NATIVE GRASS SEED DEVELOPMENT - SUMMER 2000

Manivalde Vaartnou, Ph.D.,P.Ag.

M. Vaartnou & Associates
11520 Kestrel Drive
Richmond, B.C. V7E 4E2
604-271-2705
E-mail:val_vaartnou@telus.net

ABSTRACT

Since the 1970's the use of native plants has often been suggested as a potential answer to problems associated with revegetation of disturbed sites. However, native seed for large-scale reclamation purposes has not been available in sufficient quantity nor at a reasonable price. Thus, M. Vaartnou & Associates have initiated programs to provide a source of native seed for Vancouver Island and the northern interior. The Vancouver Island program is funded through Forest Renewal British Columbia while the northern program also involves the Alberta Research Council and the Dawson Seed Company Ltd.

Results are presented from trial sites established on Vancouver Island, and sites in northern Canada. Also, progress of the Alberta Research Council in developing the northern selections as licenced cultivars is discussed, and the ongoing development of the Seed Increase Nursery and Breeders' Seed Production plots for the Vancouver Island program is illustrated. The presentation is primarily intended as an information bulletin for potential end users and regulatory officials as reasonably priced native grass seed could be available early in the new millenium.

INTRODUCTION

Revegetation/reclamation of land areas disturbed by man, primarily in exploitation of natural resources and creation of transportation corridors, has been an ongoing concern for over fifty years. Some benefits of revegetation include 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;
    b) provision of organic matter.

Since the 1970's there has been considerable interest and support for the use of native species for such reseeding programs. Two examples of this are clear recommendations in the 1977 Report of the Mackenzie Valley Pipeline Inquiry (Berger, 1977) and the 1995 Report of the Clayquot Sound Scientific Panel (Clayquot, 1995) that native species be used in revegetation of the areas relevant to these reports. Possible benefits which may be achieved through the use of native species include any of the following:

- assistance in retention of local biodiversity;
- creation of a more harmonious end vista;
- greater long-term survival;
- increased reseeding potential;
- lower costs through lower fertilization and seeding rates.

With grasses, the problem is more of one of agricultural economics than plant biology. Native grasses, if species appropriate to any given region are selected for reclamation, will grow and survive. For native grasses, the questions which need to be answered are:

1) Will the use of native grasses achieve the goals of any specific reclamation scenario? 2) At what cost can success be achieved?

M. Vaartnou & Associates are involved in two separate programs to answer these questions for Vancouver Island and northwestern Canada, respectively. The long-term objective of these programs is harvest of sufficient seed from breeders' seed plots to allow established seed companies to grow the seed at field-scale for purchase by large-scale users. For large-scale users to order native grass seed three basic conditions must be met. These are:

- There must be sufficient native seed available for large-scale reclamation by the major seed users;
- Results from native species trial plots must be comparable to results achieved on control, introduced agronomic species plots;
- The cost of native species seed must be no more than minimally higher than the cost of agronomic seed.

To satisfy the above conditions the following activities must be undertaken in the early years of any native grass seed program.

- collection of seed from selections of grises which are native to the relevant area(s);
- increase of the available seed, using a Selection/Seed Increase Nursery, so that trial plots can be established;
- establishment of replicated trial plots on disturbed sites, (accompanied by control plots seeded to the optimal mixture of available introduced agronomic selections) so that the value of the native selections collected can be determined for reclamation purposes;
- ascertainment of the seed production potential of the native selections and subsequent cost of the seed to the end user;
- multiplication of seed stock of successful selections to the extent that sufficient seed of these selections can be transferred to established seed companies for field-scale seed production.

VANCOUVER ISLAND PROGRAM

On Vancouver Island, Forest Renewal British Columbia is providing the funding for a long-term research program which, if successful, will result in the use of native grass species, and possibly some legumes, in forestry and other reseeding on Vancouver Island. The native species in this program may also be applicable to the CWH biogeoclimatic zone on the mainland coast and the CDF biogeoclimatic zone on Vancouver Island. One hundred fourteen native selections have been collected in the last four years. These were first seeded to flats in a greenhouse at U.B.C. and seedlings were transferred to a Seed Increase Nursery established just south of Duncan. Seed from this Nursery was used to establish more than forty trial or demonstration sites throughout Vancouver Island. The replicated sites are on abandoned logging roads which have a compacted growth medium not favourable to the growth of grasses. However, these roads had to be used as deactivated roads, slide tracks and ditch lines do not provide the homogeneity in site characteristics which is required for reasonable replication and subsequent biométrie analysis. The demonstration sites are on more suitable soil.

In the last three years five different native seed mixtures have been created and seeded to replicated trial plots. Each site also has an agronomic grass mixture plot as a control. Both the native and agronomic grass mixtures

have the same agronomic legumes included, as legumes are used in reclamation, but no native legumes are available. Ground cover provided by each species was analyzed using the "Daubenmire" technique, and total ground cover of the native grasses was then 'f tested against the agronomic controls. The 'f tests were done with and without the inclusion of the legumes at each plot. The trial sites have not been in place for a long enough period for definite conclusions, but first and second year results from the sites established prior to 1999 indicate that native species can provide ground cover comparable to that obtained with the agronomic cultivars which are on the control plots at each site (Table 1) (Vaartnou, 2000). Biométrie analysis of the data shown in Table 1 indicated that the minor differences in cover were not significant at the 0.05 level (Vaartnou, 2000).

Table 1. 1999 Ground Cover Percentages on the Vancouver Island Trial Sites. (adapted from Vaartnou, 2000)

GRASSES ALONE				
	Native Mixture #			
	1	**2**	**3**	**4**
	Ground Cover (%)			
Native Mixtures	16.1	15.2	25.4	17.3
Agronomic Mixtures	16.8	18.4	25.5	19.8
GRASSES + LEGUMES				
	Native Mixture #			
	1	**2**	**3**	**4**
	Ground Cover (%)			
Native Mixtures	21.6	20.0	34.4	20.6
Agronomic Mixtures	19.3	25.4	37.7	21.6

In 1999, eleven selections which had the greatest initial success in the Seed Increase Nursery were seeded to Breeders' Seed Plots near Dawson Creek. Ten plots were added in 2000. Performance on these plots will provide a good indication of the eventual cost of the native selections when grown at field-scale. Attributes of the selections which need to be determined include susceptibility to winter injury, amount of seed production, problems with seed cleaning and the number of years that fields can be harvested prior to the selection becoming sod bound and unproductive. The selections seeded to Breeders' Seed Production plots are:

Agrostis scabra #61
Bromus anomalus #35
Bromus sitchensis #45
Bromus sitchensis #48
Calamagrostis nutkaensis #1
Calamagrostis stricta #84
Cinna latifolia #101
Deschampsia cespitosa # 30
Deschampsia elongata #13
Deschampsia elongata #72
Elyntus glaucus #17
Etymus glaucus #20
Elymus hirsutus #28
Etymus trachycaulus #40
Festuca rubra ssp arenicola #91
Festuca rubra ssppruinosa #56
Festuca rubra ssppruinosa #56A
Festuca rubra ssppruinosa #56B
Glyceria elata#76
Hordeum brachyantherum #7
Leymus mollis #15

NORTHWESTERN CANADA PROGRAM

For northern reclamation purposes, M. Vaartnou & Associates are working with the Alberta Research Council and the Dawson Seed Company Ltd. to ensure a reliable, reasonably priced source of native grass seed. The northern selections collected by M. Vaartnou were tested from 1976 to 1995 at numerous locations throughout northern Alberta, northern British Columbia, some locations in the Rocky Mountains and North-west Territories, and throughout Yukon Territory. Results from these trials were published in client priority reports (Vaartnou 1982a, 1982b, 1982c and 1995) and were used by M. Vaartnou to write the two-volume Yukon reclamation manual entitled "Guidelines for Reclamation/Revegetation in the Yukon" on behalf of the Yukon Department of Renewable Resources (Kennedy (Ed.), I993 and Hill et al (Eds.), 1996). Results were also presented at conferences such as the Conference for the 25th Anniversary of the Boreal Institute of the University of Alberta in 1988 (Vaartnou, 1988), the 1992 British Columbia Mine Reclamation Symposium at Smithers, B.C. (Vaartnou, 1992) and the 1st Circumpolar Agricultural Conference in Whitehorse (Vaartnou, 1994). Two examples of the results are found below.

The first example is from the program funded by Foothills Pipe Lines Ltd. for the potential reclamation of the proposed Dempster Lateral pipeline. In these trials individual plants were followed for a number of years to ascertain survival and seed production. The survival results indicate that the four agronomic cultivars and most native selections had suffered considerable mortality after two winters (Table 2). However, five native selections were thriving after five winters and were still successful after eight winters. Seed production results (not shown) were comparable to survival results.

The second example shows some of the final results from a five year program funded by the Yukon Department of Community and Transportation Services. In this program ten sites were established in the southern half of Yukon Territory. At each site three plots were seeded. One contained the mixture used prior to 1991 for Yukon highways reclamation; a second contained the agronomic mixture recommended in the new Yukon Manual; and a third was seeded to the native mixture recommended in the Manual. Ground cover and seed production were monitored for five years. Table: 3 indicates that ground cover percentages of the improved agronomic seed mixtures recommended in the Manual and the native seed mixtures recommended in the Manual were essentially identical at two of the sites. Results were similar at the other eight locations.

Table 2. Ground Cover Production at the Richardson Mountains test site from 1979 to 1988. (adapted from Vaartnou, 1982b and Vaartnou, 1988)

	Ground Cover (%)				
	1979	**1980**	**1981**	**1985**	**1988**
Agropyron cristatum cv Fairway	96.7	10.0	0.0	0.0	0.0
Agropyron pauciflorum 159	30.0	16.3	10.0	10.0	6.7
Agropyron pauciflorum cv Revenue	100.0	56.7	6.7	0.0	0.0
Agropyron riparium 209	100.0	86.7	76.7	20.0	6.7
Agropyron Smithii 9	100.0	86.7	35.7	0.0	0.0
Agropyron violaceum 103	100.0	66.7	53.3	33.3	20.0
Agrostis scabra 105	**100.0**	**96.7**	**93.3**	**100.0**	**100.0**
Alopecurus pratensis 5	100.0	80.0	60.0	30.0	20.0
Bromus inermis cv Carlton	100.0	60.0	50.0	0.0	0.0
Bromus Pumpellianus 110	96.7	63.3	40.0	0.0	0.0
Deschampsia caespitosa 30	**76.7**	**83.3**	**70.0**	**100.0**	**100.0**
Festuca ovina 100	**100.0**	**93.3**	**70.0**	**100.0**	**100.0**
Festuca rubra 164	100.0	80.0	76.7	0.0	0.0
Festuca rubra cv Boreal	100.0	70.0	63.3	0.0	0.0
Phleum pratense 17	93.3	16.7	10.0	0.0	0.0
Poa alpina 45	**100.0**	**96.7**	**96.7**	**100.0**	**100.0**
Poa compressa 177	96.7	23.3	20.0	0.0	0.0
Poa glauca 58	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Poa palustris 74	96.7	56.7	40.0	0.0	0.0
Poa pratensis 178	100.0	83.3	70.0	53.3	23.3
Puccinellia Nuttalliana 195	66.7	36.7	26.7	0.0	0.0

In early 1998, the Alberta: Research Council expressed an interest in working with the Vaartnou selections and eight selections were sent to Alberta for development into registered northern reclamation cultivars. Initial results are promising, and it is probable that some cultivars will be registered by 2002-2004. The selections currently with the Alberta Research Council are the following.

Agropyron pauciflorum MV9
Agropyron subsecundum MV10
Agropyron violaceum MV6
Festuca saximontana MV2
Poa alpina MV3
Poa glauca MV4
Poapalustris MV5
Puccinellia Nuttalliana MV11

The Dawson Seed Company Ltd. requested permission to immediately grow the Vaartnou selections for seed production and market them as northern native species successful in northern field trials. Permission was granted and seed from some of these selections may be on the market in the near future.

Table 3. Ground cover production at the Smart River and Montague House sites from 1991 to 1995. (adapted from Vaartnou, 1995)

	PRE-1991 AGRONOMIC SEED MIXTURE									
	SMART RIVER SITE					MONTAGUE HOUSE SITE				
	Ground Cover (%)					Ground Cover (%)				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Bromus inermis	1.0	0.5	4.0	2.5	1.5	0.0	0.5	0.5	0.5	0.0
Festuca rubra	12.0	7.5	16.0	31.0	19.0	2.0	5.0	2.0	1.0	1.0
Lolium perenne	3.0	0.5	0.0	0.0	0.0	3.0	0.5	0.0	0.0	0.0
Poa compressa	1.0	3.0	5.0	0.5	0.0	0.5	2.0	0.5	0.5	0.0
Total Cover	17.0	11.5	25.0	34.0	20.5	5.5	7.5	3.0	2.0	1.0
	REVEGETATION MANUAL AGRONOMIC SEED MIXTURE									
	SMART RIVER SITE					MONTAGUE HOOUSE SITE				
	Ground Cover (%)					Ground Cover (%)				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
	2.0	19.5	4.0	3.0	0.5	1.0	9.0	4.5	0.5	0.0
	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Agopyron pauciflorum	1.0	1.5	0.0	1.0	4.0	0.5	3.5	0.5	0.5	0.0
Agropyron riparium	9.0	17.0	20.0	28.0	32.0	1.0	19.0	16.0	3.5	5.0
Medicago sativa	1.0	2.5	10.0	10.0	2.5	0.5	8.5	7.0	10.5	23.0
Poa compressa	1,5	3.0	0.5	0.0	0.0	0.5	0.5	0.5	0.0	0.5
Poa pratensis	0.5	11.0	0.5	1.0	0.0	-	-	-	-	-
Trifolium hybridum	0.5	4.5	25.0	22.5	7.0	0.5	0.0	0.0	0.0	0.0
Total Cover	16.0	59.5	60.0	65.5	46.0	4.0	41.0	28.5	15.0	28.5
	NATIVE SEED MIXTURE									
	SMART RIVER SITE					MONTAGUE HOUSE SITE				
	Ground Cover (%)					Ground Cover (%)				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Agropyron pauciflorum	-	-	-	-	-	0.5	4.5	13.0	0.5	0.0
Agropyron violaceum	1.0	12.0	14.5	25.5	26.5	-	-	-	-	-
Agropyron yukonense	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festuca ovina	2.0	10.0	4.0	24.0	4.5	0.5	6.0	0.5	0.5	0.0
Festuca saximontana	2.0	9.0	3.0	6.5	4.5	0.5	5.5	0.5	0.0	0.5
Hedysarum Mackenzii	0.5	0.0	0.5	3.0	2.0	0.5	0.5	7.5	15.5	29.0
Poa glauca	5.5	13.0	25.0	2.0	5.0	1.0	16.0	11.5	0.5	0.5
Poa palustris	5.5	7.0	23.0	2.0	1.0	0.5	14.5	1.5	0.0	0.0
Total Cover	16.5	51.5	70.5	63.5	43.5	3.5	47.0	34.5	17.0	30.0

DISCUSSION

Other political jurisdictions, such as Australia, Alaska and much of the contiguous United States, have legislation which requires the use of native species in restoration of public lands. This is not the case in western Canada as the lack of a reliable, cheap source of seed has been the major implementation barrier to the large-scale use of native species in reclamation reseeding programs in British Columbia. This is also the barrier to any consideration of introduction of legislation requiring the use of native species in restoration of public lands. Consequently, vast amounts of seed of introduced grasses are added annually to our landscape. For instance, on only one small segment of western Canada, Vancouver Island, there are over 100,000 kilograms of non-native seed distributed annually by just two of the major participants in reclamation - the forest industry as an entity, and the Ministry of Transportation and Highways.

Thus, it is readily apparent that programs wherein minor quantities of native seed are collected from the wild will not solve the overall issue. Irrespective of whether the seed collected is directly seeded to the disturbed area, or whether plants are grown in the field or in a greenhouse, and then transplanted to the disturbed site, the total impact on the amount of non-native seed added to the landscape will be insignificant. Small projects, such as that addressed by the author's recommendations for restoration of the Red Heather Meadows and Elfin Lakes areas of Garibaldi Provincial Park can be completed in this manner. Similar small projects can be addressed by collecting seed of "wild flowers", multiplying and harvesting this seed, and then reseeding the disturbed area with this seed. However, for most species the cost will be exorbitant, and no large-scale user (public or private) who has a budget to meet will voluntarily support such a program except on a few very high profile locations. Also, biology problems of native herbaceous dicotyledons and graminoids which are not grasses are best addressed in university/college undergraduate and masters' theses on a species by species basis. Because of the cost to the end user, most such studies will only have academic, not practical value. However, it may be possible to add some species to the repertoire of tools of reclamation managers.

From the perspective of field-scale seed production, the northern Canada program is closer to completion than the Vancouver Island program. The northern Canada selections have been tested at sufficient locations for sufficient years to establish their utility in northern reclamation programs from the Alaska border to eastern Alberta and from the 56th parallel to the Arctic Ocean. The plots established by the Alberta Research Council in 1998 show great promise, and if this continues registered northern native reclamation selections should be

on the market in less than a decade. However, some of the northern selections may be on the market sooner because, if seed is available, the Dawson Seed Company Ltd. is interested in growing and marketing these selections as reclamation candidates before they are fully registered cultivars.

Early results from the Vancouver Island program are very encouraging, but the program is not as advanced as the northern program because it is only at the start of its fifth year. Early results from the replicated trial sites and unique demonstration sites have shown that the native selections produce ground cover similar to that obtained with introduced agronomic cultivars. However, these initial results need to stand the test of time before the success of the native selections can be conclusively accepted. Also, it will be some years before the price of these selections can be ascertained. This can only be established after the Vancouver Island selections have been in Breeders' Seed Plots for several years, in the geographic region where they will be grown at field-scale. This may be in the Peace River region of northern Canada, other parts of Canada or, if winter survival is a concern, in the Pacific Northwest United States. Established seed merchants and native seed growers have expressed interest in working with the Vancouver Island selections in each of these regions.

In conclusion, the prerequisites for use of native grasses for reclamation throughout most of British Columbia have nearly been achieved. More work and time is needed to fully realize this objective, but the support for the concept is wide-spread. Thus, before the decade ends, British Columbia and the northern Territories could join the ever-increasing number of political jurisdictions which require the use of native grasses in reclamation of public lands.

LITERATURE CITED

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. English Edition CP32-25/ 1977-2:268p.

Clayquot Sound Scientific Panel. 1995. Sustainable Ecosystem Management in Clayquot Sound - Planning and Practices. 245p.

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, p 181-266.

Kennedy, C.E. Ed. 1993. Guidelines for Reclamation/Revegetation in the Yukon. Department of Renewable Resources, Government of Yukon. 180p.

Vaartnou, M. 2000. Establishment of a Native Seed Industry for the West Coast of Vancouver Island. Final Report -1999/2000. Prepared for Forest Renewal British Columbia. 23p + appendices.

Vaartnou, M. 1995. Yukon revegetation demonstration project:!991-1995. Final report - 1995. Prepared for Transportation Maintenance and Engineering Branches, Department of Community and Transportation Services, Yukon Territorial Government 101 p + appendices.

Vaartnou, M. 1994. The northern native grass seed industry - fall 1992. In Proceedings of the 1st Circumpolar Agricultural Conference, Whitehorse, YT, Canada, Agriculture Canada, Research Branch, Centre for Land and Biological Resources Research, Ottawa, p 129-135.

Vaartnou. M. 1992. The northern native grass seed industry - spring 1992. In Proceedings of the Sixteenth Annual British Columbia Mine Reclamation Symposium, June 15-18, 1992, Smithers, B.C. p 75-109.

Vaartnou, M. 1988. The potential of native populations of grasses in northern revegetation. In Northern Environmental Disturbances (P. Kershaw, Ed.). Occasional Publication Number 24. Boreal Institute for Northern Affairs, University of Alberta, Edmonton, Alberta, p 31-41.

Vaartnou, M. 1982a. Pipeline revegetation research: Alaska highway test sites progress report 1981. Prepared for Foothills Pipe Lines (Yukon) Ltd. 70p + appendices.

Vaartnou, M. 1982b. Pipeline revegetation research: Dempster lateral test sites progress report 1981. Prepared for Foothills Pipe Lines Ltd. 64p + appendices.

Vaartnou, M. 1982c. Pipeline revegetation research: northern British Columbia test sites final report. Prepared for Foothills Pipe Lines Ltd. and Westcoast Transmission Ltd. 41p.