cooler than that of Portland, Oregon, and ranges from about 0° to 90°F. Our annual rainfall is about 60 in. per year.

LITERATURE CITED

1. King, R.W., 1971. The balance of light, humidity, and temperature as related to cutting leaf drop. *Proc. Inter. Plant Prop. Soc.* 21:83-86.

CONTROLLING THE ENVIRONMENT FROM CUTTINGS TO FIELD

JAMES F. McCONNELL

Bailey Nurseries, Inc.
Yamhill, Oregon

At Bailey Nurseries, a significant quantity of softwood cuttings are rooted and successfully planted bareroot to the field within the same growing season. These plants normally remain in the field throughout the summer and through another full growing season producing what is referred to as a "year and a half" plant. The objective of this practice is to provide the nursery trade with a medium sized, highly vigorous bareroot plant in as short a time as possible. This plant is unattainable by other nursery practices. Certain environmental conditions must be created and maintained in order to produce healthy, vigorous rooted cuttings with good survivability.

Controlling the environment for propagation begins with healthy vigorous stock plants from which to take cuttings. The stock plants should have optimal water and nutrition, and be free of all diseases and pests. Without these essential factors, the propagator is at a distinct disadvantage. Actively growing field stock will normally provide excellent cuttings; however, in some cases stock plants must be maintained.

Once it has been determined that the cuttings are at the proper stage for propagation, they must be given a healthy environment in which to exist after being separated from the parent plant. A sharp knife or pruning shears are used to make a good clean cut. Small bundles of cuttings (25 to 50) are laid in the cool shade of the stock rows until they are picked up and placed in a basket. Cuttings are picked up within a few minutes after they have been taken from the stock plant. Baskets of cuttings are immediately drenched with cool, clean water.

Transporation of the cuttings to a refrigerated cooler is done as soon as possible. Moistened burlap creates an excellent cooling effect when placed directly over the cuttings. A refrigerated cooler maintained at approximately 40°F. (8°C) provides good storage of cuttings until they can be dipped in rooting hormones and planted in a rooting medium.

The rooting medium is a very important environment that must be created. A well-drained rooting medium is essential, consisting of 50 to 80% pumice with the remainder being washed builder's sand. A coarse, well-aerated soil mix requires attention to prevent drying out, but it is hardly ever waterlogged. Drain tiles below the ground beds ensure excellent drainage of the media.

Misting of cuttings is possibly the most critical environment to be created. At Bailey's the majority of our cuttings are rooted under a Growing Systems Traveling Irrigator. It is simply a motorized spray boom traveling on tracks that are suspended from the superstructure of the quonset style greenhouse. The irrigator has a dual clock system that allows a great deal of flexibility in determining the number of times that the boom travels through the greenhouse each hour. Nozzle size and speed of travel, as well as the number of passes through the greenhouse in a given amount of time determines the amount of mist applied to the cuttings. An excellent filtration system eliminates the worry of plugged nozzles. The application of mist is totally uniform and the results are frequently spectacular. The minimum amount of water that will keep the plants from wilting provides the most desirable misting pattern. Creating this environment requires very close supervision.

Mechanical ventilation of our greenhouses is not necessary since both ends of the greenhouse are open. Wind currents moving through the greenhouse can, however, cause rapid drying of mist from the cuttings. To avoid this problem, plastic wind barriers are used to cover the lower portion of the doors. The upper portion of the door is always open to prevent heat buildup and air stagnation. In the evenings, the wind barriers are removed to allow the cool night air to circulate through the cuttings. Allowing the cuttings to dry in the evening and early morning dramatically reduces the incidence of disease.

A piece of 47% shade cloth is normally placed over the greenhouse while the cuttings are being stuck. This shade cloth is left in place for 3 or 4 days to reduce the stress due to the sun. Some cuttings will tolerate full sun after the shade cloth is removed while others must be protected by a light coating of liquid shading over the top of the greenhouse.

As soon as the cuttings have enough roots to survive on their own, the mist is removed and fertilization begins. Liquid fertilizer (20-10-20) is applied through the traveling irrigator at a rate of 200 to 300 ppm. The fertilization continues on a weekly basis and is stopped at least one week prior to field planting.

Three to five days before planting, a portion of the new terminal growth is trimmed from the rooted cuttings. This procedure hardens the cuttings and ensures less stress when the plants are in the field. The day before the cuttings are dug, they are thoroughly watered.

The digging process begins early on the day before the scheduled planting date and is normally completed by 10:00 a.m. The rooted cuttings are carefully dug with forks to save as many roots as possible. They are packed in large wooden boxes and thoroughly drenched prior to being placed in the cooler. Several hours at 40° F causes the cuttings to be very turgid.

The field planting operations also begin early in the morning. A wagon is loaded with the boxes of rooted cuttings at 3:00 or 4:00 a.m. The wagon is kept tarped throughout the day so the cuttings will remain as cool and fresh as possible. Planting begins at 5:00 a.m. to take full advantage of the cool morning conditions.

It is essential to prepare a mellow soil for the planting operation. This begins months in advance. A plow down crop of spring oats is planted in the spring as soon as the ground can be worked. This crop of oats is used only to create organic matter, therefore, it is fertilized heavily (100 lbs. actual N per acre) to promote vigorous straw growth. The oat straw is chopped before the seed heads mature. The ground is then plowed. The soil pH is tested and adjusted with agricultural lime. Preplant fertilizer is also applied at this time after the fertility levels have been determined by soil testing. Soil-borne insects, such as symphylans, are eliminated by an application of a soil insecticide.

The actual soil conditioning for the planting operation consists of preparing a good loose seed bed with adequate moisture to make the soil slightly moist. A tractor draws trenching blades through the moist ground, creating furrows into which the rooted cuttings are placed. The actual planting is done by hand. Once the cuttings are in the furrow, they are packed by the pressure of the planter's foot. The surface of the ground is immediately leveled with a small field cultivator and a band of herbicide (usually Devrinol) is applied directly over the cuttings. It should be noted that this practice is not

recommended by the chemical manufacturer and a great deal of caution should be exercised. Slight foliar burning has been observed on certain barberry and hydrangea species.

Planting and watering-in go hand in hand. As soon as the planting crew has worked past the reach of one irrigation line, the irrigation water is turned on and the cuttings are watered in for two to three hours. Planting continues and new irrigation lines are laid down and turned on as needed until the planting is finished and all cuttings are watered in. An irrigation crew member is assigned to keep the cuttings moist and cool by periodically turning the water on and off as needed for the next week to 10 days. This operation closely resembles a propagation misting program. This is another situation where the soil should not be waterlogged. The cuttings are monitored daily for new root growth. As soon as new roots are observed, the periodic watering is stopped and the newly planted cuttings are included in the regular field watering program.

Plants that are routinely summer-planted as rooted leafy cuttings are: *Hydrangea arborescens*, *H. arborescens*, 'Annabelle', *Spiraea* × *bumalda* 'Anthony Waterer', *S.* × *bumalda* 'Coccinea', *S. albiflora*, *Prunus* × *cistena*, *P. glandulosa*, *P. triloba*, *Ligustrum vulgare* 'Lodense', *L. ovalifolium*, *Rosa rugosa* cultivars, *Weigela florida* cultivars, *Aronia arbutifolia*, *Berberis thunbergii* '*Atropurpurea*' and *Ilex verticillata*. Summer planting normally ends by the third week in August to allow the plants enough time to establish in the field before the winter rains begin. Typically, 100,000 to 125,000 rooted cuttings are field planted by a crew of 20 to 25 people in 8 hours. One person coordinates this entire planting operation.

It is strict attention to detail and leaving nothing to chance that encourages the best results. Every step of the process must be carefully monitored. When a program such as this is first initiated, it is best to start small and work up to larger quantities. This will provide valuable experience, show where improvements can be made, and bring out limitations that are peculiar to your operations.