Integration of the Biocontrol Fungi Gliocladium roseum and Talaromyces flavus with Sublethal Heating or Reduced Rates of Metham Sodium for Control of Verticillium dahliae

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The soil-inhabiting fungus Vet-ticillium dahliae causes a serious wilt disease on many important crops worldwide including potato, tomato, eggplant, artichoke, avocado, pistachio, olive, and strawberry. For some hosts, such as tomato, resistance to the pathogen is available. For other crops, control is largely limited to the use of broad-spectrum biocides such as methyl bromide and metham sodium. The beneficial fungi Gliocladium roseum and Talaromyces flavus have shown promise in the reduction of populations of V. dahliae and in suppression of Verticillium wilt. However, control by G. roseum and T. flavus is inconsistent and incomplete. This research was undertaken to determine if bioconuol could be enhanced by combining G. roseum and/or T. flavus with sublethal levels of heating or metham sodium. Sublethal treatments may be less disruptive of the soil ecosystem, may reduce competitive interactions facilitating establishment of the antagonists, and may weaken V. dahliae making it more susceptible to attack by biocontrol organisms.

Microsclerotia of V. dahliae in water were not heated or heated using one of three regimes to simulate soil solarization. Regimes 1, 2 and 3 consisted of 31C for 10h then 35C for 14h, 33C for 10h then 36C for 14h, or 35C for 10h then 38C for 14h, respectively. Five days after plating, 96-93% of microsclerotia exposed to 1 - 5 days of regime 1, respectively, had germinated while 90, 82, 62, 62 and 50% of microsclerotia treated with 1 - 5 days, respectively, of regime 2 had germinated. Heating with regime 3 for 1 - 5 days resulted in 92, 37, 14, 1 and 0%, respectively, of microsclerotia germinated 5 days after plating. Three days after plating, approximately 40% of colonies from the nonheated controls began forming melanized microsclerotia and 75% had formed microsclerotia by 7 days after plating. In contrast, microsclerotia heated with regime 3 for 1 day produced colonies which usually formed few melanized microsclerotia. Only 5 % of these colonies formed melanized microsclerotia 6 days after plating and 10% had formed melanized microsclerotia 9 days after plating. In greenhouse tests in field soil, there was a highly significant interaction between the effects of heating and T. flavus on melanization of new structures. Heating and T. flavus acted additively to reduce incidence of Verticillium wilt of eggplant.

Two hundred g of soil containing microsclerotia of V. dahliae in nylon mesh envelopes or alginate prill with conidia of G. roseum or ascospores of T. flavus was drenched with metham sodium equivalent to 0, 187 or 935 L/ha. The low rate of the metham sodium reduced the growth rate of colonies from microsclerotia but did not affect viability of V. dahliae. Growth rate of G. roseum from prill was reduced by both rates of metham sodium while growth rate of T. flavus from prill was not affected by either metham sodium treatment. Pepper plants were drenched at 0, 3 and 5 weeks after seeding with 10^6 ascospores of T. flavus / 7.5 cm-diam pot. At 5 weeks, eggplants were transplanted into soil containing 50 microsclerotia of V. dahliae / g natural field soil treated with metham sodium at the rates stated above. The low rate of metham sodium acted additively with G. roseum and T. flavus resulting in control similar to the healthy controls and the full rate of the fumigant.