Pipeline Reclamation

On Sandy Grassland Soils In The Aspen Parkland

A Research Proposal for
Alliance Pipeline Ltd.

By
Dr. M. Anne Naeth

With
Ms. Darlene Howat, M.Sc.

Department of Renewable Resources
University of Alberta
Edmonton, Alberta

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1.0 Background Information And Literature Review

Little if any research has been conducted on pipeline reclamation on sandy soils in native grasslands. Demonstrations and testing may have been conducted but it has not been published or may not have the scientific rigour for publication in scientific journals. Thus research is required to ensure good reclamation of these sites. Sandy soils have specific challenges and thus research on pipeline reclamation in other ecosystems is not directly applicable. Specific challenges include the highly erodible soils, low nutrient status and low water holding capacity. If native species are used, there is no information on their establishment and development.

Restoring the ecology of a landscape requires that all functions of the undisturbed ecosystem are reestablished (Rosales 1997). Achieving restoration success requires appropriate soil treatments and reintroduction of native plant species (Bradshaw 1987). Often complete restoration can not be achieved on a short time scale and reclamation will get the ecosystem reconstruction on the way to restoration. In reclamation, reintroducing native species is not always possible since they often have limited seed sources and availability. Because of this shortage they are often very expensive. Thus part of the revegetation plan may be to create a situation where these desired native plant species can be encouraged to colonize the area through natural invasion processes. The natural ability of the plant species to colonize disturbed areas is an important factor in species selection that can be altered by the physical and chemical properties of the soil. Specific problems associated with the disturbance including admixing, changes in hydrology and nutrient status may impede the natural ability of the plant species to colonize an area. Amendments to reduce erosion, increase stability of the soil and improve hydrologic and fertility characteristics of the soil may encourage such colonization.

Research that may provide some insight into the reclamation of soils with native species invasion was discussed by Naeth. In the Aspen Parkland in southwestern Alberta, two research sites were constructed on a pipeline right-of-way (RoW) and adjacent native grassland and measured for vegetation productivity, plant species composition and animal utilization. Data collection began one year after construction in 1988. Grass production increased significantly from 1988 to 1991 on the spoil, trench and work area and equaled or exceeded grass production on the undisturbed control sites by the fourth year following pipeline construction (Naeth et al. 1997). Forb production was greater on the disturbed treatments compared to the control in 1988, then declined from 1988 to 1990 and increased in 1991. Forbs are frequently pioneer species and will increase following a disturbance, then decrease as long-lived perennials become established.

On these sites, cover increased from 1988 to 1991, with less bare ground in 1991 than in 1988 and more litter in 1991 than in 1988. In 1991, bare ground and litter were at predisturbance levels. Individual plant species in disturbed areas did not exhibit the same patterns as the control. Rough fescue (*Festuca hallii*) had reduced cover in the disturbed areas. Kentucky bluegrass (*Poa pratensis*) was initially lower in the disturbed areas, but increased by 1991 to the same level as the control. Timothy (*Phleum pratense*) cover remained relatively consistent and slender wheatgrass was dominant on disturbed areas, but absent in the control (Naeth et al. 1997).

Treatments that compared seeding to no seeding did not show any difference in plant cover, production or individual species cover (Naeth et al. 1997). Forb production was higher in the

seeded areas, except in 1989, while grass production was higher in the unseeded areas. Overall, the unseeded areas had higher total herbaceous production in all three years (Naeth et al. 1997).

Due to the paucity of literature on pipeline reclamation, this research will benefit pipeline companies reclaiming sandy soils or sand dunes in grasslands by determining species that are sustainable where few species grow. Finding plant species that maintain the integrity of the ecosystem, which is critical to pipeline corridors in undisturbed areas and Public Lands, is needed. Because sandy soils are unstable revegetation is difficult. This research will identify treatments to enhance revegetation success through soil stabilization and enrichment.

2.0 Research Objectives

1. To determine the effectiveness of cover cropping and straw crimping on the reclamation success of a pipeline right-of-way on sandy soil in the Aspen Parkland.

2. To determine the effectiveness of seeding versus no seeding on the reclamation success of a pipeline right-of-way on sandy soil in the Aspen Parkland.

3. To determine the effectiveness of pipeline construction techniques on the reclamation success of a pipeline right-of-way on sandy soil in the Aspen Parkland.

4. To determine the effectiveness of using one or two species of local native seed on the reclamation success of a pipeline right-of-way on sandy soil in the Aspen Parkland.

5. To address reclamation success of the above treatments via their impacts on plant species composition, ground cover and plant community development.

3.0 Research Site

The research site will be located southeast of Wainwright, Alberta on the Alliance Pipeline RoW in the Aspen Subregion of the Aspen Parkland Ecoregion (Strong and Leggat 1981). The modal vegetation for the area is aspen (*Populus tremuloides*) and rough fescue (*Festuca hallii*) and the soils are typically black and dark brown Chernozems. Aspen is interspersed among the grasslands on the dark brown Chernozemic soils. The topography is undulating to hummocky.

The pipeline is scheduled for construction in late July or early August 1999 and the research sites will be established after construction is completed. If any soil handling treatments are employed, the treatments will be set up at the time the pipeline is constructed. Adjacent undisturbed sites will be used as controls/references to determine if the revegetated research sites become similar to the control and if species in the adjacent undisturbed area appear to be moving into the disturbed areas. The use of control sites also enables a comparison of plant health and vigor for revegetated sites. Treatment plots will be constructed and seeded in mid to late fall.

4.0 Experimental Design

The experimental design will be a complete randomized split block. Each reclamation treatment will be replicated four times, once in each of four blocks. A control consisting of undisturbed adjacent native prairie will also be included in each block. The blocks will provide an indication of the site variability and will be located at least 25 m from each other.

Each treatment will be the full 32 m width of the RoW and 10 m in length. In each main treatment the RoW will be split into pipeline RoW locations of stockpile, trench and work areas since these areas may respond differently to the treatments.

5.0 Potential Research Treatments

Several treatment options are suggested in this section. They will be considered in combinations in the budget section of this proposal. Thus the actual treatments implemented will be dependent on the budget level of the research. A primary focus and a secondary focus will be specified.

If weeds become problematic, future research may be considered to determine if spot herbicide applications, mowing or fertilization would reduce weedy species. However, these management options will not be implemented in the initial research. Although fencing may prevent disturbing seedbed and seedlings it is not practical in the industry. Fertilizers will not be applied since sandy soils would allow fertilizers to leach with heavy rains. Organic fertilizers, such as manure and compost, may contain weed seeds that may invade the adjacent undisturbed areas.

5.1 Minimum Root Zone Stripping

Orthic Dark Brown Chernozemic soils (Wainwright series) are located at the research site and the topsoil depth is 10 to 15 cm (Tera 1999). Minimum root zone stripping would remove only the top 5 cm of topsoil compared to the removal of 10 to 15 cm of topsoil with the proposed (conventional) stripping method. The use of minimum root zone stripping may enhance revegetation by allowing plant propagules, normally concentrated in the top few centimeters of the soil, to be replaced close to the surface following construction.

5.2 Straw Crimping

The addition of weed free straw following soil replacement will reduce soil erosion potential. Crimping and working the straw into the soil provides a wind barrier to mitigate wind erosion and provides organic matter to increase soil water holding capacity and nutrient availability. The straw will be crimped with an industry standard crimper following the normal industry practice.

5.3 Cover Cropping

Annual oats, wheat or rye will be seeded at half the recommended rate to protect seedlings from sun and wind, conserve moisture, increase water holding capacity and minimize soil erosion.

5.4 Native Plant Species Seed Mix

The native plant species seed mix normally used by industry in this area will be used in this treatment. Native species in the seed mix are generally obtained from other ecoregions. Species

composition is based on the availability of seed and will consist of both grasses and legumes if possible. To ensure adequate groundcover, 300 pure live seeds (PLS) per m^2 will be seeded. The use of a native species seed mix would provide an opportunity to determine if the species from other ecoregions have the ability to form a sustainable plant community while allowing natural invasion of native species from adjacent undisturbed areas. Drought tolerance, which has been critical to this region in recent years, is an important aspect of the plant species chosen for this research and native species are typically better able to tolerate drought compared to introduced species.

5.5 Natural Invasion

Soil will be replaced with the intent of facilitating the encroachment of surrounding plant species onto the pipeline. In undisturbed areas, seeds and rhizomes should become established on the RoW over time. Some of these plant propagules may also reside in the seedbank of the replaced soil material.

5.6 Native Seed Collection

Seed collection of one or two native plant species in the Wainwright region could be conducted in 2000. Two or three Carex species are established on sandy soils in undisturbed areas near the RoW and may be considered for seed collection and revegetation research. Collected seed would be cleaned and broadcast onto the natural invasion research plots. The feasibility of Carex seed collection would be based on the germination rate of Carex seeds collected in 1999, availability of seed and condition of the natural invasion research plots.

5.7 Treatment Combinations Recommended For The Research Program

The focus of this research should be to assess the potential for natural invasion by native species. Thus primary treatments should consist of natural recovery and seeding the native plant species mix. Treatments to enhance natural recovery would focus on minimum root zone stripping, erosion reduction and site enhancement and should include straw crimping and a cover crop. The secondary treatments could include use of additional cover crops and native seed collection.

6.0 Vegetation Measurements

Measurements will be made twice during the growing season in the first three years of the research. This will ensure detection of species that are either late or early season dominant and will also allow accountability of late season germination and over winter survival. Within each treatment, on each pipeline RoW location, 10 randomly located 0.10 m^2 quadrats will be used for vegetation measurements. Within each 0.1 m^2 quadrat, ground cover will be assessed for bare ground, live vegetation and litter. A complete plant species composition and cover of individual species will be determined. This will allow for a determination of seeded and unseeded species. A general assessment of plant health and vigour will also be completed.

7.0 Soil Measurements

Three soil samples will be taken from each plot and pooled into a composite sample in depth increments of 0 to 5, 5 to 15, 15 to 30, 30 to 45 and 45 to 60 cm. Samples will be analyzed for particle size, macronutrient content (N, P, K, S), organic carbon content and water holding capacity. In each plot, three penetrometer readings (cone penetrometer) and three bulk density readings (neutron probe) in the above depth increments will be done at the time of seeding or the following spring (depending on time available before winter).

8.0 Time Schedule

The research plot selection and establishment will be done in August 1999, followed by seeding in September or October 1999, depending on weather conditions. Monitoring will be conducted in early June and mid-August for 3 years, commencing in 2000. Native seed collection will be conducted in 2000 at the time of seed set, followed by seeding in September or October 2000.

Although this research proposal is only for a three year period, an extended monitoring program should be considered to provide a long term perspective on revegetation success and the sustainability of the experimental plant communities. There is no long term research of this nature and the results would be important to the industry.

9.0 References

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