

Title: *Integrating Monitoring, Global Information System (GIS) and Geostatistics for the Management of the Whitefly vectored disease, Cucurbit Yellow Stunting Disorder Virus (CYSDV) in Arizona Melons.*

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Location: Agricultural and Urban Settings Within Yuma County

Critical Issue: The Cucurbit Yellow Stunting Disorder Virus (CYSDV), genus *Crinivirus* and family Closteroviridae, has emerged as a extremely serious whitefly-transmitted virus of cucurbit crops within Arizona. The virus causes general plant symptoms of prominent interveinal chlorosis with chlorotic spots, shortened internodes and leaf brittleness.

In the fall of 2006, CYSDV was first confirmed in Arizona causing an estimated 60 – 70% reduction in marketable melon yield. Economic damage estimates from the Arizona Department of Agriculture (AZ Ag Stats Bulletin, 2006) showed fall, 2006 CYSDV outbreak resulted in a \$14 million loss in melon production within the Arizona. As Yuma County produces approximately 75% of the melons within the state (AZ Ag Stats Bulletin, 2006), management and control of CYSDV within the Yuma region is viewed by many as a critical need for overall state melon production.

Inputs:

We anticipate that by Mid-March, 2008, we will have in place, 100 yellow sticky traps for whitefly capture and monitoring within the melon producing areas Yuma County (Table 1). The unique setting creates a interesting research dynamic as the region contains the complexities of an urban center (The City of Yuma), an international border (Mexico), significant melon production (~3,000 melon acres in 2006), topographical elements (Gila and Mohawk Mountains), a river influence (Colorado and Gila Rivers), uninhabited desert

Table 1. Proposed Yellow sticky trap distribution.

Trap Zone	Numbers of Traps
Yuma Valley	25
Gila Valley	15
Dome Valley	10
Wellton-Mohawk Valley	20
Yuma Mesa	10
City of Yuma	20

areas and the interplay within a transition between the huge variety of agricultural commodities grown in the area (fall and winter vegetables, citrus, alfalfa, small grains and cotton). The 200,000 acre study area encompasses 4 valleys (Yuma, Gila, Dome and Wellton-Mohawk), the Yuma Mesa, areas surrounding the Colorado and Gila rivers and the City of Yuma. Yellow sticky traps will be deployed and maintained weekly in these areas to capture flying whiteflies for monitoring adult densities under field conditions. Table 1 summarizes the number of traps utilized within each

general survey zone.

Geospatial analysis of whitefly weekly trap counts will be completed using a combination of mapping software (Farmworks[®], ArcGIS[®]) and a statistical package (SAS[®]). Each trap will be geo-referenced with a hand-held global positioning unit in the universal transverse mercator (UTM) coordinate system to be used in geostatistical analysis. Yuma County Master Gardeners will be recruited to assist the PI's in maintaining the urban trap locations while a permanently employed research staff member will support other trapping sites as needed.

Budget: We are requesting \$7,000 (\$9,000 total) for supplies and travel expenses required to maintain the 9 month (2008) surveillance program until November, 2008 with weekly trap collection, whitefly counting and trap redeployment (Table 2). In a unique set of circumstances, we are also seeking an additional \$2,000 in cost recovery from the maintenance of the whitefly trap line in the Yuma Valley during the fall of 2007. This noncompetitive award, to support 2007 CYSDV and whitefly population monitoring in the Yuma Valley, required additional justification by the IPM oversight committee which has been provided to A. Fournier via email (Jan. 31, 2008).

Table 2. Proposed Budget for Project.

Item	Cost
Travel	\$ 4,000.00
Supplies	\$ 3,000.00
2007 Cost Recovery	\$ 2,000.00

Outputs:

As this project is of vital importance to melon producers, ongoing data analysis will occur throughout the monitoring period with weekly report dissemination through a dedicated website (<http://ag.arizona.edu/crops/vegetables/quality/index1.html>), timely task force meetings, and regional workshops where pest control advisors, plant protection officials and the media are invited. The long-ranging objectives of this program will benefit regional melon producers in the following 5 ways:

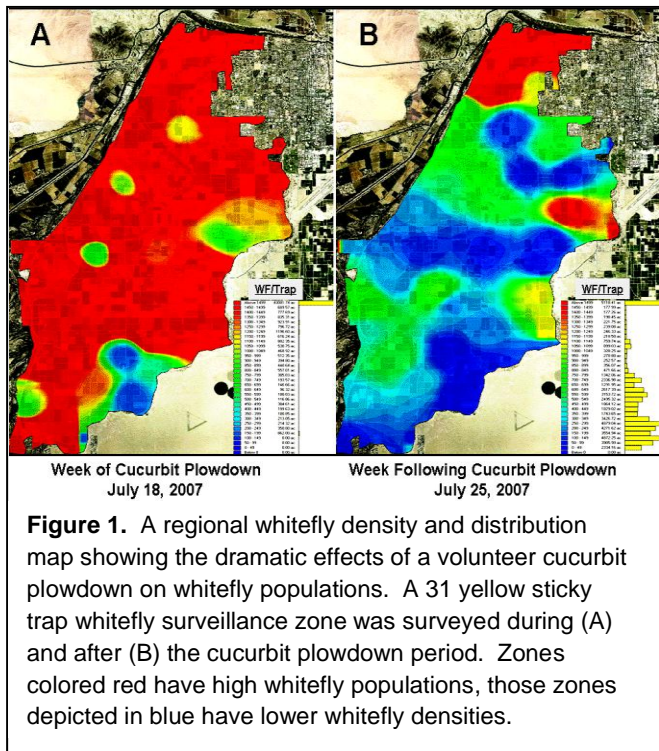
1. *Whitefly Temporal, Spatial and Density Mapping.* Preliminary data suggests that the severity of CYSDV incidence could be restricted spatially, with no apparent relationship to the abundance of whiteflies on a localized scale. By capturing whiteflies weekly at specific locations within an intricate agricultural region, perhaps *in-field* whitefly infection thresholds can be determined for CYSDV. And, with the construction of weekly whitefly density maps, we can provide to producers an overview of the yearly migration patterns of the insect and how they are influenced by the intricacy of the area.
2. *CYSDV Surveillance Workshops.* A detailed use of CYSDV incidence maps will be used to illustrate the spread of CYSDV over a regional scale, integrating cropping patterns, cucurbit plow down episodes and whitefly vector densities with disease occurrence.
3. *Whitefly Migration Patterns Within and Around Urban Settings.* It is currently not known how urban dwellers influence the whitefly population and movement dynamic. We are aware that many homeowners within City of Yuma will grow cucurbits in gardens and various sites during the year. Thus, screening whitefly populations within an urban landscape could provide keys to the management of this disease, particularly during periods of a cucurbit plow down.
4. *A CYSDV Risk Assessment Analysis Model.* Geostatistics adds the ability to model the range and directionality of the spatial correlation, which can provide clues to underlying disease processes involving spread, local, climate, and cropping patterns as hosts for CYSDV. We predict that a CYSDV disease risk maps at a variety of scales will become increasingly available and helpful. Through an iterative process of comparing spatial data on risk with observed incidence, our understanding of the spatial and temporal aspects of disease processes should improve along with our ability to produce maps useful to melon producers.
5. *A CYSDV Management Newsletter, Website and Final Report.* We feel a major benefit of this project lies in its visual imagery. Such output can be used by melon producers, pest control advisors, the media and the general public. In this light a CYSDV website will be developed which will provide weekly whitefly distributions and the CYSDV incidence within the region. A project final report will summarize the effort for Arizona producers, consultants and CYSDV experts.

Outcomes:

Short-Term Outcomes: In agricultural settings yellow sticky traps will be located in close proximity to melons in production. We will also have traps located in and around the urban areas within the City of Yuma. It is currently not known how urban landscaping influences the whitefly population and movement dynamic. We are aware that many homeowners within the City of Yuma grow cucurbits thus; screening whitefly populations in urban landscapes could provide keys to the management of this disease. Sticky traps will be set up to not only monitor the number of whiteflies, but also to determine directional migration

patterns in and around this urban center. Although whitefly yellow sticky traps will be located in and around spring and fall melon fields, monitoring for CYSDV will also take place on a biweekly basis throughout the region. A CYSDV severity index will be developed and used to correlate disease incidence with whitefly migration patterns. Geostatistics and GIS will be used to analyze the spatial patterns of CYSDV incidence severity and its relationship with whitefly population densities. This analysis of disease severity might reveal some important recurrent patterns such as the early onset of the disease occurring in areas where whiteflies are in low numbers, strengthening the hypothesis that the vector is extremely efficient at inoculating

cucurbits. Maps displaying the probabilities of occurrence of CYSDV severity could also illustrate the desirability of integrating crop management and patterns, creating the basis for disease management decisions. Such was the case during the summer of 2007, where a volunteer cucurbit plow down period was instituted. During this time, whitefly monitoring using yellow sticky traps, showed a dramatic decrease in whitefly density in and around the cucurbit plow down zone (Figure 1). Although the specific impact of the 2007 melon host-free period remains unclear, this proposed project would further clarify the role of host free periods. Disease incidence surveys for CYSDV were also taken, those producers in areas which complied with the voluntary plow down program (Yuma Valley) had less subsequent disease incidence than in locations that did not. It seems that beyond a good overall cultural and pest management program for whitefly suppression, a chief focus for virus control could include host free periods.



Medium Term Outcomes: The analysis of disease severity might reveal some valuable recurrent patterns during the timeframe of the study. Maps displaying the probabilities of occurrence of regional CYSDV severity could also illustrate the desirability of integrating crop management and patterns, creating the basis for disease management decisions. Producers will gain a greater understanding regarding disease spread and how cropping patterns influence hosts for CYSDV, especially host free periods.

Long Term Outcomes: The over arching goal of this proposed study is to provide producers, a better understanding of the interrelationship between CYSDV, agricultural production and economic decision making . In essence, we hope to illustrate the desirability of integrating crop management and patterns and create an informed basis for disease management decisions for Arizona melon producers. We also hope this effort will provide a greater awareness for the agricultural dynamic within urban settings.

Plan for Evaluation:

An assessment program will incorporate the following objectives and will be a large component of a final report which will summarize the project.

- Conduct pre and post test surveys during workshops to assess knowledge gained.
- Create a website survey and establish the usefulness of the whitefly/CYSDV monitoring program.
- Web counter to provide regional and statewide use statistics.
- Survey grower responses to melon plow down programs.