

Proceedings

2003 Southeastern Regional Vegetable Conference

**January 10 - 12, 2003
Savannah Civic Center
Savannah, Georgia**

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P.O. Box 1209
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**Sponsored by:
Georgia Fruit and Vegetable Growers Association**

In cooperation with:

**The University of Georgia
Cooperative Extension Service
Georgia Watermelon Growers Association
Vidalia Onion Committee**

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| A & B Packing Equipment | Durand-Wayland |
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FORWARD

The continued success of the Georgia vegetable industry is dependent upon the dissemination of timely and appropriate information. The assimilation and distribution of technology beneficial to the industry is a major effort of both the Agriculture Experiment Station and the Cooperative Extension Service at the University of Georgia. This is accomplished through basic and applied research, on-farm tests, observations and situation assessments and delivered through personal contact and programs such as this conference. The proceedings of this conference are provided to give our clientele an opportunity to evaluate recent information and developments that might concern them. We appreciate the participation of growers and research, extension, regulatory and service workers as well as those representatives of the fertilizer, seed, crop protection, publication, processing, packaging and handling industries. The presentations, discussions, and exhibits at this conference are designed to sustain the competitiveness and environmental integrity of the Georgia vegetable industry. Your comments and suggestions are important to us. Please address appropriate comments to authors, moderators or members of the conference committee or to the editor.

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2003 Vegetable Conference Program

Friday - January 10, 2003

10:00-11:00 a.m. Concurrent Sessions

Session #1 - Vidalia Onion Production -

Moderator: Gregory Hardison

UGA County Extension Coordinator, Mount Vernon, GA

10:00-10:20a.m. **Effect of CO₂ on Onions**

Dr. Albert C. Purvis, UGA - Tifton, GA

10:20-10:40a.m. **Preemergence and Post Emergence Weed Control in Vidalia Onion Seed Beds**

Mr. Jeff Cook, Univ. of GA Coop. Ext. Service - Reidsville, GA

10:40-11:00a.m. **Results of Controlled Atmosphere Storage of Variety Trial Onions**

Dr. George E. Boyhan, UGA - Statesboro, GA

Session #2 - New Products Update -

Moderator: James Jacobs

UGA County Extension Agent, Nashville, GA

10:00-10:20a.m. **New Disease Control Options for Georgia Vegetables**

Dr. David B. Langston, Jr., UGA - Tifton, GA

10:20-10:40a.m. **New Insecticides for Georgia Vegetables**

Dr. Stormy Sparks, UGA - Tifton, GA

10:40-11:00a.m. **New Vegetable Herbicides for the 2003 Season**

Dr. A. Stanley Culpepper, UGA - Tifton, GA

1:30-3:00p.m. Concurrent Sessions

Session #3 - Marketing, Exports and Value Added Opportunities

Moderator: Brad Mitchell

UGA County Extension Coordinator - Camilla, GA

1:30-2:00p.m. Distribution Channels, Miami Produce Exporters and the Island Markets

Ms. Margie Bauer, USDA, FAS, Caribbean Basin Agri. Trade Office
Miami, FL

2:00-2:30p.m. Export Potentials for Georgia Fruits, Vegetables and Nuts

Dr. Greg Fonsah, UGA - Tifton, GA

2:30-3:00p.m. Go South Fruit & Vegetable Marketing in Canada

Ms. Cory Streef, Faye Flack - Marketing/SUSTA, Toronto, Canada

Session #4 - Methyl Bromide Alternative Update

Moderator: Joel Hudgins

UGA County Extension Agent - Bainbridge, GA

1:30-2:00p.m. Performance of Methyl Bromide Alternatives in Pepper

Dr. A. Stanley Culpepper and Dr. David B. Langston, Jr. UGA - Tifton, GA

2:00-2:30p.m. Yellow Nutsedge Control with Methan-Sodium in Transplanted Cantaloupe

Dr. Wiley C. Johnson, III. - USDA - Tifton, GA

2:30-3:00p.m. Critical Use Exemption for Methyl Bromide

Dr. William Terry Kelley, UGA - Tifton, GA

3:30p.m.-5:00p.m. Concurrent Sessions

Session #5 - Insect Management

Moderator: Glenn Beard

UGA County Extension Agent - Moultrie, GA

3:30-3:50p.m. Use of Scouting and Thresholds in Vegetable Insect Pest Management

Dr. David Riley, UGA - Tifton, GA

3:50-4:05p.m. European Corn Borer Certification Program

Mr. Barry Smith, GA Department of Ag - Tifton, GA

4:05-4:20p.m. Management of Mosaic Viruses on Squash and Pumpkins

Dr. Stormy Sparks, UGA - Tifton, GA

4:20-4:40p.m. Cucurbit Yellow Vine Disease: A Threat to the Cucurbit Industry?

Dr. S.D. Pair, USDA-ARS- Lane, OK

4:40-5:00p.m. Management of Silver Leaf Whitefly and Spider Mites

Dr. Stormy Sparks, UGA - Tifton, GA

Session #6 - Maintaining Quality and Minimizing Rejected Loads

Moderator: Dr. Russ Hamlin

UGA County Extension Coordinator - Statenville, GA

3:30-4:00p.m. **Maintaining Quality, During Harvest and Handling Operations**

Dr. Steve Sargent, Univ. of Florida - Gainesville, FL

4:00-4:30p.m. **Understanding Chilling Injury and Recognizing Its Symptoms**

Dr. Jeffrey K. Brecht, Univ. of Florida - Gainesville, FL

4:30-5:00p.m. **Postharvest Treatments for Ripening and Sanitation**

Dr. Jeffrey K. Brecht, Univ. of Florida, Gainesville, FL

Saturday - January 11, 2003

8:30-11:00a.m. General Session

2:00-3:30p.m. Concurrent Sessions

Session #7 - Phytophthora and Tomato Spotted Wilt Virus

Moderator: Tim Flanders

UGA County Extension Coordinator - Cairo, GA

2:00-2:30p.m. **Identification of Weed Sources of Thrips Vectors of TSWV Around Vegetable Crops**

Dr. David Riley, UGA - Tifton, GA

2:30-3:00p.m. **Fungicide Performance Against *Phytophthora* Crown and Yellow Fruit Rot of Yellow Squash 2001/2002**

Dr. Kenneth W. Seebold, UGA-Tifton, GA

3:00-3:30p.m. **Management of TSWV in Tomatoes with Mulches, Insecticides and Plant Activators**

Dr. Tim Momol, Univ. of Florida, Quincy, FL

2:00-3:30p.m.

Session #8 - Homeland Security: How Does it Affect Me?

Moderator: Ben Tucker

UGA County Extension Coordinator, Adel, GA

- 2:00-3:00p.m. **Will Labor Be Available in 2003??**
 Dan Bremer, AgWorks, Lake Park, GA
- 3:00-3:30p.m. **How Can I Make My Farm More Secure?**
 Dr. Doug Archer, Univ. of Florida - Gainesville, FL

Georgia Watermelon Association Annual Meeting

Friday, January 10, 2003

Educational Session #1 - New Products Update

See Vegetable Program - Session #2

Educational Session #2 - Watermelon Production - I

Moderator: Keith Rucker

UGA County Extension Agent - Tifton, GA

- 1:30-2:00p.m. **Resistance to Azoxystrobin (Quadris) in the Gummy Stem Blight Pathogen in Georgia**
 Dr. Katherine L. Stevenson, UGA - Athens, GA
- 2:00-2:30p.m. **Powdery and Downy Mildew in Georgia Watermelons**
 Dr. David B. Langston, Jr., UGA - Tifton, GA
- 2:30-3:00p.m. **Georgia Watermelon Variety Evaluations**
 Dr. George E. Boyhan, UGA-Statesboro, GA

Educational Session #3 - Watermelon Production - II

Moderator: Ronnie Barrentine

UGA County Extension Coordinator - Hawkinsville, GA

- 3:30-4:00p.m. **Ozone Injury of Watermelon: How to Recognize It and What You Can Do About It**
 Dr. Gerald Holmes, N.C. State University, Raleigh, NC
- 4:00-4:30p.m. **Water Use Efficiency and Strip Tillage in Watermelons**
 Dr. Frank E. Dainello, Texas A&M University, College Station, TX
- 4:30-5:00p.m. **Watermelon Weed Management Update**
 Dr. A. Stanley Culpepper, UGA - Tifton, GA

FOOD SAFETY GAP WORKSHOP

Friday
January 10, 2003

MORNING SESSION:

Preparing for a Third-Party Audit

- 8:30 a.m. **WELCOME AND INTRODUCTION**
Good Agricultural Practices and a Farm Food Safety Plan
Bill Hurst, UGA - Athens, GA
- 8:40 a.m. **Why Do Georgia Growers Need Food Safety Certification?**
Consumers, Consumers, Consumers,
Charles Hall, GFVGA
- 8:50 a.m. **Georgia GAP Certification - An Overview**
What does "Certification" mean?
Vernon Mullins, GDA
- 9:05 a.m. **The Georgia GAP's Audit Process**
Where do I start?
Terry Hollifield, GCIA
- 9:30 a.m. **BREAK IN THE TRADE SHOW**
- 10:00 a.m. **The Audit Process - Section I - General**
Take a different look at your business with familiar tools
Terry Hollifield, GCIA
- 10:20 a.m. **Section II - Crop Production**
Georgia GAP's - Focus on the Field
Darbie Granberry, UGA - Tifton, GA
- 10:40 a.m. **Section III - Field Harvesting, Packing, Transportation**
Human to Product Contact - The first time or the last time
George Ponder, GFVGA
- 11:00 a.m. LUNCH (On your own)
Available in the Trade Show

FOOD SAFETY GAP WORKSHOP

AFTERNOON SESSION:

Preparing for a Third-Party Audit

- 1:00 p.m. **Section IV - Packing Facility**
Your most visible asset - Make it work for you
Bill Hurst - UGA - Athens, GA
- 1:20 p.m. **Section V - Worker Health & personal Hygiene**
Employee Hygiene - The Other Main Ingredient
Bill Hurst - UGA - Athens, GA, George Ponder - GFVGA
- 1:45 p.m. **Section VI - Storage**
Cold Storage - for Quality and Food Safety
Terry Crane, GCIA
- 2:05 p.m. **Section VII - Transportation**
Your last line of Defense
Vernon Mullins, GDA
- 2:25 p.m. **Section VIII - Traceability**
We really DO want them to know where it came from
Terry Hollifield, GCIA
- 2:40 p.m. **Water Sanitation Test Kits Demonstration**
Can I use my pool water testing kit?
Bill Hurst, UGA - Athens, GA
- 3:00 p.m. **BREAK IN THE TRADE SHOW**
- 3:15 p.m. **Collection & Analysis of Water for the Georgia GAP Audit**
Paul Vendrell, FEW - UGA
- 3:30 p.m. **Conducting an On-Farm or Packing Facility Pre-Audit**
Getting you ready for the big game - no surprises!
George Ponder, GFVGA
- 3:50 p.m. **How to Write & Implement a Standard Operating Procedure (SOP)**
What is a SOP? In a language we can all understand
Bill Hurst, UGA - Athens, GA
- 4:30 p.m. **CONCLUDING REMARKS & EVALUATION**

**VEGETABLE
ABSTRACTS
AND
SUMMARIES**

Editor's Note: Those presentations whose summaries/abstracts are not included in these proceedings were not available at press time.

Session #1

Vidalia Onion Production

Moderator: Gregory Hardison

EFFECT OF CO₂ ON ONIONS

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Translucent scale of onions is a physiological disorder that may appear during cold storage. It is characterized by a clearing and watersoaking of the normally opaque cells of the fleshy internal scales and has also been called watery scale. Although the symptoms are similar to freezing injury, freezing injury usually affects the outer fleshy scales first whereas translucent scale is found in the second, third or even more inner scales. Furthermore, translucent scale has been observed when the storage temperature was maintained well above the freezing point (approximately 30 °F or -1 °C) of onions. Predisposing factors for the development of translucent scale during storage are thought to be high humidity and high temperatures (90 °F or 32 °C) during the last two months of the growing season and a 2 to 4 week delay between curing and cold storage. It has also been suggested that the internal disorder is caused by the combined effects of high CO₂ concentrations, low temperature, and a relatively long storage period. During the 2000-2001 season some Vidalia onions growers observed translucent scale in onions stored in refrigerated storage rooms without CA.

While previous studies have implicated high CO₂ as a causal factor in the development of translucent or watery scale in stored onions, the results have been confounded by low O₂ concentrations in the storage room atmosphere. During the 2001-2002 season 'Savannah Sweet' onions were stored in air or air + 10% CO₂ in 8-gallon (32-liter) plastic containers at 34 °F (1 °C). The O₂ and CO₂ levels were monitored every three days. No attempt was made to control the relative humidity, which was probably over 85%. After 13 weeks the onions were removed from the containers and rewarmed by blowing room temperature (80 °F or 27 °C) air across them. The external surface of each onion was examined for evidence of infection with *Botrytis allii* (neckrot), *Penicillium* spp. (blue mold), *Aspergillus niger* (black mold) and *Pseudomonas cepacia* (sour skin). The onions were then cut in half and examined for internal rots and translucent scale.

All onions which had been stored in air + 10% CO₂ exhibited internal breakdown or translucent scale, but no onions stored in air alone exhibited translucent scale. However, none of the onions stored in air + 10% CO₂ showed no evidence of fungal growth or sporulation on the external surface, whereas all of the onions stored in air were mostly covered with sporulating mycelia of *Botrytis allii*, *Penicillium* spp., or both. Thus, the results show clearly that translucent scale is associated with high CO₂ and not low O₂ in the storage atmosphere. Furthermore, pre-harvest environmental conditions did not appear to be involved in the development of translucent scale since translucent scale did not occur in onions stored in air with ambient CO₂ concentrations. Translucent scale may be a greater problem in refrigerated storage rooms without CA than in CA rooms unless the CO₂ produced by respiration of the onions is monitored and the levels controlled.

PREEMERGENCE AND POST EMERGENCE WEED CONTROL IN VIDALIA ONION SEED BEDS

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There are very few options for pre and post emergence weed control in Vidalia onion transplant production. The majority of growers in the Vidalia onion belt will fumigate prior to seeding. Many fumigants will aid in weed control, but weeds can still be a problem. There are several herbicides that can be used to control grasses that are not control by fumigants, but few options for broadleaf weeds. Most growers rely heavily on oxyfluorfen (Goal) for control of broadleaf weeds. This product does a good job at controlling many weeds that are a problem during transplant production, but some onion injury can occur.

Another product that is labeled for use on transplant onions is DCPA (Dacthal). Use declined because of some crop stunting at labeled rates and because production was limited after 1997. Dimethenamid (Outlook) is a herbicide that is of interest in onions for control of small seeded broadleaf weeds, grasses and suppressing yellow nutsedge. The objective of this work was to evaluate transplant onion and weed response to a pre emergence treatment of Dacthal and Outlook. A second objective was to evaluate tank mixes with Prowl, Outlook and Goal applied post emergence to reduce the need for sequential Goal applications.

No visual injury was observed when 4 lb/A of Dacthal was applied pre emergence, however visual stunting was noted at the 8 lb/A rate. Outlook stunting was 10-17 % greater than the 4 lb/A Dacthal treatment, and a reduction in plant stand was observed. In the Tank mix trials Goal alone caused 9-15% injury. Adding 16 oz of Outlook increased injury by 6-16%, and the Outlook, Prowl and Goal mixture increased injury 5-7%. As a fall application Dacthal applied pre emergence did not hurt onions and provided excellent weed control. Injury caused by outlook pre or post emergence was not acceptable.

¹Reid Torrance, Tattnall County Extension Service; Stanley Culpepper, University of Georgia Extension Specialist, Agronomy

RESULTS OF CONTROLLED ATMOSPHERE STORAGE OF THE VIDALIA ONION VARIETY TRIAL

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Variety selection is an important part of onion production. Varieties can be quite different as to yield, flavor, and other quality parameters. Vidalia onion production has been revolutionized over the past 13 years with the adoption of controlled atmosphere (CA) storage. This high CO₂ (5%), low O₂ (3%), refrigerated storage can extend onion availability 4-6 months beyond the fresh market season.

CA storage has not, however, been the panacea that growers expected. Unpredictable storage results have plagued this technology. Several factors have contributed to this uneven success, including diseases, variety selection, and maintaining proper storage conditions.

Among the evaluation criteria for onions is suitability for CA storage. Onion varieties were grown according to University of Georgia and cooperative extension service recommendations in a randomized complete block design with four replications. Onions were harvested when mature for that specific variety, heat cured, and graded by size. Approximately 50 pounds of jumbo and medium onions from each plot was placed into CA storage for 5 months. All onions were removed on 7 October 2002 and immediately separated into marketable and unmarketable onions. In addition, 14 days later these onions were again evaluated for marketable onions.

Table 1 lists the CA storage results from the 2002 Vidalia onion variety trial. Overall the results were better this year than in past years with a higher percentage of marketable onions among the varieties. All of the onions lost marketable yield from the time they were immediately removed from storage to being reevaluated 14 days later.

After 14 days, most of the varieties still had better than 70% marketable onions. Only Yellow Granex PRR, WI-3115, Savannah Sweet, DPS 1033, Cyclops, and Sweet Melody had significantly lower marketable yield compared to DPS 1032. Both Savannah Sweet and Sweet Melody have been among the best performers for CA storage in previous years.

Table 1. Vidalia Onion Variety Trial 2001-2002 CA Storage Results

| Cultivar | Seed Company | Percent Marketable | |
|---------------------------|------------------|----------------------|-----------------------|
| | | 0 Days After Removal | 14 Days After Removal |
| DPS 1032 | D. Palmer Seed | 97% | 89% |
| SSC 6372 F1 | Shamrock | 94% | 89% |
| DPS 1039 | D. Palmer Seed | 93% | 88% |
| DPS 1024 | D. Palmer Seed | 95% | 87% |
| RCX 6043 | Sunseeds | 96% | 87% |
| Sweet Advantage | D. Palmer Seed | 92% | 86% |
| Sweet Melissa | Sunseeds | 95% | 84% |
| PS 7092 | Seminis/Petoseed | 95% | 84% |
| Numex Chaco | Lockhart | 95% | 84% |
| Sugar Belle F1 (SSC 6371) | Shamrock | 90% | 83% |
| Nirvana (1027) | Sunseeds | 92% | 81% |

| | | | |
|---------------------------|----------------|-----|-----|
| Sweet Vidalia | Sunseeds | 92% | 81% |
| 99C 5092 | Sakata | 89% | 79% |
| EX 07592000 | Seminis/Asgrow | 92% | 79% |
| WI-609 | Wannamaker | 91% | 79% |
| EX 07592001 | Seminis/Asgrow | 91% | 79% |
| Southern Belle | D. Palmer Seed | 86% | 77% |
| Granex 33 | Seminis/Asgrow | 88% | 77% |
| Southern Honey | D. Palmer Seed | 90% | 76% |
| Liberty | Bejo Seed Co. | 93% | 75% |
| Pegasus | Seminis/Asgrow | 88% | 75% |
| EX 19013 | Seminis/Asgrow | 93% | 73% |
| RCX 5195-1 | Sunseeds | 86% | 72% |
| Granex Yellow, PRR Asgrow | Seminis/Asgrow | 88% | 72% |
| Rio Bravo | Sunseeds | 90% | 72% |
| Yellow Granex PRR Sunseed | Sunseeds | 86% | 68% |
| WI-3115 | Wannamaker | 82% | 67% |

| | | | |
|-------------------|-----------------------|-------|-------|
| Savannah Sweet | Seminis/Petoseed | 88% | 59% |
| DPS 1033 | D. Palmer Seed | 83% | 57% |
| Cyclops (XP 6995) | Seminis/Asgrow | 83% | 54% |
| Sweet Melody | Sunseeds | 71% | 38% |
| <hr/> | | | |
| | CV | 9% | 20% |
| | R ² | 0.392 | 0.569 |
| | Adjusted LSD (p≤0.05) | 12.3% | 19.3% |

Session #2

New Products Update

Moderator: James Jacobs

New Disease Control Options for Georgia Vegetables

David B. Langston, Jr.
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Procure® 50WS (triflumizole) just received a new label for cucurbits. This fungicide is a good option for powdery mildew and it performs as well as Nova® in squash trials. However, Procure uses the same mode of action as Nova so it should be rotated with a fungicide of another mode of action such as sulfur, Quadris®, and Flint®. The use rate is from 4.0 - 8.0 oz/acre with the higher rates giving the most consistent results on powdery mildew.

Cabrio™ EG is a new broad spectrum fungicide that has just been labeled for many vegetables in the U.S. The active ingredient is pyraclostrobin, which is a strobilurin fungicide like Flint (trifloxystrobin), and Quadris (azoxystrobin). The new label includes uses on onions, carrots, turnips, radish, tomatoes, pepper (all), eggplant, and all cucurbit crops. Cabrio will have good activity on Alternaria, Anthracnose, and powdery mildew but has shown excellent control of Cercospora and downy mildew in university field trials. The use rates for Cabrio are 8.0 - 16.0 oz/acre. Since the mode of action is the same as other strobilurins, it should not be rotated with other strobilurin fungicides directly and the resistance in gummy stem blight is the same as Quadris (cross resistance).

Gavel® 75DF fungicide just received a supplemental label on tomatoes and cucurbits on May 21st. Gavel is primarily a material used to control downy mildew and Phytophthora diseases but it will suppress other foliar diseases such as Alternaria. In my trials Gavel performed as good or better than Ridomil Gold® Bravo® towards suppressing downy mildew in pumpkins. The use rate for Gavel is 2.0 lbs/acre.

Acrobat® 50WP has recently been labeled on cucurbits, lettuce and onions. This material is primarily going to be useful for downy mildew on cucurbits. Notice that it is also labeled for control of *Phytophthora capsici* on cucurbits. We had used Acrobat MZ (Acrobat + mancozeb) for suppression of this disease in 1998 and 1999 pursuant to a Section 18. In recent trials, Acrobat has not performed as well as Ridomil or Ultra Flourish (both contain mefenoxam) on non-mefenoxam-resistant strains. However, Acrobat may be more effective on resistant strains.

NEW INSECTICIDES FOR GEORGIA VEGETABLES

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In the past few years, several new insecticide chemistries have been developed and registered for use on vegetables. These products are typically more selective than older chemistries and more expensive, making a thorough understanding of their uses and limitations essential to maximize benefits. New insecticide chemistries, their crop registrations, and pests controlled will be discussed.

NEW VEGETABLE HERBICIDES FOR THE 2003 SEASON

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Herbicide options are limited in most vegetable crops produced in Georgia. However, herbicide options are growing at an exciting rate in Georgia due to efforts by IR-4 (Interregional Project No. 4), herbicide manufacturers, the Georgia Department of Agriculture, the Environmental Protection Agency, and the University of Georgia Cooperative Extension Service. In the past year alone, Georgia vegetable growers have received over 40 new herbicide uses. Many of these herbicide uses are listed below, however, obtain the respective herbicide label or the 2003 Georgia Pest Control Handbook for proper herbicide rates, application methods, and all restrictions regarding these herbicide uses.

- 1) Command (clomazone) labeled for at-plant applications in cabbage, green peas, lima bean, pole bean, snap bean, and southern pea.
- 2) Roundup WeatherMax (glyphosate) labeled for hooded row middle applications in broccoli, cabbage, cauliflower, celery, collard, dry bean, eggplant, green pea, garlic, Irish potato, kale, lettuce, lima bean, mustard, okra, onion, pepper, pole bean, snap bean, southern pea, sweet potato, and turnip.
- 3) Matrix (rimsulfuron) labeled for postemergence application in tomato.
- 4) Sandea (halosulfuron) labeled for cantaloupe, cucumber, and tomato.
- 5) Select (clethodim) labeled for postemergence application in collard, kale, mustard, and turnip.
- 6) Strategy (a mixture of ethalfluralin + clomazone) labeled for at-plant applications in cantaloupe, cucumber, squash, and watermelon.

Session #3

Marketing, Exports and Value Added Opportunities

Moderator: Brad Mitchell

EXPORT POTENTIALS FOR GEORGIA FRUIT, VEGETABLES AND NUTS (A CASE STUDY OF THE CARIBBEAN BASIN MARKETS)

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Introduction

The increase in US agricultural trade was triggered by several factors such as population growth, changes in macroeconomic performance, the depreciation of the US dollar against the euro and other developed economy currencies, and unfavorable weather conditions that affected some of the US competitors. Conversely, the strong US dollar against the yen and other foreign currencies has an adverse effect on the overall US agricultural trade balances. For instance, China has recently become the export leader of fresh and frozen fruits and vegetables to Japan, position that the US maintained for over a decade. In 2000, China had already captured 35% of Japanese market for fruits and vegetables, up from 6% in 1990. Furthermore, the implementation of the North American Free Trade Agreement (NAFTA) was instrumental in boosting trade ties between Canada, Mexico and the United States (Whitton, 2002; Huang, 2002).

Consequently, Canada has historically outpaced Japan to now become the US number one trading partner and a principal importer of US fruits, vegetables, grains, oilseed and meat in 2002. Even though Georgia, California and Florida are the principal squash producing states, Mexico still remains the main competitor as 98% of total US squash import in 2000 originated from Mexico (Whitton and Carter, 2002). Presently, Georgia supply of onions, watermelons, cabbages, cucumbers, bell pepper, peaches, snap beans, eggplants, pecans and lima beans surpasses local/domestic demand (Wolf and Fonsah, 2002). Therefore, the problem at hand is how to develop new markets for Georgia fruits and vegetables that would absorb the excess output, which is the main objective of this study (Fonsah et.al., 2002). The Caribbean Basin Markets were targeted for this study because of the proximity, easy to access and favorable atmosphere for American products and people.

Methods

Two sets of marketing questionnaires were developed for this research on export potential for Georgia fruits, vegetables and nuts. Fifteen copies of “Food and Agricultural Products Available From the State of Georgia, U.S.A.” survey was obtained from Georgia Department of Agriculture, Office of International Trade. Additional 50 copies were duplicated, making a total of 65 copies. This questionnaire listed a total of 45 products produced in Georgia, from bakery, beef, pork, poultry to fruits vegetables and nuts. There was separate room for “other products” and “all products”. Out of 65 copies, only thirty were actually distributed and 23, equivalent of 77% responded.

The second marketing survey was comprehensive and exhaustive, developed at the University of Georgia, Department of Agriculture and Applied Economics. It was strictly based on fresh and frozen fruits and vegetables produced in the State of Georgia. Fifty copies of the six pages long marketing survey covered all fruits such as blueberries, peaches, pecans etc. and all vegetables, known to be produced in Georgia, i.e. cucumbers, onions, cabbage, carrots, eggplants, zucchini etc. These survey/questionnaires were purposively developed to gather information on marketing channel, structure, levels of satisfaction and to determine the sources and preference of supply to the Caribbean Basin Markets in general and to St. Maarten, Barbados and Trinidad in particular. Only six, or 29% of the total 21 copies distribute, responded. These questionnaires were distributed to Supermarkets operators, Import/Export distributors, Hotel and Restaurant Managers (HRI) who attended the Caribbean Basin Trade Mission in St. Maarten, Barbados and Trinidad from June 09 – 15, 2002.

Results and Discussions

The following are some of the research findings obtained from the two marketing surveys conducted in at the Caribbean Basin Trade Show in St. Maarten, Barbados and Trinidad respectively.

1. The respondents were asked to indicate which products interested them from a list of 45 different products, including fruits and vegetables produced in Georgia. Table 1 reveals that 71% and 64% of the total respondents in St. Maarten indicated a significantly high preference for fruits and vegetables. There were 14 companies that responded in St. Maarten.

Table 1: Products from Georgia that Interest Buyers in St. Maarten

| Products | Percentage |
|--------------------------------|-------------------|
| Beef & beef products | 71 |
| Canned goods | 50 |
| Dairy products | 64 |
| Egg & egg products | 50 |
| Frozen foods | 57 |
| Fruits | 64 |
| Grocery & value-added products | 50 |
| Pork & pork products | 64 |
| Poultry and poultry products | 57 |
| Seafood | 50 |
| Vegetables | 71 |

In Barbados, 12 out 45 different products from Georgia ranked above 50% in their scale of preference. Table 2 below depicts that fruits and seafood were at the top of their preference, follow by vegetables and other products. It was also interesting to not that this market outlet actually sorted out peaches from fruits category. Furthermore, only 5 companies actually responded to the questionnaire provided.

| Products | Percentage |
|-------------------------------|-------------------|
| Bakery products & ingredients | 60 |
| Beef & beef products | 60 |
| Canned goods | 60 |
| Dairy products | 60 |
| Frozen foods | 60 |
| Fruits | 80 |
| Juices | 60 |
| Peaches | 60 |
| Peanut butter | 60 |
| Sauces & salad dressings | 60 |
| Seafood | 80 |
| Vegetables | 60 |

In Trinidad, 10 categories of products hit their preference list. Table 3 reveals that the most preferred were frozen foods, fruits, pork and pork products, spices, flavoring and extracts and vegetables. Only 4 companies responded to this marketing survey in Trinidad, but the information obtained were usable and it provides an insight into the market situation of the country.

Table 3: Products from Georgia that Interest Buyers in Trinidad

| Products from Georgia | Percentage |
|-------------------------------|-------------------|
| Bakery products & ingredients | 50 |
| Beef & beef products | 50 |
| Canned goods | 50 |
| Dairy products | 50 |
| Frozen foods | 75 |
| Fruits | 75 |
| Juices | 50 |
| Pork & pork products | 75 |
| Spices, flavorings, extracts | 75 |
| Vegetables | 75 |

2. Indicate frequently purchased fresh fruits and vegetables and their sources of supply.

Table 4 shows that about 14 fruits and vegetables produced in Georgia were in high demand in the Caribbean Basin Markets and all these crops are imported from the United States. However, one 22% of the total peach sales volume is actually imported from Georgia. Furthermore, the

studies show that an insignificant quantity of the crops are produced locally, thus very little competition for the US producers.

Table 4: Frequently Purchased Fresh Fruits and Vegetables and Their Sources of Supply

| Products | % Fresh Purchase | % Imported from the US | % Local purchase | % Georgia Purchase |
|-----------------|-------------------------|-------------------------------|-------------------------|---------------------------|
| Cantaloupes | 83 | 96 | 4 | 0 |
| Peaches | 83 | 78 | 0 | 22 |
| Watermelon | 83 | 100 | 0 | Not sure |
| Snap bean | 50 | 100 | 0 | 0 |
| Cabbage | 83 | 95 | 5 | 0 |
| Carrots | 100 | 96 | 4 | Not sure |
| Cucumber | 50 | 50 | 50 | Not sure |
| Eggplants | 67 | 67 | 33 | 0 |
| Spinach | 50 | 50 | 50 | 0 |
| Green Onions | 87 | 78 | 22 | 0 |
| Bell Pepper | 100 | 88 | 12 | 0 |
| Cherry tomato | 50 | 100 | 0 | 0 |
| Yellow squash | 67 | 100 | 0 | 0 |
| Zucchini | 83 | 100 | 0 | 0 |

- The respondents were asked their fresh product purchasing requirements. Table 5 shows that quality, price, reliability and convenience were top priorities, as they ranked high on the table. Business partner relationship, follow-ups and dependability were important factors that influenced purchasing decision and were classified as “others”.

Table 5. Average Ranking of Wholesalers and Distributors Purchase Decision for Fresh Produce

Importance of Specific Factors in Wholesalers/Distributors Purchase Decision for Fresh Produce -Ranked Most to Least Important

(n=8)

| Factor | Average Ranking |
|----------------|------------------------|
| Quality | 2.0 |
| Price | 2.5 |
| Reliability | 2.6 |
| Convenience | 2.8 |
| Transportation | 3.4 |
| Quantity | 4.4 |
| Origin | 5.8 |

Conclusion

The result of this study depicts that the Caribbean Basin is a potential export market for Georgia fruits and vegetables. These countries rely heavily on US products including fruits and vegetables. Unfortunately, Georgian farmers have yet to take advantage of this booming opportunity to penetrate these growing markets to dispose of our excess fruits and vegetables production.

Acknowledgment

I am extremely grateful to the Georgia Fruits and Vegetables Growers Association (GFVGA), that provided funding for this research project. Equal thanks to Ms Margie Bauer, Director of USDA/FAS, Caribbean Basin Agricultural Trade Office, Miami, Florida who facilitated my participation at the Caribbean Basin Trade Mission and to Mr. Andreas Villegas, Director, Marketing and International Trade Office, Georgia Department of Agriculture, who provided some of the assistance for this research. Thanks to Dr. John McKissick and Dr. Fred White for their recommendations.

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Session #4

Methyl Bromide Alternatives Update

Moderator: Joel Hudgins

PERFORMANCE OF METHYL BROMIDE ALTERNATIVES IN PEPPER

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Introduction

Methyl bromide is currently the fumigant of choice for pepper production on plastic mulch for control of weeds, nematodes and soilborne diseases. Methyl bromide has been targeted as a culprit in the depletion of the atmosphere ozone layer. As a result, the use of methyl bromide is being phased out. Under the current protocol, growers experienced a 25% reduction in methyl bromide use in 1999 and an additional 25% reduction in 2001. By 2005, methyl bromide will no longer be available for use in the United States.

Fumigant combinations of Telone II, Chloropicrin, Telone C35, and KPAM or Metam have been touted as replacement alternatives for methyl bromide. Research has shown several of these fumigants are effective in managing nematodes and soilborne diseases but nutsedge control is extremely variable. Thus, an experiment was conducted to evaluate these potential fumigant combination alternatives for the control of nutsedge species.

Materials and Methods

The experiment was conducted in the fall of 2002 at the Ponder Farm located near TyTy, Georgia. Soil was a sandy loam with 94% sand, 2% silt, and 4% clay, typical of most vegetable producing areas. Fumigant treatments and application methods were as follows:

1. Methyl bromide (300 lb/A broadcast) injected 6-8 inches in the bed with a super-bedder plastic layer.
2. Telone II (12 gal/A broadcast) injected 12 inches deep with a Yetter rig followed 6 days later with Chloropicrin (150 lb/A broadcast) injected 6-8 inches in the bed with a super-bedder plastic layer.
3. Telone II (12 gal/A broadcast) injected 12 inches deep followed immediately with Chloropicrin (150 lb/A broadcast) injected 6-8 inches in the bed with a super-bedder plastic layer.
4. Telone C35 (35 gal/A broadcast) injected 6-8 inches in the bed with a super-bedder plastic layer.
5. Telone C35 (35 gal/A broadcast) injected 10-12 inches deep with a Yetter rig.
6. Telone C35 (35 gal/A broadcast) injected 10-12 inches deep with a Yetter rig followed immediately with Chloropicrin (150 lb/A broadcast) injected 6-8 inches in the bed with a super-bedder plastic layer.
7. Telone C35 (17.5 gal/A broadcast) injected 12 inches deep with shanks on a tillage implement while spraying and incorporating KPAM (46 gal/A broadcast) 3-4 inches deep. Super-bedder plastic layer followed immediately.
8. No fumigant.

Fumigants were applied on August 7 and Stiletto pepper were transplanted on August 22. Plants were placed one foot apart with two rows on a 32 inch bed top. Pepper heights were taken 35 days after transplanting by measuring heights on 14 plants per plot. Nutsedge infestations (75% purple and 25% yellow) were measured by counting the number of shoots emerging through the plastic in a seven square meter area per plot. Percent nutsedge control was calculated by comparing number of plants in a treated plot to those in the non-treated control. Nematode

samples were taken; however, results have not been returned at this time. Insecticides, fungicides, and the fertility program followed those recommended by the University of Georgia Cooperative Extension Service.

Results and Conclusions

Nutsedge Control by Fumigants. At 18 days after pepper transplanting or 33 days after laying plastic, nutsedge control was at least 91% by all fumigant options with the exception of the co-application of Telone C35/ KPAM combination which provided only 71% reduction in nutsedge plants emerging through the plastic (Table 1).

At mid-harvest (67 day after transplanting), nutsedge control was greater than 90% with only methyl bromide (Table 1). Good control was received with Telone C35 prebed followed by chloropicrin in the bed. The only other two treatments providing at least 70% control were Telone C35 injected in the bed with the super-bedder plastic layer and Telone II applied broadcast with the Yetter rig followed 6 days later with Chloropicrin injected in the bed with the super-bedder plastic layer.

Table 1. Percent nutsedge control with methyl bromide alternative options.¹

| Fumigant Option ² | Days after laying plastic | |
|---|---------------------------|---------|
| | 33 days | 81 days |
| Methyl Bromide (300 lb/A) in bed | 99 a | 93 a |
| Telone II (12 gal/A) prebed + Chloropicrin (150 lb/A) in bed | 91 a | 63 d |
| Telone II (12 gal/A) broadcast + Chloropicrin (150 lb/A) in bed | 94 a | 75 c |
| Telone C35 (35 gal/A) in bed | 97 a | 70 cd |
| Telone C35 (35 gal/A) prebed | 94 a | 41 f |
| Telone C35 (35 gal/A) prebed + Chloropicrin (150 lb/A) in bed | 100 a | 84 b |
| Telone C35 (17.5 gal/A) prebed + KPAM (46 gal/A) prebed | 71 b | 50 e |
| no fumigant | 0 c | 0 g |

¹Trial conducted at the Ponder farm. Fumigants applied Aug-7-02. Percent nutsedge control was calculated from nutsedge counts taken from each plot. At 33 days after plastic laying there were 11 nutsedge plants per yard square emerged through the plastic; however, by 81 days after laying plastic there were over 40 nutsedge plants per yard square emerged through the plastic.

²In bed = fumigant applied with super-bedder plastic layer; prebed = application injected with Yetter rig or shanks on a tilrovator and followed within 30 minutes with super-bedder plastic layer, broadcast = applied with Yetter rig and plastic laid 6 days later.

Pepper Response. Fumigants did not stunt pepper (data not shown) compared to the no fumigant treatment at 35 days after transplant. Additionally, the number of Fancy and US No. 1 and 2 boxes harvested were similar among all fumigated plots. To eliminate loss to nutsedge competition, nutsedge control is needed for the first 6 to 10 weeks after transplanting. All fumigant options, except Telone C35 co-applied with KPAM, provided excellent early season control eliminating potential yield losses due to competition. Yield loss likely was not noted with the Telone C35/KPAM combination because early-season nutsedge (11 plants per square yard) emergence was light and over 70% of these plants were controlled by the fumigant. Thus, yield loss would not be expected with such a low level of infestation during early-season pepper production. Number of pepper fruit harvested followed trends noted with the number of pepper boxes harvested per acre (data not shown).

Table 2. Pepper yield with methyl bromide alternatives.

| Fumigant Options ² | Number of 28 pound boxes ¹ | |
|---|---------------------------------------|--------------------|
| | Jumbo (Fancy) | US No. 1 and No. 2 |
| Methyl Bromide (300 lb/A) in bed | 793 a | 546 ab |
| Telone II (12 gal/A) prebed + Chloropicrin (150 lb/A) in bed | 754 a | 775 a |
| Telone II (12 gal/A) broadcast + Chloropicrin (150 lb/A) in bed | 836 a | 545 ab |
| Telone C35 (35 gal/A) in bed | 815 a | 622 a |
| Telone C35 (35 gal/A) prebed | 746 a | 660 a |
| Telone C35 (35 gal/A) prebed + Chloropicrin (150 lb/A) in bed | 870 a | 622 a |
| Telone C35 (17.5 gal/A) prebed + KPAM (46 gal/A) prebed | 798 a | 443 ab |
| no fumigant | 409 b | 279 b |

¹ Fancy fruit were harvested three times. US No. 1 and No. 2 fruit were harvested only once on the third harvest date. Harvest dates were October 18, October 30, and November 15.

²In bed = fumigant applied with super-bedder plastic layer; prebed = application injected with Yetter rig or shanks on a tilrovator and followed within 30 minutes with super-bedder plastic layer, broadcast = applied with Yetter rig and plastic laid 6 days later.

Herbicide/Fumigant Alternative Systems: Although little has been mentioned regarding herbicides in this paper. The trial did include three herbicide systems within each fumigant

option. Several of the herbicides are not registered and thus will not be discussed. However, there were eight systems using Telone fumigant options in combination with herbicides that provided nutsedge control similar to methyl bromide. Of these eight systems, four did not negatively affect pepper height, number or weight of Fancy fruit or number or weight US No. 1 or 2 fruit.

Conclusion

Although these methyl bromide fumigant alternatives appear to be effective in maintaining pepper yields comparable to methyl bromide, this result will likely be short lived. With less nutsedge control noted in the later half of the crop with these alternative fumigants, nutsedge will reproduce astronomically. Thus, the number of plants in each succeeding crop would grow to the point where fair to good control noted with several of these alternatives may not be acceptable for long term vegetable production.

Although there does not appear to be an acceptable fumigant alternative to methyl bromide for nutsedge control, there are several systems using fumigant/herbicide combinations that do have the potential to effectively manage nutsedge. However, limitations of obtaining herbicide labels, herbicide carryover, and potential herbicide injury to the respective crops pose serious threats to developing systems that can be utilized by growers.

YELLOW NUTSEDGE CONTROL WITH METHAM-SODIUM IN TRANSPLANTED CANTALOUPE

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Introduction

Vegetable growers are losing the broad-spectrum soil fumigant methyl bromide. The regulatory circumstances surrounding the impending cancellation of methyl bromide are well documented. Efforts are on-going to extend the deadline for using methyl bromide until suitable alternatives are developed. Significant research effort is on-going to develop alternatives to methyl bromide for weed control in vegetable crop production.

Research on alternatives to methyl bromide fumigation in tobacco transplant beds began in the early 1990's. Tobacco transplant beds are fumigated and seeded in the fall. Weeds controlled by soil fumigation in this system are a composite of warm-season weeds in the fall, cool-season weeds during the winter, and a new flush of warm-season weeds in the early spring. In these early trials, observations were made regarding weed control with alternatives to methyl bromide. First, methyl bromide was not a consistent performer, particularly in controlling yellow nutsedge. Second, metham-sodium-sodium applied as a spray and incorporated was among the most effective fumigants for controlling yellow nutsedge. However, these trials were not conducted in sites with high densities of perennial nutsedges like those commonly seen in vegetable crop fields in the summer months.

Subsequent studies followed, specifically for perennial nutsedge control in transplanted cucurbit crops (particularly watermelon and cantaloupe) with the alternative fumigants and the selective herbicide halosulfuron (Sanda®). These trials clearly showed that perennial nutsedges in these crops could be controlled with systems that included metham-sodium fumigation and Sandea®. However, questions regarding the use of metham-sodium for weed control have not been fully answered.

Materials and Methods

Irrigated trials were conducted in 2001 and 2002 at the Coastal Plain Experiment Station Ponder Farm on transplanted cantaloupe grown on narrow plastic covered beds with metham-sodium used as the preplant fumigant. The trial evaluated all possible combinations of three metham-sodium rates (nontreated, 1/2x rate, and 1x rate), preplant fumigation intervals (1-wk, 2-wk, or 3-wk before transplanting), and plastic mulching (bareground or plastic covered beds). Metham-

sodium was applied with the specialized power tiller designed and modified by Mr. Dan Evarts, USDA-ARS. Sites where these trials were conducted had heavy natural infestations of yellow nutsedge (10/ft²).

Results and Discussion

Preliminary results indicated that preplant metham-sodium fumigation 2-wk before transplanting provided the best combination of yellow nutsedge control and protection from fumigant phytotoxicity of the preplant intervals evaluated (Table 1). Fumigation with metham-sodium 1-wk before transplanting provided the most effective yellow nutsedge control, but the fumigant applied just prior to transplanting stunted cantaloupe and delayed maturity by approximately two weeks (data not shown). In contrast, metham-sodium fumigation 3-wk before transplanting was not as effective in controlling yellow nutsedge as fumigation closer to transplanting and yields were correspondingly lower due to nutsedge interference.

Plastic mulch improved yellow nutsedge control and increased yields in all possible combinations of fumigant rates and times of preplant fumigation (Table 1). In fact, nonfumigated seedbeds covered with plastic mulch had surprisingly effective yellow nutsedge control compared to nonfumigated bareground plots which were heavily infested with yellow nutsedge.

Plots fumigated with the full-rate of metham-sodium had the most effective yellow nutsedge control and greatest yields compared to either nonfumigated or treated with metham-sodium at the ½x rate (Table 1). The yield response is due to superior yellow nutsedge control provided by the full-rate compared to either the ½x rate or nonfumigated control.

These results are based on two years data and several trends are readily apparent at this stage of the project. First, if metham-sodium is to be used for perennial nutsedge control, use the full rate applied with a power tiller similar to the one used in this trial. The ½x rate will not effectively control yellow nutsedge. Second, a plastic mulch is needed for adequate perennial nutsedge control, regardless of fumigation. There are less perennial nutsedge escapes in plastic covered beds than in bareground, even when fumigated with the full rate of metham-sodium.

Interestingly, it appears that plastic mulch itself provides useful suppression of perennial nutsedges, particularly if plastic mulch is laid just prior to transplanting. Rapidly growing transplants are effective shadders of perennial nutsedges when given a chance. It is plausible that laying plastic just prior to transplanting does not give perennial nutsedges opportunity to penetrate the plastic mulch before the transplants begin rapid growth. Since perennial nutsedges are highly susceptible to shading from other plants, this cultural weed control practice may be a cost-effective component of an integrated system to manage perennial nutsedges in transplanted cucurbit crops.

Future research involves repeating these studies as described in 2003. In addition, studies will be initiated to identify weaknesses in perennial nutsedge biology so that the competitive effects of crop competition can be exploited to suppress growth of shade sensitive perennial nutsedges. Enhancing crop competition is a cost effective means of weed management and may replace the need for many of the expensive weed controls inputs.

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Table 1. Yellow nutsedge control (preliminary) with metham-sodium in transplanted cantaloupe at Tifton, GA; 2001 to 2002.

| Timing | Tarping | Metham rate ¹ | Nutsedge control | Total Harvest ² | |
|--------|------------|--------------------------|------------------|----------------------------|--------|
| | | | (%) | (no/A) | (lb/A) |
| 1-wk | no plastic | nontreated | 0 | 4500 | 31,260 |
| 1-wk | no plastic | ½x | 74 | 4100 | 27,190 |
| 1-wk | no plastic | 1x | 87 | 5920 | 40,460 |
| 1-wk | plastic | nontreated | 86 | 5260 | 38,860 |
| 1-wk | plastic | ½x | 92 | 5120 | 37,660 |
| 1-wk | plastic | 1x | 94 | 7300 | 54,050 |
| 2-wk | no plastic | nontreated | 0 | 3670 | 24,550 |
| 2-wk | no plastic | ½x | 76 | 5190 | 36,060 |
| 2-wk | no plastic | 1x | 81 | 6170 | 45,970 |
| 2-wk | plastic | nontreated | 81 | 5300 | 37,740 |
| 2-wk | plastic | ½x | 88 | 5840 | 43,740 |
| 2-wk | plastic | 1x | 90 | 6750 | 47,650 |
| 3-wk | no plastic | nontreated | 0 | 2500 | 16,470 |
| 3-wk | no plastic | ½x | 55 | 4030 | 28,300 |
| 3-wk | no plastic | 1x | 68 | 4680 | 33,180 |
| 3-wk | plastic | nontreated | 73 | 5480 | 38,140 |
| 3-wk | plastic | ½x | 89 | 5990 | 42,460 |
| 3-wk | plastic | 1x | 88 | 4860 | 33,740 |

¹ Metham-sodium (Vapam HL®) rates were nontreated, 40 gal./A, and 80 gal./A with amounts proportionally reduced down to a the treated band width of 24 in.

²Total yield reflects complete plot harvest until no harvestable fruits remained. This resulted in six harvest dates in 2001 and three harvest dates in 2002. Cantaloupe maturity was delayed by metham-sodium fumigation 1-wk before transplanting and generally harvestable fruits from these treatments were in the later harvest dates.

CRITICAL USE EXEMPTION FOR METHYL BROMIDE

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The Montreal Protocol is a treaty that provides for the reduction of ozone-depleting substances. Since 1987, over 160 nations, including the United States, have signed the treaty. Methyl Bromide has been designated as such a substance. Therefore, one goal of the treaty was to eliminate consumption of methyl bromide in developed nations by 2005. Georgia produces about 30,000 acres of vegetables where methyl bromide is used as an all-purpose fumigant to control nematodes, soil-borne pathogens and weeds (primarily nutsedge). Since no viable replacements have been found for methyl bromide, the elimination of this fumigant could cost the Georgia vegetable industry over \$110 million per year.

The Methyl Bromide Technical Options Committee (MBTOC) is the arm of the United Nations Environment Program that governs the methyl bromide phaseout. Base rates of methyl bromide were set at 1991 consumption levels. Currently, the phaseout has reduced consumption to 30% of the 1991 levels. On January 1, 2005 that level will be reduced to zero.

In June 2002, the U.S. Environmental Protection Agency began a process to seek exemptions to the Montreal Protocol for critical uses of methyl bromide in the U.S. Similar programs were created during the reduction of Freon, another ozone-depleting substance. EPA set a deadline of September 9, 2002 for submitting applications to be considered for critical use exemption (CUE) regarding methyl bromide. University of Georgia Extension Scientists and the Georgia Fruit & Vegetable Growers Association submitted applications requesting critical use exemption for methyl bromide in six vegetable crops. Those crops were tomatoes, pepper, squash, cucumbers, cantaloupe and eggplant.

The application procedure was complex and detailed. For each crop, pest control practices, climate, yield, economic and acreage data had to be supplied. MBTOC had developed a list of numerous alternatives to methyl bromide used around the world. In the application, each of these potential alternatives had to be proven either economically or technically not feasible in Georgia in order to justify continued use of methyl bromide. In all, over 4,000 pages of documentation were forwarded to EPA's Office of Atmospheric Programs for the six Georgia applications.

Currently, EPA is in the domestic review process. The applications have been reviewed by a team of USDA biologists for technical purposes. The second step is for the applications to undergo economic review. The primary biologist and economist for each application has the responsibility of working with the applicant to strengthen the application if necessary. Once they pass this phase the applications will undergo a shorter secondary review process and will then be presented by the primary biologist and economist to USDA and EPA officials. This group will

develop a consensus opinion and it then becomes part of the EPA position to MBTOC's Ozone Secretary.

Applications are due to the Ozone Secretary of MBTOC by January 31, 2003. EPA, USDA and the U.S. Department of State will at that time make the case for critical use exemption on behalf of justified applicants to MBTOC. Applicants will not be informed of MBTOC's decision until sometime during the summer of 2003. If the application is denied, a second application may be submitted to begin the process in September 2003.

These CUE applications are only for 2005. Subsequent years will require additional applications. During September 2003, the second chance applications for 2005 will be accepted as well as the first chance applications for 2006. Although legislative relief is still a possibility, the CUE process is the only avenue currently open for the continued use of methyl bromide beyond 2004. The Georgia application has been used as a model for other states undergoing this process. Although it's success is certainly not guaranteed, the Georgia application appears to be as strong as any of the other packages submitted.

Session #5

Insect Management

Moderator: Glenn Beard

Use of Scouting and Thresholds in Vegetable Insect Pest Management

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Insect pests of vegetable crops in Georgia are very diverse and often economically devastating when left uncontrolled. There are effective control measures such as insecticides for many pests, but overuse of insecticide can lead to resistance. This was observed recently with the diamondback moth in collard greens. One of the most effective ways to prevent insecticide-resistant insects is to only use the products when absolutely necessary. In IPM, this generally means to only apply the insecticide when pest populations have reached an *economic threshold* (ET). The ET is based on the fundamental concept of IPM that each pest species has a definable relationship in terms of damage to the plant host that it attacks. This relationship is often referred to as the damage curve, which is often determined relative to yield loss. The curve is uniquely characterized by a critical point, the *economic injury level* (EIL), or the point in the agricultural production system where the costs associated with pest management equals the benefits from the pest management actions. In other words, the pest population below the EIL requires no pest control actions because they are not economically justified, but economic damage can occur when pest population densities are above the EIL. In Georgia, we have many useful thresholds for vegetable insect pests (Table to be provided at the GFVGA Meeting).

A recent threshold for controlling thrips in Vidalia onions with insecticides was developed for determining the need for thrips control on a year by year basis. The current action threshold being tested is a single spray of effective insecticide initiated when thrips occur at 1 thrips per plant and subsequent sprays when the thrips level reaches an average of 5 thrips per plant. This threshold was evaluated experimentally and in commercial validation studies using a prototype commercial scouting tool: “EntoNet Scouting Program for Vidalia Onion”. This program used PDA, GPS and internet technologies to coordinate scouting data collection, management and reporting of recommendations. Plant disease and weeds were also recorded in this new scouting program so that a Best Management Practice (BMP) can be generated on a weekly basis. Scouting does limit the use of insecticide to a minimum number of sprays for thrips, but currently calendar sprays for disease control seem to work the best. This commercial validation trial did indicate a need for more contract scouting in Georgia vegetables.

MANAGEMENT OF MOSAIC VIRUSES ON SQUASH AND PUMPKIN

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Several mosaic viruses, vectored by aphids, are severe problems in squash and pumpkin production, particularly in the fall crop. High infection rates early in crop development can result in complete yield loss. Factors effecting the severity of this problem and potential management approaches will be discussed.

CUCURBIT YELLOW VINE DISEASE: A THREAT TO THE CUCURBIT INDUSTRY?

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Cucurbits, primarily watermelon, cantaloupe, squash and pumpkin are important horticultural crops in the south central region of the U. S. that are affected by a variety of insect and disease complexes. Cucurbit yellow vine disease (CYVD) is a newly described disease that affects cucurbits in Texas and Oklahoma, but also has been confirmed in Arkansas, Colorado, Kansas and Nebraska, Tennessee, and Massachusetts. CYVD affected plants usually exhibit stunting, yellowing, and gradual decline beginning about 10 to 14 days prior to harvest. Occasionally a rapid wilt occurs at the time of flowering and/or fruit-set, and plants collapse within a single day without plant yellowing. Losses can range from less than 5% to 100% in affected fields of watermelon, squash, pumpkin, and cantaloupe. Squash and pumpkin are most susceptible to CYVD. Early-planted watermelons targeted for the 4th of July market generally are impacted more severely than later plantings. The symptom most diagnostic and consistent with the disease in all affected cucurbit species is a honey-brown discoloration of the phloem. Phloem discoloration is not as intense in squash and pumpkin as compared to watermelon and cantaloupe. Consequently, field diagnosis may be more difficult in these crops. Disease symptoms have been consistently associated with the presence of a bacterium, *Serratia marcescens*. CYVD is not soil borne and all evidence to date conclusively established that the bacterium is insect vectored. We have demonstrated that the squash bug is a vector of the CYVD bacterium. Furthermore, the insect can carry the bacterium through the winter and transmit the following spring. The proportion of squash bugs in a field that can transmit the bacterium may vary greatly. However, those that feed on a diseased plant certainly have a higher probability of obtaining and transmitting the agent. Historically, squash bugs prefer squash and pumpkin as hosts and have been serious pests of these crops in Texas and Oklahoma. In contrast to other production areas, squash bugs have become an increasing concern for growers of watermelon and cantaloupe in Texas and Oklahoma. There are no reports of CYVD in cucumber. Coincidentally, cucumber is one of the least preferred hosts of squash bug.

Once plants are infected with the CYVD bacterium and symptoms appear, there are no known remedies. Young seedlings are more susceptible than older plants and early-planted watermelon are generally more affected by CYVD than those planted after June 1st. Triploid seedless watermelons have varying degrees of resistance to the disease while open-pollinated and hybrid cultivars have little or none. Scientists at our laboratory are also screening wild types of watermelon and other cucurbits for resistance traits that could be incorporated into commercial lines.

With experience, field diagnosis is possible, especially in watermelon and cantaloupe. Phloem discoloration in squash and pumpkin is not as pronounced or intense as compared to watermelon and cantaloupe. The key to field diagnosis is to obtain the upper tap root and lower crown of suspect plants and make a cross-section. A honey-brown discoloration of the phloem should be clearly evident. A few healthy plants should also be observed simultaneously for comparison. A very thin cross-section from the same area and observed under the light microscope provides conclusive evidence of CYVD when phloem discoloration is present. As with field diagnosis, a few healthy plants for microscopic comparison is recommended. The bacterium is easily cultured on Nutrient Agar (NA), although individual colonies are less than 1.0 mm in diameter after four days. A 2-3 mm section of the phloem can be excised and surface sterilized, ground with mortar and pestle, and spread on NA. Finally, PCR (polymerase chain reaction in combination with phloem-discoloration affords definitive proof of CYVD.

Once squash bugs colonize a field en masse, insecticide applications may slow or slightly reduce CYVD incidence. However, multiple applications are neither desirable or economical. The key to reduced CYVD is intensive scouting, detection, and **early** control of the squash bug. Based on the insects preference for squash/pumpkin over that of other members of the cucurbit family, we are evaluating the use of squash trap crops around melon fields to intercept squash bugs that are emerging from hibernation and are seeking host plants. Once attracted to the squash, they can be controlled there and negate the need for whole-field spraying. Currently, we are evaluating the use of trap crops for control of yellow vine, the squash bug vector, and other pests such as cucumber beetle. Other research efforts are directed toward reducing or eliminating the numbers of squash bugs going into hibernation.

Prior to the advent of synthetic pesticides, it was commonly recommended that growers practice clean culture, in-season control (usually manual), and destruction of crop residue following harvest as a means to reduce the impact of squash bug. With the realization that this pest has a greater impact on watermelon growth and yield than previously thought and vectors a serious disease, there is a critical need to combine old and new technologies to combat this emerging threat to the cucurbit industry.

Why does Oklahoma and Texas have severe problems with squash bug in watermelon in contrast to other production areas? The answer may be an artifact of planting dates, climate, and production practices , but we are investigating the possibility of host-specific strains that are adapted

to watermelon. For example, squash bug nymphs whose parents were collected from squash incur almost 90 % mortality rates when reared on watermelon. Yet, we have observed extremely high populations of adults and all stages of immatures in watermelon.

Why did the disease suddenly appear? Mutation of *Serratia* strains that are able to infect plants? Accidentally imported? Or, has it always been here and confused with other vine declines? CYVD is a type of vine decline as is Fusarium wilt and symptomatic plants are often difficult to diagnose without proper training and the use of molecular biological tests such as PCR. However, molecular evidence indicates that the CYVD bacterium is a recently mutated strain of *S. marcescens*.

Will CYVD expand into other major production areas such as California, Georgia, South Carolina and Florida? Since squash bug has been reported in every state of the continental U. S., there is the distinct possibility that it will eventually be detected or will spread into other areas. We do know that the disease occurs in middle Tennessee which is not too distant, in insect terms, from Georgia. In fact, Georgia has at least two species of the insect, the squash bug and the horned squash bug. In the latter species, preliminary experiments suggest so far that the horned squash bug is incapable of transmitting the bacterium. Future investigations and intensive testing and sampling of squash bug and its close relatives from different regions of the U. S. will enable us to get a better grasp of CYVD incidence and to develop efficient controls for both the pest and disease.

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MANAGEMENT OF SILVERLEAF WHITEFLY AND SPIDER MITES

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Silverleaf whitefly, spider mites, and broad mites are presenting severe problems for Georgia vegetable producers on a more frequent basis. Management practices for these pests will be discussed, with emphasis on currently registered pesticide uses and potential new products.

Session #6

Maintaining Quality and Minimizing Rejected Loads

Moderator: Dr. Russ Hamlin

MAINTAINING QUALITY DURING HARVEST AND HANDLING OPERATIONS

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Packers and shippers are necessarily concerned with methods and technologies which minimize postharvest losses, since estimates for produce losses during wholesale and retail handling alone range from 9% to 16%.

Successful postharvest handling of vegetable crops requires careful coordination and integration of the various steps from harvest operations to consumer level in order to maintain the initial product quality. Horticultural quality refers to those characteristics which consumers associate with each commodity that are dependent upon the particular end-use, such as sweetness in strawberries and melons, tenderness in snap beans and sweet corn, and crispness in carrots and celery. Quality also refers to freedom from defects such as blemishes, mechanical injury, physiological disorders, decay and water loss. It is important to keep in mind that quality loss to fresh vegetables is cumulative: each incident of mishandling reduces final quality at consumer level.

Several factors reduce quality during postharvest handling, including:

- harvest at the incorrect maturity stage
- careless handling at harvest and during packing and shipping
- poor sanitation
- delays to cooling or sub-optimal cooling
- shipping/storage above or below optimal temperature
- lack of proper relative humidity
- for some commodities, exposure to ethylene gas.

Numerous technologies and procedures can significantly reduce quality losses during handling. These include the use of drying, curing, temperature conditioning, disinfestation (for exports/imports), ethylene treatment, application of surface coatings, sanitation treatments, controlled atmosphere storage and shipping, and modified atmosphere packaging. These applications are, in many cases, crop-specific.

Two of the most important means for maintaining vegetable quality during postharvest handling are minimizing mechanical injury and managing temperature. Proper handling and temperature management will significantly reduce losses due to decay and accelerated senescence. With vegetables typically being handled several times from harvest to retail level, it is critical that personnel at each step be properly trained and supervised.

This discussion will focus on methods and techniques for reducing losses in postharvest quality during typical commercial handling operations.

Understanding Chilling Injury and Recognizing its Symptoms

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Plants evolved around the world within relatively narrow temperature ranges and, although the cultivated descendants of wild plants may nowadays be grown worldwide, they still “remember” their origins. Thus, many cultivated fruits and vegetables that originated in the tropics and subtropics cannot tolerate low, but nonfreezing temperatures in the range of 32 to 55 °F (0 to 12.8 °C). The resulting adverse effects on their growth, development, maturation, or ripening when they are exposed to temperatures in this range are collectively referred to as “chilling injury.” For the postharvest handler, this is an ironic situation because, as we know, low temperature is our best tool for maintaining the quality of fresh fruits and vegetables.

An important yet simple concept to understand with regard to chilling injury is the “threshold temperature.” For each crop species, there is a unique temperature at or above which chilling injury will not occur. These threshold or lowest safe temperatures are the basis for the widely circulated “recommended” or “optimum” storage and handling temperatures for various chilling sensitive crops. The lower the temperature below the threshold temperature and the longer the exposure, the worse the chilling injury will be. Threshold temperatures for an individual crop can vary substantially among varieties and with differences in maturity – less mature or less ripe individuals are more sensitive to chilling. Chilling injury is also usually cumulative. This means that a number of even brief exposures to chilling temperatures, including those occurring in the field before harvest, may result in development of injury symptoms.

Examples of crops that are sensitive to chilling injury obviously include the tropical fruits such as bananas, mangoes, papayas, and pineapples. Less appreciated is the fact that almost all of the vegetables crops that are grown in the northern hemisphere as “warm season” vegetables are of tropical or subtropical origin and thus subject to chilling injury. These include beans, cucumbers, eggplants, most of the melons (cantaloupes are only slightly sensitive), peppers, all of the squashes (summer and winter types), sweetpotatoes, and tomatoes. Asparagus and potatoes are cool season vegetables that are also chilling sensitive.

The visible symptoms of chilling injury vary widely among these sensitive crops (Table 1), but typically include surface pitting, watersoaked and discolored flesh, failure to ripen normally, and increased susceptibility to decay.

An extremely important (and insidious) consequence of chilling injury is flavor loss due to inhibition of aroma volatile production. This is often the first symptom of chilling injury and, in cases of mild chilling exposure, it may be the only symptom. The infamous “tasteless winter tomatoes” are almost certainly a result of shipping and storage at below the lowest safe temperature! Another ironic aspect of chilling injury is that chilling symptoms are usually most clearly expressed after the commodity is transferred to a warm, non-chilling environment. This means that handlers who carelessly expose sensitive vegetables to chilling temperatures may very well never see the injury that they have caused – that will fall to a subsequent handler, perhaps the ultimate consumer, baffled as to why seemingly high quality vegetables quickly spoiled at home. It also means that vegetables that were chilled in the field due to inclement weather may develop chilling injury even when they are handled at recommended temperatures!

Chilling injury is a complicated phenomenon, however it behooves us as postharvest handlers to understand this disorder and be able to recognize its symptoms. In ongoing research in which we are collaborating with colleagues at University Laval in Quebec, quality curves are being established for about two dozen fresh fruits and vegetables, including a number that are chilling sensitive. This is being done by evaluating all measurable quality changes in each commodity every day or every other day (depending on relative shelf life) at 32, 41, 50, 59, 68, and 77 °F (0, 5, 10, 15, 20 and 25 °C). From these experiments, we are determining both the shelf life and the quality factor(s) that limit(s) the shelf life at each temperature. In the meantime, we recommend that in the absence of specific experience with a particular chilling sensitive crop or variety, it is best to take a conservative approach and strictly avoid any exposure to temperatures below the thresholds listed in Table 1.

POSTHARVEST TREATMENTS FOR RIPENING AND SANITATION

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Ethylene Control in the Postharvest Environment. Ethylene is almost as ubiquitous as temperature control in its range of effects on postharvest vegetable quality. Ethylene is used to initiate and coordinate ripening of some climacteric crops, most notably bananas and tomatoes. Newer ripening rooms (mainly for banana ripening) are being constructed with “pressure-ripening” systems, which are equivalent to the forced-air or pressure cooling systems used for many fruits and vegetables. This design promotes faster temperature changes and better temperature uniformity throughout the product in the room, leading to faster and more uniform ripening. More and more there is also recognition of the beneficial effects of removing/excluding ethylene from the postharvest environment for many crops. Methods for removing ethylene include chemical scrubbing (KMnO_4 , $\text{KMnO}_4 + \text{KIO}_4$, palladium chloride, activated charcoal), ozone generation, zirconia-titania photocatalytic oxidation, and electrical discharge (the “corona” effect). It is also now possible to inhibit ethylene production by fruits and vegetables with AVG (“ReTain” – labelled for apples) or render them insensitive to ethylene effects with 1-MCP (“Smartfresh” – also labelled for apples).

Controlled atmosphere (CA) shipping and modified atmosphere packaging (MAP) of perishable commodities are technologies that have increased in importance and become more common in recent years and which owe a large measure of their success to the control of ethylene. CA for shipping can differ from those traditionally used for long-term storage. More extreme atmospheres may be tolerated when CA is used during transport because of shorter exposure times, different maturity or ripeness stages (e.g., vine-ripe products), and in some cases different temperatures. MAP development has been spurred by the rise of fresh-cut vegetables and fruits. Temperature management is an extremely critical concern for produce in MAP. If the temperature is too low, respiration is slow and does not result in enough change in atmospheres (decreased O_2 and increased CO_2) to be effective. However, water loss is reduced and no damage is done to the product (unless chilling injury occurs). If the temperature is too high, the atmosphere will become too extreme and low- O_2 or high- CO_2 injury and fermentation can occur. These problems are being addressed by several approaches, such as use of microperforated films, packages with safety valves, and “smart films” (actually patches) that change permeability in

concert with produce respiration rates.

Chlorine (sodium or calcium hypochlorite) is the standard for sanitizing water and produce in postharvest operations. Managing free chlorine levels requires careful attention to water pH (maintained between pH 6.5–7.5), which controls whether the chlorine is maintained in the more active hypochlorous acid form or less active hypochlorite ion form. A number of potential alternatives to chlorine for water sanitation have been introduced on the market. These include ozone, chlorine dioxide (acidified sodium chlorite), hydrogen peroxide, peroxyacetic acid, copper ion, and electrolyzed water. Each of these alternatives to chlorine has advantages and disadvantages. Chlorine dioxide and peroxyacetic acid are more stable because they are less reactive with organics than chlorine. Chlorine dioxide, hydrogen peroxide, peroxyacetic acid, and ozone may have greater efficacy and/or show more sporocidal activity compared to chlorine. The high reactivity of ozone and hydrogen peroxide creates the disadvantage of difficulty in maintaining sufficient levels of those compounds to ensure contact with and elimination of microorganisms in hydrohandling systems. All of the alternatives are more expensive than chlorine.

For surface sanitation of fruits and vegetables, ozone gas, UV light, irradiation, and vapor heat (steam) are possibilities. Heat treatments, such as currently used for insect quarantine treatments, are also being investigated as potential nonchemical control treatments for decay-causing and food poisoning microbes. The heat may be applied as either hot water or vapor heat. A couple of important advantages of heat treatments are that there are no residues and there is little or no chance of induced resistance developing in the microbes. Heat also has physiological effects on fruits and vegetables, some of which may be beneficial, such as reduced chilling sensitivity and regulation of ripening. Irradiation may be useful for controlling vegetative stages of microbes, but the legal maximum dose for fruits and vegetables of 1 kGy is not sufficient to control quiescent stages of microbes such as fungal spores, while higher levels can cause undesirable physiological effects in the produce.

Session #7

Phytophthora and Tomato Spotted Wilt Virus

Moderator: Tim Flanders

IDENTIFICATION OF WEED SOURCES OF THRIPS VECTORS OF TSWV AROUND VEGETABLE CROPS

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A survey of weeds was made in south Georgia that are potential hosts of various thrips vector species of *Tomato spotted wilt virus* (TSWV). The principal thrips species surveyed were *Frankliniella occidentalis* or the western flower thrips, *Frankliniella fusca* or the tobacco thrips, other *Frankliniella* species, and *Thrips tabaci* or the onion thrips. Two survey methods were used. First, in a collaborative study with A. Csinos of CPES-Plant Pathology, weed samples collected for TSWV detection were also screened for thrips using a bean-bait technique. The samples were transferred to the Vegetable Entomology Lab after sub-samples of leaf tissue were taken for virus determination within approximately one week of the collection date. During preliminary storage, the weeds samples were held under moderate refrigeration and then transferred into either pint or quart plastic cups (depending on the size of the sample) at room temperature. Cups were sealed with a nylon screen top and 1-3 freshly washed green beans included inside of the cup as a thrips-bait. Beans were refreshed every 3-7 days and inspected for thrips that moved from the drying weed foliage to the green bean bait. Thrips were collected in-to a cold buffer solution, identified to species, and then brought to Plant Pathology for ELISA determination of TSWV in the individual thrips. In a second survey, weeds were collected by S. Culpepper of RDC-Crop & Soil Science and placed under moderate refrigeration in the Vegetable Entomology Lab. Within 1-4 days, sub-samples of leaf tissue were taken for TSWV determination by ELISA and the bulk of the sample was then placed in a Berlese/Tullgren type of funnel to extract thrips using heat. Thrips were collected into 50% alcohol for approximately one week in the funnel, samples were cleaned and then thrips were identified to species. One of the important weed species that harbor thrips and TSWV in the early Spring was chick weed, *Stellaria media*, and in the late summer was morning glory, *Ipomoea* spp. Studies are currently underway to determine the movement of thrips-vectored TSWV into winter weeds and then the movement of thrips and TSWV from winter weeds into pepper and tomato in the Spring. We are also evaluating the effect of herbicide usage, mowing weeds, and weed eradication on the incidence of virus in the pepper and tomato crop. Temperature and rainfall are expected to have a significant effect on the movement of thrips in and out of winter weed hosts

FUNGICIDE PERFORMANCE AGAINST PHYTOPHTHORA CROWN AND FRUIT ROT OF YELLOW SQUASH – 2001/2002

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Phytophthora crown and fruit rot, caused by *Phytophthora capsici*, is a devastating disease of yellow squash in Georgia, and significant losses of yield have been reported. The disease can occur on a number of cucurbit species; however, yellow squash is highly susceptible. The onset of symptoms is followed by rapid death in the case of root or crown infections, while infected fruit quickly decay and collapse. Favorable conditions for disease development include excessive rainfall or irrigation, poor soil drainage, and moderate temperatures. Management of the disease has proven difficult with soil fumigation, cultural practices and crop rotation, and there are no labeled fungicides available in Georgia.

Field trials were conducted in 2001 and 2002 at the Blackshank Farm in Tifton, GA in a field that had previously been inoculated with *Phytophthora capsici* to establish a disease nursery. The soil was a Fuquay loamy sand, and was prepared with a rototiller prior to planting. Guidelines established by the University of Georgia Cooperative Extension Service were followed for land preparation, fertility, weed management, and insect control. Summer squash (cv. 'Dixie') were planted on 23 April 01 into non-mulched, raised beds with a Stanhay vegetable seeder set to deliver seed every 12 in. In 2002, 3-week old seedlings were transplanted into single-row beds. Plot size was two 20 ft rows, spaced 36 in. apart in 2001, and single, 15 ft rows in 2002. Experiments were laid out in a randomized complete-block design with 4 replications in both years. The number of plants emerged at 21 days after planting (DAP) was counted immediately prior to initiation of fungicide applications. Fungicides were applied over the rows with a CO₂-powered backpack sprayer through a 4-nozzle boom (18 in. spacing) fitted with TSX-26 hollow cone nozzles and set to deliver 40 gallons per acre (GPA) in 2001 and 60 GPA in 2002. Fungicide applications were initiated at 21 DAP and continued weekly until maximum disease incidence was reached in the untreated check (total of 4 sprays). Supplemental overhead irrigation was applied to the test site after planting (0.5 in.), and daily thereafter to achieve optimal moisture conditions for development of disease. Plant mortality was recorded in plots weekly beginning at the onset of symptoms and continuing until maximum mortality was observed in untreated plots. In 2002, plots were harvested three times and yields determined.

In 2001, the combination of warm temperatures, frequent irrigation, and late-season rain resulted in severe damage to fruit by *Phytophthora capsici*, *Pythium* spp. (cottony leak), *Sclerotium rolfsii*, and *Choanephora cucurbitarum*. Yields were therefore not taken for the experiment. Incidence of crown rot was heaviest at the final evaluation in the untreated checks and in plots treated with Quadris 2.08F (1 pt/A) (Table 1). The combination of Ranman 400SC (2.75 fl oz/A), BAS500 21.9WG (9 oz/A), and Silwet (2.1 fl oz/A) gave significantly better control of *Phytophthora* crown rot than Ridomil Gold Bravo at 2 lb/A, Ranman 400SC (2.75 fl oz/A) tank-mixed with Penetrator Plus (1 pt/A), and Ranman 400SC (2.75 fl oz/A) plus BAS550 50WP (6.4 oz/A) tank mixed with Silwet (2.1 fl oz/A). No phytotoxicity was observed in the experiment.

In 2002, the combination of Ranman 400SC (2.75 fl oz/A) plus BAS500 21.9 WG (0.3 lb a.i./A) and Silwet reduced disease at the final evaluation date (final disease) by more than 50% as compared to the untreated control (Table 2). This combination was significantly more efficacious than either product applied alone. Ridomil Gold 4EC (1 pt/A) and Ultra Flourish 2EC (2 pt/acre) reduced final disease by more than 80%. No other treatment in the test provided significant reductions in final disease. As an indicator of season-long efficacy of a given fungicide treatment, AUDPC was used to rank the fungicides in this trial. The lowest AUDPC values were found in plots treated with either Ridomil Gold 4EC or Ultra Flourish 2EC, which were 86% lower than the AUDPC for the untreated check. Ranman 400SC, applied alone at 2.75 fl oz/A, reduced AUDPC by 38%, while the combination of Ranman 400SC and BAS500 21.9 WG reduced AUDPC by 63%. No significant reduction of AUDPC was seen with the remaining treatments in the test.

Highest yields (number and weight of marketable fruit) were found in plots treated with Ranman 400SC alone, Ranman 400SC plus BAS500, Ridomil Gold 4EC, and Ultra Flourish. Numerically, total number and weight of squash was highest in the Ranman/BAS500-treated plots. The broad-spectrum activity of BAS500 may have suppressed pathogens other than *P. capsici* and thus provided additional yield benefits. It must also be noted that this combination, while inferior to Ridomil Gold and Ultra Flourish in protecting squash plants against *Phytophthora* crown rot, Ranman 400SC plus BAS500 appeared to provide levels of protection to fruit that were equal to either Ridomil Gold or Ultra Flourish.

Although the combination of Ranman 400 SC + BAS500 21.9 WG did not perform as well in terms of disease control as in 2001, yield data indicate that this combination can be effective in protecting squash fruit and providing good yields. Ridomil Gold and UltraFlourish continue to be effective against *P. capsici*; however, insensitivity to mefenoxam is common in populations of *P. capsici* in other states, underscoring the need for

effective materials Press. St. Paul, MN.against this pathogen.

Citations

Gubler, W.D and Davis, R.M. 1996. Phytophthora crown and root rot. Pp. 19-20 in: Compendium of Cucurbit Diseases. T.A. Zitter, D.L. Hopkins, and C.E. Thomas, eds. APS

Table 1. Effect of fungicides on the severity of Phytophthora crown rot in yellow squash, 2001.

| Treatment and rate/A | Final disease | | AUDPC ^a | |
|--|------------------------|----|--------------------|----|
| | (6/22/01) ^a | | | |
| Ranman 400SC 2.75 fl oz + Silwet 2.1 oz | 21.14 | cd | 0.99 | b |
| Ranman 400SC 2.75 fl oz + Penetrator Plus 1 pt | 49.32 | bc | 3.38 | ab |
| Ranman 400SC 2.75 fl oz + BAS550 50WP 6.4 oz + Silwet 2.1 oz | 39.95 | bc | 2.23 | ab |
| Ranman 400SC 2.75 fl oz + BAS500 21.9WG 1 lb + Silwet 2.1 oz | 19.82 | cd | 0.90 | b |
| Ranman 400SC 2.75 fl oz + BAS500 21.9WG 9 oz + Silwet 2.1 oz | 3.56 | d | 0.12 | b |
| Omega 500F 1 pt | 18.13 | cd | 0.80 | b |
| Ridomil Gold Bravo 76WP 2.0 lb | 41.06 | bc | 1.99 | b |
| BAS 500 21.9WG 1 lb | 18.66 | cd | 1.12 | b |
| Quadris 2.08F 1 pt | 64.74 | ab | 5.50 | a |
| Ridomil Gold 4EC 1 pt | 22.87 | cd | 0.84 | b |
| Untreated check | 84.95 | a | 5.44 | a |

Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (P=0.05).

^aFinal disease rating (incidence of plants with symptoms of Phytophthora crown rot) taken on 6/22/01; AUDPC=area under the disease progress curve, constructed from evaluations taken on 6/08/01, 6/15/01, and 6/22/01.

Table 2. Incidence of *Phytophthora capsici*-induced crown rot of yellow squash – 2002 Squash Fungicide Study.

| Trt | Material | Product rate | Disease rating ^a | | | | Yield/acre ^b | | | |
|-----|--------------------|------------------|-----------------------------|----|-------|----|-------------------------|----|-------------|-----|
| | | | Final | | AUDPC | | No. marketable fruit | | Weight (lb) | |
| 1 | Untreated check | -- | 97.7 | a | 21.6 | ab | 11,132.0 | de | 2,323.2 | cde |
| 2 | Ranman 400SC | 2.75 fl oz/acre | 72.3 | b | 13.5 | c | 21,586.4 | bc | 5,517.6 | bc |
| | Silwet | 4:3 ratio (R:S) | | | | | | | | |
| 3 | BAS 500 21.9 WG | 0.3 lb a.i./acre | 89.7 | ab | 21.2 | ab | 6,292.0 | e | 1,258.4 | e |
| 4 | Ranman 400 SC | 2.75 fl oz/acre | 42.9 | c | 8.0 | d | 31,460.0 | a | 10,067.2 | a |
| | BAS 500 21.9 WG | 0.3 lb a.i./acre | | | | | | | | |
| | Silwet | 4:3 ratio (R:S) | | | | | | | | |
| 5 | Ridomil Gold 4EC | 1 pt /acre | 19.4 | d | 3.1 | e | 24,684.0 | ab | 6,582.4 | b |
| 6 | Ultra Flourish 2EC | 2 pt/acre | 17.5 | d | 3.0 | e | 25,942.4 | ab | 7,260.0 | ab |
| 7 | Tanos 50WP | 1 lb/acre | 87.4 | ab | 19.4 | b | 15,294.4 | cd | 4,840.0 | bcd |
| 8 | Tanos 50WP | 2 lb/acre | 99.9 | a | 23.5 | ab | 7,744.0 | de | 1,839.2 | de |
| 9 | Rhamnolipid 250 SC | 2 fl oz/acre | 99.9 | a | 24.1 | a | 7,744.0 | de | 1,742.4 | de |
| 10 | Rhamnolipid 250 SC | 8 fl oz/acre | 92.2 | a | 21.6 | ab | 7,550.4 | de | 1,452.0 | e |

Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (P=0.05).

^aFinal disease rating (percent incidence of plants with symptoms of *Phytophthora* crown rot) taken on 6/22/01; AUDPC=area under the disease progress curve, constructed from evaluations taken on 5/16/02, 5/23/02, 5/30/02, 6/06/02, and 6/14/02.

^bYield data are the total of three harvests - 5/23/02, 5/29/02, and 6/05/02.

MANAGEMENT OF TOMATO SPOTTED WILT IN TOMATOES WITH MULCHES, INSECTICIDES AND PLANT ACTIVATORS

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Spotted wilt caused by *Tomato spotted wilt virus* (TSWV) and vectored mainly by western flower thrips (*Frankliniella occidentalis*) and tobacco thrips (*F. fusca*) is a major disease of tomato in southeastern U.S. Field experiments were conducted to determine the separate and integrated effects of UV-reflective mulch, acibenzolar-S-methyl (Actigard) and insecticides to manage spotted wilt in tomato. Highly UV-reflective and black mulch covered plots were treated with Actigard and insecticides in field experiments. Tomato spotted wilt incidence was determined from late April to June in 2000, 2001, and 2002. Disease incidence was reduced to low levels in highly UV-reflective mulch, Actigard and insecticide treated plots, whereas black mulch without Actigard and insecticides had highest disease incidence. The highly UV-reflective mulch alone was effective in reducing disease incidence every year tested. Actigard significantly reduced spotted wilt incidence in two years (2000 and 2002) when TSWV infection pressure was high. Highly UV-reflective mulch and Actigard were effective on reducing the primary spread of spotted wilt in field-grown fresh market tomatoes. The combination of highly UV-reflective mulch, Actigard, and insecticides was the most effective integrated treatment and reduced tomato spotted wilt by as much as 81%.

Additional keywords: TSWV, UV-reflective mulch, metalized mulch, acibenzolar-S-methyl, Spinosad, Methamidophos.

Session #8

Homeland Security: How Does it Affect Me?

Moderator: Dan Bremer

**Georgia Watermelon
Association
Educational Sessions**

Educational Session #2

Watermelon Production I

Moderator: Keith Rucker

RESISTANCE TO AZOXYSTROBIN (QUADRIS) IN THE GUMMY STEM BLIGHT PATHOGEN IN GEORGIA

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Gummy stem blight, caused by the fungus *Didymella bryoniae*, is the most destructive disease of watermelon in Georgia and in many other watermelon-producing areas of the U.S. Azoxystrobin (Quadris) has been used for gummy stem blight control in Georgia since 1998. Unsatisfactory disease control was first observed in Georgia as early as 1999 in watermelon fields treated with Quadris and isolates from these fields were confirmed to be resistant to azoxystrobin (Olaya and Holm 2001). In 2001, we conducted an extensive survey of watermelon and cantaloupe fields in Georgia to determine the frequency of azoxystrobin-resistant isolates. Results of the survey provided evidence of widespread resistance to azoxystrobin in populations of the gummy stem blight pathogen in Georgia (Stevenson and Langston 2002). Of the 272 isolates from 27 fields in 13 counties, 247 (91%) were found to be resistant to azoxystrobin, providing evidence of widespread resistance. We continued to monitor fungicide sensitivity in 2002 as part of an ongoing effort to determine the source and distribution of resistant isolates.

In 2002, isolates of the fungus were obtained from infected watermelon and cantaloupe from 11 different sites in Georgia that included transplant houses, commercial fields and research sites. Sensitivity of each isolate to azoxystrobin was determined using a spore germination assay. As reported in our previous study, an isolate was considered resistant to azoxystrobin if the ED₅₀ value (the fungicide concentration that inhibits spore germination by 50% relative to the control) was >10 µg ml⁻¹. In contrast to the 2001 season, gummy stem blight was not severe in 2002. As a result of lower disease incidence throughout the state, only 136 isolates were collected in 2002. However, 83% of the isolates collected in 2002 were resistant to azoxystrobin. Of the 40 isolates collected from watermelon transplants, all but one isolate were resistant to azoxystrobin. The frequency of resistant isolates was 57-64% in the samples from research sites where fungicide trials had been conducted for many years that included tests of many different fungicides and application schedules. The frequency of resistant isolates was considerably higher (93-100%) in all but one of the samples from commercial fields.

Citations

Olaya, G., and Holm, A. 2001. Sensitivity of *Didymella bryoniae* isolates to azoxystrobin. *Phytopathology* 91:S67.

Stevenson, K. L., and Langston, D. B. Jr. 2002. Resistance to azoxystrobin in the gummy stem blight pathogen in Georgia. *Phytopathology* 92:S79.

POWDERY AND DOWNY MILDEW IN GEORGIA WATERMELONS

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Powdery mildew of watermelon, caused by the fungus *Sphaerotheca fuliginea*, has become more of a problem in Georgia watermelons over the past four years. This disease is favored by dry, high humidity conditions and generally attacks watermelons when they are beginning to reach maturity. This disease is more difficult to diagnose than powdery mildew on other cucurbits because sporulation of the fungus is so sparse. Usually, symptoms first appear as chlorotic foliage near the crown of individual plants. As the disease progresses, foliage near the crown becomes necrotic and the chlorosis may extend down the runners. Infected leaves are often turned upside down which gives the vines the appearance of those that have been blown around by wind. Closer inspection may reveal faint chlorotic spots on the upper surface of leaves with corresponding sparse tufts of fungal mycelium on the undersides of leaves. Tests in Georgia have shown that most fungicides used for control of gummy stem blight will suppress powdery mildew to some degree. In 2002, spray programs containing Procure, Flint, Nova and Quintec were the most effective for suppressing powdery mildew in that particular experiment. However, these materials generally only suppress powdery mildew well and should be tank-mixed with other materials to provide broad-spectrum disease control.

Downy mildew is altogether a different disease than powdery mildew. First, downy mildew is caused by the oomycete fungus *Pseudoperonospora cubensis*. Warm, wet, overcast conditions usually favor the development of this disease. Also, unlike powdery mildew, downy mildew can cause considerable damage prior to fruit development. Downy mildew was only recently observed in Georgia watermelons this year. In problem fields, severe defoliation occurred despite remedial fungicide applications. Symptoms initially occur on watermelon leaves as dark, angular lesions generally on the oldest leaves. These lesions are about 2-10 mm in diameter. As the disease progresses, infected leaves will curl up and turn black. This is a stark contrast to downy mildew symptoms on cantaloupe and squash where small, angular chlorotic lesions become numerous, coalesce, and defoliate the plant. Fungicides such as chlorothalonil and mancozeb are consistently suppressive against this pathogen but new products such as zoxamide + mancozeb (Gavel), dimethomorph (Acrobat), and pyraclostrobin (Cabrio) may provide acceptable control. Data on these new products is currently being collected.

GEORGIA WATERMELON VARIETY EVALUATIONS

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Watermelon are an important crop in Georgia accounting for the largest share of planted vegetable acres at just over 34,000 acres in 2001. Nationally, 156,900 acres of watermelon were harvested in 2001. Georgia production then accounts for 22% of the watermelons produced in the United States. The majority of watermelons grown in Georgia are grown in the spring with a sizable amount produced on bareground (over 60%).

Watermelon trials were established at both the Vidalia Onion and Vegetable Research Center (VOVRC) and at an on-farm location in Crisp County. Both trials were arranged in a randomized complete block design with four replications at the VOVRC and three replications at the on-farm location. Watermelons were grown according to University of Georgia cooperative extension service recommendations.

Table 1 lists the description and yield results of the trial at the VOVRC. The description is the seed company's description as it appeared on the seed packet. The yield results are broken out by size class, which should help growers in choosing a variety that meets their market needs for size. Almost half the varieties in this year's trial were triploids. This continues a trend that has been going on for several years.

Table 2 lists fruit characteristics for the varieties in the VOVRC trial. Both the flesh color and a rating are listed. When two colors are listed the first color is the color most of the cut fruit exhibited. The fruit type lists a common variety type that the variety matches. Finally, table 3 lists the results of the trial at the on-farm location.

Table 1. Watermelon Variety Trial, 2002
 Vidalia Onion and Vegetable Research Center,
 Lyons, GA.

| Entry | Company | Description | Yield | | Melons per weight class (%) | | |
|---------------------|-------------------|-------------------------------------|------------|---------|-----------------------------|---------------|---------|
| | | | (lbs/acre) | ≤10 lbs | >10 - ≤20 lbs | >20 - ≤30 lbs | >30 lbs |
| RWM 8074-VP | Rogers | Allsweet Seeded | 69,395 | 1 | 38 | 49 | 12 |
| #5031 | Seminis | Triploid | 60,450 | 9 | 74 | 17 | 1 |
| Celebration | Rogers | Allsweet Seeded, RWM 8052-VP | 59,369 | 1 | 58 | 37 | 4 |
| Carnival | Rogers | Hybrid Seeded, RXW 118 -VP | 56,519 | 4 | 47 | 42 | 8 |
| Sugar Slice | Willhite | Triploid | 54,319 | 11 | 78 | 10 | 1 |
| Jamboree | Rogers | Allsweet Seeded, RWM 8036 | 53,495 | 1 | 38 | 55 | 5 |
| Ole' | Willhite | Hybrid | 52,189 | 0 | 49 | 39 | 12 |
| AU-Producer-98 | Auburn University | Diploid Crimson Sweet | 52,069 | 6 | 42 | 40 | 12 |
| #7167 | Abbott & Cobb | Super Seedless/ Hybrid Triploid | 51,659 | 22 | 78 | 0 | 0 |
| WX255 | Willhite | Hybrid | 51,593 | 13 | 71 | 16 | 0 |
| Montreal | Sunseed | Diploid | 49,357 | 8 | 49 | 43 | 0 |
| Tri-X 313 | Rogers | Red Seedless | 48,609 | 12 | 64 | 24 | 0 |
| AU-3 | Auburn University | ZYMV Tolerance? | 47,045 | 7 | 49 | 38 | 6 |
| Pinata | Willhite | Hybrid | 46,457 | 3 | 44 | 42 | 11 |
| Revolution | Sunseed | Triploid | 45,890 | 11 | 71 | 18 | 0 |
| WX207 | Willhite | Hybrid | 45,440 | 6 | 42 | 47 | 5 |
| #7177 HQ | abbott&cobb | Super Seedless HQ / Hybrid Triploid | 44,235 | 3 | 79 | 15 | 3 |
| Tri-X Brand Palomar | Rogers | Red Seedless | 43,829 | 32 | 66 | 2 | 0 |

| | | | | | | | |
|--------------------|----------------------|----------------------------|-----------------------|--------|----|----|---|
| Cooperstown | Seminis | Triploid | 43,640 | 11 | 81 | 7 | 0 |
| Sweet Slice | Willhite | Triploid | 42,732 | 6 | 92 | 1 | 1 |
| RWT | | | | | | | |
| 8096-VP | Rogers | Red Seedless | 42,239 | 7 | 75 | 18 | 0 |
| | | Super Seedless HQ / Hybrid | | | | | |
| #7187 HQ | abbott&cobb | Triploid | 41,730 | 11 | 81 | 8 | 0 |
| Festival | Willhite | Hybrid | 40,881 | 3 | 48 | 47 | 2 |
| AU-Allsweet- BL | Auburn University | Diploid Allsweet | 40,616 | 4 | 44 | 51 | 2 |
| Gold Strike | Willhite | Hybrid | 39,977 | 7 | 75 | 18 | 0 |
| | | Summer Sweet / Hybrid | | | | | |
| #5244 | abbott&cobb | Triploid | 38,917 | 15 | 80 | 5 | 0 |
| Dulce | Willhite | Hybrid | 36,496 | 4 | 43 | 47 | 6 |
| Seedless | | Allsweet Seedless, RWT | | | | | |
| Sangria | Rogers | 8108-VP | 34,354 | 2 | 51 | 44 | 2 |
| Rojo Grande | Willhite | Hybrid | 34,235 | 0 | 43 | 54 | 2 |
| Imagination | Rogers | Red Seedless, RWT 8089-VP | 27,530 | 49 | 51 | 0 | 0 |
| #1075 | Seminis | Triploid | 26,612 | 7 | 76 | 17 | 0 |
| | | | R ² | 0.264 | | | |
| | | | CV | 39% | | | |
| | | | Adjusted LSD (p≤0.05) | 30,922 | | | |

Table 2. Watermelon Fruit Characteristics.

| Entry | Flesh Color | Flesh Color Rating ^z | Fruit | | Rind | Soluble Solids (%) | |
|-------------|-------------|---------------------------------|--------------|-------------|-----------------|----------------------|------|
| | | | Length (in.) | Width (in.) | Thickness (in.) | | |
| #5244 | Red/Pink | 3 | 10.8 | 8.5 | 0.9 | Crimson Sweet | 11.6 |
| Ole' | Red | 3.6 | 15.3 | 9.1 | 0.8 | Allsweet | 11.4 |
| WX207 | Red/Pink | 3.1 | 16.2 | 8.9 | 0.8 | Jubilee | 11.4 |
| Cooperstown | Pink/Red | 2.7 | 10.5 | 8.9 | 0.8 | Crimson Sweet | 11.3 |
| Gold Strike | Yellow | 3.6 | 12.8 | 8.8 | 0.7 | Allsweet | 11.3 |
| Imagination | Red | 3.3 | 8.3 | 8.5 | 0.9 | Icebox | 11.3 |
| Sweet Slice | Red/Pink | 2.8 | 10.2 | 8.9 | 0.9 | Crimson Sweet | 11.3 |
| Revolution | Red/Pink | 2.7 | 10.9 | 8.1 | 0.8 | Blocky Crimson Sweet | 11.3 |
| Sugar Slice | Red | 3.1 | 10.1 | 9.1 | 1 | Crimson Sweet | 11.3 |
| RWT 8096-VP | Red/Pink | 2.6 | 10.7 | 8.9 | 1 | Crimson Sweet | 11.2 |
| Rojo Grande | Red/Pink | 3.7 | 15.8 | 8.4 | 0.9 | Allsweet | 11.1 |
| Tri-X Brand | | | | | | Small Crimson Sweet | |
| Palomar | Red | 3.1 | 9 | 9.1 | 0.9 | Sweet | 11.1 |
| Dulce | Red/Pink | 3 | 15.9 | 8.9 | 1 | Allsweet | 11 |
| Montreal | Pink/Red | 2.3 | 13.6 | 9.4 | 1 | Allsweet | 11 |
| Carnival | Red | 3.5 | 14.7 | 9.6 | 0.7 | Jubilee | 10.8 |
| Celebration | Red | 3.1 | 12.3 | 8.8 | 0.9 | Allsweet | 10.8 |
| #7167 | Red | 2.6 | 9.9 | 8.4 | 0.8 | Crimson Sweet | 10.7 |
| Festival | Red | 3.3 | 15.2 | 9.1 | 0.8 | Allsweet | 10.7 |
| Pinata | Red/Pink | 2.6 | 14.5 | 9.1 | 0.8 | Allsweet/Jubilee | 10.6 |
| #1075 | Red | 2.5 | 10.5 | 9.4 | 1 | Crimson Sweet | 10.6 |

| | | | | | | | | |
|---|----------|-----|------|-----|-----|------------------------------------|------|-------|
| Tri-X 313 | Red/Pink | 2.6 | 11.2 | 8.8 | 0.9 | Small Allsweet/Crimson Sweet | 10.6 | |
| #7177 HQ | Pink/Red | 2.3 | 10.8 | 9 | 0.9 | Crimson Sweet | 10.4 | |
| #7187 HQ | Pink/Red | 2.6 | 10.5 | 9 | 1 | Crimson Sweet | 10.4 | |
| Jamboree | Red | 3 | 15.7 | 8 | 0.8 | Allsweet | 10.4 | |
| AU-3 | Pink/Red | 2.2 | 11.5 | 11 | 0.9 | Crimson Sweet | 10.3 | |
| RWM 8074-VP | Red | 3.6 | 15.9 | 8.8 | 0.7 | Allsweet | 10.1 | |
| AU-Allsweet-BL | Pink | 1.6 | 14.2 | 8.9 | 1 | Allsweet | 10.1 | |
| #5031 | Red/Pink | 2.9 | 11.7 | 8.7 | 0.9 | Crimson Sweet/Allsweet | 10 | |
| AU-Producer-98 | Red/Pink | 3.3 | 11.1 | 9.8 | 0.8 | Crimson Sweet | 9.9 | |
| Seedless Sangria | Red | 2.2 | 13.9 | 8.3 | 0.9 | Allsweet/Jubilee | 9.9 | |
| WX255 | Red/Pink | 3.3 | 12.8 | 8.7 | 0.8 | Allsweet | 9.3 | |
| z1-5 Scale with 1-poor color, 5-excellent color | | | | | | | R2 | 0.331 |
| | | | | | | | | 9% |
| | | | | | | | | 1.5 |

Table 3. Watermelon Variety
Trial, 2002.

On-farm, Crisp County.

| | Yield (lbs/acre) | Average Fruit Weight (lbs) |
|-----------------------------|---------------------|-------------------------------------|
| Dulce | 88,572 | 25 |
| Festival | 79,731 | 23 |
| Gold Strike | 71,975 | 22 |
| Carnival | 71,894 | 24 |
| Celebration | 69,333 | 24 |
| Ole | 66,441 | 22 |
| Montreal | 65,695 | 24 |
| Jamboree | 59,645 | 23 |
| WX255 | 59,274 | 17 |
| Rojo Grande | 44,972 | 21 |
| R ² | 0.458 | |
| CV | 25% | |
| Adjusted LSD (p≤0.05) | 34,552 | |

Educational Session #3

Watermelon Production II

Moderator: Ronnie Barrentine

OZONE INJURY OF WATERMELON: HOW TO RECOGNIZE IT AND WHAT YOU CAN DO ABOUT IT

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Ozone (O₃) is an important component of the earth's atmosphere. In the upper atmosphere (15 to 50 km above the earth's surface), a natural layer of O₃ absorbs harmful ultraviolet radiation. However, at the earth's surface O₃ is the most prevalent and damaging air pollutant to which plants are exposed. Plant sensitivity to O₃ is dependent on a number of factors, including species and cultivar. However, little information is available on the relative sensitivity of cultivars within most plant species. Watermelon foliage is sensitive to O₃, causing a distinctive chlorosis and necrosis.

During the 2000 and 2001 growing seasons, 93 cultivars and breeding lines (i.e., cultigens) were evaluated for foliar injury caused by naturally occurring levels of O₃ at Clayton, NC. Visible O₃ injury developed on the foliage of all cultigens tested in both years. Symptoms began as a general chlorosis of the older leaves approximately 25 days prior to the first harvest. In this study, the first distinctive symptom of O₃ injury was small necrotic flecks on the lower leaf surface. Small flecks enlarged and merged into necrotic areas visible on the upper and lower leaf surfaces. Necrosis was usually white or "bleached" at first, darkening with time. Necrotic areas enlarged progressively until they cracked and flaked off, leaving only the main leaf veins intact. Injury first appeared on crown leaves; new growth (i.e., leaves not fully expanded) was unaffected. The rate of symptom development (i.e., time between appearance of initial symptoms and severe symptoms) was 3 to 5 weeks depending on the year and the cultivar. In 2001, O₃ injury was first detected in a few plots on 26 Jun and peaked (all plots) approximately 10 days after the first harvest (20 July).

Cultigens differed significantly in their sensitivity to O₃ injury. In 2000, the range of foliar injury found in individual plots was 5 to 85% with a mean of 39%. Cultigens 'W 5051,' 'W 5052,' 'Millionaire,' and 'HMX 8913' were the most tolerant with 20% or less foliar injury. The most sensitive cultigens were 'SWX 5023,' 'Stars N Stripes,' and 'Pinata LS' with 59% or more foliar injury. In 2001, the range of foliar injury was 1 to 70% with a mean of 20%. Cultigens 'Virtigo,' 'RWT 8120,' and 'Trillion' were the most tolerant with 8% or less foliar injury. The most sensitive cultigens were 'Sugar Baby,' 'W 5023,' and 'Montreal' with 44% or more foliar injury. Mean injury for cultigens that were common to both years was greater in 2000 (37%) than in 2001 (21%). This corresponded to greater seasonal O₃ levels in 2000 (58 ppb)

than in 2001 (52 ppb). These ambient O₃ levels are common for the North Carolina Coastal Plain.

Seedless watermelon cultigens manifested significantly less O₃ injury than seeded cultigens in both years. Mean injury for all seedless cultigens was 31% in 2000 and 16% in 2001, whereas mean injury for all seeded cultigens was 47% in 2000 and 25% in 2001. In 2000, the 22 least sensitive cultigens were seedless. Watermelon growers can use this information in efforts to reduce injury due to O₃ in watermelon production areas of high O₃ pollution. For a complete listing of the cultigens tested see the citations listed below.

Citations

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WATER USE EFFICIENCY AND STRIP TILLAGE IN WATERMELON PRODUCTION

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As population continues to increase so does the competition for limited water supplies. This is becoming a very serious situation in crop production in many areas of the United States. Therefore, in order to maintain profitable crop production, increasing water use efficiency should be a major goal for all irrigated crop producers including watermelon growers.

The watermelon industry is currently converting from the production of open pollinated varieties to hybrid and triploid(seedless) varieties. Unlike the open pollinated varieties, these types are not well suited to dryland production. Consequently, to derive the maximum benefits from their use irrigation is a must. In order to optimize irrigation water, growers should pay close attention to cultural practices used and to the scheduling of appropriate quantities of water at appropriate times. Using this approach growers can improve their crop water use efficiency. In addition to cultural practices water use efficiency is also impacted by environmental condition, soil type and irrigation method.

Water use efficiency is a measure of the volume of water required to produce a unit of product, or the gallons of water required to produce one pound of watermelon fruit. The lower the ration for water required per pound of fruit, the greater is the water use efficiency. In a study conducted in the Texas Wintergarden region during the 2002 season, the use of a rainfall capture technique(RFC) was found to increase water use efficiency in a commercial production field nearly three fold (22.4 gallons water : pound of watermelon fruit with bare soil culture under a center pivot as compared to 8.3:1 with RFC).

Strip tillage is another cultural practice that has an impact on water use efficiency and fruit yield. With this technique strips are tilled into a tall standing crop such as wheat or forage sorghum in late fall or late winter. The watermelon crop is established the following spring in the striped areas. As a result, the remaining wheat or sorghum stubble functions as a windbreak. The windbreaks reduce air movement across the watermelon vines. This in turn reduces moisture lost through transpiration as well as to reduce injury from excessive vine twisting.

WATERMELON WEED MANAGEMENT UPDATE

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Watermelon growers often struggle managing weeds in watermelon due to limited herbicide availability. Five of the most common weeds infesting Georgia watermelon include pigweed species, nutsedge species, Florida pusley, morningglory species, and Texas panicum.

Texas panicum and Florida pusley can be managed effectively with at-plant applications of Curbit (ethalfluralin) or Strategy (ethalfluralin + clomazone). Alanap (naptalam) can also be applied at planting to provide fair control of Florida pusley. Select (clethodim) or Poast (sethoxydim) can be applied overtop of watermelon to control annual grass escapes.

Morningglory species continue to hamper watermelon production and to date there is no herbicide program that provides adequate control. Currently, tillage is the most effective tool to manage this weed complex.

Nutsedge species are the most troublesome weeds in Georgia watermelon. As of December 2002, no labeled herbicides provide control of this weed complex. Thus, tillage is the only option for managing this weed. However, Gowan Company is pursuing a label for the use of Sandea as a preemergence application on seeded bare ground watermelons. At this time, it is impossible to speculate if and when the label might evolve. However, it is conceivable that Sandea may be labeled for use in the 2003 watermelon crop. Check with your local Extension Service to obtain the latest information. Sandea applied preemergence in seeded bareground watermelon will provide 60 to 80% nutsedge control for at least 21 days. Although nutsedge is often only suppressed with Sandea applied preemergence, it likely will allow normal watermelon development by alleviating early-season nutsedge competition. Sandea applied preemergence at the proposed use rates may cause a slight delay in watermelon maturity when the growing season is stressful. However, most research shows no negative impact on watermelon when Sandea is applied according to the proposed label.

Pigweed species are the most common weed infesting Georgia watermelon. Growers have several effective options to manage this weed including Curbit, Strategy, and Alanap. A systems approach to control pigweed will be necessary and may vary by grower preference. Strategy or Curbit should be applied at-plant following labeled recommendations. The addition of Alanap preemergence, postemergence, or preemergence and postemergence may be made depending on pigweed intensity. A preemergence application of Alanap is more effective on pigweeds than a postemergence application. However, small pigweed can be controlled with Alanap applied postemergence. If Sandea does obtain a preemergence label for seeded bareground watermelon, it will provide excellent residual pigweed control

FOOD SAFETY GAP WORKSHOP

GOOD AGRICULTURAL PRACTICES (GAPs) & A FARM FOOD SAFETY PLAN

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The purpose of this Georgia Food Safety GAPs Workshop is to give participants a blueprint to follow in the design and implementation of an On-the-Farm Food Safety Plan that will pass third-party auditing. Many wholesale buyers and retailers are now requiring their suppliers to verify the safety of the fresh produce sold to them. Passing the “third-party audit” and receiving this certification has now become a reality for Georgia producers.

Unfortunately, most growers or packers do not have the training, expertise or time to undertake such a daunting task. They have three choices: 1) pay a food safety consultant \$10,000 to \$30,000 to develop this program for their operation; 2) “team up” with their County Agent to prepare and implement a food safety program; or 3) take on this task themselves prior to the auditing process.

The fundamental tools for developing an On-the-Farm Food Safety Plan include using Good Agricultural Practices (GAPs), which identify the locations of potential safety hazards in the operation, and Standard Operating Procedures (SOPs), which document the operating systems used to control or minimize these hazards.

Good Agricultural Practices (GAPs) were developed and published jointly by the FDA and USDA in 1998 as a guidance document for the safety of fresh produce. Participants of this program will learn about the eight (8) areas in growing and handling produce where microbial contamination or safety hazards might occur. They will receive recommendations on how to manage their particular operations to minimize that potential risk. Once the safety hazards are identified, the methods used to control them must be implemented and documented on a regular basis.

Standard Operating Procedures (SOPs) are step-by-step, written instructions that detail how to perform each operation correctly so that control over a potential hazard can be documented and verified. Documentation in a timely manner is critical to verifying that the program is working properly.

This program will provide each participant with a 135-page, three-ring notebook including supporting materials and sample forms to develop a customized Food Safety Plan for their own operations, which when implemented and verified, will ensure the production of safe, high-quality produce.

PACKING FACILITY SANITATION

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For many years, produce packing sheds have been considered part of a grower/ packer's field agricultural operation. However, with the introduction of GAPs in 1998, packing facilities have taken on the identity of a food-handling operation. Central to the activities of these businesses is sanitation, because it has a direct link to produce safety and acceptability.

The importance of sanitation to a produce packing facility is difficult to measure because it is not reflected on the profit and loss statement. Unlike fixing a price for a carton of produce, sanitation's value cannot be pinpointed in accounting terms. Sanitation is not a consumable product to fill a customer's needs. Yet the importance of sanitation can be summed up in two little words: public health. Sanitation is the most critical driving force for public health, since unsanitary conditions can lead to food-borne illness outbreaks, possibly resulting in death. A second motivating factor for sanitation is product quality. Good sanitary practices can extend fresh produce shelf-life and increase market share.

This presentation will focus on why someone needs to be designated as the farm or packing shed "sanitarian." The person selected for this position will be responsible for developing, implementing, monitoring and documenting a sanitation program as the core part of an On-the-Farm Food Safety Plan. GAP areas where potential microbial safety hazards may occur should be identified in the field, at the packing facility and during transport operations. The farm/packing shed sanitarian will also be responsible for writing all of the SOPs to document control over the potentially hazardous GAP areas. This person should develop a Master Sanitation Schedule for cleaning and sanitizing the facility and its equipment. In addition, the sanitarian will be responsible for developing and implementing all monitoring and documentation checklists, records, forms, logs, etc., to verify that the sanitation program is working as intended.

In summary, the farm or packing shed sanitarian's position and activities are essential to have someone who is accountable for food safety and to provide the necessary documents to meet and pass third-party audits.

GEORGIA GAP's - FOCUS ON THE FIELD

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To help ensure that produce grown in Georgia is safe for consumption, Georgia growers are rigorously implementing Good Agricultural Practices (GAP's). Good Agricultural Practices are those practices used during crop production to reduce the risks of contamination of produce with human pathogens. Regarding fresh produce and food safety, prevention of contamination is first and foremost - remedial procedures after contamination occurs are generally ineffective. Microbial contamination of produce can occur at many points as food flows from farm to fork. However, to effectively protect the food supply, it is essential that food safety practices begin on the farm.

The major sources of on-farm microbial contamination are infected people and human and animal feces. Agricultural water (including water used for irrigation, fertigation, frost protection, and as a carrier for pesticides) can harbor, transport and spread many disease organisms. Contaminated soils, contaminated fertilizers (particularly manures and other non-processed organic fertilizers) rodents, birds and insects are also potential sources of human pathogens.

Animals and Workers

1. Keep domestic and farm animals away from production fields and packing facilities.
2. Make sure that workers use good hygiene and appropriate sanitation practices.
3. Ensure accessibility of properly maintained toilets and hand-washing stations.
4. Conduct periodic training in good hygiene for all workers.

Manures and Biosolids

1. Manage the use of manures closely to minimize risks of microbial contamination.
2. Using properly composted manures is preferred to using non-processed manure.

Water

1. If not properly maintained/protected, surface water may contain pathogens.
2. Properly installed/maintained wells are less likely to harbor harmful microbes.
3. Water used for irrigation, fertigation or pesticide application can carry pathogens.
4. Test water for microbial contamination as recommended.

WORKER HEALTH & PERSONAL HYGIENE

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Once a produce grower/packer has spent money on building or remodeling a packing facility and its equipment, the need still exists for altering employee attitudes so that the operation can run efficiently and in a sanitary manner. Employees' attitudes can negate all of the positive efforts made by management to pack safe, high-quality produce.

Unfortunately, management often fails to fully appreciate their employees or to invest in training for them. Further development of this asset through motivational training or "awareness programs" to emphasize the importance of their performance in the packing facility operation is needed. If employees feel important and needed, they will more likely respond favorably when asked to use good sanitary practices.

Fresh produce handling is essentially a "people" business, and as such the only way to ensure continued produce safety and quality at a reasonable cost is through employee sanitary training. In order for employees to buy into your training program, they must understand the role of microbial contamination or sanitation and safety. It's much easier to show an individual the need for personal hygiene than to tell them that personal hygiene is important. Two communication tools that transcend language and cultural barriers to convey this message are included in this program. These training aids demonstrate the importance of personal hygiene and graphically illustrate microbial growth and the transfer of microorganisms from employees' bodies to Petri dishes.

In summary, research has demonstrated that a major source of human pathogens are workers' hands. So the single most effective public health measure to prevent diseases from spreading is proper hand washing.

Remember, while produce quality is negotiable, safety must be absolute! **WORKER HEALTH & PERSONAL HYGIENE**

WRITING A STANDARD OPERATING PROCEDURE (SOP)

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The Federal GAPs publication provides useful information on identifying the primary sources of microbial hazards to fresh produce during the farming operation. However, it lacks the detailed procedures to use to document control over identified safety hazards. Documentation of safety controls is what third-party auditors focus on in their inspection process. As one auditor stated, “If it wasn’t written down, as far as he was concerned, it wasn’t done!” SOPs provide the linkage to GAPs that is necessary to verify produce safety.

The presentation will focus on distinguishing between GAPs and SOPs. A GAP states what should be done to minimize microbial hazards in a farm setting. It is written in broad language, much like a policy statement. In contrast, an SOP gives the written details on how the GAP area should be monitored and documented to verify produce safety.

There are five (5) specific parts that must be address in writing an SOP. They are the following: 1) a written action plan (objective, procedures, etc.) must be developed; 2) persons responsible for performing the task must be identified; 3) the designated “sanitarian” or management must verify its accuracy and full completion; 4) written documentation of the activity, plus any corrective actions taken, must be recorded on monitoring forms, records, logs, or checklists etc.; and 5) all monitoring records must be kept up-to-date and on file at the facility.

In summary, this presentation will give model examples of SOPs written for specific GAP areas where safety hazards may exist. It is up to each farm sanitarian to implement these SOPs in their unique produce operation.

Collection and Analysis of Water for the Georgia GAP Audit

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The Georgia Good Agricultural Practices (GAP) program requires the bacteriological testing of water used for packing vegetables, irrigation, and crop protection. The water used by packing facilities must meet drinking water standards, containing no total coliform and *Escherichia coli* (*E. coli*). Water used for irrigation and crop protection must meet Georgia Department of Natural Resources in-stream fecal coliform standards for drinking water sources, containing less than 200 fecal coliform/100 ml. Irrigation or crop protection water containing fecal coliform below this standard can be used within 72 hours of harvest. Irrigation and crop protection water containing no fecal coliform can be used without restriction.

The procedure for collecting water from a packing facility is as follows: 1) Obtain a sample bottle and information sheet from a Georgia Cooperative Extension Service county office or the AESL-Feed & Environmental Water Lab; 2) Samples must arrive at the lab within 24 hours of the collection time so plan ahead by pre-selecting a day and time to collect your sample that will allow for shipping or travel time; 3) Select an inside faucet that is clean and not leaking; remove any faucet attachments such as filters, aerators, screens, splashguards, or water-saver valves; 4) Sanitize the faucet inside and out by dipping the faucet neck into undiluted chlorine bleach; 6) Open tap fully and flush the faucet and pipes by running the hot water for 3 minutes, then cold water for 3 minutes, reduce the flow to avoid splashing, uncap the sample bottle without touching the inside of the cap or bottle, fill the bottle above the 100-ml line, but not completely full and recap.

When collecting water used for irrigation and crop protection, select the appropriate sampling area needed to obtain a representative sample of the crop protection or irrigation water. For either irrigation or crop protection water from either a well or surface source, collect the sample at the point-of-use, just prior to application in the case of irrigation or in the case of crop protection water, just prior to filling the spray tank. If you need help selecting a sampling location, contact your county Extension Agent or GAP auditor.

Citations

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Georgia Department of Natural Resources, Environmental Protection Division. 2002. Rules and regulations for water quality control. Chapter 391-3-6. Revised June 2002.

Posters

CONTROL OF *Phytophthora capsici* ON YELLOW SQUASH WITH ORGANIC AMENDMENTS AND BIOLOGICAL AGENTS

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Phytophthora crown and fruit rot, caused by *Phytophthora capsici*, is a serious constraint to the production of yellow squash in Georgia and has increased in severity in recent years. The disease is common to a number of cucurbit species; however, yellow squash is known to be the most susceptible. The onset of symptoms is followed by rapid death in the case of root or crown infections, while infected fruit quickly decay and collapse. Favorable conditions for diseasedevelopment include excessive rainfall or irrigation, poor soil drainage, and moderate temperatures. *Phytophthora capsici* produces numerous sporangia, which release motile zoospores that can be spread in irrigation or surface water. Sporangia may also be dispersed in air. Splash dispersal of infested soil is also responsible for plant-to-plant movement of *P. capsici*. Oospores (thick-walled resting spores) and mycelium in infected tissue are the principal means of survival of *P. capsici* between crops. Management of the disease has proven difficult with soil fumigation, cultural practices and crop rotation, and there are no labeled fungicides available in Georgia. The search for acceptable fungicides to combat *P. capsici* has been hampered by difficulties in delivering materials to the most susceptible parts of the squash plant and by varying levels of susceptibility by *P. capsici* to fungicides such as mefenoxam (Ridomil Gold®).

Researchers have demonstrated that the addition of composted organic matter to soil results in suppression of soilborne pathogens such as *Phytophthora* spp., *Pythium* spp., and *Rhizoctonia* spp. The mechanisms behind pathogen suppression are not understood clearly, but it is known that composts promote and sustain populations of fungi and bacteria that compete with and antagonize soilborne pathogens. Studies have also shown that composts promote the establishment of biological control agents in soils. These materials have the potential to provide Georgia growers with an economical tool for disease management. Research was initiated to evaluate the potential of composted organic matter, applied at 1000, 2000, 5000, or 10000 lb/acre in combination with potential biological control agents (rhizobacteria), for the control of diseases of yellow squash caused by *P. capsici*. Results from trials conducted in the spring and fall of 2002 indicate, in the short term, that neither composted organic matter or rhizobacteria provided adequate control of Phytophthora crown and fruit rot. In both tests, no differences were seen between compost/rhizobacteria-amended plots and the untreated controls. It is possible that beneficial effects of composted organic material are manifested over several growing seasons. This research will be continued in an effort to determine if the use of compost will prove to be effective in the control of *P. capsici*.

IMPROVING THE PROFITABILITY OF FRUIT AND VEGETABLES IN GEORGIA

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The Biological and Agricultural Engineering Department of the University of Georgia in conjunction with FoodPAC has introduced a program for reducing waste, improving efficiency and thus improving the overall profitability of fruits and vegetables grown in the State of Georgia. In 2001 the farm gate value of fruit and vegetables for Georgia was estimated to be \$397,275,000. Furthermore when fruit and vegetables are processed and packaged for retail, their retail value may be more than double the original farm gate value. Yet, even though there is the potential of a high economic return, sometimes inefficiencies of operation and waste of produce reduce overall returns. For example, it is estimated that 10 % of harvested produce may be wasted during post harvest processing. Improvements in processing and handling can therefore enhance efficiency and the 'bottom line'. Visits have been made to places where produce is grown, harvested and processed. Fourteen vegetables and three types of fruit have so far been included. Through the assistance of the Cooperative Extension Service, discussions have been conducted with owner operators and staff. Following those site observations, suggestions have been made of possible improvements. A program is being developed to transfer the general results of this study to other processors.

**DO WE UNDERSTAND HOW PLASTIC FILM MULCHES WORK?
EFFECT OF SOIL-WARMING ABILITY OF PLASTIC MULCHES ON TOMATO
PLANT GROWTH AND FRUIT YIELD**

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In the southeastern United States, most tomato and pepper crops are produced on plastic film mulch. The benefits associated with use of plastic mulches include higher yields, earlier harvests, improved weed control, and increased efficiency in the use of water and fertilizers. Plastic mulches affect plant microclimate by modifying the soil energy balance and by restricting soil water evaporation. Modification of these microclimate factors influence soil temperature, which affects plant growth and yield.

Increased root-zone temperature (RZT) is one of the main benefits associated with use of plastic mulches. However, under conditions of high ambient temperature and high solar radiation which occur during the summer in the southeastern United States, plants often show poor growth and low yield. Under these conditions, mulches warm the soil to temperatures that may be deleterious to plant growth.

Research indicates that crop responses to colored mulches are inconsistent, depending on the season, the year, and the region. One reason for these apparent inconsistencies is that most of the mulch research is based on empirical studies where the effect of various mulches on yield is evaluated without regard to how the mulches modified the plant microenvironment. Significant research during the last 30 years indicates that black mulch is recommended during the spring to warm the soil. In the summer and fall, aluminum or white colored mulches are preferred because these mulches heat the soil less than black mulch.

In addition to soil warming, plastic mulches also modify the light environment around the plant. The light reflected from the mulch may affect plant growth and morphogenesis. However, the influence of mulch color on plant responses has been difficult to reconcile. The effect of mulch color on tomato plant growth and yield vary according to the geographic location and season, suggesting that plants grown on colored mulches respond to factors in addition to the light reflected from the mulch.

Root-zone temperature is important in plant growth and development because it affects physiological processes in roots such as uptake of water and mineral nutrients. Optimum RZTs for plant growth vary among species. Studies at constant RZT indicate that the optimum RZT for mineral nutrient uptake and growth in tomato is between 79 and 93 °F. However, under field conditions plants are exposed to large fluctuations in air and RZTs. Thus, it is probably difficult to extrapolate plant responses in the field to plant responses under controlled environmental conditions. To our knowledge, there is no report on optimum RZTs for tomato under field conditions, although this information would be useful in tomato production on plastic mulches, as well as in the design of plastic mulches.

The objective of this study was to determine the relationship of mean seasonal root zone temperature, as affected by the various colored mulches, to plant growth and fruit yield. The mulches were selected to differ in their soil-warming ability so that there would be a range of soil temperatures under the different mulches.

Materials and Methods

The study was conducted in Tifton, Ga. at the Coastal Plain Experiment Station, Univ. of Ga. during three seasons (Fall 1999, Spring 2000 and Fall 2000). In fall 1999, the experimental design was a randomized complete block with five treatments (plastic mulch) and 10 replications. The mulches were gray on black (>gray=) (Leco, Montreal, Canada); silver on black ('silver1') (Clarke Ag Plastics, Greenwood Va.); white-on-black ('white') (Leco); black mulch painted with white latex paint ('white-painted'); and bare soil. 'Sun Chaser' (Seminis, Saticoy, Calif.) tomato plants were transplanted on 3 Aug. 1999. In spring 2000, the experimental design was a split plot with three replications, with plastic mulches (n=8) as the main plot and three tomato cultivars as the subplot. The mulches used were black ('black1'), black-on-silver ('black2') (Sonoco Products Co., Hartsville, S.C.), gray-on-black (gray) (Leco), red ('red') (Sonoco), silver-on-black ('silver2') (Sonoco); black mulch painted with silver paint ('silver-painted'); white-on-black (white) (LECO), and bare soil. The tomato cultivars used were 'Florida-91' (Seminis), 'BHN-444' (BHN Research, Bonita Springs, Fla.) and 'Sun Chaser' (Seminis). Transplanting was on 5 Apr. 2000. In fall 2000, the experimental design was a split plot with three replications, with plastic mulches (n=4) as the main plot and tomato cultivars (n=3) as the subplot. The mulches used were black2, gray, and silver2, and bare soil. The tomato cultivars used were 'Heat Master', 'Heat Wave' (Petoseed), and 'Sun Chaser'. Transplanting was on 1 Aug. 2000.

In all three experiments, the experimental plot consisted of a 25-ft long, 3-ft wide bed formed on 6-ft centers. Before laying the mulches with a tractor, the soil was fertilized with 800 lb of 10-10-10 fertilizer. The soil was fumigated with a mixture of 7 methyl bromide : 3 chloropicrin (by weight) at 223 lb/acre. Drip irrigation tape (T-Tape; T-Systems Intl., San Diego), with 12-inch emitter spacing and about 17 mL min⁻¹ emitter flow, was placed manually on the surface of the

soil in the center of the bed. Six-week old tomato transplants were planted to the field in a single row per bed at 2-ft spacing. Fertilization after transplanting, irrigation and pest control were according to the recommendations of the Univ. of Georgia Cooperative Extension Service.

Root-zone temperature, air temperature, and photosynthetically active radiation. RZT was measured by determining soil temperature midway between the plants at 4 inch below the mulch and the soil surface. RZT over the growing season was measured with copper-constantan thermocouples (Model 107, Campbell Scientific, Logan, Utah) connected to a data logger (CR10X, Campbell Scientific) and an AM416 Relay Multiplexer (Campbell Scientific). The data logger was programmed to record readings every 10 min and store hourly averages for each plot. Air temperature data were obtained from a University of Georgia weather station located at the Coastal Plain Experiment Station.

Results

Over the season, mean root zone temperature decreased in the fall (from 90 to 75°F) and increased in the spring (from 68 to 84°F). Daily mean values of RZT over the season under plastic mulches were higher (2 to 9 °F) than those of air temperature.

The highest RZT at midday occurred with black mulch, and the lowest with bare soil and white mulch. Bare soil showed the largest diurnal RZT fluctuation. RZT at midday was up to 7°F higher under black or gray mulch compared to the other mulches or bare soil.

Vegetative top fresh weight and fruit yield increased with increasing root zone temperature up to about 79°F (optimal root zone temperature) , followed by reductions in top fresh weight and fruit yield at higher root zone temperatures. Thus, differences in plant growth and fruit yield were explained, at least partially, by the soil-warming abilities of the mulches.

The effects of colored mulches on plant response depended on the impact of the mulch on RZT. Plant growth and yield were highest as RZT approached the optimal RZT.

Conclusions

- The optimal seasonal RZT for tomato was 79°F.
- Plastic film mulches had a positive or negative effect on tomato plant growth and yield depending on how mulch color affected the soil-warming conditions in different seasons, i.e., plant's growth and yield were highest as RZT conditions approached the optimal RZT (79 °F).
- Use of color as a mulch descriptor may be insufficient to predict how plants will respond when grown on colored plastic mulches. Information on the optical and thermal properties of the mulch and the impact of those properties on the RZT will likely improve predictions of crop response when crops are grown on colored plastic film mulches.

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Bell pepper is a very important crop in Tift County, Georgia with an annual farm gate value over 1.5 million dollars. Common management problems with bell pepper include insect control for several pest. The trial included four replications in a block design with three treatments. Treatments included the imidacloprid insecticides Admire and Platinum, and an untreated check. The imidacloprid treatments were injected through the drip irrigation tape before plants were transplanted into the field. The trial was then evaluated for whitefly, Tomato Spotted Wilt Virus, broad mites as well as yield, plant height and fresh plant and fruit weight measurements. Results indicated that Admire treatments resulted in larger plants than either Platinum or the untreated check. Both Admire and Platinum had statistically significant better early season control of whitefly over the untreated check.

FEASIBILITY OF USING TWIN-ROW PRODUCTION TECHNIQUES

FOR SNAP BEANS

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Fresh-market snap beans (*Phaseolus vulgaris*) encompass over 16,000 acres in Georgia and account for \$28 million in farmgate value. Traditionally, growers plant snap beans in single rows using four to five seed/row foot. However, with the advent of twin-row peanuts, many growers have the capacity to plant snap beans in twin rows. Also, seeding rates have risen to seven and eight seed/row foot. This study was initiated to evaluate twin rows vs single rows and optimum seeding rates to maximize yield and pod quality. Seeding rates of six, seven and eight seed per foot were planted in single and twin rows at Chula, GA in 2002. Snap beans planted in single rows had significantly higher yields than those planted in twin rows. Twin-row beans produced a split crop of two distinct maturities on the same plant. Leaf and pod length and width were greater in single rows, but not significantly so. Seeding rate had little effect on any of the parameters measured. It would appear that using single rows at anywhere from six to eight seed per foot would be an acceptable practice.

IMPACT OF IRRIGATION RATE AND PLANT SPACING ON CANTALOUPE GROWN ON PLASTIC MULCH WITH DRIP IRRIGATION

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A split-plot test was conducted in Decatur County in the spring of 2002 to evaluate plant spacing and irrigation rate effects on yield and water usage of cantaloupe. Cantaloupe were planted on plastic-mulch covered beds spaced six feet apart with intra-row plant spacings of 18, 24, and 30 inches. Whole plots were beds equipped with drip tape manufactured to apply 0.3, 0.4, and 0.5 gallons of water/100 feet/minute. Records were maintained to determine total water usage.

Plant spacing did not significantly affect yield or fruit number, but fruit size was significantly (LSD 0.05) larger at the 24 inch spacing. Total yield, marketable yield and fruit size were significantly greater at the highest water use rate. The greatest fruit weight/gallon of water applied, however, occurred at the lowest water use rate and lowest total yield. Data suggests the implementation of water conservation practices will be difficult without policy changes affecting water usage.

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