PROPAGATION OF NATIVE TREES
AND SHRUBS FOR RECLAMATION USE

Paper presented

by

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INTRODUCTION

The long-term final objective of a mine site reclamation program should be to produce a plant cover which is useful, aesthetically acceptable and self-maintaining. There are also very important interim objectives which include erosion control, slope stabilization and soil improvement. These depend very heavily upon the use of agronomic species, and, in general, I think that the mining industry has undertaken and carried out programs which effectively attain the interim objectives. Achievement of the final objective will depend very heavily on the use of native plant material.

Our programs of native plant establishment are much less advanced, and our experience in the establishment of permanent native plant cover on mine sites is, to date, incomplete. We do know, however, that future reclamation plans will have to make extensive use of native plant material. In order to do so, we must be able to propagate these native plants effectively and economically. Thus, it is important that we start out with the proper facilities.

THE PROPAGATION GREENHOUSE

Most types of plant material can be propagated without the use of a greenhouse but a good greenhouse makes the job much easier, quicker and cheaper. For a propagating greenhouse, I recommend fibreglass as the preferred covering. Double skinned poly-houses are quite effective for climate control, however, they have the disadvantage of screening out the ultraviolet light. Plants grown in a polyethylene house will burn badly when put out into bright sunlight, therefore, careful attention must be paid to hardening-off the plant material before outplanting.
Plants can be moved directly from a fibreglass house with little problem.

The heating system should be designed to maintain a minimum temperature of 5°C and, depending upon the location, a combination of shade cloth and fans, or manually opened ventilators, will prevent overheating during summer. The propagating bench itself should have metal supports. We use 1-1/2 inch galvanized pipe for the legs and 1-1/2 inch x 1/8 inch angle iron for the horizontal supports. For bench sides we use copper napthanate treated 2 inch x 4 inch on edge, allowing an inside width of 42-1/2 inches. This allows for the easy placement of two standard flats of 20-1/4 inch length on the bench.

Asbestos cement sheets make the best base for the propagating bed. Adequate drainage is provided by 1/4 inch holes drilled at about 1 foot intervals. Bottom heat for the bed can be provided either by hot water pipes with a thermostatically controlled circulating pump, or more simply, by an electric soil heating cable. If cable is used, provide 10 watts per square foot of bench. The cables or pipe should be covered with at least 1/2 inch of pea gravel to ensure good drainage and heat distribution.

An efficient, controllable mist system is essential. Refinements such as high intensity lighting and CO₂ injection are expensive and not really essential. A simple, economical, and effective mist system consists of a single line of 1/2 inch PVC pipe suspended 2 feet above the bench with FLORA-MIST wire shield propagating nozzles at a 3 foot spacing. The saddle-fitting nozzles are installed by drilling a hole in the PVC pipe and gluing the saddle in place. (PVC sawdust or drill shavings must be thoroughly cleaned from the pipe before nozzle installation, otherwise troublesome clogging will occur.) The mist is controlled by a 1/2 inch solenoid valve and a time clock or other sensing device. We prefer a 12 minute clock with 12 second intervals because it is simple and more fool-proof. Twenty to forty pounds psi is adequate for the water supply and, even with a very good quality
water supply, a 5 gallon per minute replaceable screen filter should be installed in the line. A 25 micron screen is recommended.

A north-facing frame with bottom heat and fibreglass cover is a very useful addition to the greenhouse.

PROPAGATION METHODS

If you plan on propagating a fairly broad range of plant material, it will probably be necessary to use all three major propagating methods: seed, hardwood cuttings and softwood cuttings. The propagating bench can be used for both hardwood and softwood cuttings. Seedlings are generally grown in trays or flats placed directly on the floor of the greenhouse.

SEED

Unfortunately, the seed of many species is very difficult to collect and germinate. Seed of coniferous species should be collected as soon as the cones are mature and should be stored in open-weave bags with good air circulation until they can be processed. As rather elaborate facilities are necessary for cone handling, the cones should be shipped to a commercial extractory for processing and seed cleaning. The seed can then be stored in plastic bags at -2°C until required for stratification and sowing. The best single source of information regarding seed collection, storage, processing and germination is "Seeds of Woody Plants in the U.S.A.", Agricultural Handbook #450, catalogue #0100-02902 from Superintendent of Documents, Washington, D.C. 20402.

Container-grown seedlings usually establish much more easily than bare-root material. There are many different container systems in use for producing conifer seedlings. Most systems utilize pH corrected peat or peat vermiculite mixes as the growing medium. Most very large-scale
operations provide nutrients with the irrigation water. An alternative particularly handy for a smaller operation is the incorporation of slow release fertilizers into the potting medium. We use both paperpots and Spencer Lemaire containers and a growing medium made up of straight sphagnum peat (preferably not too finely ground), with the following additions per cubic yard of material: 2 pounds of dolomitic limestone, 65 mesh; 2-1/2 pounds of Mag-Amp 7-40-6; 2 pounds of osmocote 18-6-12; 2 pounds of superphosphate 0-19-0; 2 pounds of gypsum; and 1-1/2 ounces of minor element mix.

Conifers are directly seeded into the pots using a vacuum operated mechanical seeder, then a light covering of medium-grade perlite is applied to cover the seed. The perlite retains moisture around the germinating seed, reflects bright sunlight, and prevents overheating. We normally do not stratify white spruce, lodgepole pine, jack pine or ponderosa pine. Douglas fir, both coast and interior varieties, is soaked overnight and stored damp in plastic bags at +0°C for 30 days. Hemlock also responds to stratification; but with this species, there appears to be variable response depending on the seedlot. The seed is air-dried after stratification and then immediately sown.

Maintaining uniform moisture during the germination period is most important. After the initial watering, seed trays can be covered with polyethylene film but great care must be taken to see that the film is removed at the very first signs of germination.

Yellow cedar is not seeded directly. With a six month stratification period, this species germinates very erratically and over a long period. Normal procedure is to broadcast the seed in flats and to transplant the young seedlings to pots as they germinate.

Aspen is an important species and, unfortunately, one which is rather difficult to propagate. Hardwood cuttings will not root at all. Softwood cuttings produce a very low percentage of rooted cuttings. Root piece cuttings are reasonably successful but collecting aspen roots is
rather expensive. We have not grown aspen from seed, for in the past several years there has been almost no seed available in the areas where we have been collecting. However, in the past, we have successfully collected seed for European customers who reported good results. The seed must be kept cool and handled very quickly; sowing must be done as soon as possible after collection.

Birch generally germinates well from seed which is collected in the fall and stored dry without stratification. Because of the lightness of the seed and its variability in germination, it is normally necessary to seed birch in flats and then transplant. Seed is broadcast without covering.

Alder (Alnus crispa and Alnus sinuata) can be broadcast directly into the containers as there is usually no objection to having multiple seedlings in a single container. As with birch, the alder seed is not covered.

Shrubby species which can be propagated from seed include: Saskatoon berry, buffalo berry and wild rose. Snow berry seeds prolifically but its germination seems to be completely unpredictable. Both buffalo berry and rose have hard seed coats and embryo dormancy. Although acid treatment has been used successfully to shorten the stratification period to one season for rose, our experience indicates that it is better to collect ahead of time and wait for the second-year germination. We get the best results by sowing the seed in sand flats and sitting them outside under the influence of fluctuating temperatures and the leaching action of rain. The sand flats must be well screened, otherwise birds and mice will eat most of the seed.

Some species require an after-ripening period. If seed is cleaned and then put immediately into cold storage, it will not respond to the normal stratification treatment. Pin cherry, choke cherry, Saskatoon berry and kinnikinick are in this category. Seeds of these species should be given a warm stratification of 30 to 60 days immediately.
following extraction. We have found the easiest method of doing this is to mix the seed with sand, place the seeded flats on the propagating bench, and bottom heat at 20°C. After this treatment a 90-day cold stratification is required.

HARDWOOD CUTTINGS

Species which can be propagated successfully from hardwood cuttings include poplar, willow, red twigged dogwood, shrubby cinquefoil and snowberry. Poplar and willow cuttings should be taken while still completely dormant, packed in plastic bags with damp peat moss and stored at 0°C. After the cuttings have calloused, they can be placed directly into the planting area or rooted in the greenhouse. The percentage of take will be much higher under greenhouse conditions.

The normal procedure for making poplar and willow hardwood cuttings is to make a 45° angle cut directly below the bud at the base of the cutting and a straight 90° cut just above the top bud of the three bud cutting. Red twigged dogwood cuttings should be prepared in the same way as poplar and willow. However, they should be propagated in flats of either sand or a sand/perlite mixture and given bottom heat. The greenhouse temperature should be kept as cool as possible during the rooting period to prevent premature and excessive top growth. In areas where greenhouse temperatures are warm, we have found that a north-facing, cable heated frame is very effective.

Dogwood cuttings should have a 1 inch basal wound and a #3 rooting powder mix (0.8% indole-butyric acid). Shrubby cinquefoil propagates quite easily using the same method as for dogwood. However, the cuttings used are quite small - normally about a 3 inch long cutting with the branchlets stripped from the lower half. Snowberry cuttings should be made only from good vigorous growth and should be 4-5 inches in length with the bottom 2 inches of the cutting cleaned off. Hard-
wood cuttings should always be made from vigorous healthy wood, a condition difficult to obtain with cuttings taken in the wild.

If cutting beds can be set up at the nursery where the mother plants can be fertilized and watered, the quality of cutting wood will be much better and rooting percentages will be much higher. We normally get about 70% rooting from collected dogwood cuttings and at least 90% from nursery grown material. With thin twiggy species such as cinquefoil and snowberry, the difference is even greater.

SOFTWOOD CUTTINGS

Species which are difficult or impossible to root from hardwood cuttings will very often root quite well from softwood cuttings taken during the summer. Dogwood, willow, honeysuckle and high and low bush cranberry are examples of species which root very quickly and easily from softwood cuttings. The initial collecting and handling of the cuttings prior to placement in the growing medium is critical. Preferably, cuttings should be taken only during the early morning before the heat of day and should be kept moist to prevent wilting. If possible, the cuttings should be placed in the flats and under the mist within 2 or 3 hours of picking. If this is not possible, they should be wrapped in damp sacking and kept cool in styrofoam containers. For most species, a softwood cutting should include a partially unfolded pair of tip leaves and one pair of fully developed leaves. The basal pair of leaves on the cutting are removed and the cutting trimmed just below the basal bud. Many species will root quite satisfactorily without the use of hormone powder; however, hormones speed up the rooting and usually result in denser rooting, which makes for easier transplanting. We use a #1 hormone powder for easy rooting material such as willow, #2 powder for most other soft cuttings, and the #3 powder only for fairly difficult rooting species.
Careful management of the cuttings to avoid wilt is critical for the first few days. This means that mist intervals should be short. On the other hand, continuous heavy misting for too long a period will result in reduced rooting. Generally, after the first three days, the mist intervals should be gradually increased, always ensuring the cuttings do not wilt. The rooting medium we use is concrete sand which is fairly coarse; masonry sand is too fine. The sand must be clean and any silt or clay should be washed out. We usually mix about 1/3 medium grade perlite with the sand to improve aeration and reduce the mix weight; it is also easier to work with. The addition of 25% peat to the rooting mix is a help with blueberry, huckleberry and buffalo berry.

There is a greater advantage in using nursery grown wood for softwood cuttings than for hardwood cuttings. If softwood cuttings are taken from mother plants which, themselves, are from collected cuttings grown for several years in the nursery, the new cuttings can be picked, trimmed, and placed under mist within an hour or less. Good quality softwood cuttings handled this way have the best rooting results.

Another type of cutting, root piece, is adaptable to some species and works well for aspen, rose, and raspberry. Root pieces are cut in 2-inch lengths and inserted in flats with the top of the cutting barely above the surface. The flats should have bottom heat but should not be pre-misted.

In summary, there is no mystery in the successful propagation of native woody species. The basis of a flourishing propagation program can be summarized: careful attention to water, heat and ventilation.
DISCUSSION RELATED TO D. CHRISTIE'S PAPER

Frank Pells - Brenda Nines Ltd.: Is the book you recommended from Washington much superior to the one by the B.C. Forest Service?

Answer: Yes. Although the B.C. Forest Service book is good, the Washington publication includes information about a lot more species.