FIELD EVALUATIONS/INPUT FOR GROWER REPLANT SETTINGS AND NEW LINES OF NEMATODE RESISTANCE

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ABSTRACT

In 2001 we sampled roots every foot to ten feet deep and learned that without Garlon stump treatments the natural death of nematodes within the root system requires two to three years to occur. Where Garlon is applied to the old stump we obtain that level of kill within one full year. In replant settings the return of root lesion within two years after a methyl bromide treatment can be a result of vigorous new root systems reaching below five feet deep where root lesion is plentiful in roots and soil. Hence, methyl bromide would be a better treatment if it followed a Garlon application or there was a two-year fallow period. A two-day water extract from the shavings of walnut wood, English or black, roots or tops, is lethal to 99% of a root lesion nematode population exposed to 100 ppm for 48 hr. NX, a walnut seed source having four of ten seedlings proficient in providing two years of pre-infection nematode relief, has exhibited minimal growth variation from tree to tree in a field setting. Telone II applied in 12 ft wide planting strips at 50 gallons per acre provided nematode control and first-year growth similar to methyl bromide. A surface treatment of 25 gallons Vapam was applied with the Telone. Against nematodes a broadcast delivery of 75 gallons Vapam in 8 acre-inches of water performed similar to the Telone at a similar cost. Telone at 35 gallons per acre applied to a well-dried soil also produced excellent first-year growth in a separate setting. In our search for longer-term resistance we have now focused on offspring from the ‘Rawlins’ tree at Davis. We now have three seedlings out of 20 from this tree that remain nematode free after three years and another seedling (AW269) that remains clean after four years. Hardwood cuttings from this four-year-old, moderate vigor tree were made in 2001 and at least ten of the clones will receive a greenhouse evaluation against root lesion nematode beginning 2002. Another 750 seedlings from this tree were sprouted in 2001 in a nematode infested field at Kearney. At least 50 of these offspring grew well amongst numerous that grew poorly. Assessments of their level of nematode resistance will begin January 2002.

OBJECTIVES

1. Using the IPM-based guidelines for replanting of walnut we will become involved in grower replanting efforts to gain knowledge as to the performance of individual steps in the process.

2. In 2001 we will evaluate the resistance present in 1000 seedlings of ‘Rawlins’ and pursue additional evaluations of several other interesting sources of black walnut.

PROCEDURES

There are two major components to the walnut replant problem. The first is what I refer to as the rejection component where trees do not grow well the first and second years. The second component is the presence of root lesion nematode and this nematode must be controlled with
pre-plant fumigation or by planting with useful resistance. We get past most of the rejection component by applying Garlon to stumps plus 18 months of fallow. We get past the nematode problem using a number of tools. There are four procedures we use to assess control of the replant problem: (1) were the roots visibly killed by the treatment and where?, (2) were the soil-dwelling nematodes killed at 98% level (ineffective) or at the level of 99.9% (effective for up to six years relief), (3) were nematodes residing within roots also killed and at which depths, and (4) growth rate of new replants. These assessments are collected in a replicated manner. Generally we visit with the grower to assess the degree of his replant problem and then outline a set of procedures. The grower will eventually take the course he chooses to be best but if we can interject into his plan an opportunity to replicate an assessment of summer sudan grass or a new rootstock or Telone/Vapam strips versus solid Vapam then we take that opportunity. We continue to search for new experimental sites.

RESULTS

Objective 1 (IPM-based Guidelines): In 2001 we extensively sampled roots at each foot down to ten feet deep around old walnut trees that had received stump-treatments of Garlon in October 1999 and then received methyl bromide, or Telone, or a Vapam drench in October 2000. These results were compared to adjacent trees that received methyl bromide in October 2000 without a Garlon treatment the year before. Another comparison was to sample from adjacent producing trees that were untreated. It can now be shown that old walnut roots located from five to ten feet deep continue to release root lesion into soil as much as 2½ years after tree removal. Treating stumps with Garlon destroys the root source of root lesion nematode one year after the treatment.

The Rio Oso site was replanted in spring 2001 using two different seed sources. One set of trees was the grower’s standard seedlings and every other tree down each row was NX, which emanated from the Paradox Diversity Study. In addition to the fact that four of ten seedlings of NX can avoid nematode infection for several years, the NX trees grew with uniformity. This trial will eventually allow us to verify the benefit of the NX mechanism in a field setting.

Near Winters, CA an 8-acre site of 40-yr-old walnuts received Garlon stump treatments in October 1999. Garlon use was grower supervised and no MorAct added with the Garlon. After three sets of soil samplings this site was determined to be free of root lesion nematode but infested with ring nematode. In spring 2000 the cleared field was planted to safflower for drying. This clay loam soil was very dry but ripped multiple times to finally reach the five-foot depth. In October 2000 when moisture samples from the surface five feet of soil did not exceed 12% moisture the site received a broadcast application of Telone II at 35 gallons per acre ($640./acre). The combination of Garlon and extensive soil drying appeared to hasten root necrosis making the Garlon treatment appear quite effective. Since ring nematode can survive dry surface soils a surface treatment of Vapam was suggested but never applied. Each fall we will monitor nematode return at this site. After one year the grower is completely pleased with tree growth as he compares growth to an adjacent block of trees that received methyl bromide. Fumigation was used because the grower suffered a serious replant problem four years earlier very near this field.
In a third site near Capay Valley a 50-acre planting of walnuts was removed after October 2000 stump treatments with Garlon. That field will remain fallow or with an occasional rotation crop for three years. Root lesion nematode is prevalent across the field and we will monitor its decline.

In a fourth site near Visalia the grower tried to remove all the old roots from the surface five feet of soil. During the process of repeated soil ripping he did dry this fine sandy loam soil to below 12% moisture throughout the surface five feet. He also harvested and hauled away approximately ten tons per acre of walnut root shavings. To meet Telone application requirements he delivered one-inch of surface moisture via sprinklers and then applied the combination of Telone deep plus Vapam applied in front of a rotovator. We will sample nematode return over several years.

In our search for resistance to root lesion and root knot nematodes we identified one tree from which three of 20 black seedlings had remained free of nematodes even three years after planting into infested soil at Kearney Agricultural Center. In fall 2000, 1400 seeds were collected from this ‘Rawlins’ tree, stratified and planted into heavily infested soil at Kearney. Approximately 750 seedlings were germinated and grown during 2001. This tree throws 20% paradox. By July of 2001 growth of the seedlings showed remarkable differences. By time of this report there were good and poor growing paradox and black individuals. There are about 50 seedlings growing quite well this first year. Some of the black seedlings are growing as well as adjacent paradox hybrids. Roots of each of these better-growing trees will be sampled for nematodes in winter 2001. Hundreds of trees across this field stopped growing after July, an indication of intense nematode pressure.

In October 2001 our best Rawlins seedling (AW269) had been in the ground for four years and was still free of nematodes. In spring 2001 cuttings were collected from this tree by Jim McKenna and propagated at Davis. We now have at least ten clones from this original plant to enable a replicated greenhouse evaluation of this seed source against nematodes.

DISCUSSION

Objective 1: Replicated replant studies in field settings require large planting size with research costs of $20,000 per year per trial. Part of this cost is because our replacement for methyl bromide involves two to four separate steps instead of the one-step application of methyl bromide. Each step that we are testing in the field has already received replicated, randomized evaluation in smaller sites at Kearney Agricultural Center but the total steps we have packaged together must also receive evaluation in a number of real-life settings. Since growers are already faced with very high costs for methyl bromide we discuss with them the options and the unknowns and then use their field for making replicated soil samplings to evaluate the worth of each step in their replanting process. Root lesion nematode is a major component of the replant problem for walnuts. As results of replicated field samplings become available we fine-tune our IPM-based Guidelines for replanting walnuts. Guidelines can be found on the web at www.uckac.edu/nematode. Results contained in this report will soon appear in those guidelines.
During 2001 we demonstrated in a single site near Winters, CA that the treatment package of Garlon>safflower>broadcast Telone>micronutrients at planting can grow very desirable first-year trees. We will now use nematode sampling to determine if control of ring nematode will last one year or six.

During 2001, we demonstrated that Garlon treated root systems result in fewer than 0.2 nematodes per gram of root by late summer of the following year. This effect occurs as deep as the old roots occur. Without Garlon treatments walnut roots do slowly die after tree removal but require about two to three years to reach the level of 0.2 nematodes per gram of root. The historical treatment of methyl bromide results in dead roots down to five or six feet coupled with 0.0 nematodes within the roots and soil. Since nematodes reside deep in soil and new walnut rootings may have roots five feet deep in one year, it is now easy to visualize the problem associated with the replant package of harvest>rip>methyl bromide>replant the next spring. These data indicate the benefit of waiting one full year between tree removal and methyl bromide treatment, but even that wait is not enough. These data indicate the value that could be achieved from having a new root system that offers only two years of nematode relief (NX seedling). Of course, if we really do have resistance in the Rawlins source, that would be the best tree of all to plant.

Objective 2: The seedling designated AW269 is still free of nematodes after four years but the real test will be when ten clones (replicates) of this tree are placed on a greenhouse bench in the presence of the nematodes. Additionally, we now have about 25 new black seedlings and 25 new paradox hybrids from the original Rawlins tree that grow well under nematode pressure. Their nematode host status is currently being assessed.

We are searching for a grower who wants to harvest about six tons per acre of walnut roots or tops to make a walnut tea deliverable with eight inches of water. Such a treatment could destroy the soil-dwelling populations of root lesion nematode within the surface five feet of soil and would be a great treatment to follow the Garlon stump treatment.