shifted to 3-gallon containers for finishing. The less vigorous cultivars, or smaller graded plants, are spread out and left in the 2-gallon can to produce a heavy, 2-gallon, often budded, plant by the second fall. We are able to produce an 18- to 24-inch plant in 2 years by following this schedule.

Cultivars that we like to grow and which do particularly well under our conditions include 'Roseum Elegans', 'Roseum Superbum', 'English Roseum', 'Catawbianse Boursault', 'America', 'Nova Zembla', 'Anah Kruschke', 'P.J.M.', 'Blue Ensign', 'Chinoides', 'Gomer Waterer', 'Catawbiense Album', and 'Anna Rose Whitney'. Some cultivars such as 'Scintillation' tend to leaf scorch when grown in full sun and should possibly be shaded for best results in our area.

RHODODENDRON PROPAGATION

TED GOREAU

Imperial Nurseries
Quincy, Florida 32351

Imperial Nurseries' southern division is located in Quincy, Florida, approximately 20 miles northwest of Tallahassee. The climate in this part of north Florida is mild compared to the endless summers farther south or the long winters of the northern states. The long growing season, abundance of good water, and moderate winter temperatures of this area combine to make it virtually ideal for growing many species of ornamental shrubs and trees in containers.

Although most of the woody ornamentals grown here require little or no cold protection, some species do require special handling because of the prolonged periods of high humidity and warm temperatures that are common in the summer months. There are several cultivars of rhododendron among this group.

At the southern division of Imperial Nurseries the cultivars of rhododendron receiving special handling are *Rhododendron* 'Nova Zembla', *R.* 'Roseum Elegans', *R.* 'English Roseum', *R.* 'Pink Treasurer' and three catawbiense cultivars — 'Catawbiense Grandiflora', 'Catawbiense Boursalt', and 'Catawbiense Album'. These plants are more susceptible to water mold and other fungus-related diseases and are more sensitive to heat stress than most species we grow, making proper irrigation, drainage, and frequent fungicide applications critical. They require slightly lower fertilizer levels, hand pinching and, because they are more prone to mechanical damage, shipping in cartons, as opposed to the solid stacking method we normally use. One, two, and three

gallon containers are shipped by stacking one can on top of another with each can resting on the upper lips of the two cans beneath it. All of the rhododendrons we produce are grown in 5-inch pots and are the smallest container we sell. After they are potted, the plants are closely spaced in beds and remain there until they are shipped. Concentrating the plants in a relatively small area allows us to make more efficient use of the labor required for such procedures as hand pinching, dry fertilizing, weeding, and shipping. It also reduces the cost of pesticide applications and liquid feeding.

Experience has shown that environmental factors such as temperatures, light intensity, and moisture content of the propagation and growing media more acutely affect the speed and quality of root formation on rhododendron than on other species in production here. Heavy wounding and higher-than-normal concentrations of rooting hormone have also proved advantageous. This is particularly true when working with the slower rooting cultivars.

PROPAGATION

We have traditionally begun rhododendron propagation in mid-to-late October when the latest break had completely hardened off and the plants were in a semi-dormant state. The cuttings were stuck in heated greenhouses on open benches equipped with mist lines and bottom heat cables. Most plants were rooted by the end of December when misting was discontinued and soil and air temperatures were reduced. At the end of January the cuttings were potted and stored in unheated greenhouses until spring when they were moved to a shaded growing area. All shade at Imperial of Quincy is 30 percent.

Although this procedure worked fairly well, it was labor intensive and the steadily deteriorating benches were increasingly difficult to disinfect and maintain By September, 1978, the condition of the benches had declined, literally, to the point of collapse. Replacement benches were designed and built to house 12 in by 18 in by 4 in flats. Benches are simply a frame constructed of 2×6 boards laid flat and nailed to 2×4 inch crosspieces with the whole resting on cinder blocks. Benches are easy to clean and disinfect and are virtually maintenance-free. Where the old benches had to be laboriously filled with and emptied of media, bucket-brigade fashion, the flats can be filled outside the cramped greenhouses and rolled in on conveyer tracks several at a time. The savings in labor costs are significant.

One distinct disadvantage of using flats instead of open benches is that the flats are not conducive to the use of the electric bottom heat cables salvaged from the old benches. Al-

though we were cognizant of the benefits of bottom heat in rooting cuttings, budgetary limitations, and the lack of time prevented our installing an alternative system such as steam or hot-water pipes. The decision was made to proceed without bottom heat with the proviso that a system be added later if necessary.

The first crop we rooted without basal heat was, for the most part, satisfactory. The cuttings produced roots of a good quality and number and the attrition percentage was acceptable. In fact, the only major difference we observed was that their rooting time was increased by approximately one month over previous years.

Only two of our 45 greenhouses are equipped with thermostatically actuated heaters and fans. Although they are primarily intended for rhododendron propagation, we have also used them for the propagation of certain hard-to-root junipers after the rhododendrons are removed. As cuttings of these particular junipers species root best when taken before mid-February, it was obvious that if we were to continue propagating them in heated greenhouses we must, somehow, compensate for the extended rooting time of the rhododendron. We have apparently accomplished this by moving forward the date on which we commence propagating.

We began cutting rhododendrons this year on September 15. The material was, of course, much softer than we were accustomed to and more than usual effort was required to prevent wilting. All cultivars were showing light roots by the second week in November and we are confident that they will be pottable on or ahead of our traditional schedule.

Aside from moving forward our beginning date, our actual propagation methods are basically unchanged. The cuttings are taken from leaders of the coming year's salable crop in such a manner as to level off the tops of the beds. Unusually vigorous shoots may have two or more joints removed but, in general, only the latest breaks are removed from each plant. Although many propagators shun vigorously-growing leaders in favor of lateral shoots, the small size and the need to maintain the salability of our cutting stock make lateral growth unavailable for cuttings. Leaders, however, do root satisfactorily and, because the plants are bedded, can be harvested more economically than lateral growth

All cutting for each day's production is completed by 10 a.m. The cuttings are placed on a mist-equipped bench inside the propagation shed in chronological order so that the first ones cut will be the first processed and stuck. Before processing begins all shears are disinfected and the cuttings are washed in a solution of Benlate (benomyl, duPont Chemical), 1 tablespoon per gal.

After washing, the cuttings are placed on a transite-surfaced work table. The leaves on each cutting are reduced to a maximum of four and the stem is trimmed at the base to about three inches in length. The base of each cutting then receives a double heavy wound and is dipped in a mixture of IBA (indole-3-butyric acid) and talc. *Rhododendron* 'Nova Zembla' is treated with 2% IBA in talc. All other cultivars are treated with 0.8% IBA in talc. All cultivars receive a double heavy wound. They are then heeled in trays, covered with damp burlap and hauled to the greenhouses as needed for sticking. The cuttings are stuck 1½ in apart to a depth of about 1 in in a medium consisting of 40% Canadian peat, 40% coarse perlite and 20% sharp sand. As each flat is completed, it is flooded with water to insure intimate contact between the medium and the bases of the cuttings.

The cuttings are misted at four minute intervals during the daylight hours. After one week, the mist cycle is reduced to 8 minute intervals when the ventilation fans are running, or 16 minutes or more when the fans are off. The initially high rate of misting is intended to soften the shock of removal from the mother plant. In any case, some moisture is visible on the foliage at all times during the rooting process.

The heaters, though they are infrequently needed, are thermostatically set to maintain a minimum air temperature of 55°F and the ventilation fans come on when air temperature reaches 75°F. On sunny days it is not unusual for the average temperature inside the greenhouses to climb as high as 95°F. However, due to the unobstructed flow of air across the foliage and the resulting advective and evaporative cooling, the air close to the cuttings is always several degrees cooler than the average ambient temperature inside the greenhouses.

Throughout their stay in the greenhouses, the cuttings are treated weekly with Benlate, Manzate 200 (manek, duPont) and Daconil (Diamond Shamrock) applied separately on a rotating basis. The benches are inspected at least once daily and dead or diseases plants are removed as soon as they are observed. Misting is gradually reduced when light rooting begins. When most plants are rooted, misting is discontinued and the minimum air temperature lowered to 35°F. Before potting, several weeks are allowed for the cuttings to become cold acclimatized and make additional root growth.

POTTING AND LINING-OUT

When the plants are judged ready for potting, they are dug well beforehand and heeled-in in trays Any plants with insufficiently developed roots are restuck and unrooted cuttings are discarded. The potting medium consists of approximately equal

parts of Canadian peat, sharp sand, and uncomposted milled pine bark. Fertilizer and pesticides are already incorporated in the pine bark when we receive it from the milling plant.

As was previously mentioned, we traditionally stored newly-potted rhododendrons in unheated greenhouses until spring. Several years ago, however, increases in production and a shortage of greenhouse space prompted us to experiment with overwintering a small portion of our crop without cold protection. The results were encouraging, and now all of our rhododendrons are lined out directly in the growing area as soon as they are potted. After two years we have observed no detrimental effects from this practice. In fact, the unprotected plants seem to break more uniformly in the spring than those we formerly protected. There has been a definite reduction in the man-hours required for hand-pinching of the terminal buds to encourage lateral growth.

GROWING

Our most serious stumbling blocks in achieving successful rhododendron production were root-related and were due largely to the physical characteristics of our growing area and techniques. It was not unusual in the past to find a well-branched plant 14 in high with a root system that filled less than half of a 5-in pot. Water mold infections were common and extremely difficult to check. The plants were packed tightly in wire baskets or metal flats laid directly on plastic film-covered sections that had little or no gradient. Watering was done with portable sprinklers, and the umbrella effect produced by the tightly bedded plants necessitated frequent hand watering. Though awkward, this system was not impossible as long as there was adequate personnel available and production remained on a small scale. With the expansion of production, however, modifications became imperative.

The old shade was replaced and the sections have been regraded with a pronounced crown. Five-inch square pots were acquired and bedded in rows of eight, perpendicularly across the sections and the bottom of each pot was filled with a 2-inch layer of pea gravel to enhance drainage. The plants, which are potted in 5-inch round cans, are merely dropped into available openings (empty 5-inch square pots) until each bed is filled. They need not be moved again until shipped. This technique effectively anchors the plants and provides enough spacing to allow the flow of air, pesticides, and water to the soil. It has the added advantage of simplifying inventorying and handling. We also installed a permanent irrigation system that employs Rain Bird model #30-A double-headed sprinklers. Fittings are provided that allow injection pumping of fungicides and fertilizer directly into the main

lines. We are trying to isolate the rhododendron irrigation from the rest of the nursery so as to increase the flexibility of our water applications.

Since these modifications were effected, there has been a marked improvement in the quality of the root systems on our rhododendrons and a general decline in the incidence of fungus infections.

SUMMARY

Miraculous innovations and magical cures are rare in any horticultural endeavor. We feel that the success we have, so far, realized in the production of rhododendrons is due to the development of sound propagation and growing techniques and their meticulous application. Although there are many crucial factors, we feel that those most pertinent to our situation are sanitation, disease prevention, efficient irrigation, and drainage.

In the propagation phase, all tools used for harvesting and processing of the cutting are washed in LF-10 (an organic disinfectant manufactured by Sterling Drug, Inc.) at least once daily. At the end of each work week the entire propagation facility including trays, cutting storage bench, work table, and floors are also sanitized The schedule of fungicide applications to the cuttings previously mentioned is rigidly adhered to as is the removal of dead and diseased plants from the propagation benches As much time as is practical is spent metering the misting cycle to maintain the turgidity of the cuttings and yet avoid over-saturation of the propagation medium.

In the growing phase, all pots that are not new are fumigated with methyl bromide and a continuous effort is made to obtain only uncontaminated components for the potting medium. Immediately after potting the plants are drenched with the fungicides Benlate and Truban (ethazol, Mallinckrodt) at the rate of 5 fluid ounces of Truban and 8 ounches by weight of Benlate per thousand square feet. Drenching is repeated every eight weeks as a preventive measure, or more often as a symptomatic treatment. During the warmer months, the plants are sprayed bi-weekly with the insecticides Diazinon (Ciba-Geigy) and Orthene (acephate, Chevron) applied in rotation and in combination with the same fungicides used in the propagation phase. As in all phases of production dead or diseased plants are removed and destroyed as soon as they are observed.