Proceedings of the 4th Annual British Columbia Mine Reclamation Symposium in Vernon, BC, 1980.
The Technical and Research Committee on Reclamation

USE OF NATIVE SPECIES IN MINE LAND RECLAMATION

by

V.C. Brink

Plant Science Department

University of British Columbia

THE USE OF NATIVE PLANTS IN MINE LAND RECLAMATION

INTRODUCTION

Mankind has a basic and reasonable responsibility to maintain the potential productivity of earth's land surface and to recognize that solar energy harvested by plants is a prime basis of life support systems. As Man's disturbance and modification of the earth's surface increases, the topic to which we now address ourselves must also grow in importance.

There are however many in this audience, including our Chairman, who have had much more experience than I have in establishing plants on mine lands. I acknowledge at once that my interests have focussed on the establishment of plants for agricultural purposes, for amenity purposes such as golf and parkland, and for highway verges. I must admit to a largely general rather than specific interest in the establishment of plants on mine lands; over several decades my interest in mine land reclamation has met with considerable frustration and my background now seems fragmented and lacking coherence.

Of the now fairly extensive literature extant on the use of agronomic and native plants on lands disturbed by mining, I have partial knowledge but enough to know that it is largely non-quantitative, observational and empirical. There is little yet which is theoretical or predictive on the use of native plants. As Frank Egler, an applied plant ecologist of some renown in the United States repeatedly points out, vegetation science is in its infancy. I agree.

It is inevitable that agronomic or domesticated plants should offer the primary appeal in providing cover during mine land reclamation. The availability and cost of seed and the comparative ease of the agricultural method makes this so. When and where the goals are met with the use of domesticated plants, their use should be encouraged. Quite often, however, the objectives cannot be met or are only partially met by the use of agronomic species. As knowledge and sophistication grow, we should look beyond the present-day domestic gene pools and extend them to include the native plant gene pools.

PLANT ADAPTATION - GENETIC AND ENVIRONMENTAL

As almost everyone is aware, plants and animals are the product of their heredity and their environment. Thus there must be a primary concern with the adaptation of plants - through regard for their genetic constitution and the analysis of the mine land environment.

It is worth taking a few moments to review the enormous range of mine land environments in B.C. to which we expect plants to adapt. The mine land environments certainly exceed in diversity those we commonly think of as agricultural environments, although one has to admit that there are few environments on the globe today which man is not exploiting one way or another for food and/or fibre.

At Island Copper and Western Mines on Vancouver Island we are looking at cool marine west coast climates with precipitation of over 150 inches, with a long growing season, leached soils and an environment where native plants usually quickly cover any scars made by Man. On the other hand, at Tranquille where placers were worked over a century ago and precipitation is only 7 inches, the disturbed land is still much in evidence. Our mine lands are found from the 49th parallel in the Boundary Country to the 60th, near Atlin and, therefore, embrace considerable variation in day length and length of growing season. They exist from sea level on Texada Island to high alpine on, say, Poison Mt. in the South Chilcotin Mountains at 8,000 feet elevation, an environment where even under the best of circumstances plants establish very slowly indeed. Soil or edaphic conditions likewise range widely - from highly mineral and poor (oligotrophic) wet sites, to mineral rich (eutrophic) and dry and/or saline sites. Simply stated this means that in B.C. recommendations for mine land plantings, native or domestic, must almost always be site specific.

Goodman and Bray (1975) attempted a listing of features (physical, chemical and biological) of the lands disturbed by mining. These features, which often require special consideration, include: slope and aspect, wind effects, surface temperatures, water stress, stability of surface, nutrient status, spontaneous combustion, erosion, compaction, toxic substances, soil forming minerals and organic matter, and the soil flora and fauna. It is not that these factors are not encountered in establishing plants in agricultural and other contexts, but that the "ranges" or "amplitudes" met within the mine land context usually far exceed those in the agricultural or similar settings.

It is worthwhile to examine the originating sources of most agronomic species we use in mine land reclamation:

1. Virtually all of our agronomic species are herbaceous and are aliens; i.e. they originated not on this continent but on another often under climatic conditions only weakly analagous to our own.

2. In the introduction of these aliens to this continent, their distribution in their native land was usually not well considered. It is true that, even today after years of experience, our introductions represent limited provenances. This means of course that the genetic base of our introductions is quite limited. Much of the current agronomic testing continues to involve new introductions from countries of origin and includes attempts to build world or regional collections of species which have been used agronomicalIy in our country for decades.

3. The genetic base of many agronomic species is probably narrowing because of the loss of wild or quasi-wild progenitors in the countries of origin. Breeding for adaptation for restricted purposes and areas narrows the genetic base by eliminating much

variability and selection for uniformity. Species used for mine reclamation, however, are often forage species and losses of genetic variations are probably less important.

4. Most herbaceous species used in mine land reclamation, unlike cereal species, have been domesticated only in recent centuries (alfalfa is an exception). Thus many are, genetically speaking, not far from being "wild" or "feral". It can be argued that in a land such as ours which was deglaciated within the last 20,000 to 30,000 years, these aliens constitute a welcome addition by diversifying a very youthful flora.

5. Many of our agronomic species without Man's direct assistance have "picked up" genes from congener native species after their introduction to our land. Timothy is a good example of a European species which, after it came to North America, picked up an inheritance once and possibly twice from our native timothy. This is also probably true of Kentucky bluegrass and many of our fescues and bentgrasses. To some extent we are now doing this sort of thing consciously. "Polar" bromegrass and perhaps "tundra" bluegrass, issued by the Alaska research station at Palmer, incorporates some genes from native species. In the case of "Polar" brome, genes from Bromus pumpellianus, a native species, were incorporated into domestic smooth brome (Bromus inermis), a brome originating in central Europe. Thus, "making" a "new" bromegrass which would be much more useful for high latitude environments (Klebesadel and Associates).

6. Most of the herbaceous species used in mine land reclamation are highly variable genetically and phenotypically. That is to say, the populations are highly heterozygous and individuals may respond in form and size in a wide array in different environments. Usually, too, the populations adapt to a wide range of microclimatic and microedaphic conditions. Thus smooth brome, an introduced species, may be found in environments from Mexico to

the Arctic and from the Atlantic to the Pacific; the same is true for many other alien agronomic species. Usually species used in reclamation and for forage are established as mixtures of species and strains to broaden the genetic base even further; usually far more plant material is used in establishment than can possibly survive and, thus, if one plant is not genetically suited to a given micro-area another with a different genetic base may be. Hundreds of millions of seeds may be scattered over a hectare in the expectation that only a few thousands will produce plants. (This is a strategy, incidentally, widely employed by certain plant species in nature.)

7. However, it should be recognized that agronomic species are continually being selected for their ability to yield well in a limited area, or for their ability to recover after mowing, or to give a quick canopy under conditions of more or less intensive agriculture; their genetic base and adaptability for survival under roughland conditions is being slowly reduced. Thus, some selections of alfalfa and of crested wheatgrass, just as examples, are doing fine in cultivation but very poorly on native ranges or on mine land reclamation areas which embrace many microclimatic and microedaphic conditions.

8. Seed production in some agronomic species is either low or of such a nature that a stand will not maintain itself in nature or under what is ecologically termed "old field" situations. The stand is therefore short lived and one is obliged to maintain it under quasi-agricultural conditions: continual reseeding, fertilizing, top dressing, etc. are required. Sometimes stands of introduced agronomic species, but not of comparable native species, are eliminated with dramatic suddenness - by pest, disease, drought, cold, etc. Sometimes the seed of agronomic species comes to our area from areas which are climatically far different to our own; certification of seed origin becomes a matter of great signifi-

cance (e.g. white clover seed from Louisiana, although often inexpensive, is usually unsuitable for B.C.).

9. Reference has already been made to the advantages of diversifying the flora of a recently deglaciated area such as our own by introducing species from other lands. It is just possible, too, that in diversifying the plant cover on disturbed areas whether mine land, range, roadside verges, logged-over lands, etc., the native fauna may also be diversified and perhaps enhanced or perhaps introduced fauna may be maintained. Examples are not hard to find. Chukar partridge, an introduced game bird, appears to survive in areas where downy brome, an introduced grass, is abundant.

INTRODUCTION OF NATIVE SPECIES

The introduction of native plant species in reclamation procedures may be viewed as the continuation of the long process of domestication of plants by Man for his special uses. It began in the stone-age when Man ceased to be strictly the hunter/gatherer and started to encourage the development of favored species by eliminating unwanted competitive species. It is a process which should be encouraged for I believe we can usefully employ a larger repertoire to meet the need for plants in a very wide range of environments in our province.

1. The repertoire may be expanded, in part, by scrutinizing new plant materials from other lands as is being undertaken at the Research Station of Agriculture Canada at Beaverlodge near the B.C./Alberta border in the Peace River area.

2. Adaptability of species and strains currently in use may be ex tended to some degree by hybridization of introduced and native species, as is being undertaken at the Alaska Agricultural Ex periment Station, Palmor, Alaska.

3. There is much to be gained by scrutinizing our native species with a view to exploiting their usefulness in Man-modified habitats. The Soil Conservation Service of the U.S. Department of Agriculture has been doing this for many decades; some of the more active and valuable efforts have been at the Pullman, Washington station and its related stations by Drs. Hafenrichter and Schwendiman. From their efforts came useful strains of native grasses such as Whitmar Wheatgrass (Agropyron spicaturn), Bromar Bromegrass (Bromus emarginatus (?)), Streambank Wheatgrass (Agropyron riparium), Big Bluegrass (Poa ampla) and others. Some seedhouses in the U.S. (e.g. Sharp & Co.) have selected strains of native shortgrass prairie and desert species such as Blue grama grass (Bouteloua gracilis) and Weeping lovegrass (Eragrostis sp.) which have been usefully employed in many amenity and reclamation projects.

4. Within our own provincial borders there may be value in scanning native plant materials with a view to exploiting them in reclamation and other Man-modified environments. I will name only one species, Altai Fescue (Festuca altaica). In introducing provenances from a species such as this for quasi-agronomic uses in our higher altitudes and latitudes, we might avoid costly long-term selections within existing agronomic species for increased cold and drought tolerance, adaptation to day length, etc.

In Britain, where very little plant cover remains which is truly native and/or climax, Smith & Bradshaw recently selected and issued for use in reclamation, strains of bentgrass and fescue which are tolerant of the somewhat toxic waste and tailings from hard rock mining. It may well be useful to scrutinize the plants growing on our own ultra-mafic parent materials (e.g. those in the Yalakorn area which contain ferro-magnesium materials) with a view to locating strains tolerant to higher background levels of mercury or chromium. Plants too, in different ways, it may be recalled, do not necessarily reflect concentrations of the metals in the substrates and, may in fact, "screen out" as well as "screen in" elements. Scrutiny of native genotypes on calcareous parent materials (e.g. limestone mountains) or on some of the Tertiary lava parent materials (e.g. Cariboo-Chilcotin) might yield useful genotypes at no great cost.

CONCLUSION

I have often thought that it would be useful, particularly in B.C. with its many many varied near-micro environments, if all agencies interested in developing and maintaining a productive and useful plant cover over our province, could coordinate their efforts to clearly identify needs and set goals.

There are many common plant needs on the ranges, domestic stock and wildlife are often complementary as are those for highway verges, mine land and other roughlands. Singly, the needs are often minor, but collectively are often quite major. This conference could be a means of recognizing these interrelationships.

DISCUSSION RELATED TO Y.C. BRINK'S PAPER

J. Dick - Ministry of Environment: Do you have any suggestions on how people might go about collecting herbaceous seed materials? I have heard some reports of this in surface mines in the U.S. using some kind of mini-combine harvester to harvest seeds from native swards. Collecting seeds from shrubs is fairly easy, but it's always been a formidable task trying to sample a sward where different plants are flowering at different times.

Answer: Well, quite honestly, I think the only way is to put in an intermediate step somewhere in order to make the initial collections, but you will always be quite limited. And then you harvest an area under pure-standing conditions. That's particularly true in British Columbia where the terrain is so rough. In the United States there are larger areas, and I think this would also be true of the prairie provinces, where you do find fairly pure stands. There is one point that might be of interest concerning the sweet-grass Paracloa Odorata or Paracloa Alpinum. They are both loaded with tumors and are highly unpalatable, to just about all of our native grazing ungulates. In talking to people at Banff National Park about this, we found that by including just a small amount of native sweetgrass in the verges along the Trans-Canada highway we were able to keep the elk off the highway and back in the trees. I didn't follow this up by researching the interrelationships between plants and wildlife. I think that some uses of native species could become important. In relation to the conservation of wildlife habitat, winter range area continues to decrease and this could be offset, to some extent, by revegetation with native grass species.