NEMATODE MANAGEMENT IN WALNUT ORCHARDS - 1997

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ABSTRACT

Several management strategies are being examined for lesion (Pratylenchus vulnus) and ring (Ciononemella xenoplax) nematodes. The effectiveness of the “biological” nematicide DiTera (a toxin produced by a fungus) is being evaluated in a commercial walnut orchard and a significant yield increase has been demonstrated. Monthly sampling over a period of three years is in progress to develop a picture of nematode population fluctuations. This picture should demonstrate the optimum times of the year to sample in order to detect the presence of nematodes, provide data for comparing samples taken at different times of the year, and provide the background information needed to initiate trials to determine if there is an optimum time of the year to apply postplant treatments to walnut orchards. The predicted loss of methyl bromide by the year 2000 will seriously affect the ability of nurseries to produce nematode free planting stock. Although research is in progress to develop alternative soil treatments, it is unlikely that any will be as reliable as methyl bromide in producing nematode free planting stock. If alternative soil treatments fail, it would be useful to have recommendations in place for cleaning up planting stock prior to planting. Hot water treatments of walnut rootstocks were initiated in 1997 with treatment times and temperatures based on information available in the literature for other crops. Work was also initiated to determine lethal times and temperatures for plant-parasitic nematodes which parasitize walnuts.

OBJECTIVES

1. Evaluate the effectiveness of Nemacur and DiTera for management of lesion and ring nematode in a commercial walnut orchard.

2. Optimize sampling strategies and treatment timing for lesion and ring nematode on walnuts.

3. Develop hot water treatments for preplant management of nematodes on paradox and English rootstocks.

PROCEDURES

1. Evaluate the effectiveness of Nemacur and DiTera for management of lesion and ring nematode in a commercial walnut orchard.

A trial consisting of 4 replicates of 5 treatments in a randomized complete block design has been initiated in a walnut orchard infested with lesion and ring nematode in San Joaquin County. Each replicate consists of a single row of 11 trees. Baseline harvest data consisting of total yield per replicate and a 2,000 gram subsample graded by Diamond Walnut (large sound, baby walnut, edible yield, reflected light, % offgrade and predominant reason, % insect damage, % external damage and predominant type, % internal damage and predominant type) was obtained in October of 1996. Baseline nematode samples from each replicate were also taken in September 1996. Each sample consisted of 5 subsamples per replicate taken to a 2 foot depth. Additional nematode samples were taken in the Spring and Fall of 1997. Nematodes are extracted from soil via
elutriation-sugar centrifugation and from roots via mist chamber extraction. In elutriation-sugar centrifugation, a measured volume of soil is mixed with a larger volume of water, and poured through a fine mesh sieve which retains the nematodes. Nematodes washed from the sieve are then mixed with a sugar solution in a plastic tube and centrifuged. During this process, nematodes float in the sugar solution while any remaining soil particles are pulled to the bottom by the centrifugation. Nozzles at the top of a mist chamber periodically spray heated water on roots held in a mesh basket nested on top of a funnel. The stem of the funnel resides in a test-tube. Nematodes emerge from the roots and are captured at the bottom of the test-tube while excess water flows over the top of the tube. For both techniques, extracted nematodes are then counted under a microscope. Treatments (DiTera ES at 50 and 100 pounds/acre, DiTera granules at 100 pounds/acre, Nemacur at 1.5 gallons/acre and an untreated control) were applied with commercial equipment in November 1996, and June 1997. In the Fall of 1997, Bayer indicated it no longer planned to pursue a registration for Nemacur on walnuts (Rod Vargo, personal communication). Following the 1997 harvest, the plots previously treated with Nemacur were treated with DiTera granules at 50 pounds/acre. We will continue to take post-treatment nematode samples periodically for the remainder of the trial. Harvest data will be obtained for at least one more year.

2. Optimize sampling strategies and treatment timing for lesion and ring nematode on walnuts.

In 1996, we proposed to sample a single orchard in Solano County infested with lesion and ring nematode at monthly intervals over a three year period. This objective has been expanded in that we are sampling three Solano County orchards of different ages. On each sampling date, four samples of roots and soil, each composed of four subsamples are being evaluated. Nematodes are extracted from soil via elutriation-sugar centrifugation and from roots in a mist chamber as described in the previous objective. Observed fluctuations will be related to physical and(or) biological environmental factors.

3. Develop hot water treatments for preplant management of nematodes on Paradox and English rootstocks.

In 1997, we proposed to work only on Paradox rootstock. This objective has been expanded to include English rootstock as well. In 1996, both rootstocks were treated for 5 different lengths of time at each of 5 temperatures (110F, 115F, 120F, 125F, 130F) with 5 replicates per treatment to establish baseline parameters for thermal tolerances. Treated rootstocks were planted in a 1 acre site at the USDA-ARS research station in Parlier and are being evaluated for survival, vigor (visual rating), and trunk circumference. Roots will be examined for evidence of nematode and fungal infestation. Planting material for use in subsequent years will be planted in a location known to be infested with lesion nematode (P. vulnus) and ring nematode. Laboratory experiments have been initiated to determine the thermal tolerance of the ectoparasite C. xenoplax, the sedentary endoparasites Meloidogyne incognita and M. arenaria (root-knot nematode, a pest of English walnut), and to confirm those reported in the literature for P. vulnus. Treatments in 1998 and 1999 will be determined following evaluation of previous treatments.

RESULTS AND CONCLUSIONS

Lesion (Pratylenchus vulnus) and ring (Criconemella xenoplax) nematodes reduce walnut yields through root damage from direct feeding and by placing trees under stress (Lowsnbery, 1956; Lowsnbery et al., 1978). Lesion nematodes are likely to be found within roots as well as in soil, while ring nematodes are external parasites. At the present time, there are no chemical or cultural management techniques available for reducing
nematode damage to walnuts to an economically acceptable level in established orchards. Improving yields and prolonging the life of existing orchards via postplant nematicides should be examined as an alternative to preplant fumigation with chemicals such as methyl bromide.

The "biological" nematicide DiTera (a toxin produced by a fungus) is a promising postplant product. Abbott Laboratories has recently obtained California EPA registration for DiTera for several crops and is interested in obtaining a registration on walnuts (Phil Grau, personal communication). This is a very water soluble product which has potential for penetrating to depths inhabited by walnut roots and which has performed well in a number of trials on annual crops. Research on other perennial crops indicates that two years of treatments are often required before significant yield differences become evident. In the trial initiated in 1996, a small but statistically significant yield increase \( (P = 0.05) \) was evident in the DiTera granule treatment in the 1997 harvest (Figure 1).

Research on grapes (Ferris and McKeny, 1974; Feil et al. in press), prunes (Westerdahl et al., 1995), and peaches (Lownsbery, 1959) in California has demonstrated that nematode populations fluctuate throughout the year. Not knowing when these fluctuations occur in walnut orchards makes it difficult to provide recommendations on the best time of the year to sample to demonstrate the presence of nematodes, to interpret and compare samples taken at various times of the year, and to provide advice on optimum timing of treatments to mature orchards. Monthly sampling of lesion and ring nematodes in walnut orchards over a period of three years should provide a reproducible picture of nematode population fluctuations. This picture should demonstrate the optimum times of the year to sample in order to detect the presence of nematodes, provide data for comparing samples taken at different times of the year, and provide the background information needed to initiate trials to determine if there is an optimum time of the year to apply postplant treatments to walnut orchards.

Current nursery practices rely on producing clean stock by planting in soil treated with methyl bromide, by planting in soil not previously infested with plant parasitic nematodes, or by planting in soil in which nematode populations have been lowered sufficiently by other means so that populations are not detectable by sampling prior to harvest. The predicted loss of methyl bromide by the year 2000 will seriously affect the ability of nurseries in California to produce nematode free planting stock. Although research is in progress to develop alternative soil treatments, it is unlikely that any will be as reliable as methyl bromide in producing nematode free planting stock. If alternative soil treatments fail, it would be useful to have recommendations in place for cleaning up planting stock prior to planting.

Hot water treatments of planting stock have been developed for a number of nematode/crop combinations (reviewed by Bridge, 1975), have been used commercially for daffodils and garlic planting stock, and approved by CDFA for treatment of grape rootstocks following methyl bromide failures. Hot water treatments of Paradox and English rootstocks were initiated in 1997 with treatment times and temperatures based on information available in the literature for other crops. Work was also initiated to determine lethal times and temperatures for plant-parasitic nematodes which parasitize walnuts.

The time spans tested for each temperature are indicated by the outlined boxes in Figure 2. Several months following planting, each tree was rated according to the following scale: 1 = dead, 2 = dead but tree tried to push, 3 = alive but somewhat weak, 4 = alive and well. The average rating for the five trees at each of five times for each temperature and the untreated control trees are indicated. An average rating of 4 indicates all trees are alive and well following treatment at a particular time and temperature. An average rating of 1
indicates no trees survived the treatment. In this year's trial, we had good survival of the untreated English rootstocks and relatively poor survival of Paradox. Comparing the thermal tolerances for root-knot nematode (Figures 3 and 4) to the thermal tolerances for rootstocks indicates hot water treatments may be a feasible method of controlling nematodes in infested rootstocks.


FIGURE 2.

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