Options in Controlling Soilborne Pests[1]

Fred D. McElroy [2]

My purpose in selecting this topic for presentation is two-fold. First, it serves as an excellent prologue to our fumigation studies, which will be presented next. Second, and most importantly, I hope that it will stimulate same reevaluation of the subject of soil fumigation. This process of reconsideration is addressed both to nurserymen and researchers.

WHY THE CONCERN?

The first *concern* is the possible loss of registration of presently used soil fumigants. It may take anywhere from 1-5 years, but when it occurs it could happen quickly as it has in the past. The continued increase in technology of detecting chemicals in the environment, and the continued concern for environmental contamination suggests that it's only a matter of time.

Working out alternatives to presently used pesticides involves considerable time and money. We should be in the positive position of having a replacement waiting in the wings and ready to go as soon as the primary pesticide is lost.

Another concern is that the most cannon presently used fumigant is a biocide, which is hazardous to both humans and the environment. Again, with the increased pressure to reduce the use of these soil sterilants, it may only be a matter of time before pressure is brought to bare in this area.

The other problem with this presently used fumigant is the high cost. Soil fumigation is presently the most costly soil management activity conducted in a nursery. With the downturn in the forest nursery economy, and competition increases, those nurseries that can keep their cost of production dawn will be the most competitive.

Soil fumigation in forest nurseries using Methyl bromide-chloropicrin, is overkill. Many times the rates are too high and the biocidal activity of the chemical is too broad spectrum. This results in destroying both the beneficial and pathogenic organisms. It's rather like using a nuclear weapon to stop a riot. We have difficulty sorting out the good guys from the bad guys and so we kill everyone. This always results in a loss of a lot of innocent bystanders, and in this case, these are the beneficial soil organisms. Container nurserymen have learned the difference between pasturization and sterilization of the soil, but it's a lesson yet to be understood and learned by bareroot nurserymen.

Ironically, however, even with sterilization many 1-0 crops routinely experience a certain percent mortality each year from damping-off and lower stem canker diseases. Even if soil treatment is effective at sowing, its effect is gone soon after sowing. This suggests there may be a better way of dealing with this short-term problem.

More judicious use of the presently used pesticides may delay their loss from registration. If it can be demonstrated that these materials are used only under necessary conditions, and then with the consideration of environmental protection, they are less likely to be lost from registration.

Finally, a time may be approaching when future regulations may require a prescription prior to the application of a soil treatment. This has already been tried for several pesticides in sane states. While it has

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[2]Fred D. McElroy, Ph.D., Owner/Director, Peninsu-Lab, Box 3000, Kingston, WA 98346.

created many problems, there may be sane instances in which it's justified. In the case of irreparable changes in the environment as a result of the application of a pesticide, a more thorough evaluation of that environment may be necessary prior to the application of such a pesticide. This may require laboratory tests to determine several things about the environment in order to evaluate what impact this treatment may have. These might include an evaluation of the soil microorganisms, soil type, geology and hydrology of the area, etc. Then a pesticide would be recommended which would be least damaging under these circumstances (Holden, 1986).

Presently law suits involving groundwater contamination are in progress throughout the United States. Growers that have been most successful in defending their actions have had records of laboratory analyses to determine the need for fumigation. Many of these cases date back to the late 1970's and early 1980's before groundwater contamination was known to be a problem. Therefore, it's possible that at sane future date nurserymen could be sued for the use of registered hazardous chemicals in the soil environment even though they are presently legal. These are very complex issues. A lot of innocent growers are being hurt in this sorting-out process. We, therefore, need to be forewarned about such issues and be taking sane steps now to protect ourselves.

WHAT ARE OUR OPTIONS?

The use of crop rotation and/or fallow has controlled soilborne pests on a wide range of crops. This practice is currently being used on a number of agricultural crops as an effective management tool. Tests are presently being conducted by researchers at Oregon State University to evaluate this as a management practice in forest nurseries. This is a positive step forward and needs to not only be encouraged by the nurserymen, but they should *actively* be involved in sane testing an their own.

There is a need to get away from overkill, and to apply pesticides against the specific target organisms. This, of course, requires determining what those target organisms are and developing control measures specifically against those organisms. More research is needed in this area.

Seed protection is another approach in controlling seed and soilborne pests. Even if soil treatments correct the problems in the soil, they are frequently reintroduced on contaminated seed. Occasionally a more severe problem is created by planting fungus infected seed in a relatively sterile soil environment. The beneficial organisms have been reproved from the soil, and thus the fungus introduced on the seed has nothing to keep it in check and frequently creates more loss than if the soil had not been sterilized.

The use of biological control agents is another area which has not been fully explored in the forest nursery industry. There have been several breakthroughs in the use of beneficial fungi and bacteria for controlling soilborne agricultural pests. These are applied either as seed treatments or soil amendments (Cook & Baker, 1983).

In the final analysis, alternatives to biocidal soil fumigation will probably involve a combination of the above practices. The exact combination will be determined by the nurseryman's unique set of conditions and needs. There are probably also other practices which may be beneficial, but have not been fully evaluated or enumerated at this point.

PREDICTIVE EVALUATIONS

As was mentioned earlier, in order to avoid the "biocidal-overkill" approach we have to be able to sort out the "good guys" from the "bad guys". Having made that determination we can then select the correct weapon for the job. Below I have selected the areas I believe we need to be concerned about and discuss them in terms of our present knowledge and our future needs.

Soilborne Microorganism Assay

In terms of predictive assays, we probably have the greatest knowledge about nematodes. Preplant nematode assays have been used for several decades to determine soil treatment needs (Taylor, 1971, Oostenbrink, 1972). Procedures are more or less standardized and many government as well as private laboratories routinely conduct nematode assays for growers.

Routine assays for soil fungi (e.g. *Fusarium, Pythium, Rhizoctonia, Phytophthora,* etc.) appear to still be in developmental stages, although the technology has been available for several years. Several assays are presently being used for agricultural crops, but these too are limited.

The precedent for use of soilborne assays in forest nurseries was set several years ago. The Canadian Forest Service in British Columbia routinely analyzes proposed sawing blocks for soilborne fungi. Since Methyl bromide-chloropicrin is not registered for use in British Columbia, soil showing high levels of Pythium and Fusarium are taken out of production and alternative sowing areas are sought. Population reduction is accomplished by bare fallowing for one year.

The Department of Natural Resources Nursery in Olympia, Washington uses a similar technique to determine need in proposed sowing blocks (Russell, 1976). The registration of Methyl bromide-chloropicrin in Washington provides soil fumigation of heavily infested soils as an additional option.

Peninsu-Lab was the first, and still is, the only commercial laboratory offering this service to Pacific Northwest Nurserymen. Cooperative tests with Peninsu-Lab, Canadian Forest Service, B.C., Department of Natural Resources, Olympia, Wa., U.S. Forest Service, Portland, Or., and Oregon State University, Corvallis, Or. has established the accuracy and reproducability of these tests.

Two of the weak links in the present program are an understanding of population dynamics of the fungi throughout the year, and an ability to interpret the results in different situations. Our findings over the years have suggested that the interpretation is best done on an individual nursery basis, avoiding generalities between nurseries. Unique conditions within a nursery influence the amount of damage caused by a certain population of soil fungi. The presence of certain soilborne biological antagonists probably play a major role in this variation. At the present time *there* is very little understanding of what these organisms are, and their importance in the nursery situation. A better understanding of these beneficial organisms will enable us to improve our interpretation. Also with a better understanding of these organisms, we may be able to reintroduce them into the soil following treatment to regain a more balanced soil microorganism population.

Seed Asaays

Another predictive tool which would be useful would be *the* assay of each seed lot for seedborne fungi. Pathogens such as Fusarium are frequently found both externally and internally associated with seeds, which in turn influences the amount of loss experienced by *the* nurserymen. If a seedlot is found to be heavily contaminated with Fusarium and cannot be cleaned-up, less disease loss may be experienced by planting into a nonfumigated soil rather than into a sterilized environment. Also a knowledge of whether the fungus is internal or external will determine the efficacy of surface seed disinfection. From a research standpoint we need more information regarding the affect of the various fungi that are found on seed as well as more adequate means of treating the seed to control these organisms.

Weed Surveys

This is something the nurserymen can and should be doing routinely. Armed with the knowledge of weed species present in a particular block in the nursery, the nurserymen can then make a decision as to whether or not effective herbicides are available for their control or whether a biocide treatment is necessary. Often judicious use of selective herbicides is less costly than the soil fumigation.

Soil insect Surveys

Soil insects are not usually a major problem in forest nurseries. They do, however, occur on occasion and can be quite damaging. The White Grub of the Tenlined June Beetle is a good example. However, if proper surveys are conducted ahead of time the least costly control measure can be applied.

ADVANTAGES

There are several advantages in using predictive evaluations to determine the need for soil fumigation. First it allows us to target the organism to be controlled. We can then select a control measure specific for

that organism. If a pesticide is required, the population level will enable us to determine the proper rate necessary for control. At the present time we are aiming for 100% control, *whereas* proper pest management techniques suggest that it is most beneficial to just bring the populations back into balance with the beneficial microorganisms in the soil.

This type of an approach also optimizes the per acre cost for treatment. In other words, the nurseryman applies just the pesticide needed at the proper rate to bring things back into balance, which enables him to produce the healthiest seedling with a minimum input of expense.

Finally, this approach becomes the prescription which may sane day be required by government regulation. The pest population has been determined by field observation and laboratory analysis, a pesticide and rate and/or management technique has been selected to minimize the effect of the pest, optimize growth of the seedling, with minimal affect on the environment.

It may seem that we are a long way from such an ideal situation. However, I believe we are closer than many of us realize. Much of the technology is already available and simply needs to be put together and tested at the field level. I believe this can be accomplished in a relatively short time through the cooperative efforts of nurserymen, researchers, and private industry. It is not necessary for the nurseryman to wait until all the answers have been provided at the research level. Sane of these tests can be conducted at the nursery level, and in fact, each nurseryman will eventually have to conduct these tests at their nurseries to determine what will and will not work.

My challenge, therefore, is to consider sane of the options I have outlined, think of sane of your own, take the initiative and act now rather than react when your number of options are more limited.

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