TECHNICAL NOTES

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PROPAGATION OF WETLAND PLANTS FOR WETLAND RESTORATION IN THE CENTRAL SIERRA NEVADA MOUNTAINS

ABSTRACT

In 1990 the Tahoe Resource Conservation District began a 3 year Wetland Plant Propagation Evaluation. The purpose of this evaluation was the identification of wetland plant propagation techniques for mass production of plant materials for use in wetland restoration projects in the Lake Tahoe Basin.

Evaluation elements included propagation from seed, division of seedlings and harvested sections into plugs, splitting harvested materials into the smallest practical plug size, trimming roots and shoots to force root development and handling of materials at the nursery.

It was determined that plants should be harvested and immediately split and placed in a lathhouse until spring. Delay of splitting, while still yielding satisfactory results will produce greater mortality. In spring the plants should be transferred to a greenhouse for two months to improve plant vigor. Carex spp. proved to be the best adapted for division purposes, especially if harvested in the fall prior to entering dormancy.

The most successful procedure for division is as follows: 1) plants should be pulled apart into plugs by hand to a size not smaller than 3.5 inches square; 2) trim roots and leaves with scissors to a length of 3 inches; 3) dip roots into a solution of Vitamin B-1 for a period of 3 seconds; 4) transplant plugs into containers half filled with standard UCD planting mix. Pack the top half with the same mix to the top of the root crown; 5) the plants should then be thoroughly hand watered with the B-1 solution and placed in the lath house.

DISCUSSION

The Lake Tahoe Basin is on the cutting edge of technology for restoration of wetland areas and development of wetlands for control of point and non-point source pollution control. A multitude of governmental agencies are involved in this process, such as the State of California, California Tahoe Conservancy, the Tahoe Regional Planning Agency, the Lahontan Regional Water Quality Control

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Board, the U.S. Forest Service, USDA Soil Conservation Service (SCS) and the Tahoe Resource Conservation District (TRCD).

In 1989 the TRCD became aware of the need for large quantities of native wetland plants for use in wetland restoration projects. While some needs could be met through harvesting from local wetland areas this method fell short of the overall quantities of plants required for successful implementation of proposed projects. It was suggested proposed that commercial propagation of indigenous wetland plants would provide sufficient quantities of plants for proposed and future projects.

In 1990 the TRCD in association with the USDA Soil Conservation Service successfully applied to the California State Department of Water Resources for funding of a 3 year Wetland Plant Propagation Evaluation. The purpose of this evaluation was the identification of promising wetland plant materials native to the Lake Tahoe Basin which are responsive to commercial propagation. To this end it was necessary to identify horticultural techniques which would facilitate the mass production of plant materials within a short period of time to fulfill anticipated project needs.

METHODS AND PROCEDURES

The implementation of this project involved the services of the Lockeford Plant Materials Center (PMC), a facility owned and operated by the Soil Conservation Service. This facility and its staff provided logistical and technical support to the TRCD by performing all experimental work involved in this project.

Plant materials were collected from two locations on the West shore and one location on the South shore of Lake Tahoe. The elevation of the three sites averaged 6260 feet above mean sea level. The sites have an average annual precipitation of 37.1 inches, of which approximately 80% occurs as snow. Snow cover exists an average of 127 days each year. Temperatures at these sites range from an average daily low of 18 degrees F in January to a high of 78 degrees F in July, with an average growing season of 80 frost free days.

Collections were taken from these sites on four separate occasions during the summer and fall season between 1990 and 1992. The locations selected were representative of mesic and hydric plant communities common to the Lake Tahoe Basin. A mesic meadow community located at Meeks Bay is dominated by *Agrostis variabilis, A. scabra, Deschampsia caespitosa, Muhlenbergia ardia, Carex lanuginosa and Juncus oxymeris*. Soils on this site are well developed alluvial sandy loams. While soils are moist through most of the year they are rarely subject to flooding.

The remainder of the collections were taken from two wetland communities identified as Blackwood canyon and Christmas Valley. The sandy clay loam soils which typify these sites possess a significant organic horizon. These sites

are subject to flooding most of the year. The dominant species on these sites consist of *Juncus covillei, Carex paucicostata, C. serratodenens, C. rostrata, Deschampsia caespitosa and Agrostis scabra*.

Collections of seed and sod were harvested each year in August or September when plants were entering dormancy and seed was mature. Grass seed was collected by hand from selected plants. For identification purposes a representative grass plant of each selected species was harvested along with seed.

Juncus spp. and Carex spp. were harvested by cutting 1 foot square sections of sod and splitting into 1 gallon containers. Whenever possible each section included a mature seed head for species identification. The root to shoot ratio of harvested sections was usually 1:1 or greater. Care was taken not to disturb the integrity of the soil bound by the root mass. The plant materials were then transported to the Lockeford Plant Materials Center for storage and eventual exposure to treatments.

While stored at the PMC harvested sections were irrigated at 20 minute intervals, lasting 4 seconds each. The first year collections were transferred immediately to the greenhouse where they were stored until spring. Second year collections were stored in the lathhouse during the winter months and then transferred to the greenhouse in the spring.

TREATMENTS

Propagation From Seed

Plant materials were propagated by 1) seeding, and 2) division. Propagation from seed was accomplished by placing seed into an 8 inch super cell container filled with the standard University of California, Davis planting mix. The mix consisted of perlite, sand, peatmoss, Osmocote fertilizer, vermiculite and lime. Grasses selected for evaluation were *Agrostis scabra, A. variabilis, Deschampsia caespitosa and Muhlenbergia ardia*. Germination of all collections occurred within 10 days. Germination rates ranged from 31% to 67%. Following two months growth in the greenhouse the seedlings were transferred to the lathhouse for a period of 6 weeks. Surviving seedlings were then subjected to the second means of propagation treatment, division into plugs.

Division

Plant sections harvested in the field for division into plugs were identified as *Juncus covillei, J. oxymeris, Carex lanuginosa, C. athyrostachya and C. rostrata.* Seedlings grown at the PMC and sections harvested from Tahoe Basin wetlands were exposed to two levels of treatment. These were 1) division into plugs for the purpose of increasing the total quantity of plants; and 2) trimming roots and shoots of plugs to reduce transpiration and to force root development.

Division was accomplished in three ways; 1) plant sections were pulled apart by hand, 2) plant sections were cut into plugs with scissors, and 3) plant sections were cut into plugs using a paper cutter. Care was taken in all instances to insure that each plug consisted of a minimum of 1 healthy shoot and associated root collar. Rhizomatous species were to include at least 1 healthy rhizome along with fibrous roots. A 1:1 root to shoot ratio was maintained when possible. The average plug diameter produced by these methods was 3.5 inches square. A 1 foot square section would therefore produce an average of 10 plugs. The integrity of the soil mass bound by the roots was maintained as much as possible during the division process.

Following division each species was exposed to five subtreatments. The subtreatments were 1) trimming roots to 3 inches in length; 2) trimming both roots and shoots to 3 inches in length; 3) trimming the shoot to 3 inches in length; 4) trimming the shoot to 6 inches in length; and 5) leaving as is. After the treatment the roots of all plugs were dipped into a solution of Vitamin B-1 for a period of 3 seconds to reduce transplant shock. The plugs were then placed into 8 inch super cell containers filled halfway with moist planting mix. The cones were then filled to the root crown with moist planting mix and packed firmly to insure good soil-root contact and to eliminate air pockets. The plugs were then placed into either the greenhouse or the lathhouse for the duration of the observation period.

CONCLUSION

The harvesting of plant materials for use in this study proved to be a relatively successful procedure as long as a 1:1 root to shoot ratio was maintained and disturbance of the soil/root mass was minimal. A critical element of the harvest procedure involves transportation and storage. Losses of recently harvested plants were attributed to transporting from a cool to a hot environment in a vehicle that was not equipped with air conditioning. The stress of transition from a cool, low humidity environment to the high humidity environment of the greenhouse created additional stress to plants collected during the first year of the evaluation. Plants stored in the greenhouse during the winter months also did not do well due to the high humidity of the greenhouse. Freezing temperatures and very low humidity are normal environmental conditions during dormancy. When storage of undivided sections is necessary it is recommended that sections be placed in a lathhouse during winter months. Transferring sections into the greenhouse in March will increase plant vigor prior to division in April.

Splitting plant sections into plugs proved most successful when a 1 foot square section was divided into a 3.5 inch square plug and a 1:1 root to shoot ratio was maintained. In this manner each 1 foot square section would yield 10 plugs. This smallest unit of division proved to be common among all species tested. Splitting plant sections by hand proved to be the most efficient means

of division. While mechanical devices such as scissors and paper cutters were employed, neither was as effective or precise as splitting by hand. The mechanical devices worked reasonably well on the dense plant sections but separated the root from the plant on sparse sections. Table 1 thru 3 shows species, treatments and survival rates of plants tested.

To stimulate root development and reduce transpiration roots and shoots were trimmed to varying lengths. Plants with untrimmed roots did not perform well because air pockets were created in the containers when transplanted. Trimming roots to 3 inches proved very successful in most cases and was in fact necessary in order for the plug to fit into the container. Trimming shoots to force root development also showed good results. Plants with untrimmed shoots showed poor performance. Plants trimmed to 3 and 6 inches showed good performance; moreover, there was no significant increase in performance between 3 and 6 inch trimmings

While the testing of an appropriate fertilizer regime was not a part of this evaluation, it was noted that all plants tested were very sensitive to high levels of 16-20-0-6 fertilizer. High mortality resulted when this material was applied. Osmocote fertilizer improved the results when mixed at 16 oz/mix batch.

Propagation by seed proved to be very successful. The mortality of species propagated by seed varied according to species, with the best results obtained from Agrostis scabra and Deschampsia caespitosa. Seedling vigor among surviving species was excellent exhibiting rapid leaf and root development. Mortality among the Agrostis variabilis and Muhlenbergia ardia seedlings was 100 percent. Division of the seedlings into smaller units did not appear to be a viable alternative to further increasing the quantity of plants. High mortality may be attributed to the inability of the seedling to withstand the stress of division. Propagation of mesic meadow grass species by seed proved to be an efficient and highly productive means of increasing container plants on a large scale. The logistics of seed collection and transport, and relatively simple propagation requirements suggests this as a method of choice for production of large quantities of meadow grasses. Seeding rushes and sedges in containers was not successful within the confines of this evaluation.

Division of harvested rushes and sedges showed positive results. Mortality of plugs was initially high in the first year of the evaluation except for the Carex spp. which had the best performance in the plant increase process. The first year mortality rate is attributed to the transport and storage process which was successfully modified during the second collection year. The division process was most successful when splitting was performed immediately after harvesting. Storage of materials during the winter months prior to splitting, while still yielding satisfactory results produced greater mortality.

The most successful method of division is as follows: 1) plants should be pulled apart into plugs by hand (not cut); 2) trim roots and leaves with scissors to a length of 3 inches; 3) dip roots into a solution of Vitamin B-1 for a period

of 3 seconds; 4) transplant plugs into containers half filled with standard UCD planting mix. Pack the top half with the same mix to the top of the root crown; 5) the plants should then be thoroughly hand watered with the B-1 solution and placed in the lath house.