Methyl Bromide Alternatives
Research Update

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GCREC and CREC
Current Research

- Long term sustainability of methyl bromide alternatives
  - Year 3 initiated August 2010

- Evaluation of all components of the 3-WAY fumigant system
  - Spring 2009
  - Spring 2010
  - Fall 2010
Current Research

- Impact of cultivation and herbicides on the control of yellow and purple nutsedge and their impact on the selection of a tomato fumigant system
  - Fall 2010 through Spring 2011

- Interaction of Paladin Pic Concentration via Drip Tape Applications and the movement and control of purple nutsedge
  - Fall 2010 and Spring 2011
Current Research

- Evaluation of herbicide combinations for use in tomato
  - Reflex (Fall 2009, Spring 2010, Fall 2010)
  - Matrix / Solida + Envoke + Sandea (Fall 2010 and Spring 2011)

- Competition of common purslane with tomato
  - Fall 2010 and Spring 2011

- Evaluation of new polyethylene mulch technology
  - Fall 2009, Spring 2010, Fall 2010
Evaluation of the long term sustainability of methyl bromide alternatives
Long Term Sustainability Trial

- Split-Split Plot design with a randomized complete block arrangement with four replications

- First crop main treatment = Primary fumigation
  - 1st split plot – Crop (Tomato or Pepper)
  - 2nd split plot – Herbicide or No herbicide

- Double crop main treatment = Secondary fumigation

- The trial design randomization will be maintained the same for the length of the study (3 years) to determine sustainability of the treatments
Trial Design cont.

- Plot size
  - Initial fumigation is 3 beds x 300 ft. long
    - 1st split plot - 3 beds x 150 ft. long
    - 2nd split plot - 3 beds x 75 ft long
  - Secondary fumigation is 1 bed x 300 ft. long

- Plant beds are on a 5 ft. spacing with a 28 in. bed top and 9 in. bed height
Cropping System

- Years 1-3
  - Primary Crop (Summer):
    - Tomato/Pepper (transplanted)
  - Secondary Crop (Spring):
    - Summer Squash (seeded)
- Grown in a plasticulture system using drip irrigation
- Cultivars
  - ‘Security 28’ tomato
  - ‘Patriot’ pepper
  - ‘Gentry’ summer squash
Treatments – Initial Fumigation

1. Non-treated control

2. Methyl Bromide 67:33 at 175 lbs/A

3. 3 Way = Telone II at 12 gal/A + Chloropicrin at 150 lbs/A + KPam at 60 gal/A

4. 2 Way = Telone II at 12 gal/A + Chloropicrin at 150 lbs/A

5. Midas 50:50 at 160 lbs/A

6. Paladin Pic 79:21 at 60 gal/A
Treatments – Secondary Fumigation

1. Non-treated control

2. Inline at 35 gal/A (EC formulation of Telone C35)

3. Kpam at 60 gal/A
Herbicide Treatment

• Each treatment had a split plot of herbicide or no herbicide
  • Year 1 = V10142 (0.3 lbs ai/A) and Devrinol (1 gal/A)
  • Year 2 = Reflex (1 pt/A) and Devrinol 2 EC (1 gal/A)
  • Year 3 = Reflex (1 pt/A) and Devrinol 2 EC (1 gal/A)

• The herbicides were applied to a final finished bed top prior to laying plastic mulch
  • Year 1 = Canslit Metalized
  • Year 2 = Filmtec 1.2 mil VIF
  • Year 3 = Pliant Blockade 1.1 mil VIF
Insurance Policy Against Weeds

- For all methyl bromide alternatives, the use of herbicides is an insurance policy

<table>
<thead>
<tr>
<th>Fumigant control (%)</th>
<th>Herbicide Control (%)</th>
<th>Total Control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>70% of 50% = 35</td>
<td>50 + 35 = 85</td>
</tr>
<tr>
<td>60</td>
<td>70% of 40% = 28</td>
<td>60 + 28 = 88</td>
</tr>
<tr>
<td>70</td>
<td>70% of 30% = 21</td>
<td>70 + 21 = 91</td>
</tr>
<tr>
<td>80</td>
<td>70% of 20% = 14</td>
<td>80 + 14 = 94</td>
</tr>
<tr>
<td>90</td>
<td>70% of 10% = 7</td>
<td>90 + 7 = 97</td>
</tr>
</tbody>
</table>
Application Procedures – 1st Crop

- The field was prepared using conventional tillage
- Telone II treatments were applied to a depth of 12 in. below bed top
- A pre-bed was pulled and then shaped using a 3-row rig
- The fumigants MB 50:50, Midas 50:50, Paladin Pic, and Chloropicrin were applied via shank at an 8 in. depth
- Beds were sealed using a bedpress, herbicides were applied, and then VIF mulch was applied using a speedroller
- Kpam treatments were applied via injection through a double drip tape system
Tomato
Tomato Year 2 - Annual Grass Count

With Herbicide

No Herbicide

Plants/

Control MB 3-Way 2-Way Midas Paladin Pic
Tomato Year 2 – Purple Nutsedge Count

Plants/Acre

With Herbicide

No Herbicide

Control  MB  3-Way  2-Way  Midas  Paladin Pic
Tomato Year 1 – Marketable Yield

With Herbicide

No Herbicide

Boxes / A

Control  MB  3-Way  2-Way  Midas  Paladin Pic
Tomato Year 2 – Marketable Yield

With Herbicide

No Herbicide

<table>
<thead>
<tr>
<th>Variety</th>
<th>With Herbicide</th>
<th>No Herbicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>MB</td>
<td>1300</td>
<td>1300</td>
</tr>
<tr>
<td>3-Way</td>
<td>1350</td>
<td>1350</td>
</tr>
<tr>
<td>2-Way</td>
<td>1400</td>
<td>1400</td>
</tr>
<tr>
<td>Midas</td>
<td>1450</td>
<td>1450</td>
</tr>
<tr>
<td>Paladin Pic</td>
<td>1500</td>
<td>1500</td>
</tr>
</tbody>
</table>

Graph showing the marketable yield of tomatoes with and without herbicide.
Summary

- Paladin Pic does not control goose grass

- The addition of a herbicide provided 60 – 70% control of the annual grasses

- The additional herbicide helped purple nutsedge control in both years

- All systems provided satisfactory control of purple nutsedge
Summary Cont.

- In both years, the addition of herbicide increased some fumigant program’s marketable yields

- The three–way system has consistently good yields
Evaluation of all components of the 3-WAY fumigant system for tomato production
## Treatments

<table>
<thead>
<tr>
<th></th>
<th>Fumigant</th>
<th>Rate (Broadcast)</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Telone II</td>
<td>12 gal/A</td>
<td>12 inches</td>
</tr>
<tr>
<td>2</td>
<td>Chloropicrin</td>
<td>150 lbs/A</td>
<td>8 inches</td>
</tr>
<tr>
<td>3</td>
<td>KPam</td>
<td>60 gal/A</td>
<td>Drip applied</td>
</tr>
<tr>
<td>4</td>
<td>Chloropicrin + KPam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Telone II + KPam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Telone II + Chloropicrin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Telone II + Chloropicrin + KPam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>PicClor 60</td>
<td>250 lbs/A</td>
<td>8 inches</td>
</tr>
<tr>
<td>9</td>
<td>PicClor 60 + KPam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Telone C35</td>
<td>35 gal/A</td>
<td>8 inches</td>
</tr>
<tr>
<td>11</td>
<td>Telone C35 + KPam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Non-treated Control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All treatments were placed under VIF (Filmtec 1.2 mil or Blockade 1.1 mil) and LDPE (Pliant 1.0 mil) plastic mulches
2-WAY – Purple Nutsedge Control

Purple nutsedge counts (4 WAP)

Plastic Mulch and Fumigant Treatment

- Telone + Pic
- PicChlor 60
- Telone C35
- Control

VIF

LDPE
2-WAY – Marketable Yield

Marketable yield (Medium + Large + Xlarge)

Boxes / A

Plastic Mulch and Fumigant Treatment

- Telone + Pic
- PicClor 60
- Telone C35
- Control

VIF

LDPE
3-WAY – Purple Nutsedge Control

Purple nutsedge counts (4 WAP)

VIF

LDPE

Plastic Mulch and Fumigant Treatment

Telone + Pic  PicClor 60  Telone C35  Control
Yields were reduced in VIF due to Kpam injury, i.e. we planted too soon after application
Herbicide Resistance

- Resistance develops most rapidly when one control method is used repeatedly over multiple growing seasons.

- In tomatoes we are protected from developing our own resistance with the use of tillage in the fallow period and the option of multiple herbicide mode of actions.

- Movement of resistant weeds may occur from agronomic fields to tomato fields, especially in North Florida.
Herbicide Resistance

- Palmer Amaranth, a large pigweed commonly found in north Florida and throughout the Southeast, has shown multiple resistance to:
  - Glyphosate (Roundup type products)
  - ALS (Sandea, Matrix, Envoke)
- Palmer Amaranth has shown resistance to:
  - Triazines (possible cross resistance to metribuzin)
  - Dinitroanalines (Prowl H2O)
- Current control strategies in cotton rely on the use of other herbicide modes of action
  - Acetomides (Dual Magnum)
  - PPOs (Chateau, Reflex)
Reported cases of herbicide-resistant weeds in US

Number of cases

Herbicide Resistant Weeds

Herbicide Sprayed

Resistant Plant Survives And Sets Seed

Herbicide Is Used On Weeds With More Resistant Plants

Eventually Majority Resistant

= Resistant Biotype

= Susceptible Or Wild Biotype
Herbicide Resistant Weeds
Do I Have A Resistance Problem?

- Weed size
- Moisture
- Temperature
- Weather
- Rate
- Agitation
- Nozzle type
- Nozzle wear
- GPA
- Calibration
- Bad luck
- Resistance