SOME CHEMICAL, BIOLOGICAL, AND CULTURAL APPROACHES TO CONTROL OF SOUTHERN BLIGHT IN CALIFORNIA

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Southern blight, caused by the soilborne fungus *Sclerotium rolfsii*, is a serious disease of young apple trees and vegetable crops (including potatoes, carrots, tomatoes) in the Central Valley of California. Preplant applications of methyl bromide and other fumigants protect these crops from a broad range of weed, nematode, insect, and fungal pests, including *S. rolfsii*. Restrictions on use of methyl bromide and other fumigants will complicate control of southern blight if viable alternatives are not available.

In 1995, chemical and biological control investigations were initiated in a "third-leaf" commercial apple orchard that had sustained a loss of over 400 trees due to southern blight. At the sites of tree loss, treatments were assigned in a randomized complete block design. In October before fall rains, methyl bromide/chloropicrin (MB/CP) was applied with and without tarps (75%/25% mixture, 454 g per tree site, injected at 35-cm depth, tarps measured 1.2 x 1.5 m). At additional tree sites, several separate drench treatments were applied. In March 1996, metham sodium was drench applied with and without tarps (Vapam, 10 g MIT a.i. in 26.5-L solution per tree site), and sodium tetrathiocarbonate was applied only without tarps (Enzone, 216 g STTC a.i. in 26.5-L solution per tree site). In early June 1996, a drenchable formulation of *Gliocladium virens* GL-21 (W.R. Grace Co.) was applied to additional sites; each site received 2 L of suspension that contained 4 g of the biocontrol formulation. Appropriate controls were included for all treatments. All experimental trees were planted in April 1996.

Soil samples (100-ml) were collected from the experimental tree sites in early June 1996. From each sample, sclerotia of *S. rolfsii* were extracted and enumerated after a standard sieving and floatation procedure. MB/CP under tarp afforded the greatest reduction of inoculum density, and metham sodium with tarping was equally effective. Untarped metham sodium and STTC drenches were ineffective in reducing the number of sclerotia. As a factor, tarping resulted in a significant reduction in inoculum density across MB/CP, metham sodium, and the corresponding control treatments. Effects of the biocontrol formulation on inoculum density could not be evaluated in 1996 due to relatively late application of the formulation.

Disease severity and mortality correlated with the inoculum densities determined from soil samples (r=0.92 and 0.91, respectively). In July, apple tree mortality due to southern blight was 14% and 13% in tarped MB/CP and metham sodium sites, respectively, and 20% and 40%, respectively in corresponding untarped plots. In the other treatments, including controls, mortality was 39% to 57%. Our data suggest that tarped drenches with metham sodium may be a suitable alternative to the MB/CP mixture for preplant control of southern blight in apple orchards. Although STTC was ineffective under our conditions, appropriate tarping or increases in application amount may improve its performance. Due to the late application of the biocontrol agent, more tests are needed to evaluate its efficacy for control of southern blight in California.

Potatoes in San Joaquin Valley districts are virtually all sprinkler irrigated. Strategies for control of southern blight in the crop benefit directly from preplant applications of metham sodium through sprinklers and indirectly from methyl bromide applications made for other crops that are rotated with potatoes. Infection of potato stems and tubers by *S. rolfsii* is favored when warm temperatures late in the season accompany high levels of moisture near the soil surface. In the arid San Joaquin climate, significant amounts of late-season moisture at the soil surface result primarily from irrigation. We determined if subsurface drip irrigation, which simultaneously can meet crop water needs and maintain a dry soil surface, may help to control southern blight. We also evaluated relative efficacy of sprinkler and drip chemigation systems for application of metham sodium.

Compared to sprinkler and surface drip irrigation methods, subsurface drip irrigation consistently reduced incidence and severity of stem and tuber infection caused by *S. rolfsii*. The effect was associated with a relatively dry soil surface that resulted with subsurface drip irrigation. Efficacy of preplant chemigation with metham sodium was also influenced by type of irrigation system, but effects depended upon field configuration at chemigation time. For example, when chemigation was applied to preformed beds, both subsurface and surface drip chemigation killed most sclerotia buried within and near the surface of beds, whereas sprinkler chemigation only killed sclerotia near the bed surface; conversely, under furrows beside the beds, sprinkler chemigation was more effective than either mode of drip chemigation. When metham sodium was applied to level ground, sprinkler and surface drip methods of chemigation did not differ significantly in effectiveness and killed 92-100% of sclerotia at 15 cm depth, 58-68% at 46 cm, and 12-33% at 76 cm. Given economic feasibility, subsurface drip irrigation systems could augment control strategies for southern blight of potatoes under California conditions.