UF UNIVERSITY of FLORIDA | IFAS EXTENSION

Berry/Vegetable Times

Summer 2014

2014 Calendar of Events

Hillsborough County Extension Office Pesticide License Testing. Third Tuesday of each Month- Starts at 9:00am. 5339 CR 579, Seffner. Bring a photo id.

New Invasive Insect Species of Concern for Central Florida Workshop. June 24. GCREC, 8:30-12:30. To register, go to https://www.eventbrite.com/e/new-invasive-insect-species-of-concern-for-central-florida-tickets-11541303349

Pest and Beneficial Insect ID Workshop. June 26. GCREC, 8:30-2:00. To register:http://tiny.cc/pandb_insect_id

American Society of Horticultural Science Annual Meeting, July 28031, 2014. Rosen Plaza Hotel, Orlando. For more information got to www.ashs.org.

Strawberry Agritech, Aug. 5 & 6, 2014. Trinkle Building, Plant City.

Tomato Institute, Sept. 3. Naples, Fl.

9th Florida Ag Expo, Nov. 5. GCREC. More information in future.

A University of Florida/IFAS and Florida Cooperative Extension Service Newsletter
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Proposed Changes to The WPS Rule and How It Affects You

Alicia Whidden and Crystal Snodgrass

On April 3, 2014 a meeting was sponsored by the Florida Dept. of Agriculture and Consumer Services to give agriculture an overview of the proposed changes to the Worker Protection Standard (WPS) regulations. In this article we are going to bring you highlights of these changes but encourage you to read up on all the changes yourself. The EPA's website has the proposed changes at: http://www.epa.gov/oppfead1/safety/worker/proposed/index.html. A full text of the proposed changes can be found at: http://www.epa.gov/oppfead1/safety/workers/proposed/pre-pub-wps-proposed-rule.pdf. For a detailed comparison of the changes you can go to http://www.epa.gov/oppfead1/safety/workers/proposed/comparisons-current-proposed-wps.pdf.

These changes are being made by the EPA and are for the whole country. Let's start with the reasons for these proposed changes. The first is to reduce occupational pesticide exposure and incidents of exposure for workers. EPA believes with more training that numbers of incidents will be lower and the work place will be safer for workers. EPA wants to improve the clarity of the rule to increase compliance. Also, the new rules would provide better enforcement tools such as recordkeeping requirements to document compliance.

Changes in Training: A big change that is coming is that pesticide training that is currently required to be done every 5 years would be required every year. For growers in our area we retrain workers at the start of each season so this new regulation would not significantly impact you. Right now you must give a brief training before starting work but there is a grace period of 5 days for the worker to be fully trained. If the proposed change occurs, that grace period would only be 2 days. You do not have to keep records on the brief training you give in the grace period but the new change will require that you expand the training information

you give the workers and that you keep records of the training for 2 years. Right now you do not have to give your worker a copy of the record of training you provide when you give them their full WPS training. The new proposal will require you to give them a copy of the record so they can prove they have had training if they move to another employer. The new proposal will also require anyone who trains workers to complete an EPA-approved training program first. Right now pesticide license holders can train workers and handlers and handlers can train workers. With the proposed rule change, pesticide license holders and handlers can no longer train workers. You would have to complete the EPA approved train-the-trainer program. Many employers may choose to train everyone as a handler to avoid additional trainer requirements. Another major issue is that everyone who has previously completed the train-the-trainer program would need to go through the training again once these rules go into effect. There would be a 2 year grace period to get everything in place. This part is a huge issue that you as growers need to be aware of.

Also, workers and handlers would need to be given establishment-specific training before they do any WPS tasks related to handling pesticides. The training would include decisions regarding the location of pesticide safety, application and hazard information, where the decontamination supplies are located and how to obtain medical assistance.

Changes in Notification: Sprayed areas would need to be posted if the REI is greater than 48 hours regardless of the chemical used. Any early-entry workers would need oral notification of the information of what was sprayed, the specific task to be done, and the amount of time they are allowed to remain in the treated area, as well as providing the appropriate PPE for early-entry workers which is all that is required right now. Also, under the proposed changes the grower would need to keep a record of the notification given to the workers.

Hazard Communication: As the rule stands now you must post the information on what was sprayed at your central posting area and leave it until 30 days after the REI has expired. Under the new rule you will not have to post application-specific information at the central posting area. You will need to make the information available as well as Material Safety Data Sheets (MSDS) which they are now calling Safety Data Sheets (SDS). You will need to retain the spray records, labeling and SDS for 2 years.

Minimum Age: The new changes will require handlers and early-entry workers to be at least 16 years old but owner's immediate family will still be exempt.

PPE: There are more requirements for respirators. Under the proposed rule respirator use will follow OSHA standards of fit test, medical evaluation and training. There will also be a recordkeeping requirement. New requirements will be added for closed systems on tractors and will follow existing California standards.

Extend Entry-Restricted Areas to Farms/ Forests: As the rule reads now workers and other persons are prohibited from being in areas adjacent to entry restricted areas during the application and it mainly applies to nurseries and greenhouses. The proposed rule changes would establish similar restrictions for farms and forests during application. This would be a 25-100 foot entry restricted buffer area during the application and it is limited by the owner's property line. You would stop

application if an untrained or unequipped person entered the buffer area while you are spraying.

Decontamination: The new rule will specify the amount of water that must be on hand for workers and handlers on a per person basis. It will be 1 gallon per worker and 3 gallons per handler/early-entry worker. One pint of water was required for eye flushing and this will change to a requirement of running water at permanent mix/load sites for eye flushing.

Emergency Assistance: Right now it says "prompt" transportation to a medical facility must be given but "prompt" is undefined. The proposed rule defines it as 30 minutes. It will also require that employers provide SDS, labeling, specific information about product used, and circumstances of application and exposure to either the exposed person or to the treating medical personnel.

Requirements during Application: Right now it says that a handler must apply a pesticide in a way as to not contact workers and others directly or through drift. That will change to must "immediately cease or suspend application" if someone other than a trained/ equipped handler enters the area of buffer. The applicator is still responsible for applying in a manner to avoid contact. There are some changes to definitions. One regards immediate family and has been expanded. The range of handler activities is also spelled out.

Of course, added cost is a big issue. EPA is estimating that these changes will cost $25-30 per employee for both workers and handlers. EPA feels the job impact is that it would cost an additional $5 to employ a worker and $60 to employ a handler. The benefits they see will be an estimated reduction of 50-60% in the 2,800 incidents per year. EPA feels there will be a $10-14 million per year benefit from preventing acute agricultural worker illnesses.

The comment period on these proposed changes is set to close August 18, 2014. There may be an extension but if you feel this will impact your operation or have comments to make on specific areas on the changes then send in your comments to EPA. The EPA recommends submitting constructive comments regarding specifics of how these changes will affect your operation. Comments containing economic and environmental effects are especially helpful. They also welcome suggestions for alternatives to these changes. For how to comment go to http://www.regulations.gov. Search for the docket for the WPS proposal: EPA-HQ-OPP-2011-0184. There should be a blue "Comment Now" button. If you have any questions please feel free to get in touch with one of us.

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Please remember…
The use of any trade names in this publication is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named and does not signify that they are approved to the exclusion of others of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer's label.

New Invasive Insect Species of Concern for Central Florida Workshop

Gulf Coast Research and Education Center will be hosting an invasive species workshop on June 24 (Tuesday) from 8:30 to 12:30. Topics covered in the workshop will be three new invasive pests of concern to this region: bagrada bug, European pepper moth, and kudzu bug. Information covered in the presentations will include identification, damage, hosts, and current management recommendations. There will be a hands-on session included in the workshop to examine specimens of these pests using microscopes. CEU's have been applied for. This workshop is free, but is limited to 40 participants. To register, please use the Eventbrite link below. If you have any questions, please contact Hugh Smith at hughasmith@ufl.edu or 813-633-4124.

The eventbrite link for registration is: https://www.eventbrite.com/e/new-invasive-insect-species-of-concern-for-central-florida-tickets-11541303349

8:30-9:00 a.m. Introduction to Workshop and Speakers - Dr. Hugh Smith, Gulf Coast Research and Education Center

9:00-9:45 European Pepper Moth -Stephanie Stocks, UF

9:45-10:30 Bagrada Bug - Dr. John Palumbo, University of Arizona

10:30-10:45 Break

10:45-11:30 Kudzu Bug— Dr. David Riley, University of Georgia

11:30-12:00 Hands on Specimen Identification

12:00-12:30 Sample submission, evaluations, wrap-up, and raffle - Stephanie Stocks, UF

Resistance of Botrytis to fungicides: what else do we know?

Achour Amiri and Natalia Peres, GCREC Plant Pathology

During the past few years, we have been investigating the development of fungicide resistance in the fungus *Botrytis cinerea.* The situation is critical as many of the strains sampled have been found to be simultaneously resistant to multiple fungicides. The frequency of resistant isolates varies to some extent from farm to farm, but resistance to multiple fungicides was widespread as resistance has been found in all farms sampled. In order to develop practical disease management recommendations, experiments have been set up to i) investigate the importance of different sources of Botrytis inoculum and characterize their sensitivity to commonly used fungicides; ii) develop fungicide rotational programs to delay resistance development to new products; and iii) evaluate the fungicide spray recommendations by the Strawberry Advisory System for Botrytis fruit rot control.

Two main potential sources of Botrytis inoculum for Florida strawberry fields have been investigated: inoculum persisting between seasons on dead strawberry plants and inoculum on new nursery transplants. Samples (whole plants including fruits and mummies) were collected from 5 different fields from April to August during two consecutive years to determine the survival of the fungus over the summer. We found that Botrytis was present on samples in April but its frequency diminished in May and, interestingly, it could no longer be detected on samples collected between June and August. These results suggest that Botrytis does not survive on dead plants over the summer in Florida and, therefore, they do not serve as a source of Botrytis inoculum for the following season.

Transplant samples have been collected

from five nurseries in Nova Scotia and Quebec in 2012 and from 14 nurseries from five different regions (North Carolina, Nova Scotia, California, Ontario, and Quebec) in 2013. We found that 20 to 70% of transplants carried Botrytis infections. Interestingly, a large portion of these isolates were already resistant to Pristine and Cabrio, as well as Scala. Resistance to Elevate was less frequent whereas resistance to Switch and Fontelis was not detected. These results demonstrate the role of nursery transplants as a source for Botrytis inoculum early in the season which, in some cases, is already resistant to fungicides. New phytosanitary procedures that integrate nurseries and FL strawberry fields should be developed to lessen the impact of this introduced inoculum early in the season and avoid the spread of resistant strains.

Laboratory and field tests have also been conducted to evaluate rotation treatments that were effective and also helped delay the selection for resistance to the new fungicides Fontelis and Luna (not registered for strawberries yet). In addition to fungicide rotation programs, tank mix treatments with Fontelis and Luna were also tested. Tank-mixtures of Luna with the multi -site fungicides Captan and Thiram and the rotation of Luna with Switch were the most effective treatments for controlling the disease. Fontelis also performed better when rotated with Switch or when rotated or tank-mixed with Captan or Thiram.

Besides being the most effective treatments when tank-mixed with Luna or Fontelis, the multi-site fungicides captan and thiram selected less for resistance, especially for Luna. These results indicate the importance of these materials for fungicide resistance management. They should be incorporated in tank-mixes or in rotation with Fontelis and Elevate which are still partially effective. Since Luna is not registered, Switch will remain as the backbone of Botrytis fruit rot management but it should not be overused.

Finally, two trials have been conducted to evaluate fungicide recommendations from the Strawberry Advisory System (SAS). Plots were treated either weekly (conventional, 15 sprays) or only when conditions were conducive for disease development based on weather conditions (SAS, 8 sprays). Fungicide sprays included Captan, Thiram, Captevate, Switch, Pristine, Scala and the new SDHIs Fontelis and Luna. Plots were harvested from January to March to assess the impact of the different spray regimes on yield and Botrytis incidence. Results confirmed that the two most effective products for Botrytis fruit rot control are Switch and Luna. Unfortunately, it is still unclear when Luna will be registered for strawberries. The results also confirmed that Pristine is no longer effective for Botrytis control in FL. Results also showed that resistance to Scala has reached such levels that this fungicide is no longer effective for Botrytis fruit rot control in FL. Thiram, Captevate and Fontelis were intermediate and should be used when SAS indicates that conditions are moderately conducive for Botrytis development. Switch is the most effective, as expected, and should be saved for use when the Advisory System gives alerts for a high risk of Botrytis development, i.e., weather conditions are highly conducive. Recommendations from the Strawberry Advisory System have been updated and adjusted according to our findings and we are confident that these recommendations can help growers to achieve an effective control of Botrytis fruit rot with a lower number of fungicide applications.

How the IR-4 Project helps Florida Specialty Crop Growers

By Michelle Samuel-Foo[1] and Peter Dittmar[2]
[1]IR-4 Southern Region Field Coordinator, Dept of Food Science and Human Nutrition and [2]Assistant Professor, Horticultural Sciences Dept, University of Florida, Gainesville FL

Have you ever wondered how pesticides for specialty crops get registered?
The IR-4 project is the entity that works towards helping growers of specialty crops in Florida and around the nation solve their pest management issues by procuring registration of reduced risk pesticides that integrate well into existing Integrated Pest Management (IPM) programs.

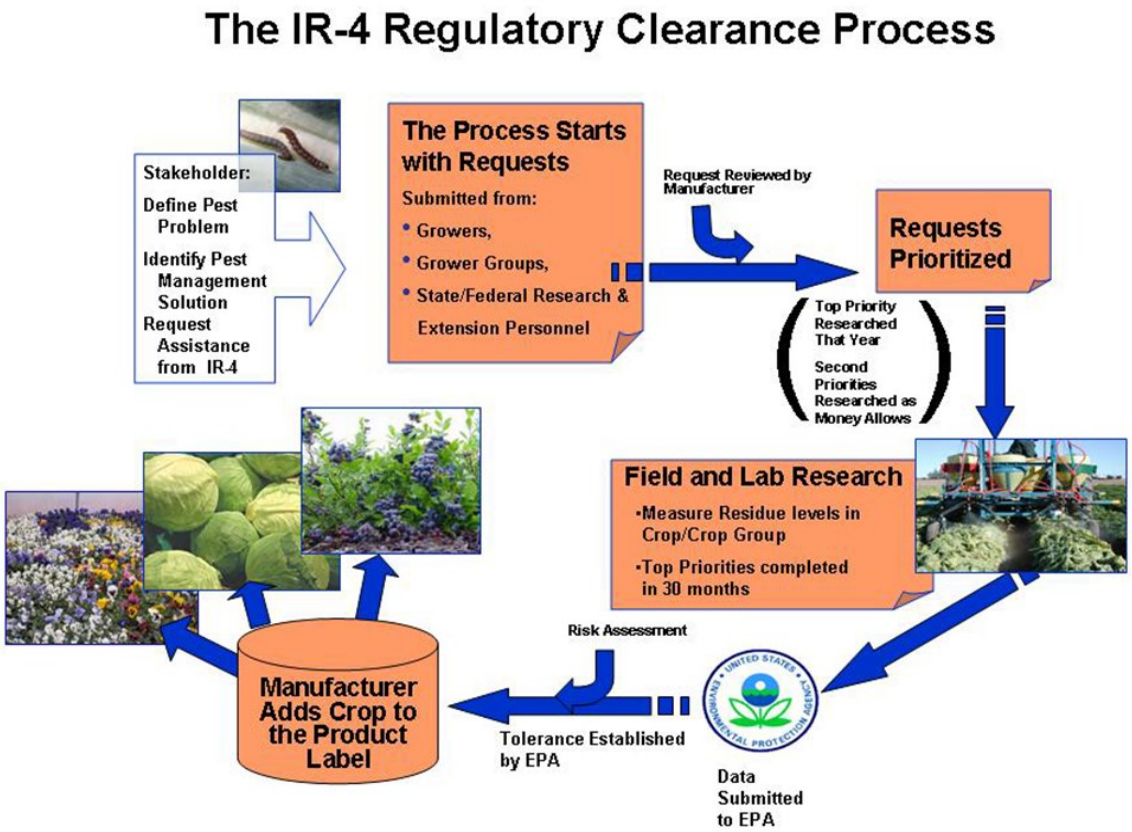
IR-4 or 'Interregional research project No. 4' is a federally funded cooperative unit that has served as the major resource for supplying pest management tools for specialty crop growers since 1963. IR-4's mission is to "facilitate registration of sustainable pest management technology for specialty crops and minor uses." This is achieved by developing data from residue trials according to US Environmental Protection Agency (EPA) mandated good laboratory practices (GLP) guidelines to support new tolerances and labeled product uses.

Background and Rationale
Specialty crops are fruits, vegetables, tree nuts, herbs, ornamentals and other high value horticultural crops that are grown on 300,000 acres or less. They make up about 40% of the total value of U.S. crop production. Chemical companies that develop and sell plant protection products (pesticides) focus their resources on research and development, registration, production, and marketing of crop protection products in major markets where there is likely to be a favorable return on investment. Potential sales in small markets typically do not justify investments in the development of the required data for either initial or continuing registration of commercial pesticides for minor/specialty crops due to the smaller market base. This results in a major void for specialty crop growers to protect their crops because in order for a pesticide to be legally used in the US, its use must be registered or exempted by the US EPA as mandated by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). IR-4 is the only program that generates GLP data in support of petitions submitted to the US EPA to secure the establishment of new tolerances and labelled uses for specialty crops.

How is IR-4 organized?
The IR-4 project consists of 4 regional programs that are housed at land grant universities across the country (Southern, Western, North Central and North Eastern), a USDA-ARS component and a centralized "IR-4 headquarters" located at Rutgers University in Princeton, NJ. Each region conducts GLP residue field trials and generates data to support tolerance petitions that get submitted to the EPA. The IR-4 Southern Region (SOR) Office is domiciled at the University of Florida in Gainesville and serves as the home base for both the Southern region field program and analytical laboratory. Approximately 100 residue field trials are conducted annually across the IR-4 SOR.

Research at UF and helping Florida growers
At the University of Florida, the IR-4 Southern Region Program maintains two dedicated 'IR-4 Field Research Centers' that are located at the Plant Science Research and Education Center (PSREC) in Citra FL and the Tropical Research and Education Center (TREC) in Homestead FL. At these two sites, GLP residue field trials are conducted annually,

based on EPA commercial production areas. Once the trials are completed, frozen residue samples harvested from the experimental sites are analyzed and the results get compiled at IR-4 headquarters where they are bundled into petitions that are submitted to the EPA to establish a tolerance for a particular chemical/commodity combination. Dr. Peter Dittmar leads the IR-4 FRC in Citra (EPA region 3- vegetables, citrus, herbs, and other commodities) and Dr. Jonathan Crane leads the FRC in Homestead (tropical fruits). The IR-4 Southern region office works closely with numerous faculty and extension personnel from the University of Florida at the various research centers across the state. IFAS personnel communicate grower needs and issues to IR-4, submit project requests, aid with prioritizing project needs and generate efficacy and performance data in support of project requests when needed. For 2014, efficacy data are being generated by faculty at the UF-GCREC to support project requests and registrations for several herbicides and insecticides. Over the years, IR-4 has responded to over 750 requests from Florida for registration of pest management products for food crops. The program provides an essential service to specialty crop growers in Florida and across the US by enabling reduced risk pesticide registrations to control key insect, disease, and weed pests.



This diagram illustrates the overall IR-4 regulatory clearance process. Project requests are submitted based on pest or disease problems and this is the initial step that engages the IR-4 project and alerts them to a need in the field. Growers are encouraged to contact their local extension and research faculty contacts or the IR-4 Southern Region Field Coordinator for assistance with submitting requests. Requests are prioritized annually (via conference calls or biennial meetings) in the IR-4 SOR and if selected as national priorities at the annual IR-4 Food Use workshop (held every September in rotating locations across the country), this translates into residue field studies the following year as an initial step towards registration.

The IR-4 regulatory process at work in strawberries

IR-4 has played an integral role in the registration of pesticides important to strawberry production (see table for examples). A current registration in strawberry that is being pursued is the reduction of the Clopyralid (Stinger ®) preharvest interval to 2 days. The project clearance request (PCR) was submitted to IR-4 in the spring of 2013. Crop safety data based on research funded by the Florida Strawberry Growers Association were provided by Dr. Dittmar to accompany the request. The PCR was nominated as an A priority project at the regional level during the IR-4 SOR annual priority setting process meaning that the request required immediate action. In general, for a project to receive an A priority rating, performance data (efficacy and or crop safety) need to accompany the request. When the PCR was discussed at the IR-4 national food use workshop later that fall, it remained an A priority project with manufacturer support ,which meant that IR-4 would dedicate resources towards pursuing the project and that GLP residue field trials across the country would begin the following field season. The IR-4 FRC at UF's PSREC in Citra, FL is one of the 7 locations slated to conduct the residue trials. Upon completion of the field trials, frozen samples from all locations will be shipped to the USDA-ARS analytical laboratory in Tifton GA for residue analysis and if residues are below allowable limits the data will be sent to EPA in pursuit of a registration.

Strawberry (13-07)			
2,4-D	Clopyralid	Malathion	Penthiopyrad
Abamectin	Fenhexamid	Mefenoxam	Polyoxin
Acetmiprid	Fenpyrazamine	Metam-sodium	Pyraclostrobin
Acibenzolar	Fenpyroximate	Methomyl	Pyriproxyfen
Acifluorfen	Flonicamid	Methoxychlor	Quinoxyfen
Azoxystrobin	Flumioxazin	Methoxyfenozide	Sethoxydim
Bifenazate	Fosetyl	Milsana	Simazine
Buprofezin	Glyphosate	Myclobutanil	Spinosad
Captan	Harpin	Naprpamide	Terbacil
Chlorantraniliprole	Hexythiazox	Novaluron	Thiamethoxam
Chlorpyrifos	Hydrmethylno	Paraquat	Thiram
Clethodim	Imidacloprid	Pendimethalin	Trifloxystrobin

Table showing an alphabetical listing of active ingredients (including insecticides, fungicides and herbicides) registered for use in strawberries through the IR-4 Project.

Interested in learning more about the IR-4 Project?

If you'd like more information about the IR-4 project, would like to learn about submitting requests to IR-4, or you have questions about how the program achieves pesticides registrations for specialty crops, please contact Dr. Michelle Samuel-Foo, the IR-4 Southern Region Field Coordinator at the University of Florida mfoo@ufl.edu or 706-614-5754 (cell).

Your Gift to GCREC Matters!

The success of the UF/IFAS Gulf Coast Research and Education Center (GCREC) is due in part to the generosity of our community and industry supporters. In order to continue producing world-class research that benefits the agricultural and natural resource industries, financial support is critical. If you or your company would like to partner with GCREC to make a financial contribution to any of the projects mentioned in this newsletter, please contact Center Director, Jack Rechcigl at rechcigl@ufl.edu or 813-633-4111. If you'd like more information about including GCREC in your estate plans or strategies to potentially reduce your tax burden through philanthropic giving, please contact Cody Helmer, UF/IFAS Senior Director Development, at chelmer@ufl.edu or 352-392-1975.

Managing broad mites in high-tunnel pepper

Lorena Lopez and Hugh Smith, UF/GCREC

In the United States, Florida ranks 2nd with 26% of field-grown bell pepper production preceded by California with 51%. The use of protected culture (e.g. greenhouses, screen houses, shade houses, and high tunnels) has increased over time in these two states as a strategy to enable bell pepper growers to realize greater returns per unit of land by modifying the microclimate around the crop. High-tunnel production can help pepper growers mitigate the adverse effects of weather while providing increased options with regard to the management of water, plant spacing, pests, and nutrients compared to field production (Fig. 1).

Despite these advantages, reduction in light intensity and increase in temperature and relative humidity that characterize high tunnels can make bell peppers more prone to

Fig. 1. High tunnels at the Gulf Coast Research and Education Center. Photo Hugh Smith

pest attack in tunnels than in the field. Broad mites (*Polyphagotarsonemus latus*) can be difficult to manage in peppers in part because they are too small to see easily with the naked eye. The grower only becomes aware of their presence when infestations have produced distorted leaves (Fig. 2) and in some cases, fruit with "zippering" (Fig. 3). Broad mites tend to become established on peppers early in the crop cycle, and it is these early infestations that have the greatest impact on yield. Broad mite infestations that initiate after flowering or fruit production tend to have a limited effect on yield. Broad mites are much smaller than spider mites and do not produce webbing. Because broad mites are so hard to see, their damage is often confused with herbicide damage or viral disease. Feeding

Fig. 2. (left) Leaf distortion on pepper caused by broad mite feeding. Photo Hugh Smith
Fig 3. (right) "Zippering" damage to pepper fruit caused by broad mites. Photo Lorena Lopez

produces a variety of symptoms, such as downward curling of leaves, leaf drop, reduction of leaf area, reduced development, malformation of fruit and flower buds, fruit drop, and when large populations are present, death of the plant. Broad mites have an extremely broad host range, and can develop on many horticultural and agronomic crops as well as weeds.

Broad mites are minute, with females measuring 0.2-0.3 mm, and males reaching about half that length. Adult females are elliptical and are typically yellow to light brown with a white stripe on their back (Fig. 4). Males lack this stripe. Broad mites pass through an egg, larval, and pupal stage (sometimes referred to as a nymphal stage) before becoming an adult. Development from egg to adult takes about five days at 77 F° (25°C) and 75% RH. Females generally live for 8-13 days and may lay around 30-76 eggs in their entire life span (an average of five eggs per day); males live only for 5-9 days. Eggs are 0.08 mm long, oval-shaped, translucent, and have whitish dome-shaped projections that are unique to the species. Males have modified hind legs to grab and carry female nymphs on their backs. Males mate immediately with the females as soon as the females become adults. Like all mites, broad mites lack wings and cannot fly. In addition to dispersing by walking, broad mites take advantage of air currents to find new infestation sites, and travel on insects, particularly whiteflies (Fig. 5), to reach new hosts. Table 1 outlines some of the materials available for chemical control of broad mites in pepper.

Research has been carried out at the Gulf Coast Research and Education Center to evaluate the potential of the predatory mite *Amblyseius swirskii* and banker plants for control of broad mites in high-tunnel pepper production. The "banker-plant system" is a rearing and release system for beneficial arthropods consisting of a plant (usually a non-crop plant), prey or other food item associated with the plant, such as pollen, and biocontrol agents such as predators and parasitoids established on the banker plant. In most cases, the aim of banker plant systems is to establish the biocontrol agent in the crop so that they do not need to be repeatedly purchased from a biocontrol company. Building on research established by Dr. Lance Osborne at the Mid-Florida Research and Education Center in Apopka, we studied 'Explosive Ember' ornamental pepper as a banker plant for *A. swirskii* to suppress broad mites in high-tunnel pepper (Fig. 6).

Fig. 4. Broad mite females and eggs. Photo Lorena Lopez

Fig. 5. Broad mites "hitching a ride" on the legs of a silverleaf whitefly. Photo Lorena Lopez

The predatory mite *Amblyseius swirskii* is one of the biological control agents used to suppress broad mites (Fig. 7). Other major pests such as thrips and whiteflies are also attacked by *A. swirskii* in the field,

greenhouses, and semi-protected vegetable production. *Amblyseius swirskii* has the

Fig. 6. Explosive Ember ornamental pepper treated with Amblyseius swirskii mix. Photo Lorena Lopez

ability to survive on alternate food items such as pollen from a variety of plant species. This predatory mite occurs naturally in Florida landscapes, and it is commercially available from companies like Biobest and Koppert in a variety of packaging and release formulations for use in augmentative biocontrol programs . These formulations include breeding sachets that release mites for a period of 3-4 weeks, long-lasting or slow-release packets (maximum of 6 weeks), or plastic pot carriers containing thousands of mites of all stages to be distributed over each plant in the crop.

Amblyseius swirskii females are orange to brownish, twice the size of males (which are 0.5 mm long and the same color as females). Adult females perform the major role in pest control because they consume 2-3 times more than males after they mate. Eggs are elliptical, amber-colored, and hatch within 2-3 days at 77°F and 70% RH. Immature development (from egg to adult) lasts on average 6-10 days and longevity is 31-36 days (both males and females) at 77-86°F and 50-80% RH. The optimum temperature for *A. swirskii* was calculated to be 31°C, which falls within the range of average temperatures measured under high tunnels in Florida. It is also similar to the optimum ranges of temperature for pepper production.

Since predatory mites cannot fly, their ability to disperse from a banker plant onto adjacent crop plants has a major impact on their ability to find and suppress pests such as broad mites. Trials carried out at GCREC between November 2013 and March 2014 confirmed that *A. swirskii* will move from a banker plant such as 'Explosive Ember' ornamental pepper

Fig. 7. Amblyseius swirskii adults and eggs in pepper. Photo Lorena Lopez

down a row of high-tunnel pepper if the pepper plants are old enough that leaves of adjacent plants touch. *Amblyseius swirskii* moved from plant to plant even when there was little or no prey for them to feed on. This ability to colonize a crop even when prey is low is essential for the suppression of early pest populations. The trials also confirmed that when pots are in contact but plants are too small for their leaves to form a bridge from plant to plant, dispersal of the predatory mite down the row is much slower, even when pepper plants are infested with broad mites. Predatory mites such as *A. swirskii* can take advantage of natural bridges such as irrigation tubing and plant support wires to move down the row, but movement is most efficient when the plant canopy is closed. Research regarding the most efficient way to establish *A. swirskii* in young pepper plants is ongoing.

Some materials labeled for management of broad mites on pepper in Florida. Check the label for use restrictions,						
Material	Rate	Re-Entry Interval	Pre-Harvest Interval	Pests controlled	IRAC Mode of Action Number	Comments
M-Pede 49% EC (Soap, insecticidal)	1-2% V/V	12	0	aphids,leaf-hoppers, mites, plant bugs, thrips, whitefly	Unk.	OMRI listed
Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	12	7	broad mite, twospotted spider mite, whiteflies (eggs & nymphs)	23	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications per crop.
Portal (fenpyroximate)	2.0 pt	12	1	mites, including broad mites, whiteflies	21A	Do not make more than two applications per season.
Suffoil-X (petroleum oil)	1-2 gal per 100 gal. water	4	0	aphids, beetle larvae, leafhop-pers, leafminers, mites, plant bugs, thrips, whiteflies	unk	OMRI listed
Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others (oil)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal	4	0	aphids, beetle larvae, leafhop-pers, leafminers, mites, thrips, whiteflies	--	Organic Stylet-Oil and Saf-T-Side are OMRI-listed[2].