Structure of the oak stands (Q. cerris)

Figure 7. Oak stand Maja Gj. selected as seed stand

3.4. Isolation

In order to achieve the desired genetic gain it is im-portant to isolate the seed stand from inferior pol-len sources outside the seed stand. Complete isola-tion is not possible since windborne pollen may travel great distances and since seed stands must be located in heavily forested areas. Heavy production of pollen within a seed stand is most important for diluting outside contamination effects. Area and shape of the seed stand are also important as conta-mination decreases rapidly away from the stand boundaries towards the centre. The most practical way to isolate a stand is to create a 100 m wide iso-lation fringe around the stand which is thinned to remove all inferior phenotypes. However, well for-med trees remain within the isolation fringe to act as a physical barrier and will also produce signify-cant quantities of pollen. Seed collection is restrict-ted to the central portion of the stand surrounded by this 100 m wide dilution zone. In designing the isolation zone the prevailing wind direction and topography should be taken into account.

3.5. Registration

Seed stands should be registered with the local office the district office and the central office of the national forest authority giving details of loca-tion and stand boundaries and legal documents concerning land ownership.

3.6. Future Management & Seed Collection

The future management of seed stands will depend on the results of longer term studies. Depending on the response of the tree crowns, it is likely that a further thinning will be required within five years to reduce stocking to the final goal of around 150 stems per hectare. Application of nitrogenous and phosphate fertilizers is the most generally accepted means of increasing cone crops (Puritch 1977). However information on dosage rates, timing of application and costbenefit analysis of such opera-tions is lacking. It is apparent that timing is critical and should be just prior to flower bud differenta-tion. The response of cone and seed production to fertilization should be assessed on the basis of smallscale trials as seed stands are established. Cone collection in seed stands must be strictly controlled to ensure that collection remains within the limits inside the isolation zone. It is of para-mount importance to avoid damage to the trees to ensure continued cone crops in subsequent years. However the most important factor is careful use of cone cutters to avoid damaging subsequent years fruits and tree climbers should be specially trained for seed stand collections.

4. Conclusions

Natural forests are the base material for all seed sources and must generally be expected to repre-sent an "average" quality. Trees growing in natural forests must be expected to show a high degree of adaptation to the prevailing environmental condi-tions of the site. Pollination is usually effective in natural forest. However, due to seed dispersal, there is in natural forests a risk that trees form family groups i.e. neighboring trees are related or in extreme cases inbred. This will normally be bro-ken in next generation plantation seed source. To assure genetic diversity is advised that seeds from natural forest be collected from widely separated trees. Seed sources in natural forests should accor-dingly typically be larger than plantations.

Natural forests consist of indigenous species, which has spontaneously generated themselves on the location for many generations. Natural forests include both edaphic and climatic climax types & pioneer forests. Natural forests can be more or less influenced by culture, e.g. by logging/regeneration techniques, but the forests must not have been sub-ject to regeneration by sowing or planting. Sele-ction of mother trees/seed trees in natural forest usually gives little, if any, genetic gain since envi-ronment & age difference conceal or veil possible genetic variation. It can be seen that seed stand establishment provi-des a useful interim measure to obtain seed of im-proved genetic quality until more highly selected material is available from seed orchards. Despite the limited selection intensities that can be achie-ved through thinning, genetic gains for highly heritable characters such as stem straightness as high as 5-6% may be expected from seed stands with resultant benefits to national reforestation pro-grammes & higher prices for seed exports.

Further than this increased seed production, improved seed physical quality & greater ease of cone collection provide extra benefits. Experience in Kosovo sug-gests that if the wood from thinnings can be sold it is likely that this will cover the costs of seed stand establishment. A further important role of seed stands is the conservation of genetic resources. The high rate of cutting for industrial uses and fuel-wood in many parts of Kosovo has created a situation of severe dysgenic exploitation which can be mitigated by setting aside high quality stands for seed production which will act as in situ con-servation stands. At the present time only a very small area of seed stands has been established in the natural beech forests of Kosovo. Ideally a suffi-cient area of seed stands to supply seed for both national use and export should be established in each provenance region of importance. The results of the CFI. International provenance trials indicate that there is no one universally superior pro-venance and it is likely to be advantageous to include a number of provenances in any commer-cial of breeding populations (Barnes 1980). The results of the C.F.I. trials provide useful guidelines indicating which provenances should be given priority for seed stand establishment. Before undertaking the establishment of seed producing tree stands it is very important to first understand seed quality, since good quality seeds are needed to generate good quality trees. Bad quality seeds will produce trees with bad traits and/or that grow poorly. When dealing with seed quality there are three factors that have to be taken into consideration: genetic quality, physical quality and physiological quality:

The ***physical quality*** of seeds includes their size, color, age & seed coat condition. Cracks, damages or the presence of pests or diseases may all nega-tively affect germination.

The ***physiological quality*** of seeds includes the seed purity, moisture content and integrity of tissuees, all of which will influence germination capacity.

The ***genetic quality*** is determined by the infor-mation contained in the genes within the seeds & is therefore inherited. High genetic diversity is a decisive factor in the success of any tree-planting project. Seeds of good genetic quality that are grown in the right environment & managed in the right way usually generate trees with desirable traits. It was very important to decide ahead of time on the right tree species to grow in the stand, since each species provides different products & is adapted to grow under specific ecological condi-tions. Additionally, the species selected should come from an area with similar environmental conditions as to those at the site where the stand will be established. Finally, if the species selected is cross-pollinating and is new to the area, it is important to ensure that the right pollinators are present.

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