Management of *Macrophomina* and *Fusarium* with fumigants and non-fumigant treatments

Macrophomina and Fusarium in soil

Fumigants

• Provide protection for most of the season
• Higher rates tend to be more efficacious

Varieties

• Some tolerant to Fusarium, not to Macrophomina (Benicia ~ Camarosa = susceptible)
Studies of pathogen hosts, fumigant and variety performance in infested fields

http://ceventura.ucdavis.edu/Com_Ag/

Vegetable and strawberry crop production

Strawberry

Recent Meetings
Fruit Yield, Ventura, 12/23/09-05/26/10

Camarosa, *M. phaseolina* isolated

-28%
Marketable yield, Ventura, CA

- Pic low
- Pic-60
- MB/Pic
- Pic low + Fung
- Control
- Pic high
- Midas

Yield decline in Non-fumigated

M. phaseolina isolated from dead plants
Drip fumigation:
dieback on bed sides

- Less fumigant distributed?
- Dryer/greater stress?
- Root pruning aids infection?
Effect of depth on fumigant efficacy

Beds fumigated with Piclor-60

Spores per gram of soil

Location in bed

Center
Shoulder
Under tape

6” depth
12” depth
2011-12 season

New locations with Fusarium related die-back in Ventura county
Flat fumigated with 350lbs MB:PIC 50:50

Macrophomina phaseolina isolated in 2011 and 2012
## Survival of *Macrophomina* after fumigation in Israel

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Crowns (%) at 30 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>60 a</td>
</tr>
<tr>
<td>MB 45 lb/a</td>
<td>10 b</td>
</tr>
<tr>
<td>MS 40 lb/a</td>
<td>5 b</td>
</tr>
<tr>
<td>MS 70 lb/a</td>
<td>5 b</td>
</tr>
<tr>
<td>Chloropicrin 180 lb/a</td>
<td>45 ab</td>
</tr>
<tr>
<td>Chloropicrin 360 lb/a</td>
<td>30 ab</td>
</tr>
</tbody>
</table>
Survival of Macrophomina under different soil temperature regimes

Freeman, et al

Inoculum (sclerotia/g soil)

Weeks

35°C

25°C

Greenhouse
Hosts of *M. phaseolina* ~ 500 plant species

*Brassica* spp. (Cabbage),
*Capsicum annum* (pepper),
*Citrus* spp.
*Lycoopersicon* (tomato)
*Cucumis* spp. (cucumber)
*Fragaria* sp., (strawberry)
Many field crops
Most legumes
Weeds (malva, fleabane, etc.)

Hosts of *F. oxysporum f. sp. fragariae*

*Fragaria* sp., (strawberry)
What about our coastal vegetable crops hosting *M. phaseolina*?

so far we have not confirmed or seen M.p. infecting 

*brassicas, lettuce, spinach, celery, cilantro, endive/escarole, radicchio* from Ventura, Santa Barbara, San Louis Obispo, Monterey, or Santa Cruz counties.

We did pick up M.p. on pepper once from Monterey county (Koike and Gordon, in-progress results)
M. phaseolina: review of 42 journal articles

- Survives on dead tissue/residue, deep plowing/tillage minimal effect, removal/destruction suggested in 5 papers
- Sclerotia growth inhibited by antifungal antagonists Trichoderma and Pseudomonas spp. in lab
- Can grow sclerotia in very dry environment, optimum temp ~85-90F but region-adapted
- Sclerotia survival decreases with increase in soil moisture and carbon
- Can be seedborne without symptoms in beans
- Populations increase with continuous host cropping (2x for beans in 2 years), long term rotations from hosts suggested
- Fumigation (MBPic 325 lb/a) reduced sclerotia from 35 to 0-3 /g soil
2011-12 season: buffer zone with both pathogens

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>Anaerobic soil disinfestation with rice bran (9 t/acre) + irrigation 3 acre-inches</td>
</tr>
<tr>
<td>Solar</td>
<td>Clear mulch</td>
</tr>
<tr>
<td>Mustard</td>
<td>Capsules of seed-meal at 2000 lbs/acre</td>
</tr>
<tr>
<td>Steam</td>
<td>Injected to soil with spikes to raise temperature at 12” to 140°F</td>
</tr>
<tr>
<td>Pic</td>
<td>Chloropicrin at 300 lbs flat fumigated (non-randomized plots)</td>
</tr>
</tbody>
</table>
ASD and Mustard incorporation. We acknowledge José Romero and Hector Gutierrez for letting us use the mixer-shaper.
Steam application
No significant effect of depth: 0-6” = 6-12”
Weeds in clear-mulched treatments

- Solar+Mustard
- ASD+Solar+Mustard
- Solar+Steam

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weed #/plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar+Mustard</td>
<td>20</td>
</tr>
<tr>
<td>ASD+Solar+Mustard</td>
<td>20</td>
</tr>
<tr>
<td>Solar+Steam</td>
<td>1</td>
</tr>
</tbody>
</table>

Weeds are significantly higher in clear-mulched treatments compared to flooded plots.
Marketable fruit yield Jan-Feb, 2012

Treatments with the same letter are statistically similar (P=0.05)
Marketable fruit yield Jan-June, 2012

Treatments with the same letter are statistically similar ($P=0.05$)
Marketable fruit: steam+solar vs check

- SS
- U
Marketable fruit: ASD vs check

- U
- ASD

g/plot

Dates:
- 1/6/2012
- 1/7/2012
- 1/30/2012
- 2/6/2012
- 2/13/2012
- 2/20/2012
- 2/28/2012
- 3/6/2012
- 3/14/2012
- 3/27/2012
- 4/2/2012
- 4/13/2012
- 4/20/2012
- 4/27/2012
- 5/12/2012
- 6/1/2012
Mortality (Out of 120 plants)
<table>
<thead>
<tr>
<th>Treatment</th>
<th>% DEAD on June 8th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam + Mustard</td>
<td>6.4</td>
</tr>
<tr>
<td>Pic</td>
<td>7.8</td>
</tr>
<tr>
<td>Steam + Solar</td>
<td>13.2</td>
</tr>
<tr>
<td>Untreated</td>
<td>17.2</td>
</tr>
<tr>
<td>ASD + Mustard</td>
<td>23.0</td>
</tr>
<tr>
<td>Solar + Mustard</td>
<td>37.7</td>
</tr>
<tr>
<td>ASD</td>
<td>42.1</td>
</tr>
<tr>
<td>ASD + Solar + Mustard</td>
<td>45.9</td>
</tr>
</tbody>
</table>
Macrophomina and Fusarium

Fumigants

• Effective when in contact with pathogens
• Repeated flat fumigation = gradual elimination of inoculum?

Non-fumigant treatments

• Work in progress, only steam reduced pathogen levels
Acknowledgements

• Terry Farms for hosting field trials
• Juan Hernandez and the Mandalay Berry Farms for bedding crew for help in setting up the treatments
• Hector Gutierrez and Jose Romero for assistance with equipment.
• Krishna Subbarao (laboratory assistance) Andrew Weimers (organizing the field day)