Potential use of brassicaceous seed meal and root removal for management of root lesion nematode in red raspberry

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Disclaimer

Some of the pesticides discussed in this presentation were tested under an experimental use permit granted by WSDA. Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties up to $7,500. In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action by WSDA and/or the U.S. Food and Drug Administration. It is your responsibility to check the label before using the product to ensure lawful use and obtain all necessary permits in advance.
Current soil management challenges

• Total acreage of red raspberry has increased in the Pacific Northwest (PNW), but crop longevity has decreased.
• Some of the decline is attributed to the replant disease complex.
• Replant disease--biotic and abiotic factors that affect the growth, development, yield, and health of new plants that have been planted in sites where older plants were recently removed.
• Factors include:
  • Pathogenic fungi
  • Bacteria
  • Plant parasitic nematodes*
  • Improper pH
  • Soil nutrient deficiency
**Pratylenchus penetrans** (root lesion nematode)

- One of the most important pests for red raspberry
- Non-segmented roundworm
- Migratory endoparasite
- Feeds on roots, causes reduced uptake of water and nutrients
- Dark lesions develop on roots
- Plants can decline rapidly

D. Wixted at http://www.apsnet.org/edcenter/intropp/lessons/Nematodes/Pages/LesionNematode.aspx
Potential alternatives to soil fumigation

• Nematicicides
• Resistant cultivars
• Mulch
• Cover crops
• Soil solarization
• Anaerobic soil disinfestation
• Antagonistic/beneficial microorganisms
• Root inoculum removal*
• Biofumigation and brassicaceous seed meal*
What is brassicaceous seed meal (BSM)?

- Material remaining after the oil has been extracted from mustard, canola, or rapeseed seeds
- Pelleted or powder formulations
- Applied to soil like a solid fertilizer and then incorporated

http://www.savoryspiceshop.com/spices/yellow-mustard-seeds.html
What does BSM do?

• Isothiocyanates (ITCs) are chemically similar to methyl isothiocyanate (MITC), the breakdown product of fumigant metan sodium

• ITCs have been shown to have fungicidal, bactericidal, and nematicidal properties
Potential advantages of BSM

• Application timing is flexible
• Application to soil is fairly quick; less time invested
• Requires less water than a cover crop
• Requires no additional fertilizer (unlike a cover crop)
• Does not serve as a host for plant-parasitic nematodes
• Does not have the restrictions that chemical fumigants have
Disadvantages of BSM

• $$$
• ~$1,800/ton
• Not many BSM production facilities exist
• Previous studies have shown mixed results of the effects of BSM on different pathogens
What is root removal?

- Also known as root inoculum removal—physical removal of old, possibly infected root material from a field that will be replanted in order to prevent future infections and aid other soil management practices.

- Root lesion nematodes can survive in plant roots for extended periods of time.

- When preparing to replant, many infected roots are left in the soil.

- Chemical fumigation does not always penetrate old root material.
Does BSM and/or root removal have a place in PNW red raspberry systems?

Objectives:
Compare BSM to metam sodium, and metam sodium at half the recommended rate, after raspberry roots have been removed in a replanted red raspberry production system
Experimental design

Site: Replanted commercial ‘Chemainus’ red raspberry field in Whatcom County, WA

Pretreatment: History of *P. penetrans* and root rot

Design: Completely randomized design with 4 treatments and 4 replications of each treatment

Experimental plots: Plots were assigned to a single row; each plot is ~30 ft x 6 ft

Timing: Began in Fall 2014, continuing through Summer 2017
Treatments

• Treatments were applied once prior to replanting
• Treatments include:
  • BSM: Root removal followed by BSM application (Farm Fuel Inc. proprietary mix) fall applied at 1.5 tons/acre to a depth of 6 in with a walk-behind tiller
  • Max Fum: Root removal followed by maximum rate metam sodium (Vapam®; Spring applied at 74 gal/acre at 16 in depth)
  • Min Fum: Root removal followed by minimum rate metam sodium (spring applied at 37 gal/acre at 16 in depth)
  • No RR: Full rate metam sodium (spring applied at 74 gal/acre at 16 in depth) with no root removal
Results to date
No *P. penetrans* found in soil in Spring 2015

- Because planting occurred in March of 2015, no raspberry roots were sampled
- No root lesion nematodes were found in any samples across all treatments
*P. penetrans* population densities - Fall 2015

*P. penetrans* densities in raspberry roots planted in BSM treatment were significantly higher.
*P. penetrans* population densities - Spring 2016

Significant differences among treatments continued, and differences became more pronounced
Significant differences continued in both roots and soil among treatments.
$P.\, penetrans$ population densities over time
Vegetative growth - Summer 2015

- No significant differences in cane height or cane number
- 5 plants were randomly selected in each treatment plot
Estimated yield and fruit quality - Summer 2016

Differences among treatments were noticeable, but not statistically significant for either yield or fruit quality.
Economics of BSM and metam sodium

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Application rate</th>
<th>Cost/acre*</th>
<th>Estimated yield (ton/acre)</th>
<th>Brix</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSM</td>
<td>1.5 ton/acre</td>
<td>$2,700</td>
<td>4.5</td>
<td>10.71</td>
</tr>
<tr>
<td>Min Fum</td>
<td>37 gal/acre</td>
<td>$185</td>
<td>6.21</td>
<td>10.55</td>
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<tr>
<td>Max Fum</td>
<td>74 gal/acre</td>
<td>$270</td>
<td>6.75</td>
<td>10.49</td>
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<tr>
<td>No RR</td>
<td>74 gal/acre</td>
<td>$270</td>
<td>5.09</td>
<td>10.29</td>
</tr>
</tbody>
</table>

*Cost of product for one acre does not include cost of application; values are estimates.

- Average $/lb of processed red raspberry in 2016 was $.83/lb
- Higher fruit quality = more $
Conclusions

• Root removal has not been shown to be effective in managing root lesion nematode during raspberry renovation
• BSM applied at the rate of 1.5 tons/acre does not suppress root lesion nematode
• Maximum rate metam sodium (74 gal/acre) suppressed root lesion nematode populations the best compared to all other treatments.
• Root lesion nematode population densities increased across all treatments at each sampling date
• There may be other factors responsible for lack of yield and fruit quality differences among treatments
So...what now?

- Data collection will continue through the summer of 2017
- Yield estimation will be conducted in 2017
- Soil microbial community analysis is underway

http://seedsandplantsonline.co.uk/raspberry-canec-hemainus-floricane/
Acknowledgments

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