UF | UNIVERSITY of FLORIDA | IFAS EXTENSION

Berry/Vegetable Times

January 2013

2013 Calendar of Events

Feb 21 Berry Expo at GCREC. 11:30-4:00. See additional information in newsletter.

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

June 2-4 Florida State Horticulture Society Annual Meeting, Sarasota.

Aug. 13 &14 Strawberry AgriTech

Nov.6, 2013 Florida Ag Expo

FLORIDA AG EXPO

The 2013 Florida Ag Expo is already on our calendar. How about yours?

SAVE THE DATE

Wednesday
November 6, 2013

A University of Florida/IFAS and Florida Cooperative Extension Service Newsletter
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From Your Extension Agent…

FLORIDA BERRY EXPO

This year the Berry Expo or as it was called in days gone by, the Strawberry Field Day, will be held at the Gulf Coast Research and Education Center on Thursday, Feb. 21. Registration will start at 11:30. While we are waiting for lunch you will be able to taste some of the latest strawberry selections that are in Dr. Vance Whitaker's breeding program and compare them to the industry standard varieties. You will get to vote for your favorite. At noon we will have a delicious lunch of local barbeque. During lunch we will have several presentations. Dr. Whitaker will give us the results of the strawberry tasting so you can see how your favorite one ranked with the rest of us. Dr. Guan will give an update on results from the strawberry industry survey that we have been working with you on. Dr. Clyde Fraise will introduce a smartphone app that will help manage irrigation. Dr. Joe Noling will give a talk on things to consider for managing nematodes in your strawberry fields.

Next we will load up the wagons and take a tour of the research in the field. Not only will we see strawberry research but also some work on blueberry and blackberry. Each researcher will give a brief overview of the research that is going on in their research plots and you will be able to see how the plots are responding to the different treatments. Our first stop will be to see work to control broadleaf weeds using Stinger by Dr. Nathan Boyd and Dr. Peter Dittmar. The second stop will be work that Dr. Bielinski Santos and Dr. Craig Stanley are doing on freeze protection methods for strawberries and blueberries and then their work on crop protectants and non-traditional irrigation methods for

Free registration at http://2013floridaberryexpo.eventbrite.com or by email to ccooley@ufl.edu or call 813-633-4132.

strawberry transplant establishment and blueberry production. The third stop will cover 2 areas. The first will be to hear of the disease work that is being done by Dr. Natalia Peres on many different diseases. The second part will be the work of Dr. Santos and Dr. Whitaker on planting dates, fertilization and Florida—produced plug plants and how they are doing in open fields and in high tunnels. The fourth stop will be Dr. Whitaker's breeding program and you will get to look at what may be the "stars" of the future for our fields. Our last stop will be to see the screenhouse work of Dr. Santos on different types of soilless systems for strawberry and blackberry.

We will be awarding 2 private applicator CEUs for pesticide licenses. Be sure not to miss this opportunity to see all the research that is going on at GCREC and find out what the researchers are saying about their research findings so far. <u>Don't be the grower who gets left out of hearing about the latest research findings!</u>

Please pre-register so we can have a headcount for lunch. There are several ways to register. You can register on Eventbrite by going to http://2013floridaberryexpo.eventbrite.com. You can also call Christine Cooley at 813-634-0000, ext.0 or contact Christine by e-mail at ccooley@ufl.edu and she will register you.

Looking forward to seeing you on Feb. 21,

Alicia Whidden

Please remember…
The use of 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.

Thursday
February 21
11:30 a.m. to 4:00 p.m.
Free Registration

FLORIDA BERRY EXPO

11:30 a.m. Registration
12:00 noon Lunch

12:15 p.m.
Moderator: Alicia Whidden, Hills. Co. Extension Agent
Opening Remarks and Welcome
Jack Rechcigl, Center Director
John Hayes, Dean for Research
Kevin Folta, Interim Horticultural Science Department Chair

Florida strawberry industry: results from a comprehensive industry survey
Zhengfei Guan, Assistant Professor

Smart irrigation: smartphone app for managing strawberry irrigation in Florida
Clyde Fraisse, Associate Professor

Nematode management considerations for strawberries
Joe Noling, Professor

Results from strawberry tasting of latest selections
Vance Whitaker, Assistant Professor

1:30 p.m. Field Tours – 20 minutes per stop

Stop 1a Northeast Block
Application timing of Stinger™ for broadleaf weed control in strawberry
Nathan Boyd and Peter Dittmar, Assistant Professors

Stop 1b Northeast Block
Comparison of freeze protection methods on strawberries and blueberries

Using crop protectants and non-traditional irrigation techniques for strawberry transplant establishment and blueberry production
Bielinski Santos, Associate Professor/Craig Stanley, Professor

Stop 2 Middle Block
Recent disease management challenges (root necrosis, charcoal rot, Botrytis fungicide resistance, viruses)
Natalia Peres, Associate Professor

Stop 3 South Block
Evaluation of planting dates, fertilization requirements, and Florida-produced strawberry plug transplants in open fields and high tunnels
Bielinski Santos, Associate Professor/Vance Whitaker Assistant Professor

Stop 4 South Block
Breeding: a sneak preview of potential varieties
Vance Whitaker, Assistant Professor

Stop 5 West Screenhouse
Determination of irrigation requirements for vertical and horizontal soilless systems for strawberry and blackberry cultivars
Bielinski Santos, Associate Professor

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ccooley@ufl.edu
813-633-4132

New Weed Scientist at the Gulf Coast Research and Education Center

Nathan S. Boyd, Assistant Professor, GCREC

In October 2012 my family and I packed our belongings, sold our home, and moved from Truro, Nova Scotia, Canada, to the gulf coast of Florida. This was an exciting move for my family and I am pleased to have the opportunity to work as the weed scientist located at the Gulf Coast Research and Education Center (GCREC).

I grew up in rural Atlantic Canada and inherited my love for growing things from my father. I obtained my BSc from Dalhousie University and my MSc from the Nova Scotia Agriculture College (NSAC) where I did my research on organic potato production. I spent the next three years studying weed biology in wheat fields at the University of Manitoba where I obtained my PhD. I began the next phase of my career studying organic vegetable production with the USDA-ARS in Salinas, California and then moved back to the NSAC where I have worked for the past seven years as an Associate Professor in Weed Science. I am developing my research program at the GCREC and plan to focus on the development of integrated weed management plans for strawberries, tomatoes, peppers, cucurbits, and ornamentals.

Weed of the Month – Carolina Geranium (*Geranium carolinianum* L.)

Carolina geranium also known as cranesbill is a low growing, widely branched, annual or biennial weed that tends to grow in a circular pattern. It has deeply divided leaves with 5 to 7 lobes. Stems and the underside of the leaves tend to be reddish in color and the flowers are pale pink to pale purple. It gets the name 'cranesbill' from the elongated structure of the fruit which looks like a bird's beak. It germinates and grows during the winter months in Florida. Little is known about its biology but it can grow in a wide range of habitats and is a prolific seed producer.

In Florida, Carolina geranium is problematic in strawberry fields where it emerges through the planting holes. It can be controlled with Stinger applications applied at 1/3 to 2/3 pint per acre in 20 to 75 gallons of water per acre. Stinger applications can cause cupping of the strawberry leaves. Do not use a surfactant as it will increase damage levels. Do not apply within 7 days of harvest. Research is on-going at GCREC in collaboration with Dr. Peter Dittmar to determine the safest time to apply Stinger.

Shedding Some Light on the Efficacy of Novel Fungicides Against Botrytis Fruit Rot of Strawberry

Achour Amiri, PostDoctoral Scientist and Natalia A. Peres, Associate Professor, GCREC

Resistance of *Botrytis cinerea*, the causal agent of Botrytis fruit rot (BFR), to existing fungicides is widespread in Florida strawberry fields. In a disease alert published following the Botrytis outbreak in February of 2012, we reported that 80% of the Botrytis isolates sampled were resistant to Pristine whereas 50 to 60% were resistant to Scala (Amiri et al., 2012). Resistance to Elevate was emerging with frequencies ranging from 30 to 40%. Switch was the only fungicide to which resistance had not been found. Resistance monitoring is being conducted this year as well to assess the extent of fungicide resistance.

Three novel fungicides belonging to the same chemical group of Pristine are being introduced to the market to control BFR and some other diseases. Fontelis (DuPont Crop Protection) was registered in 2012 and is now available to growers in Florida. Luna (Bayer CropScience) and Merivon (BASF) are expected to be registered soon. All these fungicides, including Pristine, target the respiration process of the fungus. As such, there is a risk for cross-resistance between Pristine and the three novel fungicides.

To evaluate the efficacy of the novel fungicides and the risk for cross-resistance, we conducted a laboratory screening in which about 400 isolates of *B. cinerea* were tested for their sensitivity to Luna, Fontelis and Merivon. Preliminary results show that more than 85% of the isolates were sensitive to Fontelis and Merivon whereas 98% of the isolates were sensitive to Luna. However, 15% of the isolates were found to be resistant to Fontelis and Merivon (Figure 1) and these isolates were not controlled by the recommended field rates of these fungicides on tests conducted on detached strawberry fruit. The good news is that these isolates were controlled by Luna. Our preliminary data also show that 2% of the isolates were resistant to Luna in addition to being resistant to Fontelis and Merivon. The fact that resistance is found before these fungicides have been used in the field is due to cross-resistance between these three fungicides and Pristine (to which resistance is already widespread). Therefore, these novel fungicides need to be used with great care to avoid increasing selection pressure that may lead to even higher resistance frequencies. One of the strategies to reduce the risks of resistance development is to limit the use of these fungicides to 2 to 3 applications per season and to implement rotation programs between these fungicides and the existing ones with different modes of action. Different rotation scenarios are currently being tested in laboratory and field conditions to select more appropriate programs that will extend the life of the newly introduced fungicides.

Some growers in the Dover and Plant City area have reported some burning on leaves following the use of Fontelis this year. We have not observed such symptoms in our preliminary trials at the Gulf Coast Research and Education Center when Fontelis was applied alone at 24 fl oz. Thus, it is likely that the symptoms are related to tank mixing of Fontelis with other chemicals and DuPont is currently investigating the issue.

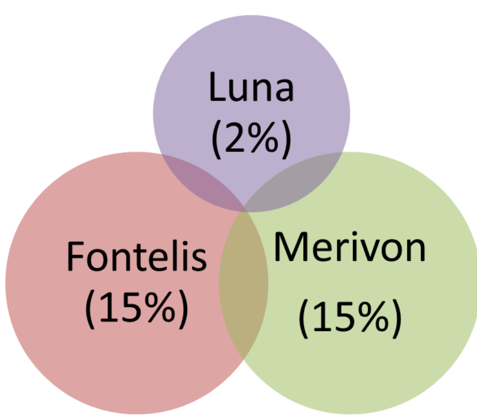


Figure 1. Frequency of Botrytis cinerea isolates from Florida strawberry fields resistant to Luna, Fontelis, and Merivon.

Reference

Amiri A, Peres N.A., Whidden, A. 2012. Perspective on resistance of Botrytis cinerea from strawberry to multiple fungicides in Florida. Berry Vegetable Times, University of Florida IFAS Extension. Special alert.

Aphid-borne Viruses Detected in Plants Shipped to Florida

Natalia A. Peres, Alicia Whidden, and Hugh Smith, UF GCREC and Robert Martin, USDA-ARS Corvallis

Some strawberry fields in Florida are facing a devastating problem this season. Plants that initially looked good after establishment stopped growing, started showing some yellowing/reddening on the leaves, became stunted, produced only very small fruit, and in some cases died. Incidence of these symptoms in affected fields was close to 100% and seemed highly linked to the nursery source (Figures 1A, B).

Figure 1. A. Symptoms associated with virus infections in ‘Strawberry Festival’. A. Leaf reddening; B. Plant stunting in field planted in October 2012 (photo taken on January 16, 2013).

Many possible causes for the symptoms were hypothesized or investigated such as fumigation or herbicide damage, and root diseases. The uniform and high incidence of the symptoms in the affected fields did not fit a disease-related problem since in that case symptoms would be expected to be more randomly distributed. Similar problems were being observed in plants shipped to North Carolina and other southern states. Pieces of this puzzle started to fall in place after samples from the different states were submitted to Dr. Bob Martin, a fruit virologist from the USDA-ARS in Corvallis. Two strawberry viruses were detected consistently in the samples submitted to Dr. Martin: *Strawberry mild yellow edge virus* (SMYEV) and *Strawberry mottle virus* (SMoV). Both of these viruses are transmitted by aphids.

Among the 20 samples received at the UF GCREC Diagnostic Clinic and submitted to Dr. Martin, 15 were confirmed positive for SMYEV and SMoV. One sample was positive only for SMYEV and four samples were negative (clean). All samples that were confirmed positive for the viruses were from strawberry plants produced in the Great Village area in Nova Scotia, Canada. No viruses were detected in samples from strawberry plants produced in other regions. Similar results were obtained for another 40 samples received from five other states along the south and mid-Atlantic coast during the winter.

What do these findings mean?

Strawberry mild yellow edge virus and *Strawberry mottle virus* are among the most economically important viruses affecting strawberries worldwide. Problems with virus diseases are usually less important in annual production areas such as Florida. That is because we do not have strawberries in the field all year long and thus there is less opportunity for multiple infections (on most commercial strawberry cultivars, symptoms are usually observed only when more than one virus is present). SMYEV and SMoV are most efficiently transmitted by the strawberry aphid *Chaetosiphon fragaefolii* (Figure 2A). Fortunately, the strawberry aphid does not occur in Florida. The melon aphid *Aphis gossypii* (Figure 2B), which is more common in Florida, can only transmit SMoV. However, even if SMoV were transmitted from the symptomatic to healthy plants, symptoms would not be observed with the SMoV infection alone.

This means that, even though the situation is devastating for the growers that received the infected plants, the viruses should not spread during the current season. *These two viruses do not have hosts other than strawberries, do not survive in the soil, and the strawberry aphid (vector) does not feed in other hosts and would not survive the summer in Florida even if introduced with the infected plants.* Thus, this should not be a recurrent problem as long *as virus-free plants are received from the nurseries*. Currently, only visual inspections are conducted before plants are certified as "virus-free" and shipped to Florida. The plants from the nurseries in the Great Village area in Nova Scotia passed this inspection since they were symptomless at the time of inspection. Some selective sampling for the most predominant virus in the area (in this case, SMYEV, which can be detected by ELISA) could be implemented before plants are dug to detect a certain level of infection and avoid such problems in the future.

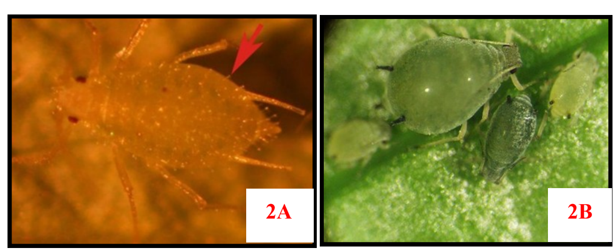


Figure 2. A. Strawberry aphid (*Chaetosiphon fragaefolii*) with "knobbed hairs" (Source: Cantliffe and Rondon UF/IFAS); B. Melon aphid (*Aphis gossypii*) (Source: Cindy Fake University of California Cooperative Extension).

Winterstar™: Early-Season Observations

Vance M. Whitaker, Natalia A. Peres, and Bielinski M. Santos

Winterstar™ 'FL 05-107' strawberry (U.S. Patent Pending) is a University of Florida cultivar being grown in its first commercial season in 2012-13. According to rough estimates, 350 acres are being grown in Florida this year. In the past two months, we have received a number of positive comments regarding the earliness and fruit quality of this new cultivar.

A recent extension publication (http://edis.ifas.ufl.edu/pdffiles/HS/HS119800.pdf) describes the characteristics of Winterstar™ and makes preliminary, research-based recommendations on planting dates, disease control and other aspects of management. In this article, we will discuss some of the most important aspects of Winterstar™ based on personal observations and growers' feedback from the first half of the season. These observations are consistent with previous research trials and are meant to reinforce the most important aspects of the cultivar and its management recommendations.

Winterstar™on November 8, 2012

Planting Dates

Best results with Winterstar™ seem to have been attained with planting dates between October 1st and 10th. However, some growers have planted as early as September 25th. With the earliest planting dates, there has been an increase in the occurrence of branched inflorescences giving rise to smaller tertiary fruit. Later planting dates have resulted in larger proportions of fruit arising from single stems. However, planting dates after the 15th of October are not recommended. Our recommendation of planting between the 1st and the 10th is intended to take advantage of the earliness of the cultivar while reducing the incidence of branched inflorescences.

Fertilization

Shortly after transplanting, Winterstar™ is very sensitive to the lack of N in the soil, similar to 'Radiance'. Thus, growers should provide adequate rates of N through the drip tape immediately after the overhead irrigation is turned off in order to promote transplant root development. However, after establishment and initial growth, the two cultivars respond differently. For 'Radiance', rates of N greater than 1 lb/acre/day will likely not result in higher yields and may result in other problems such as soft fruit. On the other hand, preliminary observations showed that Winterstar™ may respond with greater growth and yield to N rates between 1 and 1.25 lb/acre/day from late October to mid-December while maintaining good firmness.

Disease Control

Some mortality has been observed in the early season on Winterstar™, and both *Colletotrichum acutatum* and *Phytophthora cactorum* have been isolated from symptomatic plants at the UF Plant Disease Diagnostic Clinic. Since symptoms for these diseases can appear similar, this illustrates the importance of accurate diagnosis. Previous trials have shown that Winterstar™ has fruit resistance to *C. acutatum* that is superior to 'Festival' and 'Treasure'. However, this cultivar is susceptible to *P. cactorum* at a level similar to ‘Radiance’. Therefore, we remind both nursery and fruit growers that future disease prevention efforts should focus heavily on prevention of Phytophthora root and crown rots.

Winterstar™ is also susceptible to Botrytis fruit rot. In some fields this year, Winterstar™ has been observed to have a greater incidence of Botrytis fruit rot than either ‘Festival’ or ‘Radiance’. This is perfectly consistent with previous research trials in which Winterstar™ was significantly more susceptible than ‘Festival’. Therefore, growers should take appropriate sanitation and control measures and are encouraged to make use of the Strawberry Advisory System in order to time sprays appropriately (http://agroclimate.org/tools/strawberry/).

Nursery stock

There should be an ample supply of Winterstar™ nursery stock for the 2013-14 season. Nurseries in Canada and North Carolina who received mother plants from Crown Nursery in 2012 also had the option to obtain “white tag” stock in order to produce their own mother plants for 2013. Many, if not most, took advantage of this opportunity. Meanwhile, virus-tested tissue cultures have been made available to multiple California nurseries for future increase. Tissue cultures are also available to Canadian nurseries via Becky Hughes at the University of Guelph, Ontario and to North Carolina nurseries through North Carolina State University.

Conclusions

In summary, early-season results have been positive for Winterstar™. Provided that Botrytis and Phytophthora susceptibilities can be managed to the satisfaction of growers, it is not a stretch to say that this cultivar has promise for Florida. Should growers desire to increase their acreage next year, there will be enough nursery stock to go around. Until then, we appreciate hearing your feedback and comments.

Grower Vigilance is Important for Managing Late Blight

Gary E. Vallad, Assistant Professor GCREC

Another New Year has gone by, so it’s “out with the old and in with the new.” Unfortunately, it appears that Mother Nature has something else in mind and we may be in for a repeat of 2012. Last winter was quite mild and provided a perfect environment for the carry over of numerous pest and disease issues from the previous fall crops. Probably one of the most serious disease issues to be carried over for tomato was late blight. Not only did it appear in numerous fields throughout Sarasota, Manatee, Hardee, and Hillsborough Counties last winter, but the mild freeze in early January ensured that it would hang around and harass growers during spring production.

Unless the weather makes a drastic change in the next couple of weeks, this winter is on track to be even milder than the last. Although no late blight has been reported to date in the area, several outbreaks have been reported in production areas in Hendry, Lee, and Collier Counties. Passing weather systems provide the means for inoculum to move, while the cool, humid winter weather conditions typical of South Florida are ideal for infection and rapid disease development. As tomato growers throughout Sarasota, Manatee, Hardee, and Hillsborough Counties continue to plant their spring crops, it is important that they actively scout their fields and production facilities for late blight. The following article will review the symptoms of the disease, resources to keep updated about where the disease has been reported, as well as an up to date list of conventional fungicides labeled for late blight on tomato.

Late blight is caused by the fungus-like organism, *Phytophthora infestans*, and is a serious pathogen of tomato and potato. Symptoms on tomato begin as water-soaked lesions that become brown and necrotic as they expand. Rapidly expanding lesions often develope a zonate appearance. Under cool, humid conditions white mycelium and sporulation can often be seen on the underside of lesions and along their margins. The leaf tissue immediately surrounding a lesion often has a light green appearance. Tissues will rapidly blight under favorable conditions as leaf lesions coalesce or the fungus progresses to the leaf petiole. This rapid necrosis gives the blighted tissues a distinctive light brown, shriveled appearance as if they were burned or exposed to frost. Stems and petioles can also be directly infected with lesions progressing in a manner similar to foliar infections, but can be girdled by the fungus leading to wilting of associated foliage. Fruit infections begin as dark green greasy spots on the fruit that eventually turn light brown or greyish as the fruit begins to ripen. Fruit lesions can also have a zonate appearance as the lesions expand and white mycelium and sporulation appear on the lesion surfaces when cool, humid conditions exist. Disease development can be rapid, especially when conditions favor sporulation; optimum conditions are 91 to 100% relative humidity and temperature of 18 to 22 °C, although sporulation can still occur to as low as 3 °C to as high as 26 °C.

Phytophthora infestans typically survives from season to season on infected fruit (cull piles) and infected volunteer plants of tomato and potato; it requires living tissue to overwinter in most temperate climates. However, in some areas of the world where strains of both mating types of the fungus are present, the fungus is able to produce a specialized thick-walled structure called an oospore that can survive in the soil or plant debris. Although both mating types have been documented over time in Florida, the primary inoculum for initiating late blight on tomato remains unclear. Sanitation is critical for management; infected cull piles and volunteers should be destroyed to prevent the pathogen from surviving between seasons. Transplants are also susceptible and should be monitored carefully for disease.

Numerous fungicides are commercially available for managing late blight on tomato (listed in the table below). However, the timely application of fungicides in a preventative manner is critical for controlling late blight. The earlier effective fungicides are applied during an outbreak the more likely a grower will be to minimize losses to the disease. This is especially true when weather conditions are favorable for rapid disease development. To ensure timely application of fungicides, growers need to be vigilant of disease outbreaks in their production area. Alerts of new regional outbreaks of late blight and other diseases are often e-mailed to suscribers of the South Florida Vegetable Pest and Disease Hotline, an electronic newsletter which is produced by Gene McAvoy, Regional Vegetable Extension Agent with Hendry County Extension. To receive an electronic copy of the hotline and additional alerts associated with the South Florida Vegetables LISTSERV, contact Gene McAvoy at gmcavoy@ifas.ufl.edu.

Additional late blight information can also be found at the USABLIGHT website (usablight.org), which not only lists useful information about late blight and the biology of *P. infestans*, but also provides reports of late blight throughout the United States on a map. Outbreaks are reported by pathologists or other crop specialists and updated on the website. The website gives available details about the outbreak such as when the outbreak occurred, and whether it was found on tomato or potato. If a live sample was submitted to cooperating pathologists additional information about the reported outbreak is added to the website as it becomes available, such as the specific genotype of the *P. infestans* isolate, which is a way of grouping closely related isolates. Information regarding the isolate's sensitivity to the fungicide metalaxyl, which is an older formulation of mefenoxam (Ridomil) is also provided and commonly used to manage late blight in tomato and potato. Insensitivity to metalaxyl implies that isolates are insensitive to mefenoxam (Ridomil) as well. On the USABLIGHT website, 5 isolates from Florida were characterized last year (2012), 2 were characterized as *P. infestans* genotype US11 and 3 as US23. Both US11 isolates were insensitive to metalaxyl, while only 1 out of the 3 US23 isolates were reported as insensitive. Keep in mind that resistance to metalaxyl has been prevalent among *P. infestans* isolates in the past. Metalaxyl insensitivity was documented among Florida isolates characterized in 2012, so it would safe to assume that the same will be true of isolates associated with late blight in 2013. Until updated information is available, tomato and potato growers should minimize their use of metalaxyl and mefenoxam or avoid using both altogether. Results of previous field trials demonstrated that weekly applications of the fungicide chlorothalonil (Bravo, Echo, Equus) gives adequate control of late blight on tomato under most conditions, and is also effective against other common fungal diseases such as early blight (caused by *Alternaria solani* and *A. tomatophila*), and target spot (caused by *Corynespora cassiicola*).

Chlorothalonil is a contact, broad-spectrum fungicide that with proper foliar application slows late blight development. When low to moderate disease pressure is present and when conditions are not favorable for rapid disease development, a preventative fungicide program based on chlorothalonil alone was found to be sufficient for managing late blight. When weather conditions are favorable for rapid disease development, a preventative fungicide program that includes chlorothalonil will slow disease progress. However, additional applications of systemic fungicides that are specific to the late blight pathogen may be necessary for additional control (the shortest re-treatment interval for chlorothalonil is 7 days on tomato) and to avoid exceeding seasonal application rates for chlorothalonil (seasonal limit for chlorothalonil on tomato is 15.1 lbs/acre active ingreiant). Of these other fungicides, mefenoxam (Ridomil) has been the most effective when sensitive isolates are present, but as previously mentioned insensitive isolates were observed frequently last year. Growers should avoid using mefenoxam (Ridomil). If mefenoxam is used, it should be the formulated premix with chlorothalonil (Ridomil Gold Bravo SC) or as a tank mix with chlorothalonil (Bravo, Echo, Equus). Growers should also be cautious using strobilurin and related fungicides in FRAC 11, as resistance to these fungicides has been documented for the pathogens causing early blight and target spot of tomato. All isolates of *Corynespora cassiicola* (causal agent of target spot) tested to date have been insensitive to strobilurin fungicides. Applications of strobilurin fungicides in the presence of strobilurin-insensitive isolates of *C. cassiicola* actually accelerated target spot in field trials. Similar findings have been documented for early blight.

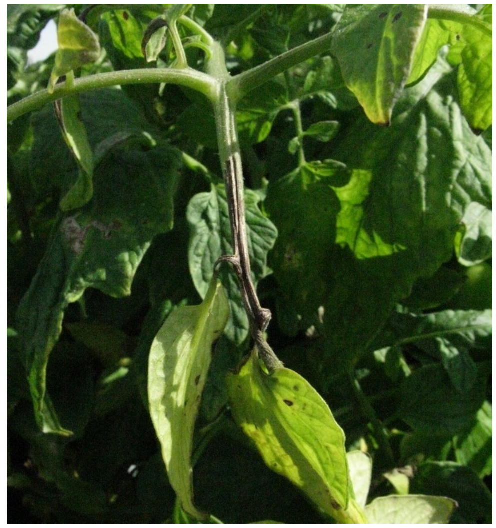
Foliar symptoms of late blight caused by fungus-like organism *Phytophthora infestans* consists of brown-black lesions that blight foliar tissue, giving leaves a burned look. As the lesions expand, they can have a circular (zonate) appearance to them well.

When humidity is high, especially in the morning, a white sporulation can be observed on the lesion. Often it will be heaviest on the margins of the lesion.

The tissue surrounding late blight lesions often has an off-green appearance. Sporulation can often be associated with this area when humidity is high.

This off-green region surrounding the lesion can appear darker if held up against the light and can be quite pronounced on older infected tissue that is beginning to turn yellow (senesce) from age; a phenomenon referred to as a "green island" effect.

Late blight lesions can also develop on stems.



Late blight lesions can also develop on stems and petioles of plants and can easily girdle the plant causing wilting of plant tissues above the lesion.

Fruit symptoms of late blight can vary depending where the infection begins, but symptoms typically start as a grayish or brownish bronzing of the fruit. The fruit surface becomes rough with a zonate appearance as the lesion expands. Late blight can infect the fruit directly or through the peduncle or calyx.

LABELED FOR LATE BLIGHT (*Phytophthora infestans*) ON TOMATO.

Sorted by FRAC group corresponding to the mode of action. (Updated January 2013).
Dr. Gary E. Vallad, UF/IFAS Gulf Coast REC. gvallad@ufl.edu
BE SURE TO READ A CURRENT PRODUCT LABEL BEFORE APPLYING ANY CHEMICAL.

		Maximum Rate per:			
Fungicide Group(s)[1]	**Chemical (active ingredient)**	**Acre**	**Acre per Season**	**Min. Days to Harvest**	**Remarks[2]**
M1	(copper compounds) Many brands available.	**SEE INDIVIDUAL LABELS****		0	**See label for details. **Be aware that reentry intervals have changed for many copper compounds.**
M3	(mancozeb) Many brands available.	**SEE INDIVIDUAL LABELS**		5	
M3 / M1	Cuprofix MZ Disperss (mancozeb + copper sulfate)	7.25 lb	55.2 lb	5	
M3 / M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	
M5	(chlorothalonil) Many brands available.	**SEE INDIVIDUAL LABELS**		0	Use higher rates at fruit set and lower rates before fruit set, see label
4 / M3	Ridomil Gold MZ WG (mefenoxam + mancozeb)	2.5 lb	10 lb	5	Limit is 4 appl./crop, see label. **Mefenoxam resistance is common among *P. infestans* isolates.**
4 / M1	Ridomil Gold Copper (mefenoxam + copper hydroxide)	2 lb	6 lb	14	Limit is 3 appl. /crop. Tank mix with maneb or mancozeb fungicide, see label. **Mefenoxam resistance is common among *P. infestans* isolates.**
4 / M5	Ridomil Gold Bravo SC (chlorothalonil + mefenoxam)	3.25 pt	12 pt	5	See label for additional restrictions regarding soil applications. **Mefenoxam resistance is common among *P. infestans* isolates.**
11	Amistar 80 DF (azoxystrobin)	2 oz	12 oz	0	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant may cause phytotoxicity; see label.
11	Quadris FL (azoxystrobin)	6.2 fl oz	37 fl oz	0	
11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	Only 2 sequential appl. allowed. Limit is 6 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group, see label.
11	Flint (trifloxystrobin)	4 oz	16 oz	3	Limit is 5 appl/crop. Must tank mix with another labeled fungicide from a different FRAC group at 75% of its labeled rate, see label.
11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	Limit is 4 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group, see label.
11	Reason 500 SC (fenamidone)	8.2 oz	24.6 lb	14	Must alternate with a fungicide from a different FRAC group. See supplemental label for restrictions and details.
11 / M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity; see label.
11 / 7	Priaxor (pyraclostrobin + fluxapyroxad) **SUPPRESSION ONLY**	8 oz	24 oz	7	Limit is 3 appl/crop. Only 2 sequential appl. allowed before rotating. See label for details on preparing and compatibility with other products.
11 / 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	Do not alternate or tank mix with other FRAC group 11 fungicides. See label for details.
21	Ranman (cyazofamid)	2.75 fl oz	16 fl oz	0	Limit is 6 appl./crop, see label
22 / M3	Gavel 75DF (zoaximide + mancozeb)	2.0 lb	16 lb	5	See label
27	Curzate 60DF (cymoxanil)	5 oz	30 oz per year	3	Do not use alone, see label for details

Table Continues on next page.

28	Previcur Flex or Promess (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	Must tank mix with Chlorothalonil, maneb or mancozeb; see label.
33	Alude Fosphite Fungi-Phite Helena Prophyte K-phite 7LP Phostrol Reveille Topaz (mono-and di-potassium salts of phosphorous acid)	**SEE INDIVIDUAL LABELS**		0	Do not apply with copper-based fungicides. See label for restrictions and details
40	Acrobat 50 WP (dimethomorph)	6.4 oz	32 oz	4	See label for details
40	Forum (dimethomorph)	6 oz	30 oz	4	Only 2 sequential appl. See label for details
40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	Supplemental label; No more than 2 sequential appl.; See label
40 / 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	only 4 apps per season; no more than 2 sequential apps Not labeled for transplants. See label
40 / 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	4	only 3 apps per season; no more than 2 sequential apps
43	Presidio (Fluopicolide)	4 fl oz	12 fl oz/per season	2	only 4 apps per season; no more than 2 sequential apps. 10 day spray interval; Tank mix with another labeled non-FRAC code 43 fungicide; 18 month rotation with off label crops; see label.

1 FRAC code (fungicide group): Numbers (1-44) and letters (M, NC, U, P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. M = Multi site inhibitors, fungicide resistance risk is low; NC = not classified, includes mineral oils, organic oils, potassium bicarbonate, and other materials of biological origin; U = Recent molecules with unknown mode of action; P = host plant defense inducers. Source: FRAC Code List 2009; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

2 Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

A Comprehensive Strawberry Industry Survey

Zhengfei Guan and Alicia Whidden

The Florida strawberry industry is facing increasing threats and challenges from both domestic regulation and international competition. In cooperation with Florida Strawberry Growers Association (FSGA), faculty at the University of Florida (UF) Gulf Coast Research and Education Center (GCREC) at Balm are exploring ways to help growers overcome these challenges. A team of researchers are conducting a comprehensive industry survey to analyze the following issues:

1) Major threats and market outlook;
2) Immigration/labor issues;
3) Compliance costs;
4) Production cost efficiency;
5) Priority traits for breeding;
6) Protected culture;
7) Disease control and risk management;

The industry is now at a crossroad; these issues are of great importance to the industry. For example, threats studied include Mexican competition, government regulation and different compliance requirements (e.g., wage and hour, worker protection standard, food safety), labor shortage, volatile market prices, among others. In particular, the record imports from Mexico in the last season caused a market crash for Florida growers; and the impending, mandatory food safety regulation for the strawberry growers will certainly increase the cost of production. The immigration and labor policies are also causing tremendous pressure on the industry in terms of both cost and labor supply.

All of these are creating great uncertainties for the industry. To survive these threats and challenges, it is important to improve cost efficiency and effectively manage risk. More importantly, growers need to ***be strategic*** and ***innovative*** in order to thrive (not just survive) under the current market and policy environment. Individual growers may consider adopting new technologies and management/marketing practices, while the industry as a whole needs to search for cost effective labor solutions and develop new varieties to stay competitive.

This project is a joint research and extension initiative from Dr. Zhengfei Guan (economist), Ms. Alicia Whidden (extension agent), and Drs. Natalia Peres (pathologist), Bielinski Santos (horticulturalist), and Vance Whitaker (breeder). We hope growers will take this opportunity to share their opinions/ concerns on major market and policy issues, including **Mexican competition, immigration and labor policies, and various regulations and compliance requirements**. *Results from this research will be used to make policy petitions and develop programs/products to help growers*. Growers' responses to this survey are anonymous and confidential. Participation is greatly appreciated. Questions regarding this survey can be directed to Zhengfei Guan (guanz@ufl.edu, 813-633-4138) or Alica Whidden (awhidden@ufl.edu, 813-744-5519 ext. 54134).

Managing Diamide Resistance in Florida Tomato

Hugh Smith, Assistant Professor GCREC

Anthrilic diamides are a recently developed class of insecticide that interferes with insect nerve and muscle function by disrupting ryanodine receptors. Diamide insecticides are systemic - they can be taken up by the plant's vascular system either through the roots or foliage. Systemic insecticides can be applied to the plant in transplant water, through drip irrigation, and directly to the foliage. There are presently three diamide insecticides available for use on tomatoes in

Florida: chlorantraniliprole, cyantraniliprole, and flubendiamide. Chlorantraniliprole and cyantraniliprole are also referred to as rynaxypyr and cyazypyr, respectively. Chlorantraniliprole, the active ingredient in Coragen, became available in 2008, and flubendiamide, the active ingredient in Belt and Synapse, became available in 2009. Cyazypyr became available in 2013, sold as Verimark for soil application and Exirel for foliar application. Diamide insecticides have been assigned the mode of action classification number 28 by the Insecticide Resistance Action Committee (www.irac-online.org). This number appears on the label of any insecticide containing diamides. Chlorantraniliprole, flubendiamide and cyantraniliprole are available in additional formulations and in some products combined with other insecticides (Table 1).

Flubendiamide is primarily active against caterpillar pests. Key caterpillar pests of Florida tomato that can be managed with flubendiamide include cutworms, tomato fruitworm (*Helicoverpa zea*), tomato pinworm (*Keiferia lycopersicella*), southern armyworm (*Spodoptera eridania*), beet armyworm (*Spodoptera exigua*), and yellowstriped armyworm (*Spodoptera ornithogalli*). Other caterpillar pests attacking tomato that can be managed with flubendiamide include tobacco hornworm (*Manduca sexta*), cabbage looper (*Trichoplusia ni*), and soybean looper (*Pseudopludia includens*).

Chlorantraniliprole is effective against the same complex of caterpillar pests of tomato as flubendiamide. In addition, chlorantraniliprole suppresses nymphs of the silverleaf whitefly, *Bemisia tabaci* biotype B, and can be used to manage the larvae of serpentine and vegetable leafminers (*Liriomyza sativae* and *L. trifolii*). In addition to killing leafminer and caterpillar pests, cyantraniliprole is effective against adults and nymphs of the silverleaf whitefly. The silverleaf whitefly vectors Tomato yellow leaf curl virus which can cause devastating losses in tomato in Florida and other regions of the world.

As with any insecticide, repeated use of diamide insecticides on successive generations of the same pest may lead to the development of insecticide resistance. In order to avoid the development of resistance to diamides by targeted pest of tomato, group 28 insecticides must be rotated with insecticides possessing different modes of action. Insecticide modes of action available for management of silverleaf whitefly, caterpillars and leafminers on Florida tomato are listed in Tables 2 and 3.

In order to conserve the efficacy of diamide and other insecticides, a "treatment window" approach can be employed. A treatment window is a period of time that is defined by the crop stage, the biology of the pest complex attacking the crop, or a combination of both. The most important period to protect a tomato crop from Tomato yellow leaf curl virus is during the first five or six weeks after transplanting. Planting resistant varieties, destroying crop residues that serve as a reservoir for TYLCV and using reflective mulches are key strategies for reducing early infection of the tomato crop. At -plant applications of neonicotinoid insecticides (Group 4A) or cyantraniliprole may also provide important early season protection from viruliferous whiteflies. Because of the importance associated with insecticides that can help suppress transmission of TYLCV, early season use of cyantraniliprole may be considered a priority "treatment window" for diamide resistance management in tomato.

If a diamide is used during the first 35-42 days after transplanting, alternate modes of action should be used instead of diamides for a period of roughly thirty days following the final application of the diamide insecticide. Under this scenario, insecticides that do not include active ingredients with a group 28 mode of action would be used for suppression of whitefly, leafminers, and caterpillars. For example, group 6 and 17 materials could be used for leafminer, and group 11, 18, and 22 materials could be used for caterpillar management, rotated with "softer" materials and materials that have not been assigned an IRAC MOA number (Table 2a) when appropriate. (Spinosyns, group 5 insecticides, are effective against leafminers and caterpillars, but should be reserved for thrips management whenever possible.)

Table 1. Insecticides containing diamides available for management of pests of Florida tomato and other crops

Product	**MOA#**	**Active ingredient(s)**
Coragen™	28	Chlorantraniliprole
Durivo™ (soil)	28 + 4A	Chlorantraniliprole + thiamethoxam
Voliam Xpress™	28 + 3	Chlorantraniliprole + lambda cyhalothrin
Voliam Flexi™ (foliar)	28 + 4A	Chlorantraniliprole + thiamethoxam
Belt™	28	Flubendiamide
Vetica™	28 + 16	Flubendiamide + buprofezin
Verimark™ (soil)	28	Cyantraniliprole
Exirel™ (foliar)	28	Cyantraniliprole

Table 2. Modes of action available for management of silverleaf whitefly, caterpillars and leafminers on tomato in Florida.

	1A	1B	3	4A	5	6	7C	9B	11	15	16	17	18	21A	22	23	28
Silverleaf whitefly	x**	x**	x	x			x*	x**		x	x*					x	cyantraniliprole
Caterpillars	x		x		x	x				x			x				x
Leafminers		x			x	x						x					x

*whitefly nymphs; **suppression

Table 2 con't. Active ingredient lacking an IRACMOA number available for management of silverleaf whitefly, caterpillars and leafminters on tomato in Florida.

	Azadirachtin	*Beauvaria bassiana*	Cryolite	Insecticidal soap	Extract of *Chenopodium ambrosioides*	Stylet oils
Silverleaf whitefly	x	x		x	x	x
Caterpillars	x		x			
Leafminers					x**	x

Table 3. Additional modes of action effective against tomato pests that are managed with diamide insecticides. Check insecticide labels for specific species and life stages targeted.

MOA #	Grouping or action Site	Active ingredient examples	Remarks
1A	Carbamate	Oxamyl*	Restricted.
1B	Organophosphate	Dimethoate, methamidophos	Resistance to organophosphate insecticides exists among some leafminer populations
3	Pyrethroid	Esfenvalerate, beta-cyfluthrin*, bifenthrin, propathrin	
4A	Neonicotinoid	Acetamiprid, clothianidin*, imidacloprid, thiamethoxam	
5	Spinosyns	Spinosad, spinetoram	
6	Avermectins	Abamectin	
7C	Juvenile hormone mimics	Pyriproxifen	Immature whitefly
9B	Selective homopteran feeding blocker	Pymetrozine*	
11	Microbial disruptor of insect midgut membrane	*Bacillus thuringiensis* subspecies *aizawai*; subspecies *kurstaki*	
15	Inhibitors of chitin biosynthesis	Novaluron	Immature whitefly
16		Buprofezin	
17	Dipteran molting disruptor	Cyromazine	
18	Ecdysone receptor agonist	Tebufenozide, methoxyfenozide	
21A	METI insecticides	Fenpyroximate	
22	Sodium channel blocker	indoxacarb	
23	Lipid biosynthesis inhibitor	Spiromesifen, spirotetramat	
28	Ryanodine receptor modulators	Chlorantraniliprole, cyantraniliprole, flubendiamide	

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