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

USE OF AGRONOMIC SPECIES IN MINE RECLAMATION

Paper presented

by

Angus S. Richardson, P.Ag.
General Manager
Richardson Seed Company Limited
Burnaby, British Columbia

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INTRODUCTION

Agronomic is the nomenclature given to plant species that, over time, have become domesticated native species; therefore, the term distinguishes a plant from a current native plant. For this discussion I have included all commercially harvested seed crops of grasses and legume species.

The purpose of establishing grass and legumes on a reclamation site is:

- to revegetate a disturbed area,
- to provide forage for native or domestic animals,
- to provide surface erosion control,
- to provide esthetic satisfaction, and
- to provide a cash crop for income where feasible.

In the first four objectives a satisfactory ground cover is what is being sought, rather than an agricultural income from the forage. With the former in mind, we must concern ourselves with the choice of the agronomic species for seeding, since the choice is between:

- the common seed types which have a wide genetic base, and
- the selected seed variety with a narrower genetic base.

The majority of plant breeders select varieties capable of providing high agricultural yield under good soil conditions. Such varieties often have high nutritional requirements and must be carefully selected for a specific situation. However, when disease threatens an area, or winter hardiness is a necessity, then varieties having these attributes can benefit the reclamation situation.

In British Columbia, common seed, which is closest in origin to the original native material, is used because it has the widest genetic base and is adaptable to variable soil types and climates. In selecting common seed it is important that the origin of the plant be known, in order to determine if the plant will adapt successfully to the area where it is to be sown. Recently, importations of wheatgrass and alfalfa from Argentina have been introduced into Canada, an origin that would not be suitable for use in British Columbia.

THE CANADA SEEDS ACT

This Federal Act, administered by the Plant Products Division of the Food and Marketing Branch, Agriculture Canada, describes the conditions under which all seeds can be sold. The Seeds Act specifies what information must be provided to describe the seed, which must then be given to the buyer. By means of grade tables the Act specifies how clean the seed must be; how many weeds, if any, are allowed; and the minimum germination rate that a seed must have. Seed is thereby classified as Canada No. 1, Canada No. 2, or Canada No. 3. The Seeds Act also describes which species of grasses and legumes can be sold in Canada, and which varieties are licensed for sale in Canada. Many of the so-called "native species" of seed cannot be sold under the terms of the Seeds Act, and special permission for the use of such species must be obtained from Ottawa.

PRINCIPLES OF SEED MIXTURE DESIGN

Because soils are not always homogeneous and weather patterns do not repeat themselves consistently, there is a distinct advantage in using a seed mixture that has been blended to suit the variables of the site. The following considerations are applicable to seed mixture design:

- The seed must be adapted to the climate and soils of the area.
- The seed must be adapted to the end use of the land and the desired longevity of the stand.
- The mixture must be economically viable.
- The mixture must be balanced:
  a. the plants should be able to withstand competition from one another (bio-compatability),
  b. it is usually desirable to blend legumes with grasses,
  c. enough seed of each major ingredient should be included to establish a stand if some species fail,
  d. the formulation expressed as a percentage of ingredients by weight, must reflect the desired percentage of ingredients by seed count, ie. end plant population. See following example calculations:

EXAMPLE: End Plant Population

Purity % (Weight)		Seeds/Pound		Seeds/Pound in Mix
25% Smooth Brome	X	125,000	=	31,250
25% Canada Bluegrass	X	2,500,000	=	625,000
25% Creeping Red Fescue	X	600,000	=	150,000
10% Timothy	X	1,300,000	=	130,000
5% Red Top	X	5,000,000	=	250,000
10% White Clover	X	800,000	=	80,000
				1,266,250

  e. consideration must be given in the formulation for the rate of establishment and germination of each kind of seed.

SPECIE AVAILABILITY AND ADAPTATION

Because agronomic species are principally used in agricultural situations, adequate inventories are maintained and planned production as seed crops is undertaken, so there is seldom a serious shortage of seed. During certain years when drought prevails or bad weather is

experienced at harvest time, certain shortages can occur. If any reclamation user is concerned about seed availability, contract arrangements can be made with any seed merchant to produce his requirements to ensure a supply. Classification of species normally available, subclassified as to their end adaptation, is given below:

1. Rapid Developing, Short-Lived Grasses

Humid Areas: Annual Ryegrass (sometimes called Common or Italian)
Westerwolds Ryegrass

Dryland Areas: Slender Wheatgrass
Tall Oatgrass

2. Rapid Developing, Long-Lived Grasses for Sub-Humid and Irrigated Areas

Orchardgrass	Tall Fescue	Perennial Ryegrass (Diploid and Tetraploid)
Intermediate Wheatgrass	Smooth Bromegrass	

3. Drought Tolerant, Long-Lived Bunch Grasses

Crested Wheatgrass Bluebunch Wheatgrass Big Bluegrass

Slow to Establish
Hard Fescue Russian Wild Ryegrass Tall Wheatgrass

4. Drought Tolerant, Long-Lived Sod Grasses

Pubescent Wheatgrass	Streambank Wheatgrass	Canada Bluegrass
Kentucky Bluegrass	Red Top	Creeping Red Fescue

5. Saline and Alkali Tolerant Grasses

Tall Wheatgrass	Streambank Wheatgrass	Slender Wheatgrass
Crested Wheatgrass	Creeping Foxtail	Tall Fescue Russian Wild Ryegrass

6. Acid Tolerant Grasses

Red Top	Meadow Foxtail	Canada Bluegrass
Red Fescue	Colonial Bentgrass	Tall Fescue
Creeping Bentgrass	Hard Fescue	

7. Dense Deep-Rooted Grasses

Crested Wheatgrass	Intermediate Wheatgrass	Hard Fescue
Orchardgrass	Russian Wild Ryegrass	

8. Dense Shallow-Rooted Grasses

Red Top	Kentucky Bluegrass	Creeping Red Fescue
Canada Bluegrass	Creeping Bentgrass	

9. Fine Leaved Multi-Purpose Grasses

Kentucky Bluegrass	Creeping Red Fescue	Canada Bluegrass
Chewings Fescue	Hard Fescue	

10. Wet Land Grasses

Meadow Foxtail Timothy Red Top Reeds Canarygrass

11. Legumes

Alfalfa	Alsike Clover	Sainfoin	Bird's-foot Trefoil Sweet
Clovers	White Clovers	Red Clovers	Cicer Milk Vetch

12. Special Agronomics

Bearded Wheatgrass	Blue Wild Rye	Mountain Brome
Alaska Brome	Basin Wild Rye	Alkali Sacaton
Siberian Wheatgrass	Beardless Wheatgrass	Harding Grass
Thickspike Wheatgrass	Big Bluegrass	Upland Bluegrass

SEED APPLICATION RATES

The application rate for seed to be used in reclamation in British Columbia is determined by the following factors:

- strength of establishment required,
- seed bed preparation,
- soil temperature (time of seeding),
- soil moisture,
- method of application,
- ingredients in seed mixture,
- companion crop.

As a rule of thumb In the dryer areas of the Province, less seed is used than in the moist areas. When agricultural equipment is used, a seeding rate of 30 - 75 Ib/acre is used. When hydro-seeding is the method of application, the seeding rate is usually increased by 25%. When seeding is carried out by aircraft, the seeding rate is increased by 50%.

COATED SEED

Coated seed, a relatively new product, is being promoted, therefore it warrants a few comments. Coated seed originated in New Zealand where much of the seeding on native ranges is done by aircraft. The ballistic weight of the coating material to the seed has benefit in this situation. When the seed is coated, the product becomes:

In grasses: 50% of the weight is seed, 50% is coating material In legumes: 66% of the weight is seed, 34% is coating material

The coating usually used for grasses is a lime based polymer with approximately 5% available nutrients. This means that when the entire product is applied at 50 lb/acre, 1-1/2 pounds of actual plant food is applied per acre. In legumes, the coating is usually a humus-lime mix containing the correct strain of rhizobia bacteria.

The benefits of coated seed are as follows:

- price per pound of the seed mixture is reduced,
- the specific weight of the seed is increased,
- there is marginal nutrient benefit,
- the coated seed usually withstands deeper planting than raw seed.

The disadvantages of coated seed are as follows:

- in grasses, you only get half as many actual seeds per pound, compared to raw seed;

- coating usually reduces the germination of the seed;
- costs per acre are much higher;
- product is difficult to handle and, generally does not flow very easily;
- coated seed is not as readily available as ordinary seed.

During an initial trial period with coated seed, the Richardson Seed Company has supplied over 100,000 lbs. of the product to the industry, and generally, the feedback we have received has indicated disappointing results. We are of the opinion that to achieve the most economical and satisfactory results, raw seed should be used wherever possible. Only in site-specific situations do we see a place for coated seed, such as the benefits of having the extra ballistic weight around the seed.

SEED PRODUCTION

British Columbia imports, either from the United States, or from other regions of Canada, most of the seed used within the Province. As indicated earlier, it is important that the origin of the seed to be used should be adaptable to B.C. conditions. Seed merchants aware of local agronomic conditions, comply accordingly. The following list shows the commonly used species, complete with their most common source of origin:

LEGUMES

Alfalfa: Idaho, Washington, Southern Alberta
Alsike and S.C. Red Clovers: Peace River, Saskatchewan
White Clover: B.C., Idaho, Oregon, New Zealand

GRASSES

Creeping Red Fescue: Peace River
Wheatgrasses: Alberta, Saskatchewan, South and North Dakota, Montana
Orchardgrass: Oregon, Southern Alberta
Ryegrass: Oregon

Timothy: B.C., Alberta, Saskatchewan, Manitoba, Minnesota
Bluegrass: Washington

Red Top: Mississippi, Poland, B.C., and the Prairies Provinces

DISCUSSIOM RELATED TO A. RICHAROSON'S PAPER

Art Bomke - University of British Columbia: I've read somewhere that the coating of legume seeds with Time has a beneficial effect on the survival of rhizobium. It could be significant in the acidic materials we're trying to vegetate. Can you tell us something about that?

Answer: I think the coating of legumes is generally more acceptable and more widely practised than is the coating of grasses. Of course, the legume seed is always coated to some degree with the rhizobia; but in what I call the "coating process", we get a definite coat containing the rhizobia around the seed. There are many people using the coated legume product. It was used extensively in Ontario last year, and it has also been used in California. I think that there may be some real benefits to coating legumes this way; but at the present time, the general concensus by farmers is that the coating is perhaps not giving them any greater benefits than they had before. The other interesting thing is the introduction of newer rhizobia strains that may allow us to get better innoculation of our legumes and consequently more nutritional benefits.

Duane Johnson - Hardy Associates Ltd.: We tested coating winter seed in the Arctic and found there were many problems with fungal infestation. I was wondering if you have had any experience with that?

Answer: I, personally, have not. We have not worked in the Arctic and I have not heard of the problem of increased fungal attack. But we have had experience sowing the coated seed in the late fall of the year, just before the snow came in, and waiting for spring germination. In those instances we felt that we gained no benefit from the coated program. The idea basically was that it would be

our "pop up" fertilizer, if you will; but it seems that one needs our fertilizer program. I'm sure coated seed will be used to a much wider extent, and there may yet be benefits which we still haven't seen in our coated seed.

Duane Johnson: Do you find that you coat all varieties of seed?

Answer: Coatings can be done on any species. It's just a simple matter of putting a solution around the seed. In legume innocula-tion, it's a little bit more difficult because the innoculant is only good for a certain period of time. Also, the seed is wrapped up in that coating, it's more difficult to reinnoculate it.

S. Parmar - B.C. Research: In the formation of seed mixtures we consider the number of seeds per pound. Don't you think it would also be good to consider the purity of the seed?

Answer: Sohan pointed out, and very rightly so, that in the formulation of seed mixtures, you should also consider the living seed aspects. What this really means is that some seeds will have a 90% purity because they are chaffy, whereas, other seeds will have a *99%* purity because they have a very low chaff content. Additionally, some seed species will grow at 90% germination or 95% germination very easily and rapidly, whereas, with others, it is difficult to get them higher than perhaps 80%. So, you multiply the pure seed aspect with the germination to take this into account. Sohan, I chose to ignore that factor here because when you work the pure-living seed into the particular table I showed you, it will alter the percentage by about half to three quarters of a percent in the final instance. It's a rather complicated process, but it is an extremely useful point, and it is one we do consider in seed mixture design.