Integrated Disease Management—Research and Development Using New Techniques and Bioremediation at Vans Pines

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The success of our integrated disease management (IDM) program depends heavily on the skills of the propagation staff.

There are many diseases that can cause considerable havoc in a tree nursery, and some are resistant to fungicides (Sanders, 1989). Costs of controlling some diseases are increasing rapidly as pesticides become unavailable for "minor" users (Spooner-Hart, 1989). During the next few years, there will be more pressure to use alternatives. This presentation is about some of those new alternatives.

I have seen dramatic results using improved cultural practices such as horizontal air in a greenhouse. However, some diseases can be so devastating that preventative fungicide applications are essential to the nursery. Nevertheless, we have found that good cultural practices decrease the amount of fungicide needed.

By restricting watering to as early in the morning as possible, some diseases are discouraged. This can be taken a stage farther in the greenhouse and with an understanding of auto-ecology (Javis, 1989) or micro-climate control, diseases can be cheated from reaching the conditions they need to proliferate. This is exciting work and the literature abounds with information that can be used in practicing IDM (Adams, 1990; Brush, 1990; Campbell, 1989; Glenister, 1989; Graham, 1988; James et al., 1990; Kuack, 1989).

Growing seedlings outdoors is another story. Cultural practices such as the use of drilled beds to improve air movement, clean fields and equipment, good surface drainage, correct fertilization (Engelhart, 1989), and raised beds all help reduce disease pressure. However, we have found that without an effective soil fumigation program, diseases will be a costly problem. Methyl bromide is the fumigant of choice at Vans Pines.

Seed is sown in a timely manner and germination is encouraged as fast as possible by pretreatment of seeds where appropriate. Sprays of one kind or another are inevitable and preventative sprays for some problems are essential. We have tried to use the best equipment to reduce pesticide use and costs. Relentlessly at times, sprayers have to cover the nursery in the narrow window of control necessary to forestall very real problems.

I became convinced of the value of biological controls during a successful experiment we tried in our greenhouses two years ago. A troublesome pest, the shorefly, resisted any kind of chemical spray program until we controlled it with a nematode. The nematode stayed alive and kept devouring our shoreflies until it was no longer a pest. After some research, I discovered that there were also biologicals that could control some of our disease problems. The first documented experiment was published by the U.S.D.A. in 1921 by Hartley (1921). Since then, the last decade has seen a resurgence of interest (Campbell, 1989). It was decided to undertake trials using three different biological products.

The initial experiment took place in the greenhouse. We purchased some medium that was inoculated with GL-21 (*Gliocladium virens*), which is being developed as an effective control for *Pythium* and *Rhizoctonia*. We used this medium to seed several conifer species. It was consumed before the other two biologicals were received so we purchased some GL-21 in prills and mixed it ourselves with sterile medium. The second biological used in the trial was Mycostop, a strain of streptomyces bacteria isolated from Finnish peat which may be used to inhibit *Fusarium* and other diseases. Thirdly, our local practitioners of biological materials supplied us with a genus-specific microbial culture called FAB-29. Samples of all bio-remediations were forwarded to the Pathology Department, Michigan State University and it was determined that each of the treatments contained no harmful substances.

The experimental design included controls and the three treatments in the form of fumigated blocks, dirty blocks, and new blocks. The white styroblocks were spray painted with four colors, one for each replication.

Mycostop was applied as a seed treatment and later as a drench. GL-21 was already premixed in the medium as described. FAB-29A was premixed into the medium and then FAB-29B applied after seeding. After normal block filling and a light pressing, they were seeded with *Picea pungens* 'Glauca'. The automatic seeder also covers the blocks with a fine layer of chicken grit. The blocks were then set on benches and watered with the traveling irrigation boom. The experiment was positioned at the end of a bay so that we could easily ensure that no fungicides would reach them. The seedlings germinated and every cavity was filled. Later the blocks were thinned to one seedling per cavity. No damping off was observed even in the control — the dirty block. Weeks later, some trees in one of the replications did die and there is some indication that *Pythium* was the cause.

The trial was subjected to our normal greenhouse accelerated-growth protocol but has never been treated with any fungicide. Data on saleable trees per treatment will be obtained at harvest time. We will also observe the performance of the trials following out-planting.

In the meantime, my biological suppliers all agreed that I should try the same materials in an outdoor seedbed. This time we agreed to try three different plants—*Acer rubrum*, *P. pungens* 'Glauca', and *Pinus sylvestris*. As the trial was to be in an area that would otherwise receive minimal attention, it was decided to install a drip irrigation system under and above the seedbed. Overhead irrigation was also available, but irrigation scheduling on that particular line would have been too infrequent for germination. The bed was made with irrigation installed 8 inches down. GL-21 and the three genus specific FAB-29B consortiums were incorporated into the seed bed. Mycostop was applied to that portion of the seed lot for each species. FAB-29B was broadcast over the FAB sections. A Love Seeder was used to sow the conifer seeds. The red maple seeds were broadcast and covered with rice hulls. The T-tape irrigation was installed over the bed.

The seedlings all germinated on a Friday. By Sunday, a flock of doves had severely damaged the spruce and pine seedlings. A call to our local biological practitioner revealed another new item: a naturally occurring clear liquid which, even in small amounts, repels birds. It was applied judiciously over the whole works, and the birds, miraculously enough, did not eat any more seedlings. Results at this point, are inconclusive at best. I learned that biological disease control could

be practical either by seed treatment (Harman, 1991), soil incorporation, drenching, or a combination. It would be interesting to apply materials with a mycorrhizal applicator. I also learned that drip irrigation on a seedbed can be useful but the design I followed did not provide even coverage.

My research indicates that there is no silver bullet (Lawson and Dienelt, 1988). The use of just one beneficial organism will probably not work. There should probably be a group of biological components delivered where they can protect the plants when the plants need them. However, research is still limited and fungicides are both sophisticated and inexpensive by comparison. Research into new biological disease controls over the past year has advanced considerably. I am particularly impressed with John Sutton's work in Canada in which *Botrytis cinerea* is controlled by *G. roseum*. The delivery system involves a little footbath of the beneficial spores in talc, which is placed at the door of a beehive. The bees then inoculate the strawberry flowers and *Botrytis* control is achieved (Peng et al., 1992).

Another element of this study was the use of the Alert Diagnostic Kits. As components of an IDM system, these little mobile labs are ideal. Within 10 min, you can identify *Pythium*, *Rhizoctonia*, or *Phytophthora*. They are very user friendly. An electronic meter can also be purchased that quantifies the infection. This small electronic marvel also logs each test for future reference. My only reservation is that they do not identify specific organisms and this could lead to an erroneous diagnosis of a problem (Pscheidt et al., 1992). They also are unable to identify other problem pathogens such as *Fusarium* species. Overall, I think the kits are useful but results should not be considered the last word. Diagnosis of pathogens is extremely complicated and a professional pathologist's diagnosis should always be preferred. The kits allow us to make an educated guess as to the probable nature of the problem fast and in my view are a worthwhile investment.

Vans Pines has been improving cultural practices over the years to produce vigorous, healthy seedlings and nursery stock. The importance of effective insect control, optimum irrigation, and an intelligent nutrition program cannot be overemphasized. Our seedbeds are drilled into ground that has been primed with organic matter, fallowed, and fertilized. Mechanical cultivation, timely weed control, living mulches, root conditioning, and effective insect control are all integral to the production of top quality seedlings.

Compost is produced on-site using modern contracted equipment. This is priceless organic matter. We may not understand exactly how it works, but good compost is very beneficial to the soil.

Another new technique that makes an excellent component of our IDM program was gained from a previous presentation at this region of the I.P.P.S. The old method of growing sugar maple seedlings involved a series of panic frost control measures usually starting in February. This was not a favorite of mine. We tried irrigation, plastic, straw, fumigated straw, and invariably ended with a mess. This year was more than elegant. The Grow Covers keep the irrigation water needed for hard frosts in the aisles, resulting in fewer disease problems. The mini-greenhouses produce 1-0 seedlings that are straight, healthy, and somewhat larger than previous efforts. Grow Covers should also be useful when using biological controls. In addition, many pests are excluded by the fibrous material. Many thanks to Richard Watson for sharing this wonderful system with us (Watson, 1991).

I am currently Nursery Manager at West Wisconsin Nursery where I have already begun new biological trials. We are also using some interesting new biodegradable seedbed covers and living mulches on some fall-seeded red oak.

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THURSDAY MORNING 3 DECEMBER 1992

The morning session reconvened at 10:30 a.m. with Deborah McCown serving as moderator.