THROUGH THE LOOKING GLASS: AN OVERVIEW OF PATHOLOGY AND PROPAGATION

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In perusing the looking glass each morning over shaving, one is presented with the same old face. In perusing the field of propagation, it seems one is presented with the same old problems — a reflection generally of the things the propagator ought to have done and those he ought not to have done.

I am assuming that if the cry for help is to a plant pathologist then no physiological problems, such as dormancy, stage of maturity, herbicide residues, hormone excesses and deficiencies, excess salts or other adverse environmental conditions, are involved. Rather, the problems are those attributable to disease-causing organisms, particularly fungi and bacteria, the commonly termed molds and germs. Hence, a more apt title would have replaced the looking glass with the magnifying glass since it is at the microscopic level, as the phrase goes, "where the action is."

Soils and organic debris literally teem with microscopic life forms, the majority of which prey on each other or contribute to the very necessary process of decay. Dead animal and plant matter are broken down, the various components recycled and ultimately made available for green plants to reuse. Fungi and bacteria are of major importance in this scavenging process and fulfill a very useful function. Growth of these organisms is extremely rapid and their reproduction rate is phenomenal. Populations of individual species fluctuate enormously in the continual struggle for food and space but the soil always contains a reservoir of resting structures which ensure survival of the species. These resting structures or propagules can persist for long periods before resuming growth.

Unfortunately, a minority of the organisms present, most commonly fungi, have the ability to invade living plant matter causing a disruption in normal function of the organ invaded and often death of the whole plant. Young succulent tissues of germinating seeds frequently are subject to fungal invasion, resulting in symptoms grouped in the "damping off" complex. Either seeds rot before completing germination or the tissues of the emerged seedling are colonized at or below the soil line and the plants collapse. If woody tissues have developed, then the seedlings may still succumb but remain erect giving the "wire stem" condition.

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Infection of the cotyledons as they emerge through the soil results in "top damping off." Cuttings offer fungi a ready means of entry via wounded tissues or through juvenile roots. Symptoms of root and stem rots in rooting cuttings are yellowing and dying of leaves, decay of stems and failure of cuttings to root. Mild infections present in the propagation unit may progress on plants transferred to liner beds or even field plantings where these unthrifty specimens may eventually die. The initial site of infection, the activities and subsequent spread of the invader within the tissues determine the visual symptoms characteristic of a particular disease.

The visual symptoms, together with any characteristic signs of the pathogen present on the diseased tissues, when viewed under the microscope, are the criteria used by the plant pathologist in the diagnosis of a disease. The distinctive signs of the invading organism present in and on the diseased tissues are most often the reproductive structures (spores) and special resting structures (resting spores and mycelium, sclerotia and stromata). These propagules, especially the minute spores, are produced in prodigious numbers and may be spread in air currents, in water or by mechanical means to initiate further disease outbreaks. Infected plant material is therefore an immediate source of inoculum for surrounding healthy plants and contributes continually to the reservoir of resting propagules present in the soil.

If clean physical facilities are provided for optimum growing conditions, if clean plant material and sterile media are used, and if there is no contamination from outside sources, then losses from diseases in propagation units would be zero. However, the disease-causing organisms are prolific and versatile adversaries. Complete eradication of all resting propagules from propagation facilities and from soil and other media by steam sterilization or chemical sterilants is seldom achieved. Seeds and cuttings are rarely free of all contamination. The small size and ubiquitous nature of the propagules makes recontamination of once clean areas almost inevitable. Nonetheless, the closer the grower can approach and maintain sterile conditions, the fewer will be the problems with disease.

CLEAN FACILITIES, CLEAN MEDIA, CLEAN STOCK AND SANITATION are the watchwords for success — and these four points are continually being hammered at by plant pathologists as witnessed by the numerous extension bulletins and presentations outlining the basic procedures to adopt. Presumably, they are still ignored by many growers, so I will remind you of the major points:

I. **Clean Facilities:** Various disinfectants are available for treating support and working surfaces, for instance, formalin, sodium hypochlorite, phenols, alcohols and quarternary ammonium compounds. Procedure:

1. Remove all old rooting media and plant debris.
2. Wash down surfaces with detergent and water to remove any organic matter prior to treating with disinfectant.
3. Repeat disinfectant treatments on painted woodwork, walkways and under benches every 2 weeks.
4. Soak all propagating tools in disinfectant for 10 min.
5. Treat all unpainted woodwork with 2% copper naphthenate (not creosote or other preservatives; they are phytotoxic).

II. **Clean Media;** Use fresh clean media or sterilize existing media by steam or chemical fumigation.

III. **Clean Stock:** Take propagative material from healthy stock plants. Stock blocks should be isolated if possible and well maintained. A regular weed, insect and disease control program should be carried out.

IV. **Sanitation:** Adopt any measures which will cut down or prevent the introduction or build-up of propagules in the propagating area.

Adoption of these measures will go a long way in reducing losses but even the most stringent attention to detail cannot exclude all pathogens, hence we supplement with protective fungicides. Older fungicides, for example those based on sulphur, copper and mercury, have been replaced with a continually expanding list of organic materials. But there is still no universal fungicide — nor likely to be one! Each particular fungicide has its strengths and weaknesses; hence accurate diagnosis of a disease problem and use of the most effective fungicide is vital. If a particular problem is anticipated, routine preventive measures can be adopted whereby a suitable fungicide is incorporated into the medium, added to the hormone treatment or drenched or sprayed onto the plants. However, contact fungicides afford only short term protection and repeated drenching or spraying is required to maintain the fungicide barrier. The advent of systemic fungicides, where the active principle becomes distributed *within* the plant tissues, is a major breakthrough in prolonging the fungicidal effect. But these new fungicides are not the universal panacea for all ills, because individual spectra of activity are limited and problems of fungal tolerance are occurring. The water molds, a group of fungi which includes those causing serious root rotting problems, eg. species of *Pythium* and *Phytophthora*, are not controlled by currently available systemics. Efforts to remedy this deficiency are underway, and initial trials with one new fungicide are promising. This material is translocated downward from the leaves and offers the novel approach of preventing root problems by spraying the leaves.

No doubt further advances will be made with these systemic fungicides, but progress is slow due to the stringent EPA regulations and immense costs involved in developing new fungicides. With the current shortages and high cost of petrochemicals, researchers are exploring ways of relying less on applied chemicals and understanding more fully the complex biological interactions of microorganisms which can be directed in favor of the healthy plant, eg. new composting procedures. Although fungicides will always play a part in successful plant propagation, good cultural practices remain the basis for healthy plants.

MODERATOR FLEMER: I thank you, Noel and all of the other speakers on this portion of this afternoon's program. I now turn the podium over to Knox Henry who will serve as moderator for the last portion of this afternoon's program

MODERATOR HENRY: This portion of the program is devoted to what many of you consider a dry subject and that is the economics of plant propagation and production. There is no sense in propagating and producing something if we can not profitably sell the fruits of our labor and the key word here is profit. The area of economics is one which many of us would prefer to ignore but with the pressure of rapidly increasing costs and equally rapidly decreasing returns on our investment is forcing us to take a hard look at how we determine and evaluate these costs. We must recognize the need to institute, on a continuing basis, a cost analysis system which keeps close tabs on each individual crop we produce. Our first speaker is Tom Pinney and, as most of you know, Tom has been very innovative in this area of keeping costs on the products which his company produces; he is going to discuss with us the economics of seedling production.