NURSERY PRACTICES WITH EXOTIC CONIFERS IN PATAGONIA, ARGENTINA, AND SOME REASONS TO AFFOREST THE REGION WITH THESE SPECIES

MARIA GABRIELA BUAMSCHA

When this paper was presented, Maria Gabriela Buamscha was with the Corporacion Forestal Neuquina, Neuqunn, Argentina. At the time of publication, Gabriela can be contacted at 2748 SE Tumblestone Dr., Hillsboro, Oregon 97123; (503) 846-0619.

gabibu@earthlink.net

Buamscha, M. G. 2002. Nursery Practices with Exotic Conifers in Patagonia, Argentina, and Some Reasons to Afforest the Region with these Species. In: Dumroese, R.K.; Riley, L.E.; Landis, T.D., technical coordinators. National Proceedings: Forest and Conservation Associations-1999, 2000, and 2001. Proceedings RMRS-P-24. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station: 169-171. Available at: http://www.fcnanet.org/proceedings/2000/buamscha.pdf

Key Words

Andean-Patagonian forest, steppe, afforestation, *Pinus ponderosa, Pinus contorta, Pseudotsuga menjiesii,* mycorrhizae, bareroot nurseries

The southern portion of Argentina is called Patagonia, and is located between 37° and 55° south latitude. Across this region, there is a strong topographic and environmental gradient. Precipitation decreases from the western mountains towards the east and temperatures from north to south. These geographic gradients impose different structural patterns of soils and vegetation, as well as different patterns of ecosystem functioning (soil water dynamics, nutrient cycling, net primary production, etc). Forests dominate the more humid west Andean-Patagonian Region, predominantly on Andisols, in other words, volcanic soils (1,000 to 3,000 mm rainfall), while a steady transition from grasslands to scattered grass and shrub steppes on Aridisols may be found to the east (from 500 to 100 mm rainfall). In the transitional zone between both regions (500 to 1,000 mm), vegetation consists of shrub-grasses with scattered patches of *Austrocedrus chilensis* on xeric Mollisols, Hiceptisols or Alfisols (Mazzarino and others 1998). As an example of the striking decrease in precipitation, the mesic Valdivian rain forest and the xeric Patagonian steppe are sometimes separated by only 50 km (31 miles) (Montana 1982).

In the western Andean-Patagonian forest, the young soils are derived from volcanic ash and generally exhibit adequate availability of cations and high water retention capacity. They also have a high capacity for P retention and organic matter stabilization, which can lead to both N and P deficiencies. In the steppe, soils are crystalline throughout the entire profile, with very low organic matter content, nitrogen content, and low water retention capacity. The main activity on the area is extensive sheep production, which is leading to severe problems of desertification. The transitional zone between the humid Andean Region and the arid steppe is a wide ecotone strip, representing the more important area for potential development of agriculture, cattle raising and forestry. Soils are mainly crystalline on the surface and amorphic (volcanic) in depth, with relative low contents of organic matter and N. During the last few years, research in this area has focused mainly on the introduction of exotic pastures, the improvement of native grasslands, afforestation with exotic pines, and agroforestry systems.

The first plantations with exotic conifers were established in 1940 and included the species *Pinus ponderosa, Pinus contorta* var. *latifolia* and *Pseudotsuga menziesii.* This initial program served to test the adaptations of these species to the Patagonian region. It was not until the 1970s that the government of Neuquen province began programs with the following objectives: 1) identify appropriate areas for forest plantations; 2) create nurseries; 3) begin intensive plantations; 4) develop human resources in both nursery and plantation practices; and 5) develop wood industries once the plantations started producing. To accomplish all these objectives, Neuquen founded a forest corporation named Corporacion Forestal Neuquina (CORFONE) in 1974.

REASONS TO AFFOREST PATAGONIA

Adaptative and environmental reasons:

There are several environmental reasons for afforestation programs in Patagonia:

(i) Large areas of available land exist for afforestation.
(ii) The high annual growth increment of imported exotic species is often higher in Patagonia than in their original areas. -
(iii) Watershed protection could result, especially in areas of steep relief where the erosion risk is high.
(iv) Eroded lands used in the past for intensive animal breeding could be restored.
(v) The Andean-Patagonian forests, which represent one of the few reserves of unaltered temperate forests in the world over extended areas, could be protected. This is assuming that timber provided by exotic conifers would diminish the pressure to cut these forests and thereby protect their biodiversity (Schlichter and Laclau 1998).

Economic reasons

There are also several economic reasons to undertake these afforestation programs:

(i) There would be a diversification of productive activities.
(ii) The initial investment required is lower than international values.
(iii) Its strategic geographic location allows access to markets on both the Atlantic and Pacific..
(iv) There are State and Federal forestry promotion policies that allow these comparative advantages to become competitive (Diaz 1997).

NURSERY PRACTICES

Bareroot production is the most extensive practice in Patagonian nurseries. Presently, *Pinus ponderosa* is the most common species produced, followed *by Pseudotsuga men.Ziesii* and lately *Pinus j ffreyii.* Initially most seeds were imported from the states of Oregon, Washington, and California in the United States. Recently, a number of plantations from different seed sources growing at different latitudes and under different environmental conditions have reached their reproductive maturity. Consequently, intensive cone collection programs and seed processing plants have rapidly developed in the region. This seed collection has drastically reduced the costs for the nurseries. The use of seeds from regional plantations insures the reproduction of adapted ecotypes. However, attention must be paid to avoid abuse of this practice, which might result in the reduction of the genetic variation of the exotic forests.

Generally, cultivation practices (in other words, sowing, transplanting, and plant extraction) are not mechanized and, consequently, a high number of workers are employed in different months of the year. In the last few years, CORFONE has made serious efforts to improve the seedling quality and outplanting performance. There have been important advances in the irrigation, fertilization, and root management programs. Several outplanting trials have been installed across the different planting sites to determine the target seedling for each site. Mycorrhizal inoculation is one important concern to consider as new tree species are being introduced. Between other mycorrhizae benefits, the enhanced uptake of P would be relevant in volcanic soils where plant P availability is low and therefore a limiting nutrient. Some of the species used for inoculation trials in CORFONE nurseries have been *Laccaria lacata (Scop.* Ex Fr.), *Hebeloma crustuliniforme* (Bull. ex Saint-Amis), *Telephora terrestris* (Ehrh.) Fr., *Pisolithus tinctorius* (Pers.) (Peredo and others 1989) and different species of the genus *Rbiiopogon.* Presently, a common ectomycorrhiza found in Patagonian nurseries is *Rhiiopogon sp.*

Intensive foliar analysis of *Pinus ponderosa, Pi jeffreyii* and *Pseudotsuga menziesii* seedlings have been carried out since 1998 in two nurseries from Neuquen and Chubut provinces (CORFONE and INTA Las Golondrinas, respectively). The macronutrients analyzed were mainly nitrogen, phosphorus and potassium. Future plans will include the analysis of remaining macro and micronutrients. In the CORFONE nursery, *Pinus ponderosa* and *P. jeffreyi* seedlings, growing in crystalline soils under intensive irrigation and receiving synthetic fertilizers, showed that foliar K was the main limiting nutrient for dry biomass yields (Buamscha and others 1999). In the INTA nursery, *P. ponderosa* and *Pseudotsuga menziesii* seedlings, growing in volcanic soils in rotations with Vicia and barley as green amendments, and without synthetic fertilizer applications showed: 1) very high N contents; 2) unbalanced P/N and K/N ratios; and 3) deficiencies of both P and K (compared with target values recommended for conifers in Chile and the Northern Hemisphere) (Basil and others 2000). There is still a need for research to determine the optimum nutritional levels for each species, especially for those growing in volcanic soils.

REFERENCES

Basil, G., Leanza, M., Mazzarino, M.J., y L. Roselli. 2000. Estado nutricional de plantines de vivero. Analisis foliar de pino ponderosa, oregon, murrayana y jeffreyi. INTA Campo Forestal Gral San Martin y Grupo de suelos - Centro Regional Universitario Bariloche. Reunion de Viveristas. AUSMA. San Martin de los Andes, Neuquen. 9 pp.

Buamscha, M.G., Roselli, L., y M.J. Mazzarino. 1999. Analisis foliar en plantines de *Pinus ponderosay Pinusjeffreyi* (1+1) y (2+0) y fertilidad de suelos correspondientes a la temporada 1998-1999 en el Vivero Junin de CORFONE SA. Informe tecnico de CORFONE SA. 28 pp.

Diaz, A. 1997. Forestar en Patagonia, Argentina. Informe CIEFAP - GTZ - 1NTA. l4pp

Mazzarino, M .J., Bertiller, M.B., Schlichter, T., and M. Gobbi. 1998. Nutrient cycling in Patagonian ecosystems. Ecologia Austral 8:167-181

Montana, C. 1982. La comunidad de &ire *(Nothofagus antarctica)* de la cuenca del rio Manso Superior (Prov. De Rio Negro, Republica Argentina). Tesis Doctoral. Univ. Nac. dc Cordoba (Fac. de Ciencias Exactas, Fisicas y Naturales). 147 pp.

Schlichter, T., and P. Laclau. 1998. Ecotono estepa-bosque y plantaciones forestales en la Patagonia norte. Ecologia Austral 8:285-296