PROPAGATION AND OUTPLANTING OF *VACCINIUM SCOPARIUM* FOR BASIN CREEK MINING, BASIN, MONTANA[1]

by

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Abstract. Basin Creek Mining is a heap leach gold mining operation located at 8000 ft. elevation near Helena in central Montana. The site has shallow rocky soils, a short growing season and severe winters. Vaccinium scoparium is the dominant shrub species in the plant community. In January 1990, Basin Creek Mining retained Bitterroot Native Growers, Inc. to develop propagation techniques for the large scale production of V. scoparium seedlings. Seedlings suitable for outplanting were successfully propagated. Propagation by seed appeared to be the most economical method of producing large numbers of seedlings. Field studies are currently being conducted to determine the efficacy and economics of selected out-planting treatments. Treatments tested include the use of shade collars, translucent plastic tree protectors, anti-transpirant application, and microbial inoculation. Overwintering survival results will be reported in the Spring of 1993 followed by a full report in the Fall of 1994.

Additional Key Words: native shrub propagation, outplanting survival, shade collar, tree protector, anti-transpirant, fungal inoculation.

Introduction

Basin Creek Mine is located at an elevation of 8,000 ft. on the Continental Divide in central Montana. The plant community is a Pinus albicaulis/Abies lasiocarpa Habitat Type. Tree species include Pinus albicaulis, Abies lasiocarpa, Pinus contorta and Picea engelmannii. Undergrowth is variable, but Vaccinium scoparium is a primary species in most stands (Pfister, et al. 1977). Baseline studies conducted by WESTECH, Helena, MT, at the Basin Creek Mine, found V. scoparium densities to exceed 10,000 stems per acre.

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V. scoparium is important at high elevation sites as a food source for big game, small mammals and birds. As a spreading shrub, it is valuable for erosion control and ground cover. Because of this species' ecological importance and it's pre-mining abundance, Basin Creek Mining included it as a major component of their revegetation plan.

V. scoparium is a shade tolerant shrub that is typically a component of climax plant communities. Vaccinium species need partial shade to protect them from desiccation and to preserve soil moisture (Stark, N. and S. Baker 1992). V. scoparium may also have specific soil requirements. Research indicates that Vaccinium species form endo/ecto mycorrhizal associations (Lindermann, W. 1992, and M. Alexander 1977). Mycorrhizal associations have been shown to enhance establishment and growth of shrub species on mined sites (Aldon, E.F. 1975, 1978, and 1980). Soils disturbed by mining reportedly lack soil microbial biomass and diversity (Birch, P., et.al. 1991). Lack of beneficial soil microorganisms, along with V. scoparium's sensitivity to disturbed conditions, may be critical limiting factors in the reestablishment of V. scoparium at Basin Creek Mine.

Large scale nursery production of V. scoparium is necessary to produce seedlings for outplanting at Basin Creek because natural regeneration of Vaccinium species seedlings in the field is poor. Natural regeneration is hindered by lack of available moisture and the extremely slow growth rates of seedlings (Stark, N. and S. Baker 1992).

Little work has been done on the propagation of V. scoparium. The only propagation information available relates to test crops grown from rhizomes and germination studies done on a very small scale (Vorsa, N. and J. Luby 1992).

Bitterroot Native Growers began initial work with Basin Creek Mining in 1990. A proposal was submitted for production of site adapted seedlings of eight species of trees and shrubs, and for the development of economically feasible propagation techniques for V. scoparium. During the winter of 1990, a literature search of published material relating to the propagation of Vaccinium species was collected. From this information, BNG compiled a list of the most promising propagation techniques. Methods were devised to compare the success of the selected techniques.

V. scoparium seed was collected at the Basin Creek mine site in the fall of 1991 in order to produce site adapted stock. Plants that are genetically adapted to particular site conditions exhibit superior long-term survival rates than nonadapted plants. Genotypes adapted to a particular site, contain the genetic combinations that allow them to survive the extreme environmental events that periodically occur. Introduced stock, on the other hand, may survive a few years until one or more environmental extremes cause severe losses. This is particularly costly because there is not only a loss of plant material but a loss of several years of growth (Millar C. and W.J. Libby 1989).

The primary goal of our V. scoparium work was to test various methods of seed and vegetative propagation, with the ultimate aim of developing an economical method for large-scale nursery production. We therefore designed a study to compare seed and cutting propagation methods.

A secondary goal was to evaluate V. scoparium outplanting success. To accomplish this, a second study was designed to test methods of mitigating the site disturbance effects on V. scoparium survival and growth.

Propagation Methods

Hardwood cuttings were collected in June, 1991 in a dormant condition, wrapped in damp burlap and refrigerated. All cuttings were wounded then treated with Indolebutyric acid (IBA) at concentrations of 1% and 5%. Treatments of both concentration levels were compared to an untreated control. Twenty-five cuttings of each treatment were then planted in flats. Two rooting mediums were compared. The first medium consisted of one part peat, one part perlite. The other consisted of one part peat, one part vermiculite. All cuttings were placed in our cutting propagation facility where soil temperature was maintained at 22 degrees, centigrade. They were shaded with a burlap covered structure and misted for 12 seconds every three minutes beginning at 7:00 a.m. and continuing until 9:00 p.m. All treatments were monitored carefully for signs of callusing or root initiation. At the end of three months there was no sign of rooting in any of the treatments and the cuttings were discarded.

Propagation of V. scoparium from seed was first attempted by the staff at BNG in the Spring of 1991. The first crop was grown from a small amount of seed, purchased from a collector. The germination rate was extremely low due to poor seed quality. Thirty plants suitable for outplanting were produced.

Results from these initial trials convinced us that seed propagation was the most economical and effective method of V. scoparium propagation. V. scoparium seed was collected at the Basin Creek Mine site in the fall of 1991 by BNG staff. Collection of the extremely small berries can be a tedious task, but a good seed crop in 1991 allowed us to collect enough seed in a few hours to produce several thousand seedlings. The seed was extracted by macerating the ripe berries, then washing off the pulp. The clean seed was dried and stored in air tight containers in refrigerated storage at 3 degrees Centigrade. Pre-sowing germination tests were conducted. Seed tested at a germination rate of 58% was used in our initial propagation trial.

Two thousand 20 cubic inch Spencer Lemaire containers were sown with the BNG V. scoparium seed on March 29, 1992. Six to eight seeds were sown in each cell. The growing medium was Growers Gold, a commercial 1:1 peat-vermiculite forestry mix. The cells were well watered then misted three times daily to maintain proper germination moisture. Germination temperatures averaged 22 degrees Centigrade.

Germination was complete in eight weeks with a total germination rate of 58% and a fill rate of 93%. Seedlings were thinned to one per container. After emergence, chicken grit was added to each container to prevent algae growth on the growing media. Plants were irrigated with a liquid high nitrogen, complete fertilizer solution until the media was saturated. This fertilizer was used during early development and consisted of total nitrogen at 175 ppm, phosphorus at 75 ppm, and potassium at 175 ppm. As plants matured, the mix was changed to a compost based, complete fertilizer (analysis 6-3-6) and inoculated with plant growth stimulating rhizobacteria.

The growth rate of seedlings was extremely variable and slow. At five months the height of the seedlings ranged from one to ten centimeters with the larger individuals having well developed, fibrous, root systems. Most plants were multiple branched, with branches arising from the base. Seedlings were sorted by size. The larger plants (4 inches and above) were hardened off for outplanting, and the smaller plants

were held in the greenhouse for outplanting the following year.

Propagation Study Results

Cutting propagation methods might be modified to produce seedlings of V. scoparium. However, even if the techniques were successful, the costs would be prohibitive when compared with propagation from seed. More labor is required for the collection and preparation of cuttings than is required for the collection and extraction of seed. One good seed collection can yield enough seed for several years of production. Cuttings, however, require a fresh collection for each crop.

An additional advantage of propagation from seed is the preservation of genetic diversity. By collecting seed from several hundred plants within the area, the diversity that is present in the original population will be preserved on the revegetation sites. This diversity may be a critical factor in the long-term survival and establishment of a functioning, self- sustaining plant community.

Outplanting Study Methods and Materials

In light of V. scoparium's environmental requirements, and the probability that it is an obligate mycorrhizal former, BNG felt that special treatments were necessary to optimize survival of seedlings on disturbed sites. Methods for mitigating the effects of open, exposed sites include: 1) shade collars, 2) translucent plastic tree protectors, and 3) the application of an anti-transpirant prior to outplanting. These methods of seedling protection were tested in all possible combinations in order to determine the most successful technique.

Pressed peat shade collars (similar to a 3 inch peat pot with the bottom removed) were placed over seedlings and anchored to the ground with wire, ground staples. These collars shade the seedlings and protect them from desiccating winds. A benefit of using these collars is that they are biodegradable and do not have to be removed as the plants grow.

The translucent tree protectors used were twin-walled tubes 4 inches in diameter and one foot tall. They were installed over planted seedlings and secured with a wooden stake driven into the ground and attached with a ratchet-tie to the stake. These protectors are designed not only for shade and wind protection, but also to collect moisture from condensation and to protect from animal browsing and rodent damage.

The anti-transpirant, Wiltpruf, was applied to seedling foliage. This material is a water-based pine emulsion that forms a protective coating on the plant. This coating mechanically reduces normal plant transpiration in response to high heat and windy conditions. Wiltpruf has an effective life of 30 to 45 days which should be long enough to protect the plants until they are covered with snow.

The soils at the Basin Creek site have been disturbed as a result of mineral extraction activities. It has been suggested that the revegetation success of mined lands is dependent on the reestablishment of a stable microbial community (Birch, P. et. al. 1991). Both free-living microorganisms and those involved in symbiotic relationships have been shown to be adversely affected by soil disturbance (Fresquez, P.R. and W. Lindermann 1982). BNG designed a test to examine the effects of native soil microflora addition on V. scoparium growth and survival. One cup of freshly collected duff (from a nearby undisturbed V. scoparium stand) was placed in the planting holes of sev-

eral treatment blocks and compared with plants to which no duff was added (Ameranthus, et al. 1990).

Field tests consisted of twelve treatments (10 plants per treatment) replicated three times. Treatments were tested individually and in all possible combinations, including a control. All plants were treated with browse repellent and slow release fertilizer tablets. The experimental design was a randomized complete block design. Each block was staked and labeled.

Data will be collected in the Spring and Fall of 1993 and 1994 by BNG staff. Measurements will include survival, leaf color and condition, height and basal area. The results of this data will be used to determine the most effective outplanting treatments.

Bitterroot Native Growers has since developed techniques for culturing an inoculant from soil collected at the site and re-inoculating seedlings at our Nursery. The effectiveness of this treatment is being tested at other mine sites.

Conclusion

Our studies indicate that Vaccinium scoparium is suitable for large-scale commercial propagation. Propagation by seed appears to be the most successful and economical method. Evaluation of outplanting techniques designed to simulate the ecological requirements of V. scoparium should reveal the requirements for successful establishment of this understory shrub on disturbed sites. It is our hope that the re-introduction of V. scoparium seedlings along with other major trees and shrubs, will hasten the recovery of the Basin Creek site to a healthy, functioning plant community.

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