same soil mixture with no fertilizer and no fungus preventatives, since I will be adding liquid fertilizer every two weeks. During the next three to six months the prothallia produce individual, but still clustered, sporophytes which I then transplant into the 96 cell units in which the ferns are sold.

My technique is to treat the prothallia as little as possible. I am not using any disease preventatives, except that the plastic trays are dipped into 5% Clorox solution in order to be able to use them again.

The biggest production problem is the small white larvae of the fungus gnat. My spore area is relatively small, away from the nursery and other plants, and still quantities of fungus gnats seem to appear overnight. In the spore container I am using lindane powder, ½ teaspooon per gallon of water, and treat only the infected area. Later in the saleable containers I use Diazinon wettable powder at only ½ the recommended strength. I found out that it is best always to use only half of any recommended concentrations in propagating ferns.

A major problem I have to fight is botrytis — the grey mold. Green or black algae are additional problems. Both seem to grow best under similar circumstances: a combination of too high a temperature and too high humidity. In both cases the same treatment works best for me, a mixture of ¼ teaspoon BanRot and ½ teaspoon of Konsan to 1 gallon of water.

CONTAINER-GROWN RHODODENDRONS

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Container growing of rhododendrons on the northern California coast is nearly identical to conventional California nursery operations in southern and northern California interior valleys. At Fort Bragg, however, we have very cool summers, and therein lies the key element of our effort to produce a commercial crop of container-grown rhododendrons.

In addition to cool summers, winters are relatively mild. Minimum temperatures drop to about 22°F., and we have occasional snow flurries, but neither the cold nor the snow is really severe or long lasting. Thus we do not have the problems of Eastern growers of container plants in having to provide winter protection. And the cool summers are certainly an advantage, almost to the point of being an absolute requirement. We have attempted to grow container rhododendrons in southern California, but experienced nothing but trouble from the warm sun burning the foliage, to extensive infections of root fungus diseases caused by excessively warm soil in the containers.

We are also fortunate in having good quality, low pH water for irrigation. So, at Fort Bragg we have many natural benefits and attempt to take advantage of them to the best of our ability. The difficulties we experience are generally created by errors we have made.

Sizes and grading. We produce approximately 30,000 rhododendrons per years. This classifies us as a small grower. Our market is exclusively California. Sizes of plants we offer are in 1, 2, 5, and 12 gallon containers. Over half of the plants we grow are sold in the one gallon size, the balance about equally divided among the other three sizes.

We do not grade our plants by inches of head size or by vertical height. This may cause confusion to those familiar with measurement by inches, but in that our customers have been trained for decades by some of the largest nurseries to buy by container sizes, we do not have a problem of identification.

Cultivar list. We do not offer all of the cultivars we grow, approximately 40, in all sizes of containers. Some plants are sold exclusively in one gallons, the others in larger sizes. The reason for this is that not all cultivars develop equally well for us. Initially, our plan was to offer a large selection of flower-budded two gallon plants. We tried for years with selections ranging up to 20 cultivars. Today, we are only confident of perhaps three cultivars, and offer up to seven. Twelve gallon containers present a similar problem. In years past, we simply shifted up unsold plants. We eventually recognized that a specimen plant, or twelve gallon, had to have a special look. And this was not obtained simply by grooming. The plant had to grow a certain way, bloom at a certain time, and be attractive the year round with outstanding, heavy foliage. Our list of five gallons, which we are constantly changing, is comprised of those plants that perform best for us in five gallon containers.

We would like to offer everything on everyone's list including all of the show winners, but we are simply not able to bring this about. The two gallon plants we grow must flower bud within three years, the five gallons within four years. And there is also a ratio of colors we attempt to maintain: more reds than pinks, and fewer whites than lavenders, blues, purples, and yellows. Blooming dates are important, too, in selecting cultivars for growing. It is better to have most of our list bloom "in season" than very early or very late. So getting all of the requirements under control and managed is a very important part of our growing procedure.

Growing areas. We grow our plants under lath and in the open. All of our growing areas are covered with several inches of 3/4" gravel. Irrigation is overhead, though we are gradually installing an emitter irrigation system which is more satisfactory. Our outdoor beds measure 100' by 12', and will hold 400 five-gallon size plants or 896 two-gallons. Sprinklers are Rainbird #20's; five heads will water two beds. Our four lathhouses measure 96' by 144' each, and will hold 30,000 one gallons. Rainjet heads are are used for overhead watering. A Smith injector 1:200 is installed in our irrigation system, and used for both liquid feeding and pest control work. A smaller 1:100 portable Smith injector is used for spot pest control work.

Canning. Potting and canning are done by hand, using no canning machines. We use tractors, trailers, and carts to haul plants, but with our present limited production we have not developed a system to handle more than 500 five-gallon plants per day.

Soil mixing. Soil mixing is accomplished on an asphalt slab using a rototiller for mixing and blending, and a front loader tractor for piling and moving the ingredients. Our standard batch of mix contains 8 cu. yd. This will last us for about one week, and works out well because this is about the time limit we can store the blend without it getting too warm.

After many experiments with materials we decided on a blend of fir bark, peat moss, and perlite. We do change proportions of these materials from time to time as our fir bark supplier continually changes the specifications of the grade of material he delivers. Fir bark in our area is a by-product and availability depends on either the number of housing starts or the demand for redwood lumber. Materials we have used in the past and which proved disastrous include redwood shavings, sand, bark treated with ammonia, and raw redwood sawdust.

Materials we add to the 8 cu. yd. mix include single superphosphate, dolomite lime, calcium carbonate, gypsum, potassium nitrate, I.B.D.U., packaged trace elements, G.U. 49, and calcium nitrate. Changes in the quantities of materials are made from time to time as recommended by a soil testing laboratory. This basic mix and additives are used for all of the material we grow: pieris, mahonias, nandinas, ferns and lithospermum.

Pest Control. Pest control work is primarily preventative. For sucking insects, we inject Cygon into our irrigation system and overhead all of the plants. For weevil control, we inject Lindane into our system and overhead the plants. Slugs and snails are controlled by applying metaldehyde crystals with a broadcast spreader. We hand spray with a pressure rig for fungus control using various materials: Captan, Daconil 2787, Dithane Z 78, and Benlate. Recently we have commenced using a new material — Dipel — for control of caterpillars and worms. For serious root fungus diseases, we drench with liquid Truban applied through a Smith injector 1:100.

Diseases. Root fungus is one of our more serious problems. For years we were plagued with phytophthora, and could not get rid of it in spite of major efforts with currently available fungicides. We reduced the problem when we changed our soil mix and substituted fibre pots (Western) for the thick walled black molded plastic containers we were using. The combination of poor aeration and overheating of soil in the container had been a major contributing factor to the fungus diseases.

We continue occasionally to have a serious phytophthora infection of either our plants' roots or stems and foliage. The infection develops rapidly over a great number of plants, and after several such experiences, we now review our nursery activities for the past year, and can determine a time at which we may have injured the roots of the plants. We believe this is the basic cause of nearly all of the root infection and stem infection problems we have.

Injury to roots is most generally caused by the application of too strong a fertilizer or too much fertilizer. Not always will the foliage or tips of the leaves burn. Sometimes the effect is more subtle. Foliage will slightly curl or leaves droop almost unnoticeably.

We have also damaged roots by the application of "safe" herbicides. While the rhododendrons in the containers survived the application, the opportunity for root infection was wide open, and more often than not during the first warm days of summer we would notice the first signs of phytophthora. At this time, we are most reluctant to apply any type of herbicide to a container-grown rhododendron.

Chemical damage to the root system of container-grown rhododendrons in a soilless medium is a very easy thing. Once accomplished, there is really no recovery of the plant. It should be discarded. Container plants are completely unforgiving. With field-grown stock it is another story. We maintain a stock block of over 1500 field-grown plants of various ages. At no time have we ever damaged field plants with identical applications which eliminated container plants.

We feel that with proper containers placed on a well drained gravel bed, a proper growing medium, and the avoidance of damaging roots with fertilizer or herbicides, one can' just about overcome fungus problems without the aid of expensive chemicals.

Propagation. We root our cuttings in a conventional greenhouse with bottom heat. Cuttings are placed in deep beds of a mix of perlite and peat moss. Overhead mist is provided. At Fort Bragg, the mist is not a critical factor.

The most critical factor for us is the condition of the wood selected for propagation. Initially, we were forced to take wood from our container-grown plants. This was always an uncertain effort because sometimes the plants we cut from were scheduled for sale, and we did not want to mar the appearance of the plant. Also, the container stock was sometimes overfed or underwatered, and always the condition of the wood was irregular.

In time, we developed a field-grown block of stock plants. Cutting wood from established field-grown plants is superior for our use to wood taken from our container-grown stock. Some cultivars we had considered discontinuing because of propagation difficulties, reversed themselves and became relatively easy to propagate after we commenced using wood from field-grown stock.

Management of the stock block is still new to us. We do not know to what extent we can cut our plants, but we are certain that a major management effort is required.

Fertilization. Our fertilization program combines liquid feeding both overhead and by hand, and dry application by hand.

At the time of canning we apply Osmocote (9 month formula) as a top dressing, and water in. In the case of our gallon cans, we then allow plants to grow approximately 3 months after canning, and then begin an overhead liquid feeding program based on the plants' needs as determined by soil tests. Feeding is every week.

Our containers, two gallons and larger, in the open, are fed dry by hand. This too commences approximately 90 days after initial canning and, generally, application is made about every six weeks. This program has been subject to many changes but the philosophy of a dry application by hand on our larger plants is our guide.

We have, on occasion, overfed our plants to the extent that the initial flush of new growth in the spring was very lush. There was no fertilizer damage to roots or foliage but we feel that the combination of very heavy, soft growth, and overhead watering was responsible for inducing stem and foliage infections which ultimately led to the death of entire limbs and sometimes entire plants. We have also slightly damaged the surface roots with fertilizer and, subsequently, the damaged plants were attacked by root fungi. The same has happened when we have applied herbicides. This appears to point out that it is essential to protect the surface roots of rhododendrons. We have discovered no safe herbicide, and all fertilizers will burn if not used with utmost caution.

Grooming. Shaping of container plants is a chore we have to perform with diligence each spring. Actually, we continue to shape up through early July. After this time, we allow any started growth to continue undisturbed because there is not sufficient growing time left for new growth to develop completely.

The first shaping is done when we place 4" pots into gallon containers. We pinch out all growth buds on all plant tips. After the plants are canned and growing we continue to inspect them and pinch back all plants that have not developed at least four shoots.

One gallon plants shifted into two gallons are disbudded at the time of canning and again we continue to groom the plants after canning, shaping them to be tight and heavy. All of our canning is done when the plants are dormant. We generally do not continue to grow plants that do not respond to shaping or do not flower bud after pinching.

As mentioned earlier, some cultivars are best suited for five-gallon sizes. These we produce by shifting a one-gallon plant up to a 5-gallon size and allowing it to grow on for nearly two additional years. We give these the same attention as the gallons and twos the first year, but the second year we may allow them to make a natural growth without too much additional pinching, though we may have to prune suckers or wild shoots.

On some cultivars, as Anton Van Welie, Pink Pearl and others, we completely remove all of the soft first flush of growth and then allow a second flush to develop naturally. This will be a much more compact flush with lighter weight wood but substantial enough to provide a good base for the following year's growth. We learned to do this after years of having the strong north winds of spring knock the elongated shoots from the plants and then having the plants develop into more attractive specimens later in the summer. Sometimes frosts damage the early flush of growth; we then remove all shoots, damaged or not, from the affected plants.

Irrigation. While we water most of our plants overhead by means of impact sprinklers, we believe that an emitter system of irrigation is a better procedure. We have experimented sufficiently to recognize that this is possible, and have discovered excellent types of valves and emitters that will develop a very efficient system.

Our conversion has been slow because of decisions we had to make regarding spacing, sizes of containers, and the type of bed we were to grow the plants on. But within this next year, we plan to install a complete system for a block of two-gallon containers using the Stuppy Turret Head emitters, electric valves with built-in batteries, and a water recovery system for irrigation of our block of stock plants.

Sales. Acceptance of container-grown rhododendrons has always been excellent. Buyers want to buy container-grown stock in ever increasing quantities. Growers, eager to make plants available, should be very careful not to obligate themselves beyond what is possible. Not all rhododendrons perform well in containers. Plants grown in areas other than Fort Bragg will not respond as ours do here. But one truth is probably universal for all container rhododendrons everywhere and that is, a good root system must be established and not allowed to be damaged, before any type of a plant can be grown or success assured.

BOB TICKNOR: Now, let's have some questions for our panelists.

VOICE: Barrie Coate, when you collect eucalyptus seeds, what tips can you give us in getting the seed out of the pods?

BARRIE COATE: We collect the seed virtually anytime but we sow them in the spring. We extract the seed from the seed pods immediately after we collect and dry the seed pods. All we do is put them in envelopes in a warm place — not in the direct sun, but in a warm place, and the seed pods gradually open. In a week or thereabouts vigorously shake the container, the envelope, and you are left with an envelope full of seeds. We found that it does not pay to keep the seed pods and go over them again and again and try to get every last bit of seed. We found that the first seeds to come out are the best; when you get them out, throw the seed pods away.

BILL BARR: I might say to Hildegarde that it probably was slime mold on the seed flat or spore flats of her ferns. Increasing light probably would reduce it. I would like to ask here what rate of Konsan and Ban-Rot she uses to control fungus in fern spore flats?

HILDEGARDE SANDERS: One-fourth teaspoon of Ban-Rot and ½ teaspoon of Konsan per gallon.

VOICE: Is there any information about the possibility of an isolated juvenile hormone that could control juvenility?

DALE KESTER: Basically the answer is no, but we can make a comment. Certain chemicals — hormones — have been associated with juvenility and certainly the main one is gibberellic acid. Ivy reversion from the adult to the juvenile form can be produced experimentally by gibberellic acid. There was a paper at the juvenility conference in Beltsville of an extract of tobacco — DNA from the flowering phase — which they injected into juvenile plants and produced flowering. But they also had to be sure that the leaves were removed from the juvenile part. This is an example of the kind of thing that we may be talking about in the future. We may have to go back to basic parts of the cell, the DNA and RNA. The implication is that you could program plants to behave in a directed manner. Whether or not this is going to happen in the future is really hard to say.

BRUCE BRIGGS: Can you accept the statement that the root system is always juvenile?

DALE KESTER: It's a question of definition, perhaps. It is certainly true that one of the ways to produce a reversion is to propagate by root cuttings. The adventitious shoots that come out of the roots are juvenile in appearance and I think we can say they are juvenile. There was a very interesting report by Professor Schwabe in Wye College in England. He took an adult apple cultivar which was very difficult to root and managed to get some roots on stems; from those roots he did stimulate adventitious shoots, which were juvenile. The interesting thing was that the shoots were juvenile as for rooting and could be rooted as cuttings. You would assume then that if they were juvenile they would be slow to flower. But he found that they were flowering in two years, which is rapid. Perhaps they were juvenile for rooting but not juvenile for other factors, as flowering.

BILL LIBBY: Question for Barrie Coate. Do you use the same medium in the seed flats, peat pots and the gallon cans?

BARRIE COATE: No, we use a sterile inert mix of peat moss and Sponge Rok in both cutting flats and seed flats in the nursery. In the liner pot mix, we use a mix that we are buying already made which has fertilizers in it and contains volcanic rock, Sponge Rok, fir bark, peat moss, and sand. In the gallon and 5-gallon soil mix we have a much less sophisticated medium: mushroom compost, sawdust, and sand. It has the same basic fertilizer combination that Soil & Plant Lab recommends for most things. In addition, we use a small amount of Osmocote, 18-6-12, directly under the plant when we plant it. We use half a teaspoon in a gallon and about a teaspoon in fives. That is, directly under the root system. In addition to that we have liquid fertilizer in the irrigation injector.

BILL LIBBY: Do you find mycorrhiza on the eucalyptus?

BARRIE COATE: I wish I knew the answer. It is a field that has been neglected. I think it is important, perhaps more for some species than others. I do believe eucalyptus is one of the genera that would respond better if we had the right mycorrhiza provided for them. I don't have the feeling that we are doing that. We hope the mushroom compost is providing a few of the things of that nature but, frankly, I can't give you any scientific answers.

BILL LIBBY: How are you doing on rooting eucalyptus?

BARRIE COATE: Zero. I have tried it, I have tried grafting, various kinds, and frankly we are not large enough to provide research of that depth. I wish we could. There is a wide open market for cutting-grown *Eucalyptus ficifolia*, for example, The closest we can come is being very careful about our seed source.

ROOT PROMOTION ON STEM CUTTINGS OF SEVERAL ORNAMENTAL PLANT SPECIES BY ACID OR BASE PRETREATMENT

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Abstract. Rooting of stem cuttings of *Bouganvillea*, *Ceratonia siliqua*, *Chrysanthemum morifolium*, *Euonymus japonica*, *Euphorbia pulcherrima*, *Hedera helix*, *Trachelospermum jasminoides*, sp., *Juglans hindsii*, *Pistacia chinensis* and *Salix laevigata* is greatly promoted by dipping in H_2SO_4 prior to applying indolebutyric acid. On the other hand, NaOH treatment results in considerable increase of rooting of cuttings of azalea, *Bougainvillea* sp., *Liquidambar styraciflua*, *Osmanthus heterophyllus* and *Pinus radiata*.

Auxin has varying degrees of effectiveness in promoting adventitious root formation in stem cuttings of many plant species. It has been suggested that auxin in the promotion of growth of *Avena* coleoptile is via induction of hydrogen ion secretion and cell wall acidification (2, 4). Acidification of the cell wall enhances its extensibility either by cell wall-loosening enzymes (3) or by breaking acid-labile links non-enzymatically (4). Media of low pH also show effects similar to that of auxin on the growth of *Avena* coleoptile (1). If at least part of the effect of auxin is cell wall loosening due to enhanced acidity, then pretreatment of cuttings in acid may further stimulate root-