Soil-chemical interactions affecting the effectiveness of reduced rates of insecticide for the control of the wireworm, *Melanotus communis*, in Florida sugarcane

By

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Biographical Information

• Bachelor’s degree in Spanish from UF
• Recruited to sugarcane industry in 2005
• Currently live in Pahokee, Florida
• Married to Kiley
• Currently work at EREC on sugarcane and vegetable entomology
Why does a Spanish major study agronomy?

• VA benefits only allow one change of major
• I like to garden
  – I took an agronomy class to improve my skills
• I liked my crop physiology course
• Started working with Dr. Sinclair
• Decided that I would continue my education in Agronomy
Sugarcane in Florida

- Brought over with the Spanish
- Many small plantations before 1900
- Drainage expanded acreage
- Large acreage increases after Cuban Embargo
- Currently ≈ 400,000 acres
Florida Sugarcane Industry (prior to 1930)

1. Turnbull Plantation - New Smyrna
2. Dunlawton Plantation - Port Orange
3. Spring Garden Plantation - DeLeon Springs
4. Gamble Plantation - Bradenton
5. Yulee Sugar Mill - Homosassa
7. Pennsuco Sugar Mill - Hialeah
8. Fellsmere Sugar Company - Fellsmere
Sugarcane in Florida

1. Sugar Cane Growers Cooperative - Belle Glade
2. Okeelanta, Florida Crystals – South Bay
3. Osceola, Florida Crystals – Pahokee
4. US Sugar - Clewiston
Sugarcane Cultivation

• Heavy land preparation
• Mostly hand planted in 6” furrows
• Many passes with mechanical cultivation
• Pre-post tank mixes for chemical control
• 12-18 months to harvest
• Crops are ratooned twice or more
• Usually only one successive planting
<table>
<thead>
<tr>
<th>Stage</th>
<th>Start</th>
<th>End</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular plant cane</td>
<td>Sep-Oct 2008</td>
<td>Feb-March 2010</td>
<td></td>
</tr>
<tr>
<td>1\textsuperscript{st} ratoon</td>
<td>Feb-Mar 2010</td>
<td>Dec-Jan 2010/2011</td>
<td></td>
</tr>
<tr>
<td>2\textsuperscript{nd} ratoon</td>
<td>Dec-Jan 2010/2011</td>
<td>Oct-Nov 2011</td>
<td>More ratoons possible</td>
</tr>
<tr>
<td>Successive plant cane</td>
<td>Nov-Dec 2011</td>
<td>Feb-Mar 2013</td>
<td>Soil insecticide applied</td>
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<tr>
<td>1\textsuperscript{st} ratoon</td>
<td>Feb-Mar 2013</td>
<td>Dec-Jan 2013/2014</td>
<td></td>
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<tr>
<td>2\textsuperscript{nd} ratoon</td>
<td>Dec-Jan 2013/2014</td>
<td>Oct-Nov 2014</td>
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<tr>
<td>Rotation winter</td>
<td>Dec-Jan 2014/2015</td>
<td>Feb-Apr 2015</td>
<td>Vegetables</td>
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<tr>
<td>Rotation summer</td>
<td>Mar-Apr 2015</td>
<td>June-Oct 2015</td>
<td>Silage/Rice</td>
</tr>
<tr>
<td>Regular plant cane</td>
<td>Sep-Oct 2015</td>
<td>Feb-Mar 2017</td>
<td>Cycle restarts</td>
</tr>
</tbody>
</table>
Wireworms

• Several species
  – *Melanotus communis*
  – *Conoderus spp.*
  – *Ischtodontus sp.*
  – *Glyphonix bimarginatus*

• Long life cycle
  – 2 to 10 years
  – Oviposit in summer
  – Emerge in spring

• Polyphagous
  – Sugarcane
  – Corn
  – Potatoes

• Habitat
  – Grassy fields in sandy and muck soils
Wireworm IPM

• Wireworms are more of a problem in successive plantings
• Clean fallowing
• Flooding
• Fast germinating, high tillering varieties
• Early planting
• Chemical control
  – Phorate
  – Ethoprop
Control Options

- Thimet (phorate) 14.6-19.5 lbs/acre
- Mocap (ethoprop) 10 – 20 lbs/acre
- Both labels advise higher rate for heavy infestation
- Cheap insurance
- Most economical rate undetermined
Soil-Chemical Interaction
Chemical Characteristics

- Sorption coefficient, Koc
- Half Life
- Solubility
- Toxicity
- Degradation products
- Volatility
Soil Chemical Interaction
Soil Characteristics

- Soil pH
- Soil Organic Matter
- Soil Moisture
- Temperature
- Porosity/structure
- Texture
- Microbial populations
Previous Studies

- Cherry and Hall (1985)-Topical Application
- Coale and Sosa (1991)- Field Trial
- Cherry and Raid (1999)-Efficacy
- Hall (2003) - Efficacy
- Hall and Simms (2004) - Efficacy
Objectives

• Determine if new method of evaluating soil insecticides against wireworms is effective
• Determine if lower rates are still effective against wireworms
• Determine if different rates should be used on sandy soils and muck soils
Experimental Design

• Place 10 wireworms in a 5 gallon bucket and plant 8 sugarcane eyes per bucket
  – Variety CP89-2143

• Compare two soil types
  – Dania muck
  – Immokalee fine sand

• Compare two chemical treatments
  – Phorate
  – Ethoprop
Experimental Design
Experimental Design
Evaluation procedures

• Stand count
  – Count number of healthy and damaged shoots and dead hearts.

• Mortality and Seed piece assessment
  – Empty the bucket and count number of live *Melanotus communis* remaining and then look for damage on the seed piece shoots and tillers.
Evaluations
Chemical - soil type interaction

- Dania muck
  - Histosol
    - 65% organic matter
  - pH
    - 7.4
  - Bulk density
    - 0.5 g/cm³

- Immokalee fine sand
  - Spodosol
    - 2% organic matter
  - pH
    - 7.8
  - Bulk density
    - 1.4 g/cm³
Soil – chemical interactions

Lauderhill muck

Immokalee fine sand
Total *Melanotus communis*

**Bar Graph: Mean no. wireworms**

- **Phorate treatment (lb/ac):** 0, 12.1, 14.6, 17.1, 19.5
- **Soil Type:** Dania muck, Immokalee fine sand
- **Graph Categories:** Adults, Pupae, Larvae

**Dania muck:**
- 0 lb/ac: 0 adults, 0 pupae, 0 larvae
- 12.1 lb/ac: 12 adults, 6 pupae, 4 larvae
- 14.6 lb/ac: 14 adults, 8 pupae, 6 larvae
- 17.1 lb/ac: 17 adults, 10 pupae, 8 larvae
- 19.5 lb/ac: 19 adults, 12 pupae, 10 larvae

**Immokalee fine sand:**
- 0 lb/ac: 0 adults, 0 pupae, 0 larvae
- 12.1 lb/ac: 12 adults, 6 pupae, 4 larvae
- 14.6 lb/ac: 14 adults, 8 pupae, 6 larvae
- 17.1 lb/ac: 17 adults, 10 pupae, 8 larvae
- 19.5 lb/ac: 19 adults, 12 pupae, 10 larvae
Seed piece damage

Mean seed piece damage rating

Phorate treatment (lb/ac)

Dania muck
Immokalee fine sand

0 12.1 14.6 17.1 19.5 0 12.1 14.6 17.1 19.5
Plant Damage

Mean damage (proportion)

Phorate treatment (lb/ac)

Dania muck

Immokalee fine sand

Shoot damage
- none
- wireworm
- disease

Eye damage
- wireworm
- disease

0 12.1 14.6 17.1 19.5
0 12.1 14.6 17.1 19.5
Soil Variable Conclusions

- Phorate highly effective in both soils
- Difference did not meet expectations
- There appeared to be a muted rate response, but it was not significant enough
Chemical differences

- **Phorate**
  - KOC = 1000
  - Half Life = 60 days
  - Solubility = 22 PPM
  - Toxicity = 0.64 – 1.03

- **Ethoprop**
  - KOC = 70
  - Half Life = 25 days
  - Solubility = 750 PPM
  - Toxicity = 0.44 – 2.00
Total *Melanotus communis*

Mean no. wireworms

- Adults
- Pupae
- Larvae

Phorate

- 4.875: 1
- 9.75: 1
- 14.6: 1
- 19.5: 1
- 0: 6

Ethoprop

- 0: 1
- 5: 5
- 10: 3
- 15: 1
- 20: 1
Seed Piece Damage

Mean Seed Piece Damage Rating

0  5  10  15  20

0        4.9       9.75      14.6       19.5

Ethoprop        Phorate

3
2
1
0
Chemical Variable Conclusions

- Phorate more effective than ethoprop
- Phorate very effective across all rates tested
- Ethoprop rate sensitive
Related experiments

• **Zeta-cypermethrin**
  - Impregnated fertilizer
  - Spray
  - Spray + impregnated fertilizer

• **Imidacloprid**
  - Soak
  - Spray
  - Spray + adjuvant

• **Field trial – wireworm seeding**
  - Ethoprop
  - Phorate

• **Sweet Corn**
  - Seed treatments
  - Granular products
Lessons learned

- Plant earlier and use smaller wireworms
- Soak the seed pieces in propiconozole
- 10 wireworms is an excellent number
- Container trials more accurate and easier to evaluate than field trials
Acknowledgements

- AMVAC
- Bayer
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