Tracking disease and insect pests using Smartphone technology: a new approach for regional pest management

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Outline

- Recap what we’ve learned about whitefly and virus management from the past 4 years of survey data
  - Hit the high points from last year’s talk
- **Decision Support System**
  - Collect scouting data → formulate management recs.
  - GPS/GIS, smartphone-based technology and the internet
  - In cooperation with ZedX Inc.
Introduction

- Project was established in summer of 2007
- Improve management of *TYLCV* and whiteflies
- Use survey data to gain an understanding of factors that contribute to “local” outbreaks of whiteflies and the viruses they transmit
  - Identify common features of problem locations (e.g., land usage, border fields, production practices)
- Develop a strategy to reduce epidemics
  - *Decision Support System*
2006/2007 Season

![Graph showing the progression of Whitefly and Virus from Start to End over the season. The graph indicates an increase in both Whitefly and Virus from the start to the end of the season.](image-url)
2007/2008 Season

Whitefly & Virus

Mean Virus
Mean Whitefly

Start
Season
End
2010/2011 Season

Whitefly & Virus

Start

Season

End

Mean Virus

Mean Whitefly
Can we rely on geographical attributes or simply location to predict whitefly and/or TYCLV outbreaks?

Can we rely on weather conditions to predict whitefly and/or virus outbreaks?

- ...Yes and No
- Daily weather variables have predictive value, but may not be all that useful
- Cold weather events may be most telling
Mother Nature’s Role

Minimum temperature and total daily rainfall recorded in Immokalee

Minimum temperature

Rainfall (in.)

2003  2004  2005  2006  2007  2008  2009  2010  2011  ...
**Some Natural Questions**

- Can we rely on weather conditions to predict whitefly and/or virus outbreaks?
  - ...Yes and No
  - Daily weather variables have predictive value, but may not be all that useful
  - Cold weather events may be most telling

- Can we rely on geographical attributes or simply location to predict whitefly and/or TYCLV outbreaks?
1st Order Nearest Neighbors (whiteflies)

\[
\log(y) = -0.1 + 0.94 \log(x)
\]
Correlation Analysis

07/08 Whitefly

07/08 Virus

Distance (~miles)

Correlation

Distance (≈miles)
Sphere of Influence
Conclusions

- It is possible to predict the severity of TYLCV & whitefly density with select weather variables
  - Cold events
- Geographical features are perhaps the best predictor of these pests
  - Natural scale of these pests is regional
- Developing or coordinating an area-wide pest management protocol is perhaps the best bet for maximizing control
  - The **Decision Support System** could facilitate such an effort
We hired ZedX Inc., (www.zedxinc.com) to develop the **Decision Support System** (DSS)

Users will use their mobile device (i.e., smartphone) to collect and upload GPS-labeled scouting data to a central server.

Data is processed and then delivered as real-time reports and management recommendations to growers and/or their scouts.

To make it widely adaptable, we enabled the system to record both production and pest information for a wide variety of crops.
Accessing the DSS

- Mobile Phone Access
  - Download the ARSWF “App”
  - Data collection

- Web-based Access (arswf.zedxinc.com)
  - Create field boundaries/name fields
  - Create data entry forms
  - View data
  - Modify data entries
  - View video tutorials

- System is secure (password protected)
  - But flexible enough to share disease and pest information among collaborating growers
**Pest Name**

- **Tomato Yellow Leaf Cub**

**Pest Amount (%)**

- 14%

**Comments**

- Empty

**Submit**

**Numerical keypad**

```
1 ABC    2 DEF
3 GHI    4 JKL
5 MNO    6 .
7 PQR    8 TUV
9 WXYZ  *
0 +  -
```

**Records**

- **Record Date**: 2011-06-20
- **Profile**: 
- **Stop**: 
- **Crop**: 
- **Pest**: 
- **Select Pest Category**: 
- **Pest Name**: 
- **Pest Amount (%)**: 0
- **Viral Diseases**: 
  - Squash Vein Yellow Virus (SqVVYV)
  - Tobacco Etch Virus (ToCV)
  - Tomato Chlorosis Virus (ToCV)
  - Tomato Infectious Chlorosis Virus (TICV)
  - Tomato Spotted Wilt Virus (TSWV)
  - Tomato Yellow Leaf Curl Virus (TYLCV)
  - Watermelon Mosaic Virus (WMV)
  - Zucchini Yellow Mosaic Virus (ZYMV)
- **Weed**: 

**Agricultural Research Service**

**USDA**
Connected
Record Saved to Server.

Record Date
2011-06-20

Profile
ARS Demo
Gargiulo
Farm 4
10N

Stop
2
Auto Increment Stop

Crop
1. Please click "Select Language" button.

   Select Language

   English, English (US)

2. Please click "Create Profile" button to create levels.

   Create Profile

   English: Location, Grower, Farm, Field
   English (US): Location, Grower, Farm, Field

3. Please click "Create Role" button to create roles and select tools.

   Create Role

   **The proceeding display reads as follows- Language: role (number of tools), ...**
   English: Surveyor (1), Scouter (4)
   English (US): Surveyor (1), Scouter (4)

4. Please click "General Settings" button to change general settings.

   General Settings
<table>
<thead>
<tr>
<th>Level</th>
<th>Profile</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>GCC Test</td>
<td>--</td>
</tr>
<tr>
<td>Grower</td>
<td>Farm Op 15_05</td>
<td>--</td>
</tr>
<tr>
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<td>--</td>
</tr>
<tr>
<td>Field</td>
<td>01C</td>
<td>--</td>
</tr>
</tbody>
</table>

**Boundary Import/Export**

- **Mode**: Upload
- **Format**: ESRI Shape (.dbf, .prj).zip
- **Projection**: WGS84 (EPSG:4326)

**Boundary Modification**

[Diagram of a boundary area]
DSS: Pros and Cons

- **Cons**
  - Transitioning to new technology
    - Learning curve
  - Open sharing of pest data

- **Pros**
  - Open sharing of pest data
  - Pest information readily available for mapping and viewing
  - Comprehensive database of pest data
  - Potential for improved pest management
Acknowledgements

- Lisa Rouse
- Rachel Broadbent
- Mark Verbeck
- Glades Crop Care
- Agmart
- Gargiulo
- Immokalee Tomato Growers
- Pacific Tomato Growers
- Six L’s
- West Coast Tomato