USE OF STEAM IN PLACE OF METHYL BROMIDE AS A DECONTAMINATE FOR THE GOLDEN NEMATODE

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Because of the effectiveness of methyl bromide, it has been the treatment of choice as a regulatory treatment to decontaminate equipment and other articles infested with the golden nematode and is used routinely to decontaminate such items when moved from golden nematode regulated areas to nonregulated areas. Because of the effectiveness of this treatment, there has been little or no effort to develop other types of treatments. A more environmentally compatible treatment is needed to ensure the integrity of the golden nematode quarantine.

We demonstrated earlier that exposure of golden nematode cysts to 55°C that were presoaked in water was lethal to the encysted eggs. In contrast, eggs in desiccated cysts tolerated temperatures as high as 75°C for brief periods. Further studies using solarization (sealed in clear polyethylene and exposed to sunlight) suggested that heat had potential for decontaminating items infested with the golden nematode and that if cysts were presoaked in water, a temperature of 55°C under solarization was lethal to golden nematode eggs.

Because moisture appeared to influence the lethal time / temperature requirements for golden nematode eggs, investigations focused on the effect of different sources of heat on golden nematode survival. In these studies, solar heat (8-16 hours) was not lethal to the golden nematode consistently enough for a decontamination treatment in a quarantine setting. Supplemental dry heat under polyethylene was not effective even though lethal temperatures were achieved. However, steam heat under polyethylene was as effective as methyl bromide in disinfesting equipment contaminated with the golden nematode. Prewashing equipment with high pressure water did not sufficiently hydrate the eggs to increase their sensitivity to high temperatures suggesting that moisture to sensitize the eggs to heat was provided by the steam. In later experiments we concentrated on establishing the effectiveness of steam for decontaminating equipment infested with golden nematode cysts. These experiments demonstrated that a steam treatment at 60°C for 1-2 hours was sufficient to kill 100% of the nematode eggs.

Experiments in 1998 focused on determining the lethal time / temperature requirements and the feasibility of steam heat in decontaminating equipment infested with the golden nematode. The source of steam was a steambath generator model SM-12 manufactured by the Steamist Company, Rutherfored, NJ. This generator was equipped with a Model 4004-71 Paragon Electric timer and a Johnson Control thermostat Model A319 with a range of 40-100°C. To adequately distribute the steam,

the generator was plumbed with one-inch steel piping that extended in a U-shape for 6 feet from the generator. The pipe was drilled with 1/16 inch holes at 8-inch intervals.

The equipment used for treating was a two-wheel trailer (4 x 6 ft.). Nylon sackettes containing five golden nematode cysts each in one gram of soil were placed in five locations on the trailer. The trailer was placed in a 4 m^3 chamber covered with clear polyethylene (6 mil) to which the steam was applied. Steam was applied to the chamber and temperatures at 61-65ºC were maintained for 1, 1.25, 1.50, 1.75 and 2.0 hours. Temperature in the chamber was recorded with a thermocouple temperature recorder model KTX with a range of 0-100ºC that was manufactured by the Dickson Company. The check consisted of cysts contained in soil-filled nylon sackettes that were not subjected to treatment. After the treatments were completed, cysts were retrieved and subjected to a hatching test. The hatching test consisted of soaking the cysts in water for five days then placing them in potato root exudate in ELISA plates for three weeks. The number of juveniles that emerge were counted weekly and fresh exudate was added.

Regardless of treatment time, all steam treatments were lethal to 100% of the golden nematode eggs as no juveniles hatched from any of the treated cysts. Also, location of the cysts on the treated equipment did not influence egg survival, indicating that temperature and moisture were uniform throughout the treatment chamber. An average of 476 juveniles / replication hatched from eggs in untreated cysts.

The use of steam resulted in a considerable amount of condensate inside the treatment chamber which is related to size of treatment chamber and length of treatment. Amount of condensate ranged from 2.5 l / m^3 for the one hour treatment to 4.3 l / m^3 for the two hour treatment. Consendate accumulated at an rate of 153 ml / min during treatment. This amount of condensate had no apparent effects on the electrical system of a tractor.

The time to achieve the maximum temperature of 60-65◦C varied depending on initial water temperature causing some cysts to be exposed to steam longer than others. Treatments starting with cold water required 45 minutes to reach maximum whereas successive treatments required only 17 minutes to reach maximum temperature. Differences in exposure time of cysts to steam was not reflected in egg survival. However, different exposure times could influence hydration of cysts which is essential to sensitize the eggs to heat.