# Alternative Methods to Propagate Herbaceous Plants

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## THE NEED FOR AN ALTERNATIVE

The need for an alternative indicates there is a problem with the current method. Our need for an alternative has risen from the fact that the herbaceous liner market has become very crowded, and in most cases, our competition has a distinct climatic advantage at key times of the year. What I will discuss here is how we at Skagit Gardens try and counteract some of the disadvantages of propagating herbaceous plants at our latitude during the winter months.

## WHERE WE ARE AND WHO WE ARE

Skagit Gardens is located in Mount Vernon, Washington, 60 miles north of Seattle, at Latitude 48° North. Our location is nearly 10 miles east of North Puget Sound, so we experience a West Coast marine environment. We are growers of herbaceous annuals and perennials, in finished (retail ready) and liner sizes. About 50% of our sales are of annuals, and 50% are of perennials; of those, 70% are to finished customers and 30% to liner customers. Half of our plants are asexually produced, the other half sexually propagated. In total, we grow approximately 30 million plants annually. Our production facility includes about 10 acres of covered space split between glass, double poly, and retractable-roof greenhouses, as well as 30 acres of outdoor growing beds. We are active in the market year-round.

## COMPARING CLIMATES

Our location gives us production advantages and disadvantages depending on the season. From a propagator's point of view, during the late spring and summer months we experience a distinct environmental advantage over most other areas of the country because of our moderate climate and relatively long days. However, during the late fall and winter months we deal with these production challenges: an average temperature of 40°F, short day length, and heavy cloud cover 95% of the time. Since 80% of the annual cutting market is derived from cuttings produced during this cold, dark, damp period, we find ourselves at an extreme climatic disadvantage compared to cutting producers in California (Table 1). Of course, the people we compete with contend with problems of location as well, but from a winter climate standpoint, we are truly and figuratively in the basement.

One solution might be to buy unrooted cuttings from southern climates to fill our demand, but supply problems have shown this takes us out of control of our own destiny. It also leaves a large piece of our capital investment unused for a portion of the year. We could invest in lighting systems to force our stock plants, but this has proven to be economically unattractive. So we have developed alternative methods to offset some of the difficulties of producing annual cuttings in the dark.

## ANNUALS OR TENDER PERENNIALS?

A large percentage of the cultivars that occupy the asexually produced annual market are not annuals at all; they are tender perennials (Table 2). If treated as

**Table 1.** Climate comparison for Seattle, San Francisco, and San Diego.

| Average daily temperature in degrees Fahrenheit. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|
| Maximum | | | | | | |
| Seattle | 50.5 | 45.5 | 45.0 | 49.5 | 52.7 | 57.2 |
| San Francisco | 62.4 | 56.1 | 55.6 | 59.4 | 60.8 | 63.9 |
| San Diego | 69.9 | 66.1 | 65.9 | 66.5 | 66.3 | 68.4 |
| Minimum | | | | | | |
| Seattle | 40.1 | 35.8 | 35.2 | 37.4 | 38.5 | 41.2 |
| San Francisco | 47.1 | 42.7 | 41.8 | 45.0 | 45.8 | 47.2 |
| San Diego | 53.9 | 48.8 | 48.9 | 50.7 | 52.8 | 55.6 |
| Mean | | | | | | |
| Seattle | 45.3 | 40.5 | 40.1 | 43.5 | 45.6 | 49.2 |
| San Francisco | 54.8 | 49.4 | 48.7 | 52.2 | 53.3 | 55.6 |
| San Diego | 62.0 | 57.4 | 57.4 | 58.6 | 59.6 | 62.0 |

| Average sky cover | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|
| Clear | | | | | | |
| Seattle | 2.5 | 2.3 | 2.8 | 2.9 | 3.4 | 2.7 |
| San Francisco | 11.1 | 9.4 | 8.5 | 7.8 | 9.6 | 10.8 |
| San Diego | 14.7 | 13.6 | 12.3 | 10.2 | 10.8 | 10.2 |
| Partly Cloudy | | | | | | |
| Seattle | 4.7 | 3.9 | 3.9 | 4.2 | 5.8 | 7.3 |
| San Francisco | 8.3 | 7.5 | 7.6 | 7.4 | 8.6 | 9.3 |
| San Diego | 8.0 | 7.7 | 7.5 | 7.6 | 9.4 | 10.0 |
| Cloudy | | | | | | |
| Seattle | 23.3 | 24.9 | 24.2 | 21.2 | 21.9 | 19.9 |
| San Francisco | 10.6 | 14.1 | 14.9 | 13.1 | 12.9 | 9.9 |
| San Diego | 7.3 | 9.6 | 11.2 | 10.4 | 10.8 | 9.8 |

**Table 2.** Perennial genera cold-treated at Skagit Gardens.

| | | |
|---|---|---|
| *Anagallis* | *Felicia* | *Nemesia* |
| *Artemisia* | *Fuchsia* | *Plectranthus* |
| *Brachyscome* | *Hedera* | *Rhodanthe* |
| *Chlorophytum* | *Ipomoea* | *Rosmarinus* |
| *Cosmos* | *Lamium* (syn. *Lamiastrum*) | *Verbena* |
| *Glechoma* | *Lotus* | *Vinca* |
| *Diascia* | *Lysimachia* | |

such, they show greatly enhanced performance. Since the majority of hardy perennials require a dormant period in order to perform optimally, it follows that if tender perennials were given a typical dormancy period prior to the cutting season, one might see some of the same advantages. These include increased yields of carbohydrate-rich cuttings, and often, vernalized cuttings. Since carbohydrate-rich cuttings are nearly impossible to produce in low light, it became apparent to us that we needed to produce stock plants that have a store of carbohydrates that could be called upon when needed.

The so-called annual liner market demands a product that is actively growing; therefore, shipping a dormant plug is in most cases out of the question. However, for in-house use, dormant plugs are quite acceptable, if not preferred. We have decided to take a significant percentage of cuttings for our finished spring production in the fall and hold them in a 45°F area through the winter. Although we must care for the cuttings longer, the stock is not needed through the winter, nor is the space the cuttings utilize as expensive as stock space. We have found that two flats of 105-cell plugs take up the same amount of greenhouse space as a stock plant yielding 200 cuttings over the course of the season. The plug flat cuttings are taken in September and October and are produced with ambient heat and the available natural light. The cuttings taken from the stock plant in the dead of winter require supplemental heat and light for production. The cuttings in the 105-plug flats experience a dormant period when maintained through the winter at 45°F, so they often produce flowers earlier and in more abundance than cuttings taken in winter. Another advantage is we can also use the 105-plug flats as a cutting source in late winter if cutting demand is high.

## SCHEDULING STOCK PLANTS: GROW-THROUGH VERSUS DORMANCY

Typically, cuttings are taken from clean stock around the middle of March. In mid-May the cuttings are transplanted into an intermediate size, usually a 32-cell tray. After 8 to 10 weeks (mid to late July), the young plants are transplanted into a 2-gal pot, at one, two or three plants per pot depending on the cultivar. The plants are allowed to establish until the middle of August. At this point, we break from the traditional grow-through method. We split the stock: a percentage of the stock is

**Table 3.** Cutting yields: grow-through versus revived dormant cutting per stock plant per week.

| Week | 48 | 49 | 50 | 51 | 52 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Lotus berthelotii*** | | | | | | | | | | | | | | | | |
| Grow-through | 26 | 26 | 20 | 20 | 18 | 18 | 16 | 16 | 14 | 14 | 14 | 16 | 16 | 16 | 18 | 268 |
| Revive dormant | 0 | 0 | 6 | 12 | 18 | 18 | 22 | 24 | 24 | 24 | 24 | 24 | 24 | 26 | 30 | 276 |
| ***Diascia* 'Coral Belle'** | | | | | | | | | | | | | | | | |
| Grow-through | 16 | 16 | 14 | 14 | 14 | 10 | 8 | 8 | 8 | 8 | 6 | 6 | 8 | 8 | 8 | 152 |
| Revive dormant | 0 | 0 | 0 | 6 | 10 | 12 | 14 | 18 | 18 | 20 | 22 | 22 | 22 | 26 | 26 | 216 |

grown on in the greenhouse and the balance is placed in a protected area in ambient outdoor temperatures. The ratio is determined by the need for cuttings in the periods before and after the 1st of the year. The stock grown through inside is manicured to produce cuttings between the first of October and the end of December. The stock grown at outdoor temperatures is prepared to produce after the first of the year. Temperatures on stock maintained inside run between 55 and 80°F. Stock maintained outdoors is grown at our climate's ambient temperature, as long as it stays above 28°F. At temperatures below 28°F, some form of protection is provided. The first week of December, stock maintained outside is groomed and moved to a 55°F greenhouse. An assessment is made of the potential of the stock as a whole and a harvest plan is made to fill our needs. Typically, the grown-through stock is beginning to produce fewer, weaker cuttings by mid-December, and we start to cull the weakest plants. At this point, the outside plants coming out of dormancy are beginning to produce useable cuttings.

## THE CUTTINGS

We have learned not to mix cold-grown and warm-grown cuttings during the crossover period in December and January. Cuttings from the cold-grown stock root faster and at lower temperatures than warm-grown cuttings. Usually, we root our warm-grown cuttings at 70°F soil temperature; for our cold-grown cuttings, we prefer 62°F soil temperature. Both are under computer-controlled mist. Cuttings from cold-grown stock root 2 to 3 days more quickly than cuttings from warm-grown stock. Cuttings from both regimes receive an overspray of Rhizopon® after sticking. We have found this to be as effective as a quick dip at the time of sticking, and far more efficient from a labor standpoint (not to mention that it's legal).

If everything goes as planned, by the second week of January we have shifted to the stock that has experienced dormancy. We need this stock until the end of February, at which point it is either discarded or moved back outside. A number of cultivars we cut in winter are also required in our summer programs, so winter stock is carried through to fill our summer cutting needs. In March we start the cycle anew.

We have found that the seasonal yield from stock that has experienced dormancy is as great or greater than plants grown through. That is to say that we can produce the same number of cuttings in 10 weeks, which we used to produce in 20 weeks, in the same amount of space (Table 3).

## OTHER CHALLENGES

During all phases of production, care is taken to keep the stock disease free. Where possible, we start with virus-indexed stock and grow in protected environments. We test for viruses on a regular basis throughout the year.

A large part of the challenge in growing cost-effective stock comes from trying to keep the plants out of a reproductive mode. Considering that a large percentage of the cultivars we deal with are hybrids selected largely for their ability to stay in flower, convincing them to do otherwise can be tricky. Through manipulation of light and temperature, and by applying various plant hormones, we have become relatively successful.

## CONCLUSION

We know we will probably never compete in the winter cutting market on an even footing with growers to the south. But growing the plants for what they are and developing the methods of which I have spoken has defrayed our variable costs enough to make the market tolerable. Through continual examination of the plants we grow and reassessment of our procedures, we will continue to experiment, discover, and move ahead.

# Regulating Root Growth in Ericaceous Plant Propagation

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## INTRODUCTION

Control of adventitious rooting is complex, involving regulation by several compounds which vary during stages of root development (De Klerk et al., 1999; Kevers et al., 1997). Regulation of rooting involves interactions between carbohydrates, nitrogen compounds, enzymes, and hormones (Haissig, 1982). In our lab, we are investigating hormonal and nutritional regulation of root growth during propagation of common ericaceous plants grown in Pacific Northwest nurseries. There is little available information describing hormonal and nutritional changes in ericaceous plants during vegetative propagation or during container production. This paper presents information on the relationship between rooting and tissue nitrogen and protein content of ericaceous plants.

## NUTRIENT COMPOSITION OF CUTTINGS AND ROOTING

**Total Nitrogen.** Mineral requirements for rooting vary during the different stages of root initiation and growth (Blazich, 1989; Hartman et al., 1990). Nitrogen (N) is required during root initiation for nucleic acid and protein synthesis. In general, it is believed there are optimum N concentrations for rooting, above which rooting declines and below which rooting decreases. Reducing N fertilization to stock plants, reduces shoot growth, allows for carbohydrate accumulation, and increases rooting (Hartman et al., 1990). We are looking at the relationship between rooting and nutritional composition of several cultivars from genera in the Ericaceae (Table 1). Our results show a strong relationship between rooting and tissue levels of N (nitrogen), zinc (Zn), manganese (Mn), and sulphur (S) for most of the cultivars tested. There is also a cultivar-specific optimum N content above and below which root initiation is reduced (Fig. 1). The amount of new root growth on cuttings also shows a similar relationship to N content.

**Protein.** Quantitative and qualitative changes in macromolecules occur during rooting of cuttings (Dua et al., 1983; Haissig 1986). In some species, rooting only