VEGETATIVE PROPAGATION OF BLUE BLOSSOM

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ABSTRACT

Stem cuttings of Ceanothus thyrsiflorus Esch. were propagated in a greenhouse to compare six soil media and three collection times for relative rooting success. Spring/summer cuttings rooted far more readily than those taken in fall or winter. Sand and sand/perlite were found to be superior to other media. The use of peat moss appeared to discourage rooting.

INTRODUCTION

The rehabilitation of disturbed wildlands is often assisted by woody shrub pioneers. A successful brush cover can mitigate erosion in the absence of rapid natural forest regeneration.

Vegetative propagation by stem cuttings may have specific advantages over seed propagation for certain taxa of native plants in wildland rehabilitation prescriptions. Vegetatively-generated stock of some species may, under given circumstances, be produced more rapidly, cheaply or reliably.

Since rooted sprigs are genetic clones of their parent stock, they can be reintroduced to their original native habitats without any fear of transforming gene pools, causing unintended hybridization, or unleashing potentially invasive exotic strains. Moreover, viable cuttings may be taken virtually year-round, whereas mature seed is typically available for a relatively short period of time.

Blue blossom (Ceanothus thyrsiflorus Esch.) has characteristics that make it useful for revegetation at disturbed sites in north coastal California. It forms root modules with a nitrogen-fixing symbiont and can thus grow rapidly on nitrogen-poor sites (Rose, 1976). Its attractive blossoms make it useful for environmental purposes where native plants are desired. The development of rapid techniques of propagation would increase the usefulness of blue blossom in revegetation and rehabilitation programs.

The purpose of this study was to determine the influence on rooting of blue blossom stem cuttings attributable to 1) propagation medium and 2) season of collection and propagation.

METHODS

The vegetative propagation experiment was conducted on a propagation bench along a white-washed, south-facing window of a forestry greenhouse at Humboldt State University, Arcata, California.

Six wooden propagation flats (approximately 46 x 46 x 8 cm) were divided into four equal quadrants and planted with 16 cuttings in each quadrant.

Table 1 shows the propagation media used. Table 2 shows the pH of materials used in the media.

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Table 1. Media Used in the Propagation Experiment.

Flat Number	Medium
1	100% Perlite
2	50% Vermiculite; 50% Perlite
3	50% Peat moss; 50% Perlite
4	50% Dune Sand; 50% Perlite
5	25% each: Perlite, Vermiculite, Dune Sand, Peat moss
6	100% Dune Sand

Table 2. pH of Materials Used in the Propagation Media.

Material	pH
Perlite	6.8
Vermiculite	6.7
Peat Moss	3.5
Dune Sand	6.0

Cuttings were collected in Redwood National Park, Humboldt County, at an elevation of 600 meters. Associated plants at the collection site included Baccharis pilularis DC. ssp. consanguinea (DC.), Pseudotsuga menziesii (Mirb.) Franco, Lithocarpus densiflora (H. & A.) Rehd., Quercus garryana Dougl., and an occasional Abies grandis (Dougl.) Lindl. or Arctostaphylos columbiana Piper. Groundcover consisted of Iris douglasiana Herb., Sisryinchium bellum Wats., Whipplea modesta Torr., Rubus species, grasses, rushes, sedges, and various annual wildflowers.

The three collections were taken, respectively, on 20 June, 1980 (from bushes 1 through 5), on 22 October, 1980 (bushes 1, 2, 3, 6 and 7), and on 20 February, 1981 (bushes 1, 2, 3, 8 and 9). In each of the three collections, half the material was derived from the same three bushes; half was derived from two bushes unsampled in any other collection.

Samples from two newly-selected shrubs at each collection assured fresh, high-quality material, but introduced the possibility of minor genetic or environmental differences. Samples from the same three shrubs each time provided genetically identical material for each season, but introduced the unknown influence of previous pruning and removal of choice material.

Each collection was made at 6 p.m. and consisted of 384 cuttings. All sprigs were terminal stem shoots trimmed 12 to 15 cm. long, bagged in plastic, and stored under refrigeration within about three hours.

All cuttings were implanted on the second day following collection. Although a shorter lag time might have yielded higher rooting percentages, the delay more realistically approximated the practical circumstances of a large-scale propagation effort.

In the greenhouse, all flowers, flower buds, side shoots, lower leaves, and excess or damaged leaves were removed. The sprigs were recut diagonally at the second or third node above the stub.

No root-stimulating chemical treatment was employed. Limited trials during the preliminary phase of the study demonstrated that blue blossom cuttings treated with "Rootone" powder (containing naphthylacetamide) rooted somewhat less often than identical cuttings left untreated.

The cuttings were watered by an automatic overhead mist system of timed duration and frequency. Misting was applied equally in all seasons, hourly during daytime with two additional bursts around midnight. Air temperature within the greenhouse was thermostatically controlled at 21.1°C by forced-air heating and mechanically-operated overhead ventilation. Insulated electrical wires running directly under the flats provided bottom heat thermostatically set at about 21°C.

Duration of the propagation period for each batch was 90 days, after which the cuttings were lifted and examined. Any root formation whatsoever was considered a positive result. Any cutting which lacked roots, whether alive or dead, calloused or not, was considered a negative result.

In order to supplement the basic results, data on root quality were also recorded. Length of longest or lead root and length of new top growth was examined for each rooted slip. A subjective root grading system was also developed in order to score the overall density and vigor of each incipient root system.

RESULTS

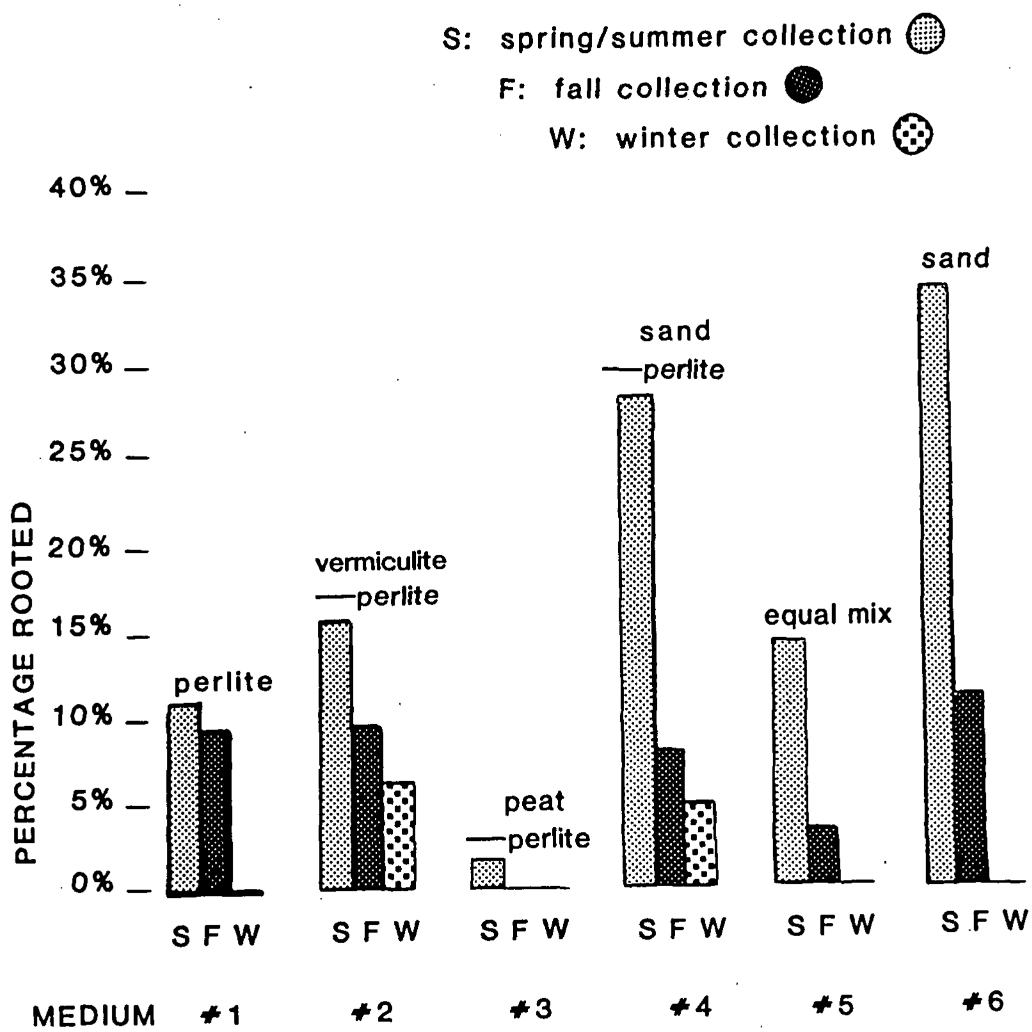
Results of the propagation trials are expressed in Figure 1. Pure dune sand achieved the highest total production for all seasons, with 29 rooted cuttings (15.1% rooting success). Sand was closely followed by sand/perlite, which produced 26 rooted cuttings (13.5%). Success was lower for vermiculite/perlite with 20 rooted (10.4%); pure perlite with 13 rooted (6.8%); and the equal mix with 11 rooted cuttings (5.7% success). Peat moss/perlite managed only 1 rooted cutting out of 192 tried (0.52%).

Not much difference was evident among the media with regard to the quality of rooting, except in terms of mean root-leader length. Pure dune sand had the longest roots, with a mean of 14.4 cm. Sand was closely followed by the equal mix with 13.9 cm.; vermiculite/perlite with 12.0 cm.; sand/perlite, with 9.7 cm.; pure perlite, with 7.7 cm.; and finally, peat/perlite with 1.0 cm.

It was noted that no root nodules were observed on any roots which formed in these sterile media. Evidently, nodulation requires innoculation with symbiotic nitrogen-fixing soil organisms (Rose, 1976,1980).

The spring/summer collection produced the most rooted cuttings, with 67 rooted out of 384 attempted, or 17.4% rooting success. The autumn collection produced 26 rooted cuttings, or 6.8% success. The winter collection produced only 7 rooted cuttings, or 1.8% success.

FIGURE 1: Histogram of Rooting by Medium



It had been assumed that a slip would either strike roots or die. Not all, however, could be so neatly categorized. When the first (spring/summer) batch was uprooted, five cuttings were green, calloused and apparently alive, yet devoid of roots. One or two others had developed roots, but had died.

A surprising result of the second batch, collected in fall, was that 45 sprigs were green and calloused, but had not in fact rooted. The 26 cuttings that had sprouted roots were outnumbered nearly two to one by those that had apparently gone dormant, while still alive.

Almost all cuttings from the third batch died fairly early in the winter. The seven which did survive produced roots that were, on the whole, equal or superior in form to those of either previous collection.

The spring/summer collection accounted for the longest mean root-leader (the greatest mean length of the longest roots of all of a season's rooted cuttings), which was 14.0 cm. Mean root-leader for autumn was 5.5 cm.; for the winter collection it was 8.7 cm.

ANALYSIS AND INTERPRETATION

A statistical analysis of the results was carried out by means of two-way analysis of variance (ANOVA) with an arcsine transformation (Sokal & Rohlf, 1969). The significance of differences between propagation media, for each of the three collections and overall, was determined by the Studentized Range test (Goldstein, 1964). The media are ranked below in descending order, left to right. Flat numbers joined by the same underline represent media which were not significantly different from each other at the 5% level:

Flat Nos. 6 4 2 1 5 3

Thus, dune sand (flat #6) and sand/perlite (#4) were significantly superior to perlite (#1), equal mix (#5) and peat/perlite (#3); and all media were superior to peat/perlite (#3) at 5% significance.

Rankings of the media (utilizing the arcsine transformation) are broken down by season as follows:

SPRING/SUMMER -- Nos. 6 4 2 5 1 3

AUTUMN --------- Nos. 6 2 1 4 5 3

WINTER --------- Nos. 2 4 6 5 1 3

The Studentized Range test revealed the significance, at the 5% and 1% levels, of all differences between each of the three seasons of collection. Additionally, the interaction between the factors of medium and season was found to be significant at the 1% level, through the analysis of variance. Pure sand was significantly superior to other media in the summer but lost its advantage for fall and winter propagation.

The interaction effect may be due to the differing characteristics of grain size. The superior moisture-holding capacity of finer-grained materials (dune sand and peat moss) is more crucial in summer; whereas, the superior drainage and gas-exchange qualities of coarser materials (perlite and vermiculite) would have greater advantage in winter.

Rooting success for the intermediate (mixed-grain) media may have been depressed somewhat by the apparently deleterious effects of peat moss. The relatively poor rooting response to the equal mix (#5) and especially to the peat/perlite blend (#3) was probably due to the low pH of natural peat moss (3.50). Hitchcock (1928) reported that best rooting for most species occurred at pH 4.5 to 7.0. Below pH 4.1, root formation was curtailed.

DISCUSSION AND CONCLUSION

Results of the present study do not necessarily contradict the diverse findings of other workers. Coate asserts (personal communication, 1981) that choice of medium and season depends in large measure on the location and circumstances under which propagation is conducted. Clearly, frequency of irrigation, humidity (Chadwick, 1944), ventilation (Laurie & Ries, 1950), temperature (Kramer & Kozlowski, 1979), season, weather, latitude, aspect, species and other factors must be taken into account in determining the water-holding characteristics and qualities which will be required of the optimum propagation medium.

Presumably, some of the calloused-but-unrooted cuttings from the autumn collection may eventually have struck root, had they been sustained through the onset of spring and beyond the arbitrary 90-day propagation period allowed each seasonal batch of cuttings.

The factor referred to as "season," moreover, was actually a composite of at least two major variables:

1) Physiological nature of the cutting material itself, determined by the individual parent plant's yearly cycle and response to environmental stimuli up until the moment of cutting.

2) Uncontrolled seasonal influences on the cuttings during propagation in the medium, particularly diurnal period and light intensity, beginning at the moment of implantation.

These intervening variables were inseparably linked within the design of the study. As a practical matter, this linkage occurs whenever cuttings are collected and promptly propagated in a greenhouse. Nevertheless, there may be circumstances under which these two variables should be separated: for propagation under controlled sunlight or artificial illumination, when planning longterm storage of cutting material, or when transporting cuttings great distances north or south. In physiological research, it may be desirable to separate these factors. Controlled growth chambers can be used in order to discriminate among the variables which comprise the "season" factor.

Further investigation should also be undertaken to test other media and collection times. The technology of innoculating rooted cuttings of blue blossom with its nitrogen-fixing symbiont also remains to be developed.

The optimum combination of medium and season (summer cuttings propagated in dune sand) had a 34% success rate. This rate can undoubtedly be improved. Implications of this study for more cost-effective native-plant propagation await confirmation in repetitive greenhouse trials. However, it is clear that clean dune sand, cheap and plentiful along the North Coast, deserves consideration as an alternative to the exotic and expensive media commonly used today. Time and money might also be conserved through the potential advantages of summer propagation, over the more traditional dormant-season practice.

Controlled and systematic study of these matters, broadening the present work to encompass many diverse species and varieties, may one day lead to reliable predictability of the rooting characteristics of untested taxa, fuller understanding of the physiology of plant propagation, and higher standards of wildland rehabilitation.

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