

It must be remembered that many individuals who are currently conducting research in the area of plant propagation are also responsible for other areas of research with ornamental crops, with teaching, with advising undergraduate and graduate students and, in some instances, with administrative duties.

The results of basic research with plants are published in a number of scientific periodicals, such as the *American Journal of Botany*, *Plant Physiology*, *Botanical Gazette* and *Physiologia Plantarum*. The results of applied research are found in other periodicals, for example, *Proceedings of the American Society for Horticultural Science*, *Proceedings of the International Horticultural Congress*, and similar publications. These reports are prepared for the scientist and are of limited use to the commercial propagator. Results of research reach the commercial propagator through the activities of the extension specialist, reports at meetings of commodity groups, the trade publications, and certainly at meetings of this Society.

If there is any purpose for this discussion, it is two-fold: first, a compliment to this organization for the opportunity for teachers, researchers and commercial nurserymen to discuss formally and informally the problems of plant propagation and second, an earnest plea that each of you encourage and support both basic and applied research at institutions throughout the country.

MODERATOR DAVIS: Thank you, Bill. Our second paper will be given by Dr. Ken Reisch, Ohio State University.

## **DISEASES INITIATED IN THE PROPAGATING PHASE WHICH LATER CAUSE PLANT LOSS**

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The incidence and spread of disease organisms in the propagating phase is probably far more critical and costly than most propagators realize. We know that disease or insect infected wood can readily be a source for infection and spread, but the contamination of previously "clean" stock is a problem with which all plantsmen should be concerned. Many growers on the West Coast have recognized the seriousness of some of these problems and have taken positive steps to correct them, through sanitation and disease control programs.

We are all familiar with fungus diseases such as those causing damping-off and we can readily diagnose the cause and take steps to prevent or correct it. If all diseases initiated in the propagating phase killed the plants at this time it would be fine, but the initiation of pathogens, which are evidenced later in the life of the plant, can prove to be very costly. The decline

of plants in later phases of growth often results in death, or weakened plants of poor quality, which lead to losses of money, time, and a certain amount of pride on the part of the grower. Also, losses of this type may occur after the plant is sold to the retailer or ultimate consumer and can create marketing and public relations problems. In relation to this, how many growers see the plants they produce two years after they are planted in a landscape planting?

We have all heard and used the standard reasons given for plant decline and it is common to anticipate five to ten per cent or greater loss in each phase of production from propagation to sale, and the loss becomes more costly with time. We attribute much of this to soil, drainage, watering, fertility, high salts, weak stock, temperature and weather conditions, the workers, the time of year, or poor practices such as deep planting, improper cultivation, or possibly planting in the wrong phase of the moon. Many previously unexplained losses and poor quality stock have probably been due in part to pathogens which could readily have arisen in the propagating phase.

There is little research information on specific diseases arising in woody plants at the time of the propagation; however, there is evidence of this problem with certain florist's crops and we know it can be a problem on many softwood cuttings of ornamentals. Common causes of this trouble are soil borne diseases such as *Rhizoctonia*, *Pythium*, *Phytophthora*, *Fusarium*, and *Verticillium*, as well as parasitic nematodes. *Rhizoctonia solani* causes decay on stems and roots near the soil surface. It is spread by splashing water, dipping infected cuttings in water or auxin, soil in the watering hose, infected cuttings in the propagating bench, and infected flats, benches, medium, pots, tools, as well as hands and shoes of the workers. Spores are not usually produced in the propagating phase and spread is generally by mechanical transfer on tools, hands, etc. Also, conditions in the propagating bench, which may include good root aeration and drainage, will suppress expression of the disease with symptoms appearing later in the field, container, or landscape plantings.

*Pythium* and *Phytophthora*, called water molds, are most damaging when soil is very wet. Mycelia penetrate root tips and these diseases may also be expressed, and can cause most damage, at a later stage in growth. The water molds may survive in dry soil for several months and then spread and develop when moisture is provided.

The greenhouse poinsettia is a good example of the subject of this presentation. Diseased plants are frequently sold and provide satisfaction to the consumer even though pathogens are present, which were introduced in the propagating phase.

The three fungi most commonly affecting this crop are *Rhizoctonia solani*, *Pythium* species, and *Thielaviopsis basicola*. *Rhizoctonia* is most severe at high soil temperature and low soil moisture. *Pythium*, in contrast, is most severe at low soil

temperature and high moisture. Thielaviopsis is most severe at low soil temperature and damage usually occurs at the end of the growing season. Since the poinsettia is grown over a period of two to seven months, the disease organisms can become critical at almost any stage of growth; however, with proper manipulation of the environment, it is possible to produce plants, although diseased, which have adequate sales value. This situation is different with woody ornamentals which are expected to live, grow, and be of aesthetic and functional value for several years.

Fusarium wilt of carnations is another more specific fungus disease that causes abnormal growth of young shoots, and may gain entrance through wounds when the cuttings are made. As indicated earlier, many woody plant problems may also be due to pathogens which could easily be introduced in the propagation phase. Two specific types which have become serious in Ohio nurseries recently, were found on Rhododendrons. The evidence did not show up until plants died in beds or even in the field blocks. The United States Department of Agriculture, Ornamental Plant Research Laboratory in Delaware, Ohio, diagnosed the problem as (1) a root disease caused by *Phytophthora* species *cinnamoni* and (2) a stem canker, *Botryasphaeria ribis*. Some growers have indicated up to 75 per cent loss because of these problems. The root rot can readily be spread in infected mediums and the stem canker through any wound or on a cutting knife from cutting to cutting. Baker (1) indicated the same problem exists on Heather, on both cuttings and large plants and on avocado root stock and trees, as well as on some other economic crops.

As with most other plant problems, prevention is far more valuable and successful, and less costly than the control. Although there are chemicals such as Terraclor, Panodrench, Dexon and others which are affective against some of these soil borne diseases, their use should be considered as an addition to, and for maintaining sanitary conditions, rather than a replacement for preventive practices.

The proper approach is through sanitation and sterilization or pastuerization of medium, containers, benches, and all materials coming in contact with the plants. This can be accomplished by use of chemicals or steam and I refer you to the paper by W. W. Osborne (2) for a thorough coverage of this subject. This, unfortunately, is probably of least concern and one of the most violated practices in the nursery industry. The florist is concerned because he can see the results in a short time and is dependent on maximum production from high investment growing areas. With woody plants, however, the unseen long-term problems do not present immediate evidence of trouble and are therefore ignored.

Not only should propagating areas be sterilized and maintained free from reinfection, but this should also apply to bed

areas, container plants, lath houses, and even field blocks when specific, difficult to control problems arise.

We are operating in the era of so-called soil-less mediums today, but even these must be checked for diseases. Weed seeds might be lacking, but actually are the least of the possible problems which could be present. This applies to peat moss, sand and other organic or non-organic additives which should also be sterilized.

The old adage "A stitch in time saves nine" certainly applies here since it is not possible to over emphasize the important place of diseases and other pathogens which originate early in the life of woody plants.

I have said nothing of nematodes, viruses, or other organisms which can be brought in on the propagating stock itself and introduced at this stage of production. For instance, virus in scion wood on grafted plants will reduce successful take. The practice of developing disease free stock plants is another extensive subject in this area and certainly of equal importance.

In summary, these problems are related to plant quality, production efficiency, cost saving, and indirectly to the building of an industry image. I believe we should strive to upgrade our industry in all phases of production and sale and certainly this aspect constitutes an extremely important phase.

I have possibly over-emphasized the problem, but I do not believe we can minimize any factor which may lead to tremendous losses and, more important, to a reduction in plant quality which we should constantly try to improve rather than maintain at a minimum level.

#### LITERATURE CITED

- 1 Baker, Kenneth F. 1957, The U. C System for producing healthy container-grown plants Calif. Agr. Exp Sta Manual 23 333 pp.
- 2 Osborne, W W. 1961 Soil Sterilization and Fumigation Eleventh Proc. Plant Prop Soc

MODERATOR DAVIS: Thank you very much, Ken. We will now have questions on the two papers you have just heard.

MR. MARTIN VAN HOF: Who do we go through or who do we approach if we want more help from research?

DR. SNYDER: I would suggest first contacting the people in the Horticulture Departments who are working on your problems, and then through channels to department heads, and deans. Also, contact your state representative.

MR. AL LOWENFELS: Dr. Reisch, do you recommend sterilizing peat moss and perlite?

DR. REISCH: Perlite should be free of pathogens because of the heat used in processing, but the peat moss may carry pathogens. It is recommended by Baker in California that it should be sterilized as a safety measure.

MR. HANS HESS: You may sterilize the greenhouse benches and paths, but what is going to prevent bringing disease organisms in on potted understock which has been held outside in frames?

DR. REISCH: Actually nothing. However, we are not trying to reach an absolutely sterile situation. What we should strive for is reducing disease organisms as much as possible