Methyl bromide alternatives – research and education for herbaceous perennials, woody ornamentals and vegetables in Michigan, New York and Rhode Island for biological control agents: A progress report for 2003 and 2004

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Objective

Screen nematode biological control agents for use as methyl bromide alternatives in nursery production systems.

Justification

The northern root-knot (RKN, *Meloidogyne hapla*) nematode is among the persistent problems in vegetable and ornamental production systems in temperate climates. Without resistant cultivars and pending loss of methyl bromide (MBr) and few sustainable alternatives available, the vegetable and nursery industries face many challenges in managing RKN and other soil pests and diseases. Because of the overlap of vegetable and ornamental production systems with field crops, Michigan growers are subjected to soybean cyst (*Heterodera glycines*) nematode-free certification. In order to meet the challenges, a multi-dimensional approach to developing MBr alternatives is needed. This objective was initiated to do the ground-work of screening for the presence of RKN fungal parasites in Michigan and to test the reaction of RKN populations to *Hirsutella minnesotensis* (*Hm*, nematode parasitic fungus) found to parasitize soybean cyst nematode juveniles in over 14% of soils from the Midwestern USA.

Progress

A series of studies were conducted. In 2003 analysis of 48 soil samples collected from Michigan nursery (Hosta, Coreopsis 'Moonbeam,' Artemisia, Ajuga) and vegetable (celery, corn, carrot and potato) production systems showed the presence of varying degrees of RKN, root lesion and other nematodes. While fungal parasitism of root-knot nematodes ranging from 1 percent to 95 percent was observed in 37 percent of the samples, only one sample had 39 percent parasitism by *Pasteuria* spp.. In 2004 60 soil and root samples from Hosta and celery were analyzed and fungal parasitism was observed in the latter. The surveyed fields included sandy, sandy loam and muck soils (which represent most common soil types for Michigan agriculture) and have variable history and degree of pesticide use. Several RKN populations isolated from the surveys are being used for further characterization of their parasitic and adaptive behaviors.

Using tomato cv. Rutgers, the pathogenecity of *Hm* SD3-2 against RKN populations from Connecticut, Rhode Island, New York (Geneva and Manhattan), Michigan (greenhouse population) and Wisconsin was tested in two greenhouse experiments over two months (25 ± 2 ^{o}C). In each experiment, either 0 (check) or 600 eggs of each nematode population were

separately mixed with either 0, 0.02, or 0.1 g fresh *Hm* mycelium/100 cc of sandy loam soil. Each nematode-fungal treatment combination, replicated fives times, was thoroughly mixed in a plastic bag, poured into a pre-labeled clay pot, and tomato seedling transplanted. While all RKN populations were susceptible to *Hm*, the degree to which each population was affected varied slightly. Across fungal treatments and nematode populations, the fungus reduced total number of nematodes in roots by 61-98 percent with the highest for Geneva and Rhode Island, intermediate for Manhattan and Connecticut, and lowest for Michigan and Wisconsin populations. It is postulated that in ecosystems where the two organisms occupy, *Hm* may used as a potential suppressor of RKN.

The interaction effects of *Hm* and N-Viro Soil® (NVS, a recycled municipal biosolid with nutrient and pH adjustment qualities and adverse effects on several important plant-parasitic nematodes) on RKN populations was tested. Single and combined effects of either 0 or 0.1 g fresh *Hm* mycelium and 0 or 1 NVS per 100 cc of sandy loam soil on RKN populations from Rhode Island, Connecticut, New York, and Michigan were tested in two greenhouse experiments over 30 days (25 ± 2 ^{o}C). Nematodes were inoculated at either 0 (check) or 600 eggs per 500 cc of pre-mixed NVS containing 20-days old tomato seedling cv Rutgers. Each nematode treatment was replicated fives times and plants watered as needed. NVS treatments significantly increased shoot weight and there were no significant interaction effects on plant growth. NVS and *Hm* treatments significantly decreased galling, and NVS x *Hm* and NVS x RKN interactions were significant. There were statistically fewer females and total numbers of nematodes in the controls compared with the NVS treatments, confirming other studies. *Hm* treatment had similar effect to NVS in Experiment 2. The effects of NVS x RKN in both experiments, NVS x *Hm* in Experiment 2 on nematode population densities were significant. Some of the inconsistencies observed are similar to what other colleagues have been reporting. While the preliminary interaction effects of NVS and *Hm* are encouraging, more studies are needed to produce consistent results.

Preliminary tests of four Michigan isolates of the RKN populations (from the surveys) indicated that they do not respond the same way to NVS and that soil type and soil pH may be contributing factors to the variable responses. While the cause-and-effect relationships are yet to be determined, the data suggest that the one-size fits all approach may not work against RKN populations even if they come from close proximities. Hence, identifying the possible mechanisms of different responses will be helpful to avoiding wrong conclusions and may be costly decisions as well.

Publication

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