Cutting Requirements for Propagation of the Endangered Species, *Clematis socialis*©

L. L. Bruner, D. J. Eakes, J.L. Sibley, C.M. Morton, P. R. Knight, and J. J. Cain
Auburn University, Dept. of Horticulture, Auburn, Alabama 36849

A study conducted in 2000 determined the effects of non-amended rooting medium, dolomitic-limestone-amended medium, and IBA and NAA concentrations on root initiation and root growth of *Clematis socialis*. *Clematis socialis* is an endangered native clematis, with small populations known to exist in two Alabama counties and one Georgia county. Propagation of the species would introduce new genetic material for hybridization and provide plants for additional self-sustaining populations in protected areas. Cuttings propagated in non-amended media were most successful in a sand or perlite medium, which produced a significantly greater root number and root quality than those propagated in vermiculite or sphagnum peat, pine bark, and sand medium. Root length, number, and root quality increased with increasing rate of dolomitic limestone incorporated into a sphagnum peat, pine bark, and perlite medium. Root length, number, root quality, and cutting survival increased with increasing rate of IBA and NAA up to 5000 ppm IBA and 2500 ppm NAA.

INTRODUCTION

Clematis socialis is characterized by erect stems 30 to 60 cm (12 to 24 inches) tall which lack tendrils. The plant colonizes by underground rhizomes and is clonal by nature. The spreading groundcover habit of *C. socialis* is desirable and not typically found in *Clematis* species already in commercial production. Flowers are solitary, urn-shaped, and approximately 1 inch long (Boyd and Hilton, 1994). The exterior of the flower is blue-violet in color, with a yellowish-green interior (Grey-Wilson, 2000). The species is vulnerable to extinction because known populations occupy no more than a few acres and are subject to repeated disturbance (Norquist, 1989).

Propagation techniques and media for other *Clematis* sp. have shown varying success, and are cultivar and species dependent (Erwin, 1997; Evison, 2000; Hatch, 2000). Currently, sand is the primary medium for commercial clematis propagation in the United States (Erwin, 1997). Information on cutting requirements for propagation of *C. socialis* could aid in producing plants to establish additional self-sustaining populations, new genetic material for hybridization, and provide a source for horticultural demand, reducing collection from the few natural existing populations. The objective of these studies was to determine the effectiveness of: (1) four different non-amended media, (2) dolomitic limestone amended media, and (3) basal IBA and NAA applications on root initiation and growth of *C. socialis* stem cuttings.

MATERIALS AND METHODS

On 26 May 2000, mature two-node cuttings of *C. socialis* were collected from a Department of Transportation highway easement located in Cherokee County,

Alabama. One inch of stem tissue was left on the bottom-most node and one-half inch on the uppermost node. Blooms and seed heads were removed during collection. Cuttings were placed in plastic bags on ice for transport to Auburn University.

Experiment 1. Media Evaluation. Later during the same day, 1000 ppm of indole-3-butyric acid (IBA) and 500 ppm of naphthalene acetic acid (NAA) was applied to cuttings for approximately 5 sec with the first node submerged. Cuttings were stuck in 606 cell packs with a volume of 163 cm^3 (10 $inches^3$) per cell containing the following non-amended media:

- Sand
- Perlite
- Vermiculite
- Sphagnum peat, pine bark, and sand (1 : 1 : 1, by volume)

Experiment 2. Dolomitic Limestone Amended Media Evaluation. Following the same IBA and NAA application, cuttings were stuck in 606-cell packs containing a sphagnum peat, pine bark, and perlite medium (2 : 1 : 1, by volume) amended with the following concentrations of dolomitc limestone: 1.48 $kg \cdot m^{-3}$ (2.5 lb per yd^3), 2.9 $kg \cdot m^{-3}$ (5.0 lb per yd^3), 4.5 $kg \cdot m^{-3}$ (7.5 lb per yd^3), 5.9 $kg \cdot m^{-3}$ (10.0 lb per yd^3), 7.4 $kg \cdot m^{-3}$ (12.5 lb per yd^{-3}), 0 (control).

Experiment 3. IBA/NAA Concentration Evaluation. Cuttings were placed in a treatment solution (Dip 'N Grow, Astoria-Pacific, Inc.), covering the first node, for 5 sec containing one of the following auxin concentrations:

- 250 ppm IBA and 125 ppm NAA
- 500 ppm IBA and 250 ppm NAA
- 1000 ppm IBA and 500 ppm NAA
- 1500 ppm IBA and 750 ppm NAA
- 3000 ppm IBA and 1,500 ppm NAA
- 5000 ppm IBA and 2.500 ppm NAA
- Distilled water (control)

Following IBA and NAA applications, cuttings were stuck in 606-cell packs containing sphagnum peat, pine bark, and perlite medium (1 : 1 : 1, by volume) amended with 5.9 $kg \cdot m^{-3}$ (10 lb per yd^3) of dolomitic limestone.

Cell packs for all studies were placed in trays under intermittent mist (6 sec every 5 min from 7:30 to 18:30) in a double-poly greenhouse. Greenhouse temperature controls were set at 21°C and 27°C (70°F and 80°F). Average mid-day light levels were 950 µmol.

Data collection included root ratings (0 to 4, with four highest), root number, and the average length of the three longest roots 10 weeks after treatment. Additionally, leachate was collected using the Virginia Tech Extraction Method (VTEM) to assess medium pH.

RESULTS

The results of our study show *C. socialis* can be successfully propagated in both non-amended media and a sphagnum peat, pine bark, and perlite medium amended with dolomitic limestone at the rates tested, and that IBA and NAA applications at the rates tested significantly increases cutting survival (Tables 1, 2, and 3).

For example in non-amended media, root lengths of *C. socialis* cuttings grown in

Table 1. Effect of propagation media on rooting of *Clematis socialis* stem cuttings propagated for 10 weeks.

Rooting medium	Root length (cm)	Root (no.)	Root rating[y]	Cutting survival (%)
Vermiculite	23.9 a[z]	1.7 b	1.4 b	58.3 ab
Perlite	15.0 a	4.2 a	1.5 ab	66.7 ab
Peat, pine bark, and sand	0.1 b	0.2 b	0.1 c	12.5 b
Sand	28.8 a	4.2 a	2.2 a	70.8 a

[y]Roots were rated on a 0 to 4 scale, with 4 being highest.
[z]Similar letters were not significantly different at the 5% level using Duncan's Multiple Range Test.

Table 2. Effect of dolomitic limestone on rooting of *Clematis socialis* stem cuttings propagated for 10 weeks.

Dolomite limestone (lb per yd^3)	Root length (cm)	Root no.	Root rating[y]	Cutting survival (%)
0.0	1.7	0.5	0.3	25.0
2.5	8.5	1.1	0.6	41.5
5.0	2.3	0.7	0.4	41.5
7.5	2.5	1.0	0.5	33.3
10.0	9.3	2.0	1.0	70.5
12.5	21.9	2.6	1.4	54.0
Significance[z]	L***	L***	L***	NS

[y]Roots were rated on a 0 to 4 scale, with 4 being highest.
[z]Nonsignificant (NS) or Linear (L) response at the 0.01% (***) level.

sand, vermiculite, or perlite were greater than those in a peat, pine bark, and sand mix (Table 1). Root number and quality were greatest for cuttings propagated in sand and perlite. Mean survival rate of cuttings was similar between sand, vermiculite, or perlite media, ranging from 58% to 70%. Similar survival rates were found in a previous study evaluating the rooting of several commercially grown *Clematis* cultivars and species using sand or perlite medium (Erwin, 1997). Mean survival rate of cuttings grown in the peat, pine bark, and sand mixture was lowest (12%).

Root length, number, and root quality in the second experiment increased with increasing rate of dolomitic limestone incorporated into the sphagnum peat, pine

Table 3. Effect of varying rates of IBA/NAA on rooting of *Clematis socialis* stem cuttings propagated for 10 weeks.

Rate of IBA/NAA (ppm)	Root length (cm)	Root no.	Root rating[y] (%)	Cutting survival
Control	20.4	1.3	1.0	45.8
250/125	19.2	1.5	1.1	45.8
500/250	45.3	3.0	1.5	70.8
1000/500	29.2	2.3	2.1	79.2
1500/750	37.9	4.9	2.1	83.3
3000/1500	51.7	4.5	2.6	87.5
5000/2500	77.4	5.3	3.0	95.8
Significance[z]	L***	L***	L***	L***

[y]Roots were rated on a 0 to 4 scale, with 4 being highest.
[z]Nonsignificant (NS) or Linear (L) response at the 0.01% (***) level.

bark, and perlite medium (Table 2). With increasing rate of dolomitic limestone compared to non-amended controls, root length increased 35% to 1188%, root number increased 40% to 420% and root quality (rating) increased from 33% to 367%. Survival rates of cuttings grown in medium amended with increasing rates of dolomitic limestone were similar to those grown in non-amended medium.

Root length, number and root quality in the third experiment increased with increasing IBA and NAA application rates. With increasing rates of IBA and NAA, root length increased up to 279% at the highest rate compared to controls, increased from 15% to 307% for root number, and 10% to 200% for root quality. Survival rates of cuttings increased with increasing IBA and NAA application rates from 54% to 109% compared to controls. Cutting survival at the highest application rate (5000 ppm IBA/2500 ppm NAA) was 95.8%.

DISCUSSION

Results of these experiments show that medium type, dolomitic limestone amendment to a sphagnum peat-based medium, and IBA/NAA application greatly affects the rooting of *C. socialis*. Sand is the most common propagation medium for clematis and very economical costing approximately $0.001 per cell. At a somewhat higher cost of around $0.01 per cell, perlite is a suitable, lighter substitute. The least successful non-amended medium was peat, pine bark, and sand with the lowest cutting survival percentage (12%). The peat, pine bark, and sand mixture had a lower pH (4.9) than the other three media due to the presence of peat and pine bark. The pH of the sand, perlite, and vermiculite, ranged from 6.5 to 6.6, and was likely influenced by the irrigation water that exhibited a neutral pH of 6.5. Dolomitic limestone incorporated into a sphagnum peat, pine bark, and perlite mixture greatly improved the propagation success compared to the similar non-amended

media in the first experiment. The mean pH of media in the dolomitic limestone amendment study ranged from 4.8 (non-amended control) to 6.9 [4.5 kg·m^{-3} (7.5 lb per yd^3)]. Cuttings for this study were collected from plants growing in native soils with a pH range of 6.8 to 7.3. Based on the results of this experiment, this characteristic of *C. socialis* appears to influence the success of adventitious root formation and growth. IBA / NAA application greatly influenced the root number, length, quality, and cutting survival in a dolomitic limestone amended sphagnum peat, pine bark, and perlite medium with the highest average survival rate of 95.8%. At the highest application rate of 5000 ppm IBA/2500 ppm NAA, the cost per stem cutting is approximately $0.001.

Based on these results, there are several propagation media and growth regulator application options for *C. socialis* that are economical and would be successful in the horticultural trade. Propagation of *C. socialis* would provide a ready source of an endangered species that could be reintroduced into more protected areas than it is currently found and offer genetic diversity for hybridization with desirable, attractive characteristics.

These results presented above represent data collected from one growing season. The test will be repeated in 2002 to obtain additional data from a second growing season and verify the preliminary results.

LITERATURE CITED

Boyd, R.S. and **C. D. Hilton**. 1994. Ecologic studies of the endangered species *Clematis socialis* Kral. Castanea 59:31-40.

Erwin, J.E., D. Schwarze, and **R. Donahue**. 1997. Factors affecting propagation of *Clematis* by stem cuttings. HortTechnology 7:408-410.

Evison, R.J. 2000. Propagation of clematis. Comb. Proc. Intl. Plant Prop. Soc. 50: 436-440.

Grey-Wilson, C. 2000. *Clematis* the genus. Timber Press, Inc., Portland, Oregon.

Hatch, T.C. 2000. New Zealand clematis from cuttings. Comb. Proc. Intl. Plant Prop. Soc. 50:186-188.

U.S. Fish and Wildlife Service. 1989. Alabama leather flower recovery plan. U.S. Fish and Wildlife Service, Jackson, Mississippi.