FORTY-FIRST ANNUAL

CITRUS

PACKINGHOUSE

DAY

August 29, 2002

CITRUS RESEARCH & EDUCATION CENTER
700 Experiment Station Road
Lake Alfred, FL 33850

STATE OF FLORIDA--DEPARTMENT OF CITRUS
Lakeland, Florida

IN COOPERATION WITH

FLORIDA CITRUS PACKERS

COOPERATIVE EXTENSION SERVICE

INSTITUTE OF FOOD & AGRICULTURAL SCIENCES

UNIVERSITY OF FLORIDA, GAINESVILLE

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CITRUS RESEARCH & EDUCATION CENTER
700 EXPERIMENT STATION ROAD
LAKE ALFRED, FL 33850

REGISTRATION - 8:30 AM

PROGRAM - 9:30 AM

EXHIBITS - AFTERNOON

Packinghouse Day Coordinators:

Mark Ritenour, Ph.D. - Program Coordinator
Bill Miller, Ph.D. - Exhibits Coordinator
Renée Goodrich, Ph.D. - Local Arrangements Coordinator

FORWARD

Welcome to the Forty-First Annual Citrus Packinghouse Day! This year we have several diverse but

important issues that will be addressed. Leading members of industry and scientists from the University of Florida (UF), Florida Department of Citrus (FDOC), Florida Department of Agriculture and Consumer Services (FDACS), and the United States Department of Agriculture (USDA) will present practical and applied information of interest to your business. This year's keynote speaker is Dr. Joseph Smilanick from the USDA in California who will discuss recent developments relating to the control of postharvest citrus diseases. Other topics presented this morning will include:

* Quarantine issues (especially the current status of Spanish Clementine importation)

* Information about a new USDA-FDACS postharvest good handling practices (GHPs) and good agricultural practices (GAPs) third-party auditing program

* Food security issues for citrus packinghouses

* The performance of non-destructive, Brix-sensing equipment now being used in Florida

* Commercial sales of fresh-cut citrus this season

* Citrus postharvest resources on the Internet

* Effectiveness of preharvest compounds at reducing postharvest decay

Because of a generous donation from DECCO/Cerexagri Inc., an excellent lunch will again be provided to the first 200 people to register at the door. Be sure to stop by DECCO's exhibitor booth to say thanks!

Over 30 commercial exhibitors will be on hand to provide valuable information for your business. Check out what they have to offer after lunch. An exhibitor list is provided including the names, addresses, telephone numbers and products sold.

Be sure to stick around for the door prize drawings. We will again be giving out $250 in door prizes. The only catch is that you have to be present to win. One of the door prizes will be given out in the exhibitor area. Also, please complete and turn in an evaluation form to give us valuable feedback on how we can improve Packinghouse Day. One of the door prizes will be awarded only to participants who turn in a completed evaluation form.

Mark A. Ritenour
Indian River Research & Education Center
Program Coordinator

PROGRAM

Forty-First Annual Citrus Packinghouse Day
The University of Florida - IFAS
Citrus Research and Education Center
700 Experiment Station Road
Lake Alfred FL 33850-2299

Thursday, August 29, 2002

8:30 AM REGISTRATION

9:30 AM WELCOME (10 min.)

Dr. Harold W. Browning, Center Director
Citrus Research and Education Center, Lake Alfred

INTRODUCTORY REMARKS (10 min.)

Dr. M. Joseph Ahrens
Director of Scientific Research
Florida Department of Citrus, Lake Alfred

PRESIDING (10 min.)

Mr. Dennis Broadaway
Executive Vice-President & General Manager
Haines City Citrus Growers Association, Haines City

10:00 AM COMMERCIAL AND EXPERIMENTAL DEVELOPMENTS IN CALIFORNIA FOR THE CONTROL OF POSTHARVEST CITRUS DISEASES - Joseph L. Smilanick, Ph.D., Research Plant Pathologist, USDA ARS San Joaquin Valley Agricultural Sciences Center, 9611 S. Riverbend Avenue, Parlier, California 93648

The production of most of the California/Arizona citrus industry is destined for the fresh market, and protection of these fruit from postharvest decay remains very important, particularly when long storage or distant transport of the fruit is needed. Several new fungicides have been tested extensively and

registration efforts for them are in progress. They include PM066, from Janssen Pharmecutica, and fludioxonil and azoxystrobin, from Syngenta. Registration for these materials, classified as 'reduced risk' by the USEPA, is expected between 2003 and 2005. Although the practice in California packinghouses to pass lemons and oranges through heated tanks containing soda ash, borax/boric acid, or other substances is more than 80 years old, its popularity has increased and refinement of this technology continues, particularly to combine tank or drench treatments with new fungicides or biological control products. The use of imazalil in heated, aqueous solutions began in 1998 and has become very popular in California.

Recently, two approaches employing heated solutions were evaluated in large-scale tests. The first objective was to evaluate the efficacy and residues associated with the use of heated, aqueous solutions of thiabendazole (TBZ) combined with sodium bicarbonate and chlorine. TBZ drenches are popular in Florida to control stem end rot, while in California, the process is gaining popularity to control green mold, caused by *Penicillium digitatum*, particularly when applied before degreening of lemons and oranges. In laboratory tests, warm, aqueous solutions of TBZ controlled green mold more effectively than the TBZ wax sprays commonly used in packinghouses. This had been shown in prior reports from Italy and elsewhere, and our objective was to develop it into several practical regimes for packinghouses. The addition of chlorine (Cl_2, 200 ppm) and sodium bicarbonate (SBC, 3% wt/vol) did not influence TBZ residue levels. Cl_2 sanitized the solution, while SBC significantly improved its efficacy, particularly when TBZ-resistant *P. digitatum* isolates were present. Mild heating, an increase from 75 to 105°F (24 to 41°C), increased TBZ residues in lemons about two-fold. Mild heating greatly increased the efficacy of a solution containing TBZ (400 ppm) + SBC (3%) + chlorine (200 ppm), and no injury to lemons or oranges was ever observed. Among lemons inoculated with a TBZ sensitive isolate, green mold incidence in storage after treatment with nothing, cool TBZ/SBC/Cl_2, or warm TBZ/SBC/Cl_2 was 83.6, 13.1, or 1.3%, respectively. Among lemons inoculated with a TBZ resistant isolate, green mold incidence among lemons in storage after treatment with nothing, cool TBZ/SBC/Cl_2, or warm TBZ/SBC/Cl_2 was 99.6, 64.8, or 16.6%, respectively. In commercial tests with naturally inoculated oranges, five collections of 8 to 25 bins of navel oranges per treatment were drenched for 15 seconds with TBZ/SBC/Cl_2 before degreening. Drenching reduced green mold losses during subsequent degreening from 10.8% among untreated oranges to 1.9% among those that were drenched with TBZ/SBC/Cl_2. This equipment did not heat the solution, which was about 60°F (15°C). The efficacy would have been better if it was heated, but the energy costs to do this may be prohibitive in some locations.

The second objective was to evaluate a brief hot water drench applied to citrus fruit on rotating brushes, a technology developed originally in Israel. A brief (15 or 30 seconds) high volume, low pressure, hot water (68, 120, 130, 140, or 145°F; 20, 49, 54, 60, or 63°C) drench was applied over rotating brushes on "Eureka" lemons and "Valencia" oranges. The impact of this treatment on populations of surface microbes, injury to the fruit, the incidence of green mold or sour rot (caused by *P. digitatum* or *Geotrichum citri-aurantii*, respectively) inoculated into wounds one day prior to treatment, and temperatures required to kill the spores of these fungi and *Penicillium italicum* suspended in hot water

were determined. Microbe populations were determined immediately after treatment. Decay and injuries were assessed after storage for 3 weeks at 55°F (13°C). The efficacy of the hot water treatments was compared to immersion of fruit in 3% wt/vol sodium carbonate at 95°F (35°C) for 30 seconds, a common commercial practice in California. Natural yeast and mold populations, initially $\log_{10}$ 6.0 per fruit, were reduced to $\log_{10}$ 3.3 on lemons and $\log_{10}$ 4.2 on oranges by treatment for 15 seconds at 145°F (63°C). Green mold control improved with increasing temperature and treatment duration. Green mold incidence was reduced from 97.9 and 98.0% on untreated lemons and oranges, respectively, to 14.5 and 9.4% by treatment for 30 seconds with 145°F (63°C) water. However, immersion of lemons or oranges in 3% wt/vol sodium carbonate was superior and reduced green mold to 8.0 and 8.9%, respectively. Sour rot incidence on lemons averaged 84.3% among all the treatments and was not significantly reduced by any hot water treatment. Sodium carbonate, however, did partially control sour rot. Immersion of lemons in 3% wt/vol sodium carbonate for 30 seconds at 95°F (35°C) reduced sour rot to 36.7%. None of the treatments caused visible injuries to the fruit. Our results in general agree with those from Israel, and this treatment may be particularly of use for organic growers.

10:30 AM QUARANTINE ISSUES AND THE CURRENT STATUS OF IMPORTATION OF SPANISH CLEMENTINES INTO THE UNITED STATES - Connie Riherd, Florida Department of Agriculture and Consumer Services, Division of Plant Industry, P. O. Box 147100, Gainesville, FL 32614-7100 riherdc@doacs.state.fl.us

Live Mediterranean fruit fly larvae were found in several shipments of cold treated Clementine fruit from Spain during the fall of 2001. In response, the United States Department of Agriculture suspended the importation of this fruit indefinitely and initiated a technical review of the Spanish cold treatment program. The review revealed that unseasonably warm weather conditions, higher than average fruit fly populations, high host susceptibility of early season Clementine varieties, low trap densities, inadequate bait spray applications, and lack of any fruit cutting activities to adequately monitor larval populations contributed to an overwhelming larval presence that was not adequately mitigated during the cold treatment process.

The USDA is working with the Spanish government to develop a work plan that would require field mitigations to be used in conjunction with cold treatment in order for importations of Spanish Clementine fruit to resume. Presented here is an overview of the citrus production and packing process in Spain, the proposed field mitigations to control medfly, the cold treatment process, and the proposed regulations that would govern future importations of this product into the U.S.

Biographical Sketch: Connie Riherd is the Assistant Director of the Division of Plant Industry with the Florida Department of Agriculture and Consumer Services. Connie graduated from the University of Florida with a Bachelor of Science in Agriculture in 1977 and joined the Division of Plant Industry in the fall of 1977. Connie has served as Assistant Director since 1988. Connie is the current President of

the Southern Plant Board, and as such was selected to represent the National Plant Board on the USDA Spanish Clementine Review Team.

10:45 AM FRESH PRODUCE AUDIT VERIFICATION PROGRAM - Robert Spann, Federal Program Manager, USDA AMS, Haines City, FL

At the request of the State Departments of Agriculture, USDA's Agricultural Marketing Service is helping the states develop an audit-based verification service that will attest industry participants' voluntary adherence to the Food and Drug Administration's "Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables" and Good Agricultural Practices (GAP) and Good Handling Practices (GHP). The service will be provided by the Federal-State Inspection Service (FSIS) via cooperative agreements between the state agencies and AMS. The primary users of these services will be fresh fruit and vegetable packers.

The initial request to develop a GAP and GHP program came from the New Jersey Department of Agriculture as a result of New Jersey growers/packers being asked by retailers to demonstrate adherence with "food safety" practices. AMS responded favorably to this request and to a similar request from the Association of Fruit and Vegetable Inspection and Standardization Agencies (AFVISA), a group that represents the interests of the inspection programs at the state level. In part, the response noted that the states would take the lead in program development, with AMS involvement and oversight to ensure program uniformity and consistency nationwide. Since then, industry members from throughout the country have expressed interest in participating in such a program and in FSIS being the service-provider of choice. A 12-month pilot program involving several industries throughout the country is ongoing.

Program Benefits include:

o Independent third party audits by Federal-State Inspection Service staff.

o USDA oversight to ensure integrity and uniformity throughout the nation.

o Auditors are trained, licensed fresh fruit and vegetable inspectors, and are trained in auditing and the specifications of the program.

o Auditors are available in many locations throughout the country, including shipping and packing locations.

o Program is an audit-based verification program that will attest to a participants' voluntary adherence to the Food and Drug Administration's (FDA) "Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables" (FDA guidance document). Participants are audited against a checklist that

demonstrates adherence with GAPs and GHPs.

o Passing audit results are posted on the USDA's website and accessible to participants and their customers.

o Successful participants receive a Certificate from the USDA that is suitable for display.

Passing audit results do not guarantee "safe" food. It does, however, demonstrate that the participant was adhering to generally recognized GAPs & GHPs. The purpose of the USDA's Federal-State Inspection Service's Audit Verification Program is to demonstrate that the participating company was adhering to generally recognized Good Agricultural Practices and Good Handling Practices when audited. This is a voluntary program established to attest to the participants' adherence to the Food and Drug Administration's "Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables," and does not guarantee a safe product.

Commonly Asked Questions About the Program:

1. Where can I obtain a copy of the "Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables?"

Copies are available by contacting the Food Safety Initiative Staff at (301) 436-2428 or http://www.fda.gov.

2. Is additional information available so I can learn more?

Yes. There is a growers guide entitled "Food Safety Begins on The Farm" compiled by the National GAP Program. To order the guide, visit the following website: www.gaps.cornell.edu. In addition, contact your local State University Cooperative Extension Educator's office for specific information on local practices, outreach and educational opportunities.

3. Is the USDA's Federal-State Audit Program currently available in the State where my business is located?

The size of the program and its availability is growing every day. For information regarding availability in your area refer to the contact information on the back of this brochure or contact your local Federal or Federal-State Inspection Service office. This voluntary service is provided on a first-come, first-served basis and is user-fee funded.

4. How will my customers know that my company has met the requirements of the program?

With the participant's permission, passing audit results are posted on USDA's website and are accessible by you and your customers. In addition, organizations with passing results are acknowledged with an

official USDA Certificate verifying that the organization passed the applicable elements of the audit.

5. Who performs the audits?

Audits are performed by trained Federal-State Inspection Service (FSIS) staff. Auditors are licensed fresh fruit and vegetable inspectors, and are trained in the technical specifications of the GAP&GHP Audit Program. AMS has worked with the States to develop the program and with AMS' involvement and oversight ensures program integrity, uniformity, and consistency nationwide.

6. What is a "passing score" on an audit?

A score of seventy percent (70%) per element is passing. However, a higher "passing" percentage may be applied based on the customer's specifications. In addition to the individual elements of the audit, the questions in the "general" section must be defined by the participant. Audit results are valid for one year.

7. What will I be audited against?

Audits are based on questions derived from the FDA guidance document. They are not intended to require certain activities, only determine if a participant is adhering to generally accepted practices. They are separated into sections, including:

* General (including personnel hygiene and practices)

* Farm Review

* Field Harvesting and Field Packing Activities

* Packing House Facility

* Storage and Transportation

* Trace-back

The FDA guidance document identifies the following areas that participants should demonstrate control of in their operations to minimize microbial hazards in fresh fruits and vegetables:

* Water

* Manure and municipal bio-solids

* Worker health and hygiene

* Sanitary facilities

* Field sanitation

* Packing facility sanitation

* Transportation

* Trace-back

Interested in the Audit Verification Program? For more information: Visit the Fresh Products Branch Website at: www.ams.usda.gov/fv/fpbgapghp.htm

Contact:

Leanne Skelton, Head, or Vincent Fusaro, Staff Assistant, Field Operations Section, Fresh Products Branch, FVP, AMS, USDA at, (202) 720-2482 or (800) 811-2373, or leanne.skelton@usda.gov or vinny.fusaro@usda.gov

Gordon Poulsen, AFVISA GAP & GHP Sub-committee Chair, California Dept. of Food and Agriculture at (916) 654-0810, or gpoulsen@cdfa.ca.gov

Your local Federal or Federal-State Inspection Service office at: Florida Dept. of Agriculture and Consumer Services, Division of Fruits and Vegetables, Winter Haven, FL. Contact: Milton Rains, (863) 291-5820, or Rainsm@doacs.state.fl.us <mailto:Rainsm@doacs.state.fl.us>

11:00 AM FOOD SECURITY FOR PACKING HOUSES - Marion H. Fuller, DVM, DABT, Director, Division of Food Safety, Florida Department of Agriculture and Consumer Services, Tallahassee, FL

This presentation will include a brief overview of general concepts in food security and provide practical measures that any business can consider to enhance the security of their establishment. Topics will include practical considerations for improving premises, site access, managing personnel, and response strategies. Attendees will also be provided a copy of the Department's brochure, "Food Security Guide", which summarizes many of the concepts to be presented.

11:15 AM NON-DESTRUCTIVE BRIX SENSING OF FLORIDA GRAPEFRUIT AND HONEY

TANGERINE - William M. Miller, University of Florida, Citrus Research and Education Center, Lake Alfred, FL

Non-destructive sorting of fruits and vegetables is important in matching premium produce with consumers who are quality conscience. Florida citrus may be highly blemished externally, but the internal quality, typically based on Brix, acid, Brix/acid ratio and percent juice, is higher than fruit grown in arid areas. Many techniques, either electrical, mechanical or optical based, have been proposed to undertake non-destructive quality assessment. These include: dielectric, fluorescence, X-ray, nuclear magnetic resonance (NMR), near infrared (NIR) transmittance and reflectance, firmness by vibration, acoustic, ultrasonic transmission or impact, density and gas analysis. Commercial development has been intense in the external blemish detection and there are now efforts underway to merge these other internal quality sensors into on-line processes.

At the end of the 2000-01 season, preliminary tests were undertaken to assess the accuracy of near infrared (NIR) technologies to measure Brix level of intact Florida grapefruit. Two units were utilized: (1) an on-line prototype unit (Mitsui QScope, Sumitomo Metal Mining Co., Tokyo, Japan) and (2) a handheld unit developed for general fresh fruit quality assessment (Inst. of Agric. Engr.-Bornim, Potsdam, Germany). The on-line tests were conducted at a rate of ~5 fruit per second. Pre-conditioned Interior white grapefruit were tested at two temperatures, 5 and 20C, while commercial Indian River red grapefruit were tested at ambient conditions. Comparative measurements were obtained for both on-line and handheld NIR units with the fruit subsequently juiced to obtain a refractive index measurement of the fruit's Brix level. Linear regression relationships were developed between the non-destructive NIR techniques and the laboratory Brix measurements. The highest correlation, $r^2 = 0.67^{**}$, was found for Indian River red grapefruit of the smaller size of fruit tested (9.5-11.0 cm diameter). Percent correct classification analysis was ascertained at 9Brix, Interior grapefruit, and 10Brix, Indian River red grapefruit. Higher classification rates were obtained for ambient temperature tests at ~20C and for the smaller size of Indian River red grapefruit. A neural network (NN) model with combined inputs of physical and color attributes, plus predicted Brix, was evaluated. Corresponding Brix data for Honey tangerine also were obtained utilizing a handheld NIR probe.

11:25 AM **FRESH CUT CITRUS: WAVE OF THE FUTURE** - Paul D'Albora and John D'Albora, Golden Groves, Vero Beach, FL

- Golden Groves
  Golden Groves was created two years ago solely to produce and market fresh cut citrus
  Golden Groves believes that fresh-cut citrus is an important part of the citrus industry's future;
  More people will eat citrus if it becomes more convenient to eat

- Advantages of Fresh Cut Citrus
  New outlet for fresh market elimination and non-marketable fruit. Fruit to be marketed on internal quality, not external quality. Consumer-friendly product

Easy to eat. Consumer eats 100% of the purchased fruit (no waste)

- Fresh-cut = Untapped market for the citrus industry
  Fresh cut as a whole = $19 billion industry (new and positive consumer exposure)

- New Citrus Fresh-Cut Plant
  Location - Fort Pierce. Will be fully operational by November 2002. Capacity = 40,000 to 45,000 lb/day (equal to 500 to 750 boxes of fruit)

  Fruit Procurement. Primary source = packinghouse eliminations. Will have the capability to use field-run fruit if necessary. Fruit quality will be the first priority. Will use only fruit with a 8.5 ratio or above. Brix quality will be a key element (must taste good). All varieties of citrus can be used. Only exception is Pineapple oranges due to their high quantity of seeds.

- Sizes: Grapefruit - size 36 and smaller. Oranges - size 64 through 125. Planning for year-round operation (by storing fruit). Will operate no less than 10 months of the year.

- The Process
  Single bin dumper and then washed to remove dirt and field debris.

  Hot water bath (176F) to sanitize the peel.

  Perforator (1 mm long pins make random holes in the peel of the fruit to allow enzyme to be infused).

  Enzyme infusion (Fruit placed inside vacuum tanks were a vacuum is drawn and the enzyme is infused into the albedo of the fruit). The enzyme creates a void between the peel and the fruit itself, allowing the peel to be removed.

  Heat tunnel (incubation) to speed up the enzymatic process. Fruit passes on a variable speed belt through a tunnel with the temperature ranging from 90 to 120F.

  Fruit transferred into the processing room (clean room).

  Peelers. Two cuts and barbs peel fruit similar to a banana. Peel removed and discarded.

  Cold water rinse. Fruit rinsed with 32 to 36F water. Lowers fruit temperature. Rinses off residual enzyme.

  Sectioning machines. Equally divides fruit into 6 to 10 sections.

  Packaging. Fruit is weighed then distributed into various containers and sealed. Placed in master containers, stacked on pallets

Transportation to various customers.

- Markets.
  Foodservice will be our primary market: Sysco, PYA Monarch, Red's Market, US Foodservice, etc. School districts, colleges, and universities. Nursing homes and hospitals. Hotels, cruise lines, and airlines

- Uses Outside of Fresh Market
  Used as garnishes in restaurants, etc. High quality juice - once peeled, fruit can be squeezed and not have impurities that come from the peel. Organic markets and certified kosher

- Shelf Life and Sanitary Handling.
  Product will be sold with a stated 7 day shelf life. Actual shelf life is 14 to 21 days. Key is to maintain correct temperature (34 to 38F) for increased shelf life.

- HACCP and USDA principles. Maintain a safe product using a documented food safety plan to prevent microbial contamination. USDA standards for fresh squeezed juice will be followed. Third party audits will verify the food safety plan is being followed.

- Golden Groves' Future. After 2 to 3 years, expand sales into the Southeast. After 5 to 7 years, potential construction of a plant in Northeast to tap key markets there.

11:40 AM USER-FRIENDLY ACCESS TO POSTHARVEST CITRUS INFORMATION ON THE INTERNET - Mohamed Ismail, Florida Department of Citrus, Citrus Research and Education Center, Lake Alfred, FL and Mark Ritenour, University of Florida, Indian River Research and Education Center, Fort Pierce, FL

With access to the Internet becoming almost universal, information is now available to a large segment of the public and the business community. Effective and timely use of information is vital and can contribute to success of individuals, businesses and institutions. Search engines are becoming so sophisticated to where specific topics can be easily accessed using few key words on the desired subject. However, the volume of available information can sometimes be overwhelming requiring time and effort to sort out.

The FDOC website "Postharvest Florida Citrus Information Guide" (www.fdocitrus.com) is designed to provide pertinent information to Florida fresh citrus growers and packers. The University of Florida's postharvest website (http://postharvest.ifas.ufl.edu) also provides information and publications of interest to citrus packers and contains all issues (back to 1965) of the Packinghouse Newsletter.

In an effort to consolidate postharvest information and enhance its availability to Florida fresh citrus

growers and packers, we are combining efforts to design and publish a comprehensive postharvest citrus database. Such database should provide in a secure website, information on citrus quality and handling from the grove to the consumer. It will be updatable and user-friendly to allow quick browsing as well as in-depth examination of important topics. The database will also include articles on specific topics of interest to fresh citrus growers and packers such as ways to reduce mechanical injury to fruit, proper degreening procedures, and methods of color sorting and Brix measurements. Work has already started and we hope it will never be finished.

11:50 AM EFFECTS OF PREHARVEST FUNGICIDES AND OTHER COMPOUNDS ON POSTHARVEST DECAY CONTROL - Mark A. Ritenour, Ed Stover, Robert Pelosi, and Michael Burton - University of Florida, Indian River REC, Ft. Pierce, FL; Greg McCollum - USDA, ARS, Ft. Pierce, FL; Huating Dou and Jiuxu Zhang - Florida Department of Citrus, Citrus REC, Lake Alfred, FL

Strategies to reduce postharvest decay in fresh citrus shipments are always a high priority. Proper harvest and packinghouse sanitation, temperature management, use of fungicides, careful handling, etc. are all critical to keep postharvest decay to a minimum. However, preharvest factors have a profound impact on the potential for postharvest decay, even with the best postharvest practices. The warm temperatures, rain and humid conditions in Florida create a suitable environment for the growth and spread of many decay organisms. Furthermore, unlike more arid environments such as in California and Israel where molds (Penicillium species) are the main decay threat, conditions in Florida promote the development of additional decay organisms such as the stem-end rots (Diplodia and Phomopsis) and anthracnose (Colletotrichum) which form latent infections in the tissue that are much more difficult to control. Preharvest application of Benlate has proven an effective tool in reducing postharvest decay, even for harvest intervals up to 3 weeks after application. With Benlate no longer available and several new registered and experimental compounds being investigated for the control of preharvest diseases in citrus, we investigated several of these new fungicides and compounds to determine if they are effective in reducing postharvest decay under Florida conditions. Studies over the past two years have tested the following compounds:

Abound (Azoxystrobin) - 16 fl oz/acre.

Actigard - 100 ppm + 0.025% Silwet. - Stimulates plant defensive compounds.

Aliette WDG - 5 lb/acre.

Benlate (Benomyl) - 2 lb/acre.

Enable - 8 fl oz/acre.

Ferbam - 8 lb/acre.

Headline (a strobularin) - 16 fl oz/acre.

Metallic copper (Kocide DF) - 4 lb/acre.

Messenger (Harpin protein) - 9 fl oz/acre.

Phosphorous acid (Nutriphite or Phostrol) - 4 pints/acre.

Topsin - 2 lb/acre. - Breaks down to the same active ingredients as Benlate.

Except for Messenger, materials were applied at 125 gal/acre to 'Fallglo' and 'Sunburst' tangerines, 'Valencia' oranges, and to 'Marsh' grapefruit. Fruit were harvested 2 days after application and then again 2 weeks after application, degreened if necessary, washed, waxed (shellac wax without fungicide), and then placed in storage at 50F (95% relative humidity). During the 2000-01 season, Messenger was applied to 'Ray Ruby' grapefruit, 'Murcott' tangerine, and to 'Hamlin' and 'Valencia' oranges. Fruit were evaluated for decay and physiological disorders at different times during storage.

Preharvest applications of phosphorous acid and Headline rarely reduced postharvest decay (primarily anthracnose and stem-end rot) significantly compared to the control. There was never significant differences between the control and Aliette, Abound, Enable, Actigard, or Kocide. On degreened (10 ppm, for 3 days) 'Ruby Red' grapefruit, Messenger applied 1 to 2 weeks before harvest significantly reduced decay (stem-end rot) compared to unsprayed controls. However, no significant reduction in decay was detected in similar treatments on the other citrus varieties. As expected, Benlate was the most consistently effective product for reducing postharvest decay. Last season's results with Topsin are quite promising, however, and warrant further study. In many cases, Topsin was just as effective as Benlate in reducing citrus postharvest decay.