EFFICACY OF MIDAS AGAINST ARMILLARIA ROOT ROT OF CHERRY - LAB AND FIELD STUDIES

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Armillaria root rot caused by *Armillaria mellea* is a major problem when establishing new orchards in riparian areas and when re-planting at locations where the disease occurred previously (Ogawa and English, 1991). The pathogen can persist in the soil for many years as mycelium in infested dead roots or as rhizomorphs. Trees are infected by root contact with infested roots or by rhizomorphs. From the roots, the pathogen grows into the tree crown and trunk and may kill the tree. The disease spreads as circular infection centers, ultimately rendering the orchard nonproductive. Historically, pre-plant methyl bromide-chloropicrin soil fumigations were the most effective treatments for managing Armillaria root rot. Alternatives such as sodium tetrathiocarbonate were less effective (Adaskaveg et al., 1999), whereas carbon bisulfide, a relatively effective option, had additional challenges due to its explosive nature that limited its use (Ogawa and English, 1991). Due to the phasing out of methyl bromide for agricultural use, iodomethane was evaluated as an alternative soil fumigant.

Duration and temperature of iodomethane treatments were evaluated in the laboratory using Mahaleb cherry roots naturally infested with *A. mellea*. Root segments 2.5 cm long and 1 to 2 cm in diameter were placed into glass jars, iodomethane was added to obtain a concentration of 100 mg/L, and jars were sealed with a fumigant virtually impermeable film (VIF). After incubation for selected time periods at 10 or 20°C, root fragments were aired out and internal root pieces were then plated onto agar media to evaluate viability of *A. mellea*. Viability at a treatment temperature of 20°C was 80% and 18% using treatment durations of 5 h and 7 h, respectively (Fig. 1). Treatments at 10°C were much less effective and resulted in viability of 86% and 39% for durations of 8 h and 20 h, respectively. This indicates that field applications will be more effective at higher soil temperatures.

A field fumigation trial was established at a commercial orchard site on Tokay fine sandy loam in the San Joaquin Valley of California in July 2010. This site was previously planted with 'Bing' cherry on 'Mahaleb' rootstock and trees were excavated due to Armillaria root rot. 'Mahaleb' root segments approximately 20 cm long obtained from this site were validated to contain viable *A. mellea* and were grouped into two size classes (approximately 1 cm or 1.5 to 3 cm in diameter) for use in the fumigation study. Six fumigation sites (3 m x 3 m) for each of the six fumigation treatments were prepared in a randomized complete block design, and infested root segments were buried to a depth of 0.3 m or 1.2 m using a backhoe in mid-October.

Treatments were applied by a probe 'site injector' in early November 2010 and consisted of: 1) Midas 33:67 (33% iodomethane:67% chloropicrin) - 681 g (1.5 lb)/

site, applied to 12 sites; 2) Midas 98:2 (98% iodomethane:2% chloropicrin) - 454 g (1 lb)/site; 3) Midas 98:2 – 908 g (2 lb)/site); 4) methyl bromide 98:2 (98% methyl bromide:2% chloropicrin) – 454 g (1 lb)/site; and 5) untreated control. For the Midas treatments (with the exception of 6 of the 12 sites of the Midas 33:67 treatments that received no tarp covering), the soil surface was first covered with a 1.4-mil thick VIF. Sites for methyl bromide treatments were covered with HDPE (high density polyethylene) tarp.

In late-February of 2011, buried root segments of each treatment were recovered using a back hoe. From each root segment, 16 internal root pieces were plated onto agar media and evaluated for efficacy of the fumigation treatments based on growth of *A. mellea*. For roots of the untreated controls that were buried at a depth of 0.3 m, the incidence of *A. mellea* recovery was 100% for the plated pieces from both smaller roots and larger roots (Fig. 2). For roots buried at a depth of 1.2 m, the pathogen was recovered at an incidence of 66.7% for the smaller roots and of 50% for the larger roots (Fig. 2). All treatments were highly effective in inactivating the pathogen and there was no significant difference among treatments. Thus, Midas 33:67, Midas 98:2, and methyl bromide 98:2 were equally effective. Additionally, no differences were found between tarped and non-tarped treatments which may be due to the soil type and soil moisture levels of the trial site. Further studies will be needed to verify this result. The current Midas label only requires broadcast applications to be tarped. Probe injections at single planting sites may be tarped or left non-tarped after application. A small number of pieces from the large roots at 0.3 m and from the small roots at 1.2 m still contained viable *A. mellea*, however, the pathogen was slow to grow out. Potentially the pathogen was weakened and may be subjected to fungal competitors and parasitism as previously described (Munnecke et al., 1981).

The need for alternatives to methyl bromide to manage Armillaria root rot in perennial crops is high. With increasing demand for tree fruit commodities such as sweet cherry, walnut, almond, and citrus, acreages are increasing and orchards are often being immediately replanted. Thus, soil-borne diseases such as Armillaria root rot will have a greater impact on the production of these crops. In this study, iodomethane-chloropicrin had an equivalent efficacy to methyl bromide-chloropicrin that previously was the most widely used and highly effective fumigation treatment for this disease.

References

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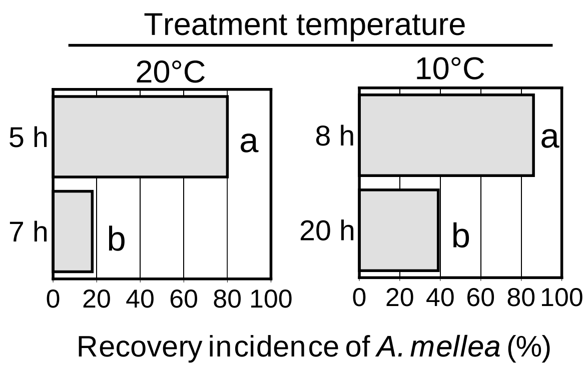

Fig. 1. Effect of iodomethane treatment (100 mg/L) duration time at two temperatures on viability of *Armillaria mellea* in infested root segments of sweet cherry in laboratory studies (*see text for experimental details*).

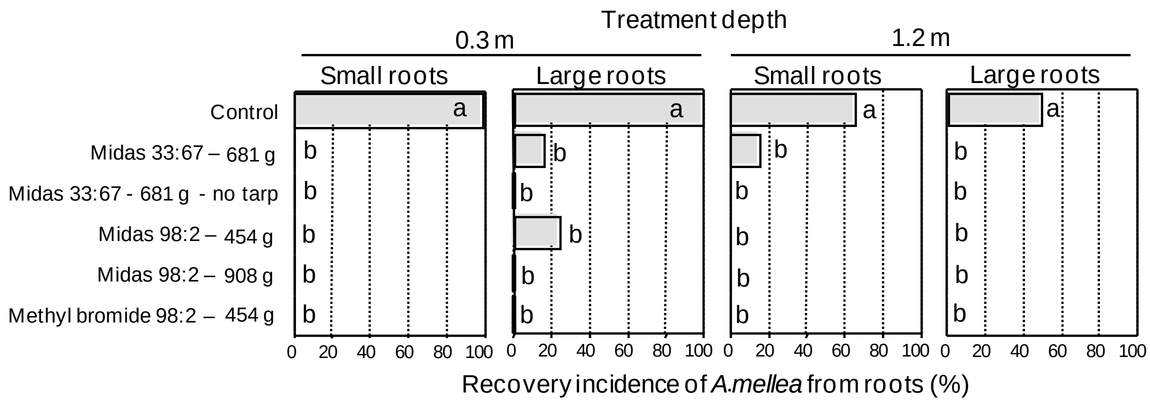

Fig. 2. Efficacy of iodomethane fumigation treatments for management of Armillaria root rot of sweet cherry (*see text for experimental details*).