METHYL BROMIDE ALTERNATIVES AND IMPROVEMENTS – YEAR FIVE

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ABSTRACT:

As of this reporting there are six months remaining in our five-year generic study of methyl bromide alternatives and improvements. Our final report will be presented on March 30, 1998 as a written text entitled the “Replant Problem and Its Management.” On that date there will also be an open tour of our existing field trials at Kearney Agricultural Center. These five years have altered our understanding of the replant problem. We have separated out at least four components of the replant problem. The most visible component I refer to as the rejection component. It is managed by killing the old tree/vine root system and waiting for 18 months. Several other components including soil pests and chemical or physical layers in the soil must also be managed, pre-plant. However, unless these components are in very high numbers or concentration they are usually not the major components that result in reduced first-year growth. These latter components are responsible for the long-lasting plant growth problems that remain after the rejection component subsides. The rejection component for peach subsides in six months to a year after replanting but is longer lasting in grape.

OBJECTIVES:

1. Field test various methods of soil sterilization in an effort to replace soil fumigants. Examples include use of a soil drenching device, use of the existing dripper system to deliver Vapam, Furfural, Urea, or Telone. Use of winter and summer rotation crops plus root-killing techniques.
2. Reduce volatilization percentage of Telone and MB using new application procedures.

Our long-term objective has been to develop a better understanding of the replant problem and its components. We have envisioned at least three necessary goals. These include 1) Kill the old roots (and nematodes within). 2) Cleanse the surface 5 ft of soil of nematodes and other unknown microorganisms. 3) Identify promoters of the IGR or “increased growth response” which is a common event following soil fumigation.

We have shown that one year after a trunk treatment of 2,4-D and diesel oil or Garlon and diesel applied to five-year-old Paradox or NC Black Walnut can result in complete death of the walnut roots to 5 foot depth. Even more exciting, the root lesion nematodes within the old walnut roots were greatly reduced in number by the treatment. In peach root, by comparison, Roundup treatments that killed old roots did not kill root lesion nematode within roots two years later. We have already repeated these treatments but they now need to be initiated in commercial settings.

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In a separate site we have now shown that peach and NC Black Walnuts planted with 100 g Triple 15 plus 8.3 ml of Super Micro® added into 2 gallons water around each tree at replanting gave significant plant growth benefit whether soil had been fumigated or not. This indicates that part of the replant problem can be nutritional deficiency and a full range of nutrients are needed at planting or within 6 weeks thereafter. This 6¢/tree treatment needs to be a part of replanting experiments. This is still not the IGR we are familiar with following soil fumigation.

We now know several limitations to use of Vapam as well as some of its advantages. For walnut sites with root lesion nematode the treatment rate will need to be 200 gal/acre unless some other treatment can kill old roots effectively. Also, many walnut soils are not suitable for drenching Vapam because successful drenching whether by basin, sprinkler or a portable soil drencher requires the infiltration of 6 inches water in 8 hours. Many walnut soils do not take water that fast. Telone can also be drenched or shanked. One advantage of a drench is that it can reduce the volatilization of the nematicide. An advantage of Telone is that we may be able to deliver the 6 inches water over 12 or 15 hours instead of 8 hours. If Telone is to be drenched, however, a reusable tarp during treatment will likely need to be included. Air monitoring of Telone volatilization is needed in field settings.

PROCEDURES:

We have continued to conduct replicated field station trials in four subject areas as outlined below.

To study remedies to the replant problem requires replant sites and we have found most of these at field stations. It is now time to include farm advisors and extension specialists within some of our field work. Over the next year I would like to see the following treatment(s) initiated at a commercial site: Kill of old roots after harvest with Garlon or 2,4-D painted to the trunk followed by a shanked or drenched treatment of Telone or comparable product. This would be followed in spring by tree removal, fallow or nonhost crops for 12 months and then the use of NPK+ at the time of planting.

It will be farm advisors or specialists who design this experiment. We will continue to provide technical support.

Back at the field station we will screen walnut seedlings for resistance to root lesion and root knot nematodes.

RESULTS OF STUDIES FROM 1996-97:

1. Establishment of field trials in commercial settings.

Although most of our work has been in field settings, much of it has been at a field station. We must now financially encourage farm advisors and others to take the best, most practical methods developed here and elsewhere into grower settings. For a given test site there will need to be a nontreated check, and a methyl bromide treatment compared to 1-3 of our
potential alternatives specifically tailored to the pest/disease problem present in the test site. Underway we have one site being initiated in grapes, two in peaches and one currently with almonds or walnuts. More trials are needed in walnuts and they specifically include:

a. Pull trees, rip, treat dry soil with 35 gpa Telone II followed on day 1½ to 4 with 2 inches water containing 250 ppm MITC (e.g. Vapam). This is currently a nonregistered treatment.

b. Apply 50 ml Garlon 3A plus 50 ml diesel fuel or 100 ml Mor Act to the cut cambial region of the trunk. Remove trees after 60 days and fallow one full year. During the fallow period treat with either 35 gpa Telone or 100 gal/acre Vapam drench where conditions permit. If a pest-free virgin soil is nearby place at least ½ yard at each planting site before planting. Add micronutrients at planting. (Diesel fuel is nonregistered.)

2. Filling the biological vacuum.

Following 350 to 400 lb/acre MB or 40 to 80 gal/acre 1,3-D one achieves 99.9% reductions in pest populations. A biological vacuum is created but few nematodes remain to fill it. With a limit of 35 gal/acre 1,3-D there can be greater pest survival (99.5%) specifically on soils with moisture or those being of finer texture. If only 98% reductions in soil pest populations are achieved but a biological vacuum is also created, nematodes can overrun the planting within 1-2 years. A special weakness of Vapam is its inability to penetrate deeply into remnant roots where endoparasitic nematodes occur. We are continuing to evaluate methods of filling a biological vacuum, however this year’s testing was highly revealing. Into sites drenched with Vapam we added singly or in combination seaweed, compost, and manure, and then challenged the sites by adding nematodes at various monthly intervals. In these sites ruby seedless grapes were the test plant. Our data will be coming in for another year but there is one striking result. The grapes that grew the best all involved the use of “virgin soil” at planting and addition of amendments was unimportant. A second, larger field trial involves these same amendments following methyl bromide.

3. Understanding how to make, use, or not use NRPS (= virgin soil).

We now have partial results from a trial comparing growth of Mission Almond/Nemaguard Peach following use of MB, ½ yard NRPS, and ½ yard NRPS placed within a Vapam-treated site. This site was chosen because it manifests the rejection component of the replant problem without the presence of a nematode pest component (see Table 1). At the end of the first leaf, trees grew just as well in ½ yard NRPS as they did in a field site only containing NRPS. Both these treatments provided trunk diameter significantly larger than where MB was used. By the end of the second year the ½ yard NRPS treatments were significantly smaller than those growing in an entire site with NRPS but identical in growth to those treated with MB. Essentially, the planting of trees in ½ yard NRPS gave trees comparable to those treated with MB but a third and fourth year of study will be necessary. Last year we asked the logical next question and came up with a surprising result. Can one treat a site or
strip with 100 gpa Vapam, then place ½ yard NRPS soil at the planting site and mitigate the
growth slowdown as the roots move from NRPS soil into RPS soil? The answer is yes they
grow as well in the first year as those treated with MB but they did not grow as well as those
with ½ yard NRPS placed directly into an RPS field fallowed 15 months. After searching for
errors in our methodology and finding none, our conclusion is that the microbiology
following a Vapam treatment may not be compatible with the existing microbiology within
NRPS or RPS. There are obvious shortcomings to our work with NRPS. First, there isn’t
much available and second it is expensive to move. However, dramatic plant growth
achievable following its use and our ignorance about how to make it and then use it point the
direction for new research.

4. Summarizing of five years’ work.

My compilation of the many results from various field trials will show that there are some
MB alternatives available for some situations. We will need to better characterize the fields
to be replanted. Killing of remnant roots is a must to solving the rejection component of the
replant problem. There must be pre-plant, at-plant, or post-plant nematode control to
accompany these treatments. There will also be sites where there is no replacement for
methyl bromide. Commodities such as walnuts with 85% of their acreage having root lesion
nematode pose a more serious need for MB or alternatives than do those commodities with
only 1/3 or 1/2 of their acreages nematode infested. Tree and vine crops for which there are
registered, reliable post-plant nematicides will bode better than those with no reliable
resistance or post-plant nematicides available.
Table 1. Growth of Mission Almond on Nemaguard Peach in a 4.0 acre site without nematode problems but having a replant problem present.

<table>
<thead>
<tr>
<th>No.</th>
<th>Treatment</th>
<th>Fallow Period</th>
<th>Reps</th>
<th>1st leaf</th>
<th>2nd leaf</th>
<th>1st to 2nd year Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>NRPS site</td>
<td>NA</td>
<td>2</td>
<td>3.62 a</td>
<td>8.34 a</td>
<td>4.72</td>
</tr>
<tr>
<td>2.</td>
<td>½ yd RPS within NRPS site</td>
<td>4 mo</td>
<td>2</td>
<td>2.35 c</td>
<td>6.54 c</td>
<td>4.19</td>
</tr>
<tr>
<td>3.</td>
<td>½ yd NRPS within RPS site</td>
<td>4 mo</td>
<td>5</td>
<td>3.54 a</td>
<td>7.48 b</td>
<td>3.94</td>
</tr>
<tr>
<td>4.</td>
<td>RPS site backhoed + 1 lb MB</td>
<td>4 mo</td>
<td>5</td>
<td>2.98 b</td>
<td>7.56 b</td>
<td>4.58</td>
</tr>
<tr>
<td>5.</td>
<td>RPS site backhoed only</td>
<td>4 mo</td>
<td>5</td>
<td>2.27 c</td>
<td>6.31 c</td>
<td>4.04</td>
</tr>
<tr>
<td>6.</td>
<td>RPS site untreated</td>
<td>4 mo</td>
<td>5</td>
<td>2.41 c</td>
<td>6.47 c</td>
<td>4.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(P=0.01)</td>
</tr>
<tr>
<td>7.</td>
<td>½ yd NRPS within RPS site</td>
<td>15 mo</td>
<td>4</td>
<td>3.67 a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>RPS site backhoed + 1 lb MB</td>
<td>15 mo</td>
<td>4</td>
<td>3.19 b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>RPS site backhoed + MIT @ 250 ppm + ½ yd NRPS</td>
<td>15 mo</td>
<td>4</td>
<td>3.29 b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>RPS site untreated</td>
<td>15 mo</td>
<td>4</td>
<td>2.90 c</td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>(P=0.01)</td>
</tr>
</tbody>
</table>

Note: These Nemaguard trees were 0.95 cm diameter at planting time.

- NRPS = non replant problem soil or "virgin soil" that had not grown trees/vines for 15 years.
- RPS = replant problem soil due to removal of 15-year-old almond/Nemaguard orchard.
- Backhoed = digging to 5-6 ft depth by backhoe than caving in side walls and refilling.