NATIVE GRASS SEED DEVELOPMENT: 1975 – 2007
CHALLENGES AND RESULTS

Manivalde Vaartnou Ph.D., P.Ag.

M. Vaartnou & Associates
11520 Kestrel Drive
Richmond, BC V7E 4E2
604-271-2505
E-mail: val_vaartnou@telus.net

ABSTRACT

Sound ecological restoration of disturbed areas includes the use of native species in the herbaceous layer. In the last thirty years the use of native grasses has been recommended for Alaska, Washington State, the North-west Territories, Yukon Territory, Alberta and several locations in British Columbia. However, seed of grasses native to British Columbia, Yukon Territory and the Northwest Territories has neither been available in sufficient quantity, nor at a reasonable price. Thus, since 1975, the author has been involved in several long-term programs to increase the availability of native grass seeds for restoration practitioners. This presentation discusses the major challenges that have been encountered, and summarizes the progress to date for north-west Canada, the pacific coast and the southern interior of British Columbia, respectively.

Major challenges in native grass seed development can be grouped into three broad categories: development of suitable methodology; problems associated with plant biology; and the agricultural economics component that needs to be addressed and dealt with. The presentation covers what the specific challenges are within these broad categories, and how these have been resolved.

Extensive progress has occurred in the last 32 years and the individual programs for northwest Canada, the pacific coast and the southern interior are at different stages in the developmental process. The presentation concludes with a summary of each program to date, and indicates what still needs to be done in each of the three areas prior to the commercial, large-scale availability of native grass seed for use in reclamation of disturbed areas such as mine sites; highway, hydro and pipeline corridors; and sites disturbed by activity in the forestry sector.

INTRODUCTION

Revegetation is required after disturbance caused by logging operations, the completion of linear projects such as highways, hydro transmission corridors and pipelines, and prior to the closure of mines. Benefits obtained through reseeding can be any of the following:

- aid in erosion and dust control
- reduction of siltation of fish streams
- provision of forage for wildlife and domestic species
- improvement of aesthetic values
- improvement of soil through:
    a) nitrogen fixation by legumes
    b) provision of organic matter

Sound ecological restoration includes the use of native species. Their use has been recommended since the 1970's for the North-West Territories (Berger 1977). Similar recommendations have been made for Yukon Territory (Kennedy 1993, Hill et al 1996) and in Alberta (Native Plant Working Group 2000). In British Columbia, the 1995 Clayoquot Sound Scientific Panel (Clayoquot 1995) recommended that native species be used in forestry revegetation and this was reiterated in 2004 (Coast Information Team 2004). Comparable recommendations have been made in Australia, Alaska, Washington State, most of the other states in the contiguous United States and the Muskwa-Kechika Protected Area in British Columbia. Benefits which may occur through the use of native grasses will vary, depending upon the site characteristics of the area under restoration. These may include any of the following:

- assistance in retention of local biodiversity
- higher long-term survival because of adaptation to local climate
- greater reseeding potential because of adaptation to the local photosynthetic regime
- lower costs through lower seeding rates and reduced need for fertilization
- less rapid colonization by invasive and other undesirable species
- a more harmonious landscape

Prior to the use of native grasses in restoration, the problems that need to be addressed are related to agricultural economics and plant biology. If native grass species that are appropriate to any given region are selected for reclamation, they will grow and survive. The questions that need to be answered are:

- Will the use of native grasses achieve the goals of any specific reclamation scenario?
- Which native grasses produce seed in sufficient quantity so that they can be used by end-users at reasonable cost?

Unfortunately, there has not been a source of native British Columbia grass seed available for use by reclamation practitioners in the past. Thus, the three programs discussed herein: a) northern Canada program; b) Pacific coast program; and c) southern interior program, were initiated to eventually provide a source of native grass for use throughout British Columbia. Significant progress has occurred in northern Canada and the west coast, and there is a high likelihood of seed availability for use in northern British Columbia and the west coast in the immediate future. The southern interior program was initiated more recently; thus it is not as advanced as the two former programs, but definite progress has also occurred in this program.

OBJECTIVES

The long-term objective of the programs was the harvest of sufficient seed from Seed Production Plots to allow established seed merchants to grow the seed at field-scale for purchase by large-scale users. For this to happen, four basic conditions have to be met. These are:

- native species trial plot results must be comparable to results achieved on control introduced agronomic species plots

- enough seed must be grown in Seed Production Plots to transfer this seed to established seed merchants for subsequent commercial seed production
- the long-term cost of native species seeds must be no more than minimally higher than the cost of agronomic seeds
- there must be sufficient native seed available in the market for large-scale reclamation by major seed users

CHALLENGES

Development of Methodology

The first challenge in native grass seed development is the development of a methodology which will achieve the objectives stated above. Over the last thirty-two years, the following activities have been pursued in the course of the programs:

- collection, from the wild, of seed of grasses, which are native to the region of concern
- sowing these seeds to flats in a greenhouse at U.B.C., or in greenhouses at other locations
- transplanting the emergent seedlings to Seed Increase Nurseries in the different regions
- establishment of replicated native grass seed trial plots with accompanying agronomic grass seed control plots
- establishment of demonstration and operational sites on areas which could not be replicated because of a lack of homogeneity in site characteristics
- annual evaluation, on an individual species basis, using the Daubenmire method (Daubenmire 1959,1968) of all replicated sites, demonstration sites and operational sites until five years of data was available from each
- biometric analysis ('t' test) of total ground cover on replicated plots which had agronomic seed control plots
- establishment of large Seed Production Plots to determine the seed production capability of the native grasses
- maintenance and harvesting of the Seed Increase Nurseries and Seed Production Plots
- assessment of germination percentages of selections which were successful in field trials
- maintenance of a pictorial record of all aspects of the programs
- annual extension activity through E-mail distribution of annual Final Reports; open house/field days at the Seed Increase Nurseries; and presentation of papers and/or poster displays at relevant conferences
- ongoing communication with established seed merchants re future field-scale seed production

Biological Issues

There are four major biological issues which need to be addressed for all native species that have potential for commercial seed production. These are discussed in turn below.

Germination Percentage

Prior to consideration of commercial seed production of any native species it is necessary to carry out germination tests for each. Optimally, these should be undertaken by an independent laboratory not connected to the plant breeder. In the last thirty-two years, germination tests carried out on behalf of the author have shown germination percentages ranging from eight per cent to ninety-nine per cent. Any species with a germination percentage less than fifty per cent should not be considered for commercial seed production, and species with germination percentages from fifty to seventy-five per cent should be considered with caution.

Winterkill

As a general statement, native species will suffer little or no winter damage if these are seeded and grown in the general proximity of their provenance. However, this may not be possible in some cases, and some species which are adapted to the mild climate of the Pacific coast may not survive in the harsher climate of northern Canada. The cost of land in the Lower Mainland/Fraser Valley and Vancouver Island, and the lack of infrastructure, eliminate the possibility of commercial seed production on the west coast of British Columbia. Thus, if it is deemed appropriate to attempt commercial seed production of species which will winterkill in northern Canada, it is necessary to locate seed production fields in a more moderate climate; in most cases the optimal location is the Willamette River valley in Oregon, which is one of the major grass seed growing locations in the world. One example is slender hairgrass (*Deschampsia elongata*). This is an important reclamation species on the west coast but has one hundred per cent mortality when grown in Dawson Creek.

Quantity of Seed Production

Native grass species produce seed in widely different quantities. Some may produce no seed if moved from their area of provenance, while others may produce as much seed as commercially available introduced agronomic species. It is essential to ascertain the seed production potential of any native species prior to commercial, field-scale seeding. Species which do not produce significant quantities of seed are of limited value because farmers growing these species would have to raise the prices they charge seed merchants for these species. Thus, the seed merchants would have to raise their prices to the end-users, and, in many cases there would be no interest in using expensive species in large-scale reclamation. One example is a western sub-species of red fescue (*Festuca rubra* ssp *pruinosa*). This species produces large amounts of seed when grown on the west coast, but produces no seed in Dawson Creek even though the plants have no winter mortality.

Susceptibility to Disease

Native grasses are similar to agronomic grasses in that some may be susceptible to one disease and others to different diseases. It is necessary to establish which disease problems may occur prior to field-scale seed production to avoid the possibility of total failure on a large field. Most disease problems can be thwarted through the use appropriate fungicides and insecticides, but it is necessary to establish which

may occur and which remedial measures will be necessary prior to large-scale seeding. One example is Canada bluegrass (*Poa compressa*). This species is susceptible to an insect-caused disease, silver tip, which eliminates seed production, but does not otherwise harm the plants. This can be thwarted by spraying the plants with an insecticide, Matador, just prior to seed set.

RESULTS

Northern Canada Program

The northern Canada program has reached the stage where there has been sufficient seed multiplication in large plots to commence commercial field-scale seeding in 2008. This decision will be made by established seed merchants, dependent upon their analysis of future demand. At present, two species are already available on the commercial market. These are *Agropyron violaceum* and *Poa glauca*.

Another nine species are also available for 2008 seed production. These are: *Agropyron macrourum, Agropyron pauciflorum, Agropyron subsecundum, Agrostis scabra, Deschampsia caespitosa, Festuca saximontana, Poa alpina, Poa palustris* and *Trisetum spicatum*.

B.C. West Coast Program

The B.C. west coast program has reached the point where field-scale production is possible in 2007, and commercial quantities of seed should be available in the fall of 2008. At the time of writing (June 2007), final decisions have yet to be made by seed merchants, but any of the following species could be on the market by 2008: *Agrostis exarata, Agrostis scabra, Bromus carinatus, Bromus sitchensis,Calamagrostis stricta, Deschampsia cespitosa, Deschampsia elongata, Elymus glaucus, Festuca rubra* ssp *arenicola, Festuca rubra* ssp *pruinosa* and *Poa compressa*.

B.C. Southern Interior Program

The southern interior program was initiated much later than the other programs—thus it is not as far advanced. However, seed production in the Seed Increase Nursery was successful in 2007 for most selections, and these could be seeded to large seed multiplication plots in 2008. Successful species in this program are *Achnatherum occidentale, Bromus carinatus, Bromus ciliatus, Festuca idahoensis, Helictotrichon hookeri, Koeleria macrantha, Leymus cinereus* and *Poa compressa*. Also in the program are three other species which have not been successful to date: *Aristida longiseta, Pseudoroegneria spicata* and *Sporobolus cryptandrus.*

CONCLUSIONS

These native grass seed development programs have reached the stage where reasonable quantities of commercially available native grass seed will be on the market in the very near future for the west coast of British Columbia and northern Canada. Also, it is conceivable that native grass seed will also be available for the southern interior of British early in the next decade. Thus, while it is not reasonable to expect to

restore disturbed areas to a precise duplicate of the pre-European settlement flora, the use of native species of grasses will allow reclamation managers to at least partially mitigate the impact of industrial development.

REFERENCES

Berger, T.R. 1977. Northern Frontier Northern Homeland. The Report of the Mackenzie Valley Pipeline Inquiry. Volume Two Terms and Conditions. Ministry of Supply and Services Canada. 268 p.

Clayoquot Sound Scientific Panel. 1995. Sustainable ecosystem management in Clayoquot Sound: planning and practices. 245 p.

Coast Information Team. 2004. Ecosystem-based management planning handbook. 80 p.

Daubenmire, R. 1959. A canopy-cover method of vegetational analysis. Northwest Science. Vol. 33. pp. 43–64.

Daubenmire, R. 1968. Plant Communities: A Textbook of Plant Synecology. Harper & Row, New York. 300 p.

Hill, T., C.E. Kennedy and D. Murray (eds). 1996. Guidelines for Reclamation/Revegetation in the Yukon: Volume Two. Department of Renewable Resources. Government of Yukon. Pp. 180–266.

Kennedy, C.E. (ed). 1993. Guidelines for Reclamation/Revegetation in the Yukon: Volume One. Department of Renewable Resources. Government of Yukon. Pp. 1–179.

Native Plant Working Group. 2000. Native plant revegetation guidelines for Alberta. H. Sinton-Gerling (ed.), Alberta Agriculture, Food and Rural Development and Alberta Environment. Edmonton, Alberta. 13 p. + appendices.