Bed fumigation and other ways to live with the New EPA rules on soil fumigation

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Walters Ag Research
Phase 2 fumigant labels

In effect now
Label requirements are very complex!!!

- Fumigation management plans
- Responder/community outreach
- Applicator training
- No applications near sensitive areas
- Buffers and buffer credits
- Posting
- Emergency preparedness
22 Acre Raspberry field (yellow block) fumigated with Telone C-35, 39 gallons/A, no tarp

Broadcast fumigated, 625 ft buffer

Bed fumigated with VIF tarp, 25 ft buffer
Grower Trials of Bed Fumigation

Five trials established in raspberry fields:

- Lynden 1, non-replicated, substantial *P. rubi* and *P. penetrans*
- Lynden 2, replicated, low *P. penetrans* and *P. rubi*; Also trialing non-tarped bed
- Lynden 3, replicated, substantial *P. penetrans*
- Burlington, replicated, high *P. penetrans* and *P. rubi*; Also trialing middle row management
- Mount Vernon, replicated, high *P. penetrans*

Treatments applied Sept 2010, raspberries planted April 2011
Treatment and evaluation timeline

- Soil fumigated: Sept 2010 (Lynden and Burlington trials), 2011 (Mt Vernon trial)
- Raspberries planted April-May 2011
- Primocane growth measurements, December 2011
- Yield evaluations, July 2012
- Soil bioassay for *P. rubi*, October 2011 (and annually thereafter)
- *P. penetrans* extraction from soil and from roots, April and October of each year
Plants in bed-fumigated plots generally grew as well as those in broadcast-fumigated plots.

<table>
<thead>
<tr>
<th></th>
<th>Burlington</th>
<th>Lynden 1</th>
<th>Lynden 2</th>
<th>Lynden 3</th>
<th>Mount Vernon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-fumigated</td>
<td>130 c</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Bed fumigated</td>
<td>166 a</td>
<td>140</td>
<td>201</td>
<td>258</td>
<td>54</td>
</tr>
<tr>
<td>Bed fumigated (custom applicator's apparatus)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>60</td>
</tr>
<tr>
<td>Bed fumigated+cover crop</td>
<td>146 b</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Broadcast fumigated</td>
<td>137 bc</td>
<td>139</td>
<td>218</td>
<td>244</td>
<td>56</td>
</tr>
</tbody>
</table>

**P-value**

|          | 0.0012 | n/a    | 0.1002  | 0.4     | 0.29        |

Cane Height (cm) 2011
2012 Harvested fruit weight, bed fumigated plots: percent of fruit weight from broadcast-fumigated plots

Harvested fruit weight from bed fumigated plots as percent of fruit weight from broadcast-fumigated plots

- Burlington (non-fumigated control)
- Burlington (plus cover crop)
- Burlington
- Lynden 3
- Lynden 2
- Lynden 1

Bed-fumigated plots were as productive as broadcast-fumigated plots, sometimes much more productive.
Root rot control in bed-fumigated plots has been as good as in broadcast treated plots so far.

<table>
<thead>
<tr>
<th>Root rot severity</th>
<th>Burlington</th>
<th>Lynden 1</th>
<th>Lynden 2</th>
<th>Lynden 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>beds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-fumigated</td>
<td>5.5</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Bed fumigated, tarp</td>
<td>5.8</td>
<td>6.0</td>
<td>4.0</td>
<td>2.3</td>
</tr>
<tr>
<td>Bed fumigated, tarp+cover crop</td>
<td>4.3</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Broadcast fumigated</td>
<td>4.8</td>
<td>7.0</td>
<td>3.8</td>
<td>5.3</td>
</tr>
<tr>
<td><em>P</em>-value</td>
<td>0.68</td>
<td><em>n/a</em></td>
<td>0.70</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>alleyways</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-fumigated</td>
<td>6.3</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Bed fumigated, tarp</td>
<td>6.0</td>
<td>7.0</td>
<td>3.8</td>
<td>6.7</td>
</tr>
<tr>
<td>Bed fumigated, tarp+cover crop</td>
<td>6.0</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Broadcast fumigated</td>
<td>6.5</td>
<td>6.0</td>
<td>4.3</td>
<td>4.0</td>
</tr>
<tr>
<td><em>P</em>-value</td>
<td>0.90</td>
<td><em>n/a</em></td>
<td>0.80</td>
<td>0.01</td>
</tr>
</tbody>
</table>
In some trials, less root rot in alleyways than in beds. No treatment differences.

<table>
<thead>
<tr>
<th>Sampling location</th>
<th>Burlington</th>
<th>Lynden 1</th>
<th>Lynden 2</th>
<th>Lynden 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>alleyways</td>
<td>5.6 a</td>
<td>5.8</td>
<td>4.1</td>
<td>2.7 a</td>
</tr>
<tr>
<td>beds</td>
<td>6.8 b</td>
<td>6.0</td>
<td>3.8</td>
<td>7.0 b</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fumigation treatment (all sampled from beds)</th>
<th>Burlington</th>
<th>Lynden 1</th>
<th>Lynden 2</th>
<th>Lynden 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-fumigated</td>
<td>6.3</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Bed fumigated, tarp</td>
<td>7.3</td>
<td>7.0</td>
<td>4.0</td>
<td>6.3</td>
</tr>
<tr>
<td>Bed fumigated, tarp+cover crop</td>
<td>6.8</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Broadcast fumigated</td>
<td>7.0</td>
<td>5.0</td>
<td>4.0</td>
<td>7.7</td>
</tr>
</tbody>
</table>
Nematode recolonization in bed- and broadcast-fumigated plots

**Lynden 2**

**From Soil**

- Bed fume-tarped
- Bed fume-nontarped
- Broadcast fume

**From Roots**

- Bed fume-tarped
- Bed fume-nontarped
- Broadcast fume

**Lynden 3**

- Bed fume - tarp
- Broadcast fume
Challenges:

• The shaper we used (an adjustable unit for vegetables) can only make beds up to about 8” high. You’d need a different shaper to make larger beds.

• You’ll need GPS or some other way to assure that beds are made in the correct location.

• It takes more time to fumigate a field this way; we usually travel at about 3 mph when fumigating and laying tarp. (Broadcast rig travels about 5-6 mph.)
Another option—metam (Vapam)

- Telone C-35, deep shank injected
  - 35 gal/A
  - 20 A field
  - 20% credit for 2-3% organic material
  - 460 ft buffer

- Vapam HL, applied with rotary spader
  - 75 gal/A
  - 20 A field
  - 20% credit for 2-3% organic material
  - 96 ft buffer

- ?Less volatile?
Applying Vapam with a rotary spader
Applying Vapam with a rotary spader

About 75% of the fumigant is injected in these sweeps near the front of the spader
Applying Vapam with a rotary spader

Spader blades rotate slowly, mixing soil and Vapam

Sweep
Applying Vapam with a rotary spader

Remaining 25% of Vapam is injected ahead of this shallow power harrow.
Applying Vapam* with a rotary spader

Seal generated by power roller

*Relax. They are just applying water in this demonstration.
Other options?

• Paladin (Dimethyl Disulfide)
  – Effective, strong smell
  – Must be applied under VIF or TIF tarp
  – 25 ft buffer for bed applications

• Mustard meals
  – Effective in greenhouse tests, less encouraging in field
  – Incorporate with rotary spader?
  – Mustard variety matters
Thanks!!

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