the outside with the front end loader of a tractor. The pots are supplied between the bins from the outside. The plants are brought from the hardening-off area on a rack trailer. The cuttings are pulled and trimmed by a crew of pullers. After the plants are potted they are placed on rollers and pushed to the end of the building where a rack trailer is loaded with the plants and taken to the liner area. Our minimum requirement for potting is 2,000 3" pots, 2,500 rose pots, and 3,000 2¼" pots per person per 8 hr. day.

MODERATOR TOMLINSON: Thank you, Bill. Our next speaker has a strong background in ornamental horticulture. He graduated in 1964 from California Polytechnic University and then went to Michigan State in 1966 for an M.S. degree. He worked as a co-ordinator for New Mexico State University and then went to Hawaii where he worked in Ornamental Horticulture Extension and also consulting for Cal-Turf in Hawaii. Presently he is technical director in charge of research at Hines Wholesale Nursery, Santa Ana, California. I would like to introduce Dennis McLain.

LARGE SCALE PROPAGATION AT HINES NURSERY

DENNIS A. McLAIN

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Santa Ana, California 92680

An hour's drive south of Los Angeles is located Hines Wholesale Nurseries — growers and distributors of ornamental nursery stock. From a small ten-acre operation nestled among the orange groves of the immense Irvine Ranch of Orange County, the nursery has prospered and grown over the years. Today, Hines Nurseries encompass over 300 acres of container-grown stock. So ideal is the year-around climate that seven other wholesale growers of ornamentals have located on the Irvine ranch. To provide one-stop shopping, Hines has expanded its product line to well over 1800 items, ranging in size from the small liner to the 24-inch boxed specimen. Last year, over six million containers were distributed within the continental United States. In an operation of this size, plant propagation is an extremely important facet of the business.

PROPAGATION FACILITY

Over ten acres of the nursery is devoted to propagation and liner production. The principal propagation structures are simple

pipe-frame poly-houses which provide enough bench space for over two million cuttings. With the aid of the computerized quota books, the propagator and his assistant map out the daily production strategy. This process involves the coordination of the activities of over fifty full-time employees to produce the five million liners needed annually.

The propagation cycle starts with the selection of vigorous pest-free stock plants on our extensive growing grounds. The plant material for the cuttings is collected by a highly skilled staff in the early morning hours of the day the cuttings are to be prepared. This process assures us that the cutting material will be in prime condition. The collected cutting material is hurried to the preparation room where the proper-sized cuttings are prepared. A skillful processor can prepare 2500 to 3000 cuttings per day. Over the years, the application of root-promoting growth regulators, such as IBA and NAA has been useful in speeding up the rooting process. Both powder and concentrated spray formulations are utilized. The concentration varies from 1,000 to 10,000 ppm, depending upon the crop being treated.

To minimize damping-off diseases, all plastic cutting flats are dipped in a 50 ppm chlorine solution and filled with a clean rooting medium such as Sponge-Rok and/or peat mixtures. After the cuttings are stuck, the prepared flats are moved to one of the 38 propagation structures. In one of our newer installations, the cutting flats are placed on an elevated sand bed that is maintained at a temperature of 80°F by means of a buried radiant heating hot water grid. This grid is constructed of a new chlorinated polyvinyl chloride (CPVC) plastic pipe that can withstand temperatures approaching the boiling point of water. At one-fifth the cost of copper tubing, the plastic pipe provides a less expensive material without sacrificing performance. Also the ease of assembly minimizes the installation cost. To provide the hot water, a 400,000 BTU/hr. boiler was installed to heat the 3,000 sq. ft. of bed space. This new compact boiler utilizes a modulated firing system which maintains the water temperature at 120°F regardless of the ambient air temperature. This system eliminates the need for a bed thermostat and, therefore, simplifies the control system. In our location, a heating load of 50 to 100 BTU/hr. per sq. ft. of bench is adequate to maintain the bed temperature even on our coldest winter nights. Although use of bottom heat is not new, the use of new materials puts a new wrinkle in its application. So far, this system has performed very well with a minimum of attention.

Another method of providing bottom heat in the nursery is with electric cable heaters. The modern electric cable heater is no more than the old lead-shielded cable covered with a thin vinyl jacket and costing twice as much. In our case, it was necessary to use a 1500 watt cable to provide sufficient heating capacity for

100 sq. ft. of surface. Also, it was necessary to use a 230 volt system so that the transmission conductors to the cables could be reasonable in size. Because of the possible shock hazard, the electrical code required that the heating cables be protected by setting in concrete. Although costly, the concrete does provide a smooth surface that can be easily cleaned and sanitized between croppings. In comparing the two methods of furnishing bottom heat, it was found that the installation cost was about the same, but that the operational cost of the hot water system was much less than the electrical installation.

The majority of our propagation structures are equipped with mist. Over the years a variety of misting nozzles have been used with varying degrees of success. The least troublesome nozzle has been the wide-angle TeeJet (Spraying Systems Co.), which is an oil-burner type of nozzle. At 50 psi, this nozzle provides even coverage on 30-inch centers with a water consumption of 8 gallon/hour. For several years, the water in the propagation area has been chlorinated. This simple procedure has helped to control the build-up of algae on the nozzles and the surface of the cutting flats. The mist application is regulated by a series of mechanical and electronic timers.

Since the irrigation water in our nursery is heavily laden with soluble salts (one ton/acre-ft.), it was found advantageous to install several exchange resin deionizers to provide salt-free water for the propagation of salt-sensitive crops, such as azaleas and mahonias.

The hardening-off process is done in the age-old cold frames of yesteryear. After properly hardened and fertilized, the rooted cuttings are moved to the adjacent liner division.

LINER FACILITY

In the liner house the rooted cuttings are sorted and transplanted to 2¼" square plastic containers and placed in liner trays of 49 units. The potting medium is a blend of coarse and horticultural grade sphagnum moss to which is added slow-release fertilizers and pH correctants. All media is fumigated with methyl bromide gas under a 2 mil polyethylene cover for 24 hours at a rate of 4 lbs./100 cu. ft. This treatment eliminates most weeds, insects and some boil-borne pathogens. For moisture conservation and shading, most liners are placed under 55% shade cloth on beds of 2-inch thick crushed gravel. Each year five million liners are produced in the six acres of shade house. Of the 1400 cultivars listed in our catalog, over half are grown in the liner division. The remainder are specialty items such as roses and fruit trees. Although most of the preparation time is involved in cutting propagation, it should be emphasized that a good percentage of our plants are still produced from seeds.

FERN PROPAGATION

A recent addition is the propagation of ferns from spores. This *is not a difficult process, but it is one that requires constant atten*tion to detail and cleanliness. When the sori of a fern are ripe, the propagator places the fertile frond in a smooth-textured paper bag (not plastic) so that the spores can be easily gathered up after the sporangia have opened. In a warm environment this process can occur very quickly. Since the collected spores are mixed with fragments of sporangia and other debris, it is helpful to use a fine sieve that only allows the spores to pass through. Also the sieve permits even distribution of the spores over the surface of the fine peat planting medium. Within a short period of time the dark surface of the peat displays a bright green sheen. This growth indicates the development of the prothallium stage of the fern. Slowly the small sporophytes emerge from moss-like surface; showing for the first time the typical fern leaf. To give the small developing ferns adequate growing room, small clusters of sporophytes are picked out of the prothallium flats and planted 2'' apart into a Peat-lite mix. As the small clusters expand, the young ferns are again moved to larger pots. The majority of the hardy ferns produced in the nursery can be easily spored, but there are a few notable exceptions such as Boston ferns and some sterile types. These cultivars must be propagated either by division or by aseptic ''*meristem*'' *(shoot-tip) techniques. In our experience, we have* found that ferns produced by such techniques are extremely vigorous and reach maturity in a very short time and, therefore, the high cost of the technique is offset by the rapid production of the crop. In the near future, this useful technique may be applied in other areas of our propagation procedures.

MODERATOR TOMLINSON: Thank you, Dennis. Our next speaker on the program this afternoon is a graduate of UCLA in chemistry. He worked for over four years with Frolich Gardens in Los Angeles as a propagator's assistant and then 7 years ago he and his brother started the California Propagation Company. Robert King is a noted horticulturist today in Southern California and is getting the reputation of being a true plant reproduction specialist. I would now like to introduce Bob King.[1]

MODERATOR TOMLINSON: Are there any questions at this time?

BRUCE BRIGGS: This is for Dennis McLain. With regard to the tissue culture, what medium did you use, and what part of the tissue did you use to multiply from?

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[1]Robert King described propagation operations at the California Propagation Company. Fillmore. California.

DENNIS McLAIN: Well, right now we don't have a tissue culture set up. But there is a tissue culture installation now, I gather, at Monrovia Nursery. Is this right, Bill?

BILL BARR: We are buying the equipment.

VOICE: To what extent are you using the new solar mist control systems — working off light intensity?

DENNIS McLAIN: Well, we are looking into one of those types of installations. There have been several installations made to control mist timing by using light intensity. They are successful in varying degrees.

BOB KING: We worked with the people that developed the Water Wizard unit. We have had one installed in our nursery for a year now and have had very good success with it. It is a solar intensity irrigation control.

VOICE: A question for Bob King. Bob, with your evergreen pear, apparently you have been able to find a source of material that is bacteria-free so that you get away from fire blight pretty well? Is that right?

BOB KING: Yes. We take a great deal of care in collecting all of our material and we have a blight-free source.

MODERATOR TOMLINSON: Austin Kenyon, our next speaker, received his B.S. degree in ornamental horticulture from Oklahoma State University and then he got his M.S. at Iowa State. He went back to Oklahoma where he worked on the staff of the University there for 2½ years. He has been with Greenleaf Nursery for over 10 years and is now the vice-president of that firm. At this time I would like to introduce Austin Kenyon.