ACHIEVING CONSISTENCY WITH ALTERNATIVES

Joe Noling¹ and Andrew MacRae²
University of Florida, IFAS
¹Citrus Research & Education Center, Lake Alfred, FL 33850
²Gulf Coast Research and Education Center, Balm, FL

Florida Tomato Institute – Sept 8, 2011 Naples, FL

Many Thanks to Growers who allowed us access to their fields and for the time and resources committed

Overall, CUNs continue to fall. The EC, Israel, New Zealand and Switzerland have phased out for controlled uses. Japan has ceased all soil CUNs.

Source: MBTOC CoChairs, Montreal Protocol, OEWG-31, 1-5 August, Montreal
Summary of 13 USDA CSREES sponsored large scale field demonstration conducted Plant City, FL Fall 2006-07, comparing net difference of methyl bromide with alternative system.

Net $ Difference / acre from 1x LDPE Methyl Bromide

Avg. Net Benefit = $56.40 / acre

95% CI = $118.30 to -$5.50 / acre

Inconsistency can and does occur!
Causes of Inconsistency:
- Physical
- Chemical
- Cultural
- Environmental

Physical & Chemical Characteristics

Soil Movement – Behavior in Soil

Full System Approach

Fallow Program Selection

Fallow Weed Management

Summarize Key Concepts
### Properties of Soil Fumigants

<table>
<thead>
<tr>
<th>Fumigant</th>
<th>Boiling Point °C</th>
<th>Vapor Pressure 20° C</th>
<th>Solubility In Water</th>
<th>Soil Half Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl Bromide</td>
<td>4</td>
<td>1420</td>
<td>13400</td>
<td>12-22</td>
</tr>
<tr>
<td>Iodomethane</td>
<td>42</td>
<td>400</td>
<td>12400</td>
<td>4- 40</td>
</tr>
<tr>
<td>Chloropicrin</td>
<td>112</td>
<td>18</td>
<td>2270</td>
<td>1-2</td>
</tr>
<tr>
<td>1, 3-D</td>
<td>120</td>
<td>28</td>
<td>2250</td>
<td>3-5</td>
</tr>
<tr>
<td>Metam Sodium</td>
<td>112</td>
<td>0.04</td>
<td>578290</td>
<td>4–5*</td>
</tr>
<tr>
<td>Metam Potassium</td>
<td>114</td>
<td>24</td>
<td>complete</td>
<td>4-5*</td>
</tr>
<tr>
<td>Dimethyl Disulfide</td>
<td>110</td>
<td>28.7</td>
<td>3000</td>
<td>?</td>
</tr>
</tbody>
</table>

- **Boiling point** is the temperature in which molecules anywhere in the liquid are forming vapor / gaseous molecules and are escaping the liquid.
- **Vapor pressure** is a measure of the tendency of a fumigant compound to change into the gaseous or vapor state. Compounds with high values tend to readily flash from liquid to gas phase and readily / rapidly diffuse through soil.
### Properties of Soil Fumigants

<table>
<thead>
<tr>
<th>Fumigant</th>
<th>Boiling Point °C</th>
<th>Vapor Pressure 20° C</th>
<th>Solubility In Water</th>
<th>Soil Half Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl Bromide</td>
<td>4</td>
<td>1420</td>
<td>13400</td>
<td>12-22</td>
</tr>
<tr>
<td>Iodomethane</td>
<td>42</td>
<td>400</td>
<td>12400</td>
<td>4- 40</td>
</tr>
<tr>
<td>Chloropicrin</td>
<td>112</td>
<td>18</td>
<td>2270</td>
<td>1-2</td>
</tr>
<tr>
<td>1, 3-D</td>
<td>120</td>
<td>28</td>
<td>2250</td>
<td>3-5</td>
</tr>
<tr>
<td>Metam Sodium</td>
<td>112</td>
<td>0.04</td>
<td>578290</td>
<td>4–5*</td>
</tr>
<tr>
<td>Metam Potassium</td>
<td>114</td>
<td>24</td>
<td>complete</td>
<td>4-5*</td>
</tr>
<tr>
<td>Dimethyl Disulfide</td>
<td>110</td>
<td>28.7</td>
<td>3000</td>
<td>?</td>
</tr>
</tbody>
</table>

They require higher temperature and volitalize to gases much more slowly, and then move thru soil much slower than MBr
Additional Planning & Aeration Time is Required to Account just for Chemical Differences between Fumigants
INTEGRATING HIGH BARRIER MULCH TECHNOLOGY

OVER 50 STUDIES SHOW:

- That they Work
- Rates can be reduced
  But they can
- Prolong Dissipation

High Barrier Metalize Mulches

TIF mulches

VIF +100%
VIF +25%
VIF + 0%
VIF +25%
(75% Less!)

VIF +100%
VIF +0%
ESTIMATED IMPACT of ENVIRONMENT (Temp°, Moisture, Mulch) on the PERSISTANCE of FUMIGANTS IN BEDDED SOIL

In hot, moist September Soil, near disappearance of MI (50/50; 175 lb/ta) in a weeks time

Methyl iodide (ppm 5" soil depth)

Days After Application

12 films, Sept 2008
ESTIMATED IMPACT of ENVIRONMENT (Temp°, Moisture, Mulch) on the PERSISTANCE of FUMIGANTS IN BEDDED SOIL

COLD, WET SOILS w/ VIF or TIF

Methyl iodide (ppm 5" soil depth)

Days After Application

LDPE

High Barrier

Mostly VIF

30-40
Additional Planning & Aeration Time is Required to Account just for a Gas Impermeable Mulch covering the Fumigant
The Role of the Environment:

EDAPHIC

CLIMATIC

New Fumigants require longer periods for Soil Dissipation under cold, wet conditions!
The importance of open passages to diffusion of fumigants in Soil

VIF covered soil (maintained) at Near Field Capacity (air passages blocked, little movement)

VIF covered soil (maintained) at AIR DRY Condition (little impediment to movement)

Vertical Distance

Horizontal Distance (cm)

Contour lines of 1,3-D Concentration in soil profile
The importance of open passages to diffusion of fumigants in Soil

VIF covered soil (maintained) at Near Field Capacity (air passages blocked, little movement)

VIF covered soil (maintained) at AIR DRY Condition (little impediment to movement)

Contour lines of 1,3-D Concentration in soil profile
Impact of Water on Fumigant Movement

Chloropicrin  Methyl bromide  Iodomethane

Water Saturated Soil Horizons effectively block soil fumigant penetration into, thru, or if applied into, Volitalization from the saturated horizon

Modified From Ajwa et al., 2006
Impact of Irrigation Water on Movement of Shank applied Fumigants

Chloropicrin  Methyl bromide  Iodomethane

Tarp Seal  Tarp  Seal  Tarp  Seal

Block Air Passages Provide Effective Containment – Prolonged Aeration
SUMMARY

- Many factors effect fumigant Dissipation from soil:
  - Physical
  - Chemical
  - Cultural
  - Environmental

4 - 6 weeks

All Have to be Planned and Accounted for!
Production = Full System Approach

- Preplant preparation
  - Herbicides/cultivation
- Fumigation
  - Select fumigant and plastic mulch based on known field history
- Herbicides
  - Preplant, under mulch, postemergence, row middles
- Post production burn-off
- Fallow season programs
  - Cover crop or stale seedbed technique
Fallow Programs

• Do not allow fields to sit after harvest!

• 1\textsuperscript{st} application – Gramoxone/Firewall
  • burns down existing foliage but it does not clean up a field
  • Yellow and purple nutsedge, goosegrass, purslane, etc. continue to grow

• 2\textsuperscript{nd} application - glyphosate plus carfentrazone
  • for control of nutsedge and difficult to control broadleaf weeds
Fallow Program Selection

• Integrated Pest Management
  • Cover crops vs. Fallow weed management program
  • Weedy fallow is not an option

• What is your major pest problem
  • Nematodes and/or disease – cover crop
  • Weeds – fallow weed management program
Fallow Weed Management

- Cultivation only
  - Controls annual grass and broadleaf weeds
  - May spread perennial weeds while providing little control

- Herbicide only
  - Controls weeds that will emerge with little disturbance to soil
Fallow Weed Management Programs
Cultural Control of Nutsedge

- Yellow and Purple nutsedge
  - underground reproduction by rhizomes and chains of tubers

- Cultivation → break nutsedge tuber chain

- Glyphosate → systemic POST emergent herbicide

- Cultivation (break the chain of tubers) followed by glyphosate (kills the tuber that the sprout is growing from)
Whitefly Management

- Cover crops
  - May allow for increase in whitefly population
  - Should not be a host for whitefly transmitted diseases

- Fallow weed management program
  - If timely, should help reduce whitefly populations
  - If timely, should reduce whitefly transmitted diseases

- Weedy fallow
  - Will provide a place for whiteflies to breed
  - May possibly be a sink/source for whitefly transmitted diseases
Nutsedge count 28 days after no fumigation

Shoot Number/A

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Shoot Number/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>bc</td>
</tr>
<tr>
<td>C x C</td>
<td>ab</td>
</tr>
<tr>
<td>G</td>
<td>ab</td>
</tr>
<tr>
<td>G x G</td>
<td>d</td>
</tr>
<tr>
<td>C x G</td>
<td>cd</td>
</tr>
<tr>
<td>G x C</td>
<td>bc</td>
</tr>
<tr>
<td>G x C x G</td>
<td>e</td>
</tr>
<tr>
<td>None</td>
<td>a</td>
</tr>
</tbody>
</table>

C = cultivation, x = followed by, G = glyphosate
Nutsedge count 28 days after PicClor 60 fumigation

Shoot Number/A

<table>
<thead>
<tr>
<th></th>
<th>Shoot Number/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>3000000</td>
</tr>
<tr>
<td>C x C</td>
<td>2500000</td>
</tr>
<tr>
<td>G</td>
<td>2000000</td>
</tr>
<tr>
<td>G x G</td>
<td>1500000</td>
</tr>
<tr>
<td>C x G</td>
<td>1000000</td>
</tr>
<tr>
<td>G x C</td>
<td>500000</td>
</tr>
<tr>
<td>G x C x G</td>
<td>100000</td>
</tr>
<tr>
<td>None</td>
<td>5000000</td>
</tr>
</tbody>
</table>

C = cultivation, x = followed by, G = glyphosate
Nutsedge count 28 days after Paladin Pic fumigation

Shoot Number/A

C = cultivation, x = followed by, G = glyphosate

C = cultivation, x = followed by, G = glyphosate
14 Days After Application

Non-treated Control

Paladin Pic at 50 gal/treated acre

PicClor-60 at 250 lbs/treated acre
12 Month Pest Control Program

- Keep your fields clean
  - Pests will take refuge on weeds in row middles and field edges

- Know your fields
  - Use different programs for different fields

- Tailor your off-season programs to target your pests

- If you are having problems with virus
  - Check field edges/old fields
Questions?