PREPLANT NURSERY SOIL ADDITIONS OF FOREST SOILS, COMMERCIAL SEWAGE AND MUSHROOM COMPOSTS AND BASAMID (DAZOMET) TO CONTROL THE FUNGAL PATHOGEN, *CYLINDROCLADIUM SCOPARIUM*

Hunter, B. B., M. T. Lyons*, R. Bulluck, A. Burd and J. C. Gore. Department of Biological & Environmental Sciences, California University of Pennsylvania, California , PA 15419, and T. Hall Pennsylvania Bureau of Forestry, Division of Forest Pest, Middletown, PA

Cylindrocladium scoparium and many other species of the genus are pathogenic to many economically important plants in the United States and throughout the world. These fungal pathogens attack various plant structures and often kill their hosts. *Cylindrocladium scoparium* is primarily a root pathogen and is especially destructive to hardwood and conifer nursery seedlings in Pennsylvania. This fungus is well established in the Pennsylvania Bureau of Forestry Nursery at Spring Mills, PA (Penn Nursery) where this research is ongoing. Its presence has negated the plantings of black walnut (*Juglans nigra*) and yellow poplar (*Liriodendron tulipifera*) and caused excessive losses to white pine (*Pinus strobus*) and many other nursery forest seedling species. Many chemical, cultural and biological controls have been attempted at this nursery and elsewhere to lessen the incidence of diseases caused by *C. scoparium*, most having little or no affect. The persistence of *C. scoparium* in soil is because of its resistant, multicellular microsclerotia (MS) which develop by bulbous budding of the hyphae. The widespread nature of this soilborne root rot pathogen at the Penn Nursery makes it an ideal organism for testing the efficacy of forest soils, selected compost substrates (commercial human sewage and spent mushroom) and the soil fumigant, Basamid (dazomet).

The human sewage (HSC) and spent mushroom (SMC) were used separately and together to evaluate their fungal suppression efficacies. The two composts are licensed and commercially available, and are routinely used by landscape maintenance and greenhouse production companies. Prior to the field studies, laboratory research was conducted to determine whether the composts could reduce soilborne *C. scoparium* populations. We found that the composts were suppressing these fungi. Consequently, we then initiated our first of several field studies in 1995, to ascertain whether the composts would be as effective in a nursery soils environment. Basamid and forest soils would also be used as separate selective amendments, and in concert with the composts, to determine whether enhanced fungal suppression could occur. Basamid is a soil fumigant which breaks down in the soil to form methyl isothiocyanate and other volatile liquids which kill soil microbes on contact. Soils containing the various amendments were randomly collected and returned to CUP for processing. The geranium baiting procedure, a differential selective medium, and a soil chemical procedure were

used to qualitatively assay for the cylindrocladia. A quantitative wet-sieving procedure was also employed to enumerate soilborne microsclerotia. Field data were analyzed using a random block design ANOVA. Multiple means comparisons between all samples were determined with the Scheffe F-Test. Tables 1, 2 and 3 provide information on the compost

treatments employed at the Penn Nursery in Field Study 1 (FS-1), began in 1995, Field Study 2 (FS-2) and Augmentation Studies (AUG), both began in 1996. All amended soils in the FS-1 showed varying degrees of suppression, and when the experimental samples were averaged and compared to the control soils, the amount of compost suppression, or degree of inhibition/death of the cylindrocladia, was clearly evident (Figure 1). However, the Basamid soils displayed even greater population reductions of the cylindrocladia when compared to the composts. Figure 2 shows that fungal suppression occurs when either compost is used singly or in combination with each other. This degree of fungal suppression is similar in the other combinations of amendments given in Table 1. We also employed different compost loading rates of 20, 40 and 60 tons/acre(t/a) (Figure 3). On the basis of our data analysis, the 25/75 ratio of amendments at 30 or 40 t/a appear to be optimal mixes for maximum suppression over time. This is important because we want to use a minimum amount of the HSC in our mix to reduce heavy metal loading in the nursery soils. The controls (no amendments) were significantly different from the composts and Basamid. Soil samples taken over a period of several months, regardless of the rate of application of the composts, demonstrated fungal suppression below 50%. The duration of the amendments in the soil (time) appears to be the most significant variable regardless of the compost combinations and regardless of the compost loading rates. Table 4 and Figure 4 provide data on four years of soil sampling of FS-1. The suppression of the cylindrocladia via the composts is evident during the first three years, but diminishes during the fourth year; however, the Basamid treatments maintain their suppression, albeit, slightly higher than the first three years, during the fourth year of sampling. When and if the composts are used without a prior Basamid treatment, the soils must have compost additions to maintain the soil suppression of *C. scoparium*.

The data from FS-2 (Figures 5 and 6) corroborates and extends the information gained from FS-1. When data from Figs 1 and 5 are compared, they are most similar. Figure 6 shows that Basamid applications with additional compost amendments are equally as effective as when Basamid is used alone. However, Basamid is a soil sterilant which eliminates much of the natural soil microbial biota. Therefore, we used Basamid in conjunction with the composts, and ultimately with forest soils, to establish new microbial populations (Figures 7 and 8). All of our Figures and Table 4 show that Basamid effectively suppresses *C. scoparium* initially and throughout the field samplings. Figure 7 shows that Basamid with the composts is equally as effective as Basamid alone.

On the basis of our investigations we concluded that *C. scoparium* soilborne populations were dramatically reduced in our laboratory

and field studies and this reduction could be maintained in the field for three years with the composts and is continuing with the Basamid during the fourth year (1998) of soil sampling. The reduction in soilborne MS where the composts and/or Basamid were placed was dramatic. Soils with initial MS numbers of greater than 10 per gram of soil were reduced to less than two. The less soil MS the greater the reduction in root diseases and seedling deaths at the Penn Nursery.