UF IFAS Extension UNIVERSITY of FLORIDA

An Equal Opportunity Institution

Berry Vegetable Times

Volume 15 Number 3 Fall 2015

SOLUTIONS

Contents

Calendar of Events

Hillsborough County Extension Office Pesticide License Testing. 5339 CR 579, Seffner. http://hillsborough.ifas.ufl.edu/prohort/pesticide_licenses/index.shtml for dates and how to register for testing.

Oct. 20 - Thrips Management In Strawberry Grower Meeting. FSGA conference center, noon to 3. RSVP to Alicia Whidden is required for lunch. **See Page 16 for details.**

Oct. 28—FFVA Food Safety: What's your risk? Workshop. GCREC 9:00-4:00. For more information call 321-214-5240 or register at https://www.eventbrite.com/e/food-safety-what-is-my-risk-tickets-18630296719. Cost is $30 for FFVA members and $55 for non-members.

November 4—2015 Florida Ag Expo at the Gulf Coast Research and Education Center. 10th Anniversary! **See Page 17 for all the details.**

December 8—Government Dollars Working for You, Agricultural Economic Workshop. Hillsborough Co. Extension Office, 10 a.m. to 3 p.m. RSVP to 813-752-1474 ext. 3.

From Your County Extension Agent…

Changes are a coming just like the weather!

A new growing season is starting for everyone and along with this there are many changes coming up on the regulatory front. You have been hearing for the last several years of the changes the new Food Safety Modernization Act (FSMA) will be bringing both to the farm and the packinghouse. This will be the first major changes for food safety since the 1930's. One of the new requirements is the Produce Safety Rule that will require that all farms will need to have someone undergo a one day class and receive a certificate. This will be required just one time but all farms across the country will need to comply. We are working on scheduling that training hopefully for next spring for the growers here. Packinghouses will also have a one time training requirement under the Preventative Control Rule. Their training session will be a three day course and trainings will be scheduled in 2016.

Growers are familiar with the regulations they must comply with for Worker Protection Standards (WPS). WPS is also undergoing changes and the new standards are just being released. One change will be that anyone who is a WPS Trainer and allowed to train workers and handlers will need to go through a new training session to learn the new rules and will then be certified to be a trainer under the new WPS. This means that all trainers across the country will need to be retrained but there will be a grace period to get this done. Trainings will be offered as soon as possible when the rule goes into effect.

At Agritech this year we had a speaker from FDACS speak on the new bee pollinator protection program. This is part of EPA's Mitigation of Exposure to Bees from Acutely Toxic Pesticides proposal. This proposal could have a great impact on spraying your crop if you have contracted beehives for pollination on your farm. Comments are being taken right now so the rules have not been finalized. Both FFVA and FSGA are working on this issue. This will impact all crops across the country so I just want you to be aware that this issue should be on your "radar screen" and for you to be paying close attention to what happens.

Don't forget this is to be a strong El Nino year. See the article on this in the newsletter, Page 12. So far this El Nino is shaping up to be almost as strong as the 1997-98. We all remember how wet we were that year!

All the best to you in the upcoming season,

Alicia Whidden

A University of Florida/IFAS and Florida Cooperative Extension Service Newsletter
Alicia Whidden, Editor, Hillsborough County Extension Service, 5339 CR 579, Seffner, FL 33584 (813) 744-5519

Jack Rechcigl, Center Director and Christine Cooley, Layout and Design, Gulf Coast Research & Education Center, 14625 County Road 672, Wimauma, FL 33598 (813) 634-0000

Advances in Strawberry Genetics

Sujeet Verma, Research Coordinator and Vance Whitaker, Associate Professor
GCREC Strawberry Breeding Program

Early varieties with better fruit quality and resistance to diseases is the major focus of UF/IFAS strawberry breeding program. We are blessed to have a breeding population that has been developed over the last 67 years to be specifically adapted to Florida conditions and market needs. Now that we have entered an era of modern plant breeding that emphasizes the use of genetic technologies, how is our program taking advantage?

In the last three years, our breeding program has begun utilizing advanced genetic research tools to breed more effectively for several disease resistance and fruit quality traits. This is possible because of recent technological advances in strawberry genetics. The genome of the wild strawberry was sequenced four years ago, and last year a genome scanning technology called the IStraw90 Axiom® array was developed that allows us to track genetic markers across all 28 chromosomes of the cultivated strawberry. Our lab submitted DNA sequence of two of our Florida cultivars for the development of the IStraw90 Axiom® array, ensuring that this tool is particularly valuable for the UF breeding program.

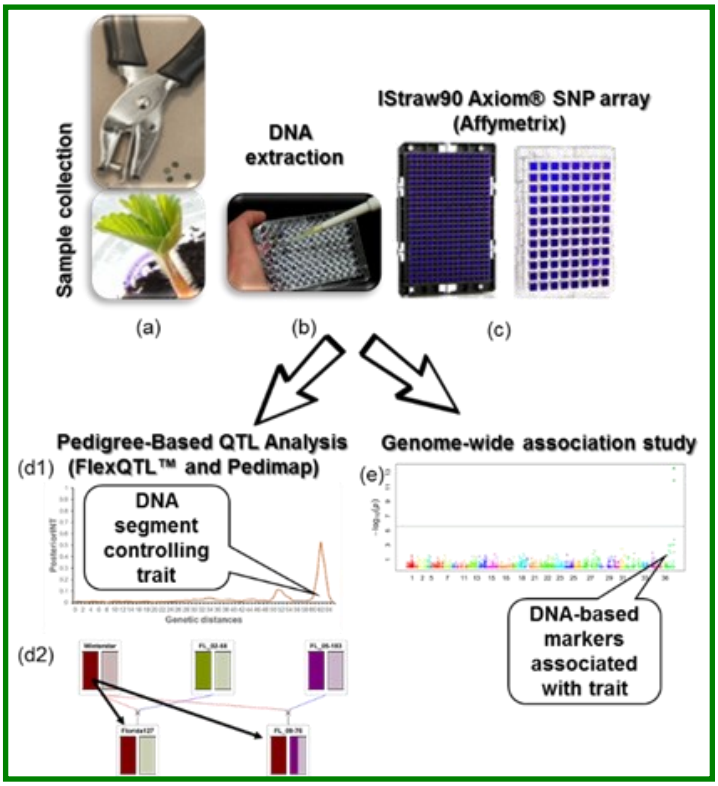


Figure 1. Molecular and statistical approaches used for genetic analysis at UF/IFAS strawberry breeding program.

So how does this process work? One aspect of a successful marker-assisted breeding program is developing a system of DNA extraction and genetic screening. Plant tissue samples are brought from the field or greenhouse to the laboratory and mixed into a chemical soup to extract the DNA (Figure 1a, 1b) which is submitted to Affymetrix for genome scanning using the IStraw90 Axiom® array (Figure 1c). Information on nearly 90,000 points or "markers" across the strawberry genome is obtained from Affymetrix and processed by our team. Field data and marker data are combined for Pedigree-Based Analysis (PBA) using FlexQTL™ software (Figure 1 d1, d2). This analysis identifies chromosomal locations and markers associated with disease and fruit quality traits (Figure 1e).

At this point, we know the genetic location of the segment of DNA associated with the trait, however breeding materials that carry good (associated with desirable values) and/or bad (associated with undesirable values) variant of that DNA segment are still to be identified. For instance, in the case of a disease resistance trait, we want to associate a DNA sequence variant at a particular genomic location with resistance and other genetic variants with susceptibility. Several DNA-based tags (primers) are designed to screen the breeding material. The best tags that can clearly distinguish between good and bad variants are utilized for high-throughput genetic screening of thousands of seedlings before they are sent to the summer nursery.

(Continued on page 3)

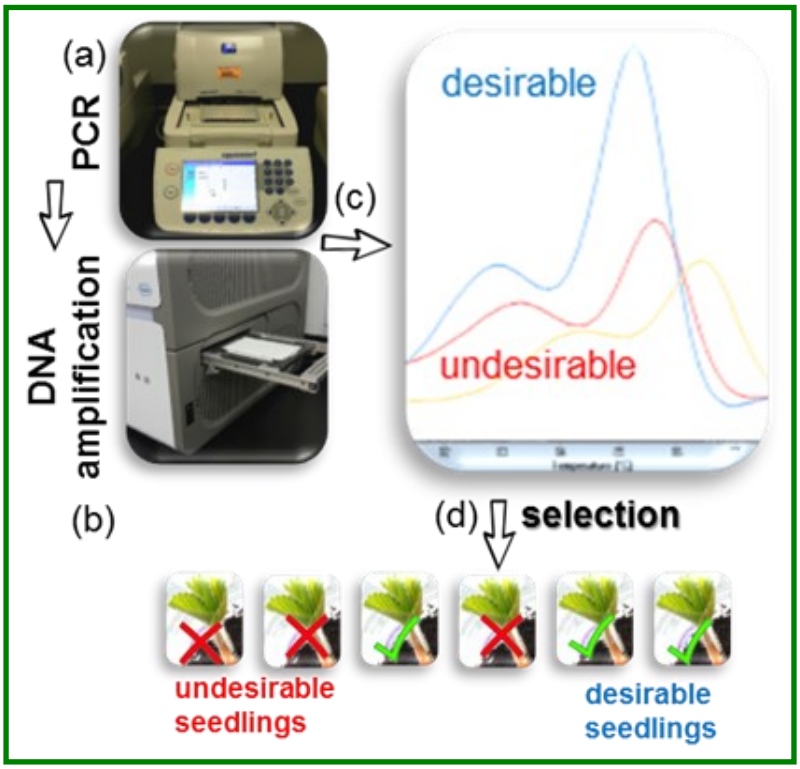


Figure 2. Stepwise visualization of procedure to utilize DNA -based tools for marker-assisted seedling selection.

To achieve this, DNA is extracted and amplified thousands of time (Fig. 2a). Pieces of DNA containing good and bad tags are decoded and read by a machine that accomplishes high resolution melting (HRM) (Fig. 2b, 2c). The HRM machine provides output in colored and easily readable format. Seedlings with desirable (good) and undesirable (bad) pieces of DNA are distinguished (Fig. 2d) and seedlings carrying bad piece of DNA are culled out and are not planted in the fruiting field.

The practical outcome is that we can germinate and grow many more seedlings than we can feasibly grow in the field, cull out the undesirable seedlings based on a quick genetic test, and essentially "stack the deck" for desirable traits for those seedlings that are planted in the fruiting field.

It will still take 5-7 years from the initial cross until the release of a variety using this approach as much field testing is still needed in the breeding and evaluation process. However, our hope is that the quality and performance of the varieties being released will be increased. It is important to recognize that what we have described here is not "GMO" technology. Rather, it is the use of genetic tools to make the classical breeding approach more precise and effective. In other words, these genetic tools help guide our decisions about what parents to cross and what seedlings to evaluate.

We have taken the time and effort to describe these tools and processes because we want our growers to get a sense of how their royalty investments are being utilized. We are grateful for the investments the FSGA has made in our breeding program, as well as for the technology, funding and support provided by the USDA-SCRI RosBREED project.

Florida Flower Thrips, *Frankliniella bispinosa* Morgan

Jeffrey D. Cluever, GCREC Grad Student; Hugh A. Smith, Assistant Professor, GCREC Entomology; Joseph E. Funderburk, Professor, NFREC Entomology; and Galen Frantz, Glades Crop Care.

Introduction

Frankliniella bispinosa was first described by Morgan in 1914 from individuals found near Dade City, Florida in 1910 (Morgan 1914). Before this, no distinction was made between this species and *Frankliniella tritici* (Watson 1923). Frankliniella bispinosa does not have an Entomological Society of America approved common name, but it is commonly referred to as the Florida flower thrips. The original name for *Frankliniella bispinosa* was *Euthrips tritici* var. *bispinosus* Morgan (1913) (CABI 2008; Hoddle et al. 2012). Some other synonyms include *Euthrips projectus* Watson (1915) and *Euthrips masoni* Watson (1919) (Hoddle et al. 2012).

(Continued on page 4)

Distribution

Frankliniella bispinosa is native to Florida. In the United States, its current distribution includes Florida and the southern portions of Georgia and Alabama. Its worldwide distribution has been reported to include the Bahamas, Bermuda, Colombia, Japan, Mexico, Taiwan, Trinidad, and the Republic of Georgia. It is the most common thrips species in most flowering weeds and crops in central and southern Florida. However, use of broad spectrum insecticides may cause this species to decline in favor of other thrips species (McPherson et al. 1999; Funderburk et al. 2007; CABI 2008; Martin et al. 2012).

Figure 1. Florida flower thrips.

Description

The Florida flower thrips is approximately 1 mm in length and light in color (Frantz and Fasulo 2013) (Figure 1). This species can be distinguished from other *Frankliniella* species by the distinctive flange-shaped pedicel at the base of the third antennal segment (Figure 2). It also has unusually heavy spines arising from the distal end (away from the body) of the second antennal segment (Figure 3), a characteristic it shares with another species in Florida, *Frankliniella cephalica.* The third pair of ocellar setae is separated by more than 1.5 times the diameter of one ocellus (Figure 4). Usually there are two minor setae between the pronotal antemarginal setae (Figure 5). The metanotum has a pair of campaniform sensillae (Figure 6). The comb of microtrichiae on the end of the eighth abdominal segment is well developed but interrupted in the center (Figure 7).

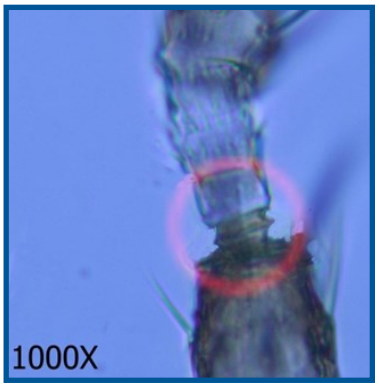


Figure 2. Pedicel on antenna of Florida flower thrips.

Biology and behavior

Frankliniella bispinosa has a "punching-sucking" feeding habit, where the mandible is used to punch a hole into the host tissue and the maxillae are inserted into the opening. The maxillae ingest the fluids from the cells, but not directly from the vascular tissue. *Frankliniella bispinosa* will not only ingest the contents of plant cells, but also the contents of pollen grains. *Frankliniella bispinosa* males are produced from unfertilized eggs and females are produced from fertilized eggs. The adult female uses her saw-like ovipositor to oviposit (lay) eggs into foliage of a plant. Even though this species does not exhibit sociality, males will form mating swarms (Terry and Gardener 1990; Lewis 1991).

Figure 3. Stout spines on antenna of Florida flower thrips.

Life History

Frankliniella bispinosa has three active and three inactive stages. The active larva I, larva II, and adult stages are spent in concealed spaces

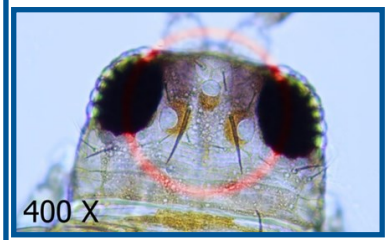


Figure 4. Ocellar setae (within red circle) on Florida flower thrips.

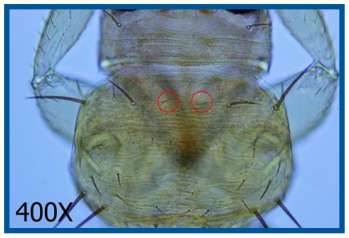


Figure 5. Antemarginal setae on Florida flower thrips.

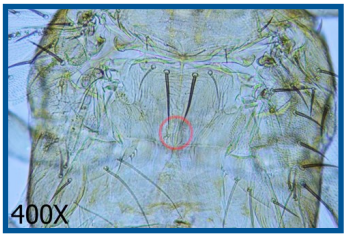


Figure 6. Campaniform sensillae on Florida flower thrips.

Figure 7. Michrotrichial comb on Florida flower thrips.

(Continued on page 5)

on the plant, such as in flowers. The inactive prepupal and pupal stages are spent in the soil and the egg stage is spent inside plant tissue. This cryptic behavior limits exposure to insecticides (Brodsgaard 1994). At 25°C, *Frankliniella bispinosa* completes development from egg to adult in 13.8 days when reared on Alocasia cucullata leaves and cattail pollen. The individual stages last 4.9, 1.9, 2.9, 1.3, and 2.8 days for the egg, larva I, larva II, prepupal, and the pupal stages respectively. At this temperature a single female can lay about 120 eggs in her lifetime (Bi-Song 2001).

Hosts

This species is polyphagous and is known to feed on plants in about 30 families (Martin et al., 2012). Some examples include common weeds such as Spanish needle, nightshade and wild radish; horticultural crops (blackberry, blueberry, corn, cucumber, eggplant, pepper, strawberry, tomato, watermelon); field crops (corn, peanut) and trees (citrus and oak). Some of these plant species may not be reproductive hosts but are used for food and shelter (Frantz and Mellinger 1990; Rhodes and Liburd 2011).

Economic importance

Florida flower thrips is a known pest of blueberries (Rhodes and Liburd 2011), however its pest status in other crops is not well documented. Damage by Florida flower thrips can either be direct or indirect. Direct damage is caused by feeding or oviposition injury to the crop. Direct damage can result from feeding injury to pepper fruits (Frantz and Fasulo 2013). In strawberry, feeding by thrips on the flowers may lead to abortion of the fruit and feeding on the fruit may cause bronzing (Linder et al. 1998; Zalom et al. 2014). Indirect injury refers to the transmission of viruses by the thrips. An example of indirect damage occurs when Frankliniella bispinosa transmits Tomato spotted wilt virus (TSWV), although this species is not as efficient a vector as western flower thrips (Frankliniella occidentalis) and has not been recorded as causing epidemics under field conditions in Florida (Avila et al. 2006).

Monitoring

To sample for *Frankliniella* thrips or other flower-inhabiting thrips randomly take a set number of flowers from an area. Either strike these flowers against a light-colored board and count the thrips while in the field, or place the flowers in a vial of ethanol and count the thrips later in the lab. Blue, yellow, and white sticky cards are sometimes used to sample flower thrips, but the catches have rarely been shown to reflect population size accurately or to be accurate predicators of damage (Frantz and Fasulo 2013; Muvea et al. 2014). Thrips caught on these sticky cards may be difficult to identify to species. Accurate identification to species requires at least 40X magnification.

Management

Ultraviolet-reflective mulches are effective in suppressing *Frankliniella bispinosa* and other species of flower thrips (Stavisky et al. 2002; Momol et al. 2004). UV-reflective mulches confuse the host-finding behaviors of thrips. Reflective mulch can be combined with companion plants such as sunflowers that harbor natural enemies to manage thrips (Tyler-Julian et al., 2014). Florida flower thrips is easily controlled by most insecticides with efficacy against flower thrips. It is possible that the application of insecticides can suppress Florida flower thrips but have less impact on more pestiferous species such as western flower thrips and common blossom thrips (*Frankliniella schultzei*). In these instances application of insecticides may shift the thrips species mix in favor of more damaging species. Many predators feed on thrips, of which the most important in Florida landscapes are Orius sp., minute pirate bugs.

References

Avila Y, Stavisky J, Hague S, Funderburk J, Reitz S, Momol T. 2006. Evaluation of Frankliniella bispinosa (Thysanoptera: Thripidae) as a vector of the Tomato spotted wilt virus in pepper. Florida Entomologist 89: 204-207.

Bi-Song Y. 2001. Growth, reproduction and field population dynamics of Frankliniella bispinosa (Thysanoptera: Thripidae). Entomologia Sinica 8: 265-270.

Brodsgaard HF. 1994. Insecticide resistance in European and African strains of western flower thrips (Thysanoptera: Thripidae) tested in a new residue-on-glass test. Journal of Economic Entomology 87: 1141-1146.

(Continued on page 6)

CABI. 2008. Invasive species compendium Frankliniella bispinosa. Centre for Agricultural Bioscience international. http://www.cabi.org/isc/datasheet/24417. 20 December, 2014.

Frantz G, Mellinger HC. 1990. Flower Thrips (Thysanoptera: Thripidae) collected from vegetables, ornamentals and associated weeds in south Florida. Proceedings of Florida State Horticultural Society 103: 134-137.

Frantz G, Fasulo TR. 2013. Thrips KnowledgeBase. Glades crop care. http://www.gladescropcare.com/thrips/pg1.html. (20 December 2014).

Funderburk J, Diffe S, Sharma J, Hodges A, Osborne L. 2007. Thrips of Ornamentals in the Southeastern US. University of Florida, Institute of Food and Agricultural Sciences, Electronic Data Information Source. ENY 845. http://polkhort.ifas.ufl.edu/documents/publications/Thrips%20of%20Ornamentals%20in%20the%20Southeastern%20United%20States.pdf . (20 December, 2014).

Hoddle MS, Mound LA, Paris DL. 2012. Thrips of California. CBIT Publishing, Queensland. http://keys.lucidcentral.org/keys/v3/thrips_of_california. (20 December 2014).

Lewis T. 1991. An introduction to the Thysanoptera: a survey of the group. In Parker BL, Skinner M, Lewis, T. (eds), Conference: Toward understanding Thysanoptera, Burlington, VT. 3-22. General Tech. Rep. NE-147, Randall, PA. U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. http://www.nrs.fs.fed.us/pubs/gtr/gtr_ne147/gtr_ne147_003.pdf

Linder C, Antonin P, Mittaz C, Terrettaz R. 1998. Thrips on strawberries in western Switzerland. Species, population dynamics and harmfulness [Abstract]. Revue Suisse de Viticulture, d'Arboriculture et d'Horticulture 30: 161-166.

Martin KW, Hodges AC, Leppla NC. 2012. Citrus pests: Florida flower thrips. Citrus Pests http://idtools.org/id/citrus/pests/factsheet.php?name=Florida+flower+thrips (20 December 2014).

Momol MT, Olson SM, Funderburk JE, Stavisky J, Marois JL. 2004. Integrated management of tomato spotted wilt on field-grown fresh market tomatoes in Florida. Plant Disease 88: 882-890.

McPherson RM, Pappu HR, Jones DC. 1999. Occurrence of five thrips species on flue-cured tobacco and impact on spotted wilt disease incidence in Georgia. Plant Disease 83: 765-767.

Morgan AC. 1914. Euthrips tritici, var. bispinosus: New Variety. Proceedings of the United States National Museum 45: 10-11.

Muvea AM, Waignjo MM, Kutima HL, Osiemo Z, Nyasani JO, Subramanian S. 2014. Attraction of pest thrips (Thysanoptera: Thripidae) infesting French beans to coloured sticky traps with Lurem-TR and its utility for monitoring thrips populations. International Journal of Tropical Insect Science 34: 197-206.

Rhodes EM, Liburd OE. 2011. Flower thrips (Thysanoptera: Thripidae) dispersal from alternate hosts into the southern highbush blueberry (Ericales: Ericaceae) plantings. Florida Entomologist 94: 311-320.

Stavisky J, Funderburk J, Broadbeck BV, Olson SM, Andersen PC. 2002. Population dynamics of Frankliniella spp. and tomato spotted wilt incidence as influenced by cultural management tactics in tomato. Journal of Economic Entomology 95: 1216-1221.

Terry LI, Gardener, D. 1990. Male mating swarms in Frankliniella occidentalis (Pergande) (Thysanoptera:Thripidae). Journal of Insect Behaviour 3: 133-141.

Tyler-Julian, K, Funderburk J, Frantz G, Mellinger C. 2014. Evaluation of a push-pull system for the management of Frankliniella bispinosa (Thysanoptera: Thripidae) in bell pepper. Environmental Entomology 43: 1364:1378.

Watson JR. 1923. The proper name and distribution of the Florida flower thrips. Florida Entomologist 7: 9-11.

Zalom FG, Bolda MP, Dora SK, Joseph S, Phillips PA, Tuscano NC. 2014. UC IPM Guidelines: Strawberry. University of California. UC ANR Publication 3468 http://www.ipm.ucdavis.edu/PMG/r734301211.html#DAMAGE. (20 December, 2014).

Strawberry Pests Wanted!

Justin Renkema, Assistant Professor, GCREC Entomology and Alicia Whidden, Hills. County Extension Agent

1. Diaprepes root weevil – Last year strawberry damage caused by weevil larvae was reported by a few growers. Larvae live in the soil and feed on roots, limiting the ability of the plant to take up water and nutrients. Damaged plants appear dry and stunted and are easily pulled-up. Adult beetles may be flying in or around field early in the season (October), but are more common in summer.

Larvae of Diaprepes root weevil on artificial diet.
From: http://entnemdept.ufl.edu/creatures/citrus/diaprepes_root_weevil.htm
Photo by: R.M. Giblin-Davis

Adult Diaprepes root weevil.

From: http://entnemdept.ufl.edu/creatures/citrus/diaprepes_root_weevil.htm

Photo by: Peggy Grub

2. Cyclamen mite – These small mites (about 2.5 mm long) can be found in unfolding leaves, often along the midvein. If significant numbers are present and damage occurs, leaves may be irregularly folded or appear roughened or distorted. Adults are yellowish brown, and larvae and eggs are opaque white. A hand lens is required to see these mites.

Adults, larvae, and eggs of cyclamen mite.

From: http://www.ipm.ucdavis.edu/PMG/r734400211.html

If you find either of these pests in your fields or have damage you suspect is caused by these pests, please inform Dr. Justin Renkema, Small Fruit Entomologist at GCREC. justin.renkema@ufl.edu or 813-633-4117.

To Dip or Not to Dip

Natalia Peres, Associate Professor and Jim Mertely, Research Coordinator, GCREC Plant Pathology

Planting time is here, and strawberry growers are faced with many important decisions. One of them is: "Should I dip my transplants in a fungicide solution or biological product before planting?" Pre-plant dips are viewed as an insurance policy against Colletotrichum acutatum, a fungus which causes root necrosis and anthracnose fruit rot. Unfortunately, insurance policies cost money, and don't always pay off as expected. Similarly, dipping may be a key crop input for some growers, but an unnecessary expense for others. Some of the pros and cons of dipping are given below.

C. acutatum frequently colonizes leaves and petioles of runner plants in the nursery. Symptoms may not be visible in the nursery environment, but if inoculum is allowed to build up and the weather is favorable, lesions may develop on the petioles (Figure 1). Little is known about how or when the pathogen spreads from colonized tissue above the ground to the root system below. However, C. acutatum grows freely in diseased tissues, and healthy plants may be contaminated by this inoculum during normal digging, trimming, and packing operations in the nursery. Stress associated with digging and shipping transplants and hot weather during plant establishment probably increase susceptibility to root necrosis. Transplants with infected roots fail to establish after overhead irrigation is withdrawn and few functional roots are found even 1 to 2 weeks after transplant (Figure 2). Old structural roots are brown or black, and new roots develop brown lesions, die back from the tip, or fail to emerge from the crown. Surviving plants are often stunted, flower late, and produce a poor early crop (Figure 3). These plants may recover during the cool winter months and produce normally in February and March, if an outbreak of anthracnose fruit rot does not occur.

Disease spread below ground is unlikely since the root systems are relatively isolated; however, above -ground spread may occur and may be facilitated by overhead irrigation during establishment. Even cultivars that are not highly susceptible to anthracnose fruit rot, such as Radiance, Winterstar, and Florida 127 are susceptible to root necrosis.

Diseases caused by C. acutatum are best controlled by exclusion (not introducing the pathogen into the field). Once symptoms appear, treatment is hindered by the difficulty of reaching a root system covered with soil. Chemigation is one possibility, but a single dripper in the center of the bed may not reliably deliver an effective dose to a row of plants 6 inches away. Thus, pre-plant dips are probably the best way of applying a product to all parts of the plant.

In research trials conducted in 2003-04 and 2004-05, naturally infected transplants were dipped for 5 minutes in Abound®, Switch® or Oxidate® just before planting. Abound® and Switch® were effective in reducing plant mortality but Switch was more effective in reducing plant colonization and increasing early

Figure 1. Petiole lesions caused by Colletotrichum acutatum.

Figure 2. Root necrosis symptoms on plants affected by Colletotrichum acutatum.

Figure 3. Stunted and dead plants due to root necrosis caused by Colletotrichum acutatum.

(Continued on page 9)

and total yields.

A similar trial was conducted in 2013-14 with infected Florida Radiance plants. Results confirmed the efficacy of Switch® in reducing plant mortality. However, Abound® performed poorly. In this more recent trial, plants dipped in Actinovate® had reduced mortality and increased growth, but plants dipped in Actinovate + Abound fared poorly. During the same season, different fungicides were applied weekly to the foliage of infected plants during the establishment period. These treatments did not produce many differences in plant mortality but captan applications seemed to improve growth of the surviving plants.

Going back to the initial question, the decision to dip or not to dip hinges on whether transplants are carrying C. acutatum and to what extent the shipment is contaminated. Making this determination is more of an art than a science. One method is to check a hundred plants from each of several boxes in the shipment. Carefully inspect each plant for the dark sunken spots on the petioles (Photo 1) and stolons, if present. Infected petioles may be broken, twisted, or curved near the lesion. Symptoms may also be seen on the roots. Look for structural roots that look unusually dark, like those on older mother plants. Distinct root lesions and root-tip dieback may also occur. Root symptoms are less diagnostic than those on the petioles, since they may be caused by C. acutatum and other fungi as well. If plants with suspicious symptoms are found, submit them to the Diagnostic Clinic at GCREC for confirmation of the disease.

If anthracnose is confirmed, dip treatment is a wise decision. Even one or two diseased petioles per hundred plants is an indication that anthracnose developed in the nursery, probably spreading from mother to daughter plants. Additional plants in the shipment may be colonized by the pathogen, but not show obvious symptoms. Other plants may be superficially contaminated by spores, soil, and infected debris from diseased plants. Although dip treatment may not eliminate deep-seated infections, it helps to reduce superficial colonization and kill spores and contaminated material adhering to healthy plants.

Finally, it is important to note that, according to the labels, plants should be set as soon as possible after dip treatment. Plants which have been treated the day before and stored in the shade or in the cooler may show stunting, burning, root abnormalities, and other symptoms of phytotoxicity. It is also important to keep in mind that these products might be toxic to fish and other aquatic life and old solutions must be disposed of properly.

Row Middle Weed Management in Tomato and Pepper

Nathan S. Boyd, Associate Professor, GCREC Weed Science

Weeds are a constant problem for most growers in the state of Florida. They reduce crop yields, lower crop quality, hinder harvest operations, host pests and diseases, lower profits due to increased management costs, and they just make a field look messy. Fortunately, there are a lot of tools available for weed control and putting those tools together to form a season-long management plan is the best way to reduce your weed pressure over time.

In this article I want to focus on the management of weeds that grow between the raised beds (row middles) of the plasticulture systems typical of Florida vegetable production. There are multiple management options but most growers rely on herbicide applications to achieve satisfactory levels of control. In some cases hand weeding is required to control difficult to manage weeds. It is also important to remember that a good fallow program can reduce weed pressure in the row middle and reduce the number of trips across the field required to achieve adequate control. Here are some important issues to keep in mind when applying herbicides:

1. Post emergence herbicides can be used to control weeds that have already emerged from the soil. Caution should be used to reduce drift as droplets or even blowing sand with herbicide residue can cause crop damage.
2. Preemergence herbicides are active in the soil and control weeds as they germinate. They frequently have very little activity on plants that have already emerged (Prowl) but in some cases preemergence herbicides

can also burn emerged seedlings (Chateau). Be careful during hot periods as some herbicides such as Dual can volatize from the soil surface and cause crop damage. How long a preemergence herbicide remains active in the soil varies with the herbicide, weather, and the soil type.

3. Herbicides that come in contact with the plastic can cause crop damage as the crop grows and comes in contact with the residue on the plastic mulch.
4. No herbicide will control all weed species. Identify the weeds present and implement a spray program to address those needs.
5. Some row middle herbicides can only be applied prior to transplant. The use of an effective preemergence herbicide just prior to transplant is often the safest way to manage weeds while minimizing the risk of crop damage.

Row Middle Research at GCREC. In 2014, the Weed Science program at GCREC evaluated a range of herbicides for use in row middles. The treatments consisted of a preemergence herbicide (none, Aim, or Gramoxone) tank mixed with a post emergence herbicide (Table 1). Weed control ratings were evaluated 2, 4, and 8 weeks after spraying. The percent weed control values listed in Table 1 are an average of all ratings. Gramoxone was the most effective post emergence herbicide evaluated though Aim was also effective especially when combined with Dual + Goal or Dual + Chateau. Prowl, Goal, and Dual on their own were weak and did not provide adequate control. Chateau was one of the most effective preemergence herbicides evaluated. Chateau + Dual or Chateau + Goal combined with Aim or Gramoxone tended to give the best broad spectrum weed control.

Table 1. Percent overall weed control in row middles following herbicide applications at the Gulf Coast Research and Education Center in the spring and fall of 2014.

Foliar Active	Soil Active	Rate	Spring 2014	Fall 2014
		--rate/acre--	----------% Weed Control----------	
None	None	-	40	7
	Chateau	4.0 oz	67	46
	Dual Magnum	1.0 pint	39	33
	Goal 2XL	2.0 pint	56	48
	Prowl	1.5 pint	40	22
	Sencor	0.67 lbs	-	70
	Dual + Chateau	1 pint + 4 oz	85	64
	Dual + Goal	1 pint + 2 pint	78	-
	Dual + Prowl	1 pint + 1.5 pint	54	44
Aim	None	-	58	30
	Chateau	4.0 oz	70	81
	Dual Magnum	1.0 pint	58	49
	Goal 2XL	2.0 pint	67	66
	Prowl	1.5 pint	62	18
	Sencor	0.67 lbs	-	57
	Dual + Chateau	1 pint + 4 oz	92	75
	Dual + Goal	1 pint + 2 pint	93	-
	Dual + Prowl	1 pint + 1.5 pint	60	51
Gramoxone	None	-	76	63
	Chateau	4.0 oz	90	78
	Dual Magnum	1.0 pint	82	76
	Goal 2XL	2.0 pint	92	71
	Prowl	1.5 pint	80	68
	Sencor	0.67 lbs	-	66
	Dual + Chateau	1 pint + 4 oz	95	82
	Dual + Goal	1 pint + 2 pint	90	-
	Dual + Prowl	1 pint + 1.5 pint	90	69

(Continued on page 11)

Table 2. Photos taken one month after the row middle herbicides were applied. Note that some weeds had already emerged at application and as a result preemergence herbicides such as Dual and Goal applied without a burn-down product such as Gramoxone or Aim did not provide adequate control although they inhibited the germination of new weeds.

Summary

There are many weed management options for row middle weed control in tomato and pepper crops in Florida. Research conducted at GCREC found that prior to transplant a tank mix of Gramoxone plus Chateau, Dual + Chateau, or Dual + Goal were the most effective. Chateau cannot be applied following transplant. Potential post-transplant herbicides for tomato with soil residual activity include Dual Magnum, Sencor and Prowl. Potential post-transplant herbicides for pepper with soil residual activity include Dual Magnum and Prowl. Sencor is not registered for use in peppers. Sandea can be applied to row middles where nutsedge is a problem and Select can be applied for grass control.

The use of trade names in this article is solely for the purpose of providing information. It is not a guarantee or warranty of the products and does not signify that they are approved to the exclusion of others of similar composition.

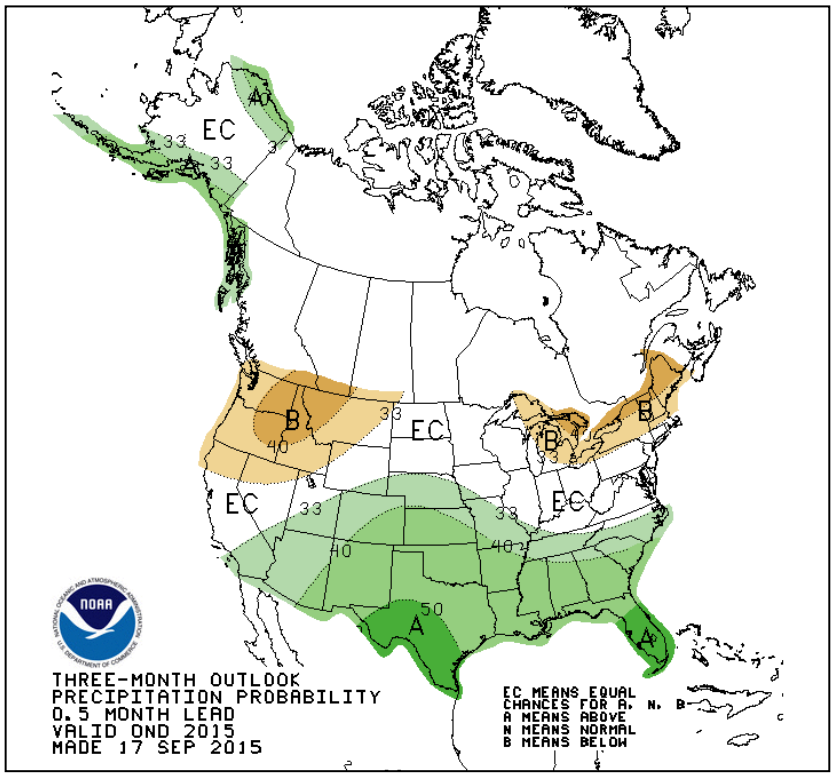
El Niño is Back in the Tropical Pacific Ocean: How will it impact agriculture in the Southeast? And how will it affect strawberry diseases?

Clyde Fraisse, Associate Professor, Agricultural and Biological Engineering Gainesville, and Natalia Peres, Associate Professor, GCREC Plant Pathology

A mature and strong El Niño is now present in the tropical Pacific Ocean. Most of the climate outlook models suggest that the 2015-16 El Niño is likely to strengthen further before the end of the year. Models and expert opinion suggest that surface water temperatures in the east-central tropical Pacific Ocean are likely to exceed 2° Celsius above average, potentially placing this El Niño event among the four strongest events since 1950 (1972-73, 1982-83, 1997-98).

The El Niño Southern Oscillation (ENSO) is the most important coupled ocean atmosphere phenomenon that causes global climate variability on interannual time scales. It manifests itself as changes in: (1) the sea-surface temperatures in the equatorial Pacific Ocean; (2) the sea level pressure difference between eastern Pacific high pressure and western Pacific low pressure (the "Southern Oscillation"). During El Niño events ocean surface temperatures warm in the central and eastern equatorial Pacific Ocean and easterlies are less strong. El Niño events normally bring cooler and wetter winter and springs to the Southeast USA. More information about ENSO impacts can be found at: http://agroclimate.org/fact-sheets-climate.php

During the winter El Niño causes the Pacific jet stream current to dip into the Southeast. This provides cold fronts with more moisture and energy. El Nino typically leads to 40 to 50% more rainfall than normal for the Florida peninsula. El Niño's impacts on the weather in the Southeast US are usually most prominent in the winter, but given the strength of this year's event, we could begin to see its effects this fall. Many climate models are predicting a wet fall with above-normal temperatures for the Southeast.



The seasonal precipitation forecast for October-November-December of 2015 produced by NOAA indicates increased probabilities for above average rainfall for the Southeast USA, reflecting the effects of El Niño in the region. Although seasonal forecasts are probabilistic and there is always a chance for weather patterns during the season not to behave as expected, it is well known that the presence of a strong El Niño or La Niña increases the "skill" of the forecast, meaning the ability of climatologists to produce a more accurate forecast.

Winter vegetables such as tomato and green peppers generally yield less during El Niño years than during Neutral or La Niña years. Most soil-borne pathogens and fruit quality problems increase in El Niño years. Fruit quality problems like gray wall and bacterial and fungal diseases that are typically associated with wet climates can be more prevalent during El Niño winters.

Nutrient management can also be affected by wetter cropping seasons as the frequency of leaching rainfall events increases, causing nutrients, mainly Nitrogen, to be washed out of the root zone, especially in fields irrigated by seepage irrigation. Recent studies demonstrated that during El Niño years, at least one leaching rainfall event of 1.0 inch or more in 1 day occurred in most locations where winter vegetables are grown in Florida and two of these events occurred in 9 out of 10 years.

(Continued on page 13)

In the case of temperate fruits (peach, nectarine, blueberry, strawberry), El Niño conditions generally result in increased chill accumulation in the early part of the winter (Nov-Jan) and can reduce the need for oil or other dormancy-compensating sprays in peaches and blueberries. Growers can keep track of chill accumulation by checking the AgroClimate chill hours calculator tool on AgroClimate (http://agroclimate.org/tools/Chill-Hours-Calculator/).

Cooler rainy conditions may slow development rates in some perennial fruit crops such as strawberry. Lower levels of solar radiation resulting from cloudy conditions may also affect growth in some cultivars. Additionally, conditions may favor the development of fungal diseases such as anthracnose and Botrytis fruit rots. Angular leaf spot (caused by Xanthomonas fragariae) is another disease that is favored by cool wet winters (EDIS publication: http://edis.ifas.ufl.edu/pp120). Strawberry growers in Florida can monitor the risk for anthracnose and Botrytis fruit rot diseases using the Strawberry Advisory System (SAS) available on AgroClimate: http://agroclimate.org/tools/strawberry/. More information about SAS is available in the following EDIS Publication: https://edis.ifas.ufl.edu/ae450

Current fungicide recommendations in SAS integrate our findings on fungicide resistance in Botrytis populations. To reduce selection of resistant strains, number of applications should be minimized for only when needed, i.e. when weather conditions are favorable for disease development. In addition to timing of application, fungicide selection is very important for good disease control. The current recommendation in SAS is to apply captan or thiram when conditions are moderately favorable for Botrytis but bloom is not present. When bloom is present and conditions are moderately favorable, the recommendation is to apply captan or thiram tank-mixed with Elevate, Fontelis or Merivon. Switch is only recommended when bloom is present and conditions are highly favorable for Botrytis development. The table below summarizes weather conditions favoring Botrytis development and current fungicide recommendations.

LWD (h)*	Temp (ºF)	BFR Risk	Peak Bloom	Spray Recommendation
< 13	any	Low	Yes or No	No spray
> 14	62 - 77	Moderate	No Yes	Multi-site: Captan, Thiram Single-site: Elevate, Fontelis or Merivon + Multi-site: Captan or Thiram
> 18	62 - 77	High	No Yes	Single-site: Elevate, Fontelis or Merivon + Multi-site: Captan or Thiram Single site: Switch

* Leaf wetness duration in hours

We have recently released SAS smartphone apps, with the support of the Florida Strawberry Growers Association, to help strawberry growers in Florida be more prepared for a season with potentially higher disease pressure. The apps for iphone and Android can be found at:

Apple iOS: https://itunes.apple.com/us/app/sas-strawberry-advisory-system/id898025106?mt=8

Google Android: https://play.google.com/store/apps/details?id=org.agroclimate.strawberry

Likewise the web-based SAS, the SAS mobile app monitors and forecast weather conditions that increase the risk for anthracnose and Botrytis, providing risk level information for the two diseases. The SAS mobile app can also provide alerts for user-selected stations via push notifications, alerting when the system detects moderate or high infection risk levels according to weather conditions. The app is designed to be easy to use, so it contains only the essential functionality available in the web-based SAS. For more extensive functionality, growers should refer to the web platform and online information.

Two New Fungicides Might Be Available for Strawberry this Season

Natalia Peres, Associate Professor, GCREC Plant Pathology

Strawberry growers might have an additional tool to fight Botrytis this season. Luna Tranquility® (fluopyram + pyrimethanil), from Bayer CropScience, and Kenja® (isofetamid), from ISK Biosciences, are on their final steps of registration. Considering all goes well, they might be available before the second and major peak bloom in February. Luna has been evaluated for many years in our trials and Kenja was evaluated in last season's trials. Both products were very effective controlling Botrytis and can be considered an alternative for rotation with Switch when conditions are highly favorable for Botrytis development. It is important to note, however, that Luna® and Kenja® belong to the same chemical group as FontelisTM and Merivon® and no more than four applications of them (all together) should be applied per season.

Early-season Nitrogen Fertilization for Strawberry: What Is the Optimal Rate?

Shinsuke Agehara, Assistant Professor, GCREC Horticultural Sciences

Strawberry growers in Florida generally apply 150–200 lb of nitrogen (N) per acre through drip irrigation during the growing season. The daily N application rate varies depending on the cultivar, growth stage, and environmental condition. The common practice is to start with 1.75–2 lb/acre/d during the transplant establishment, and then to lower to 0.75–1.25 lb/acre/d for the rest of the season. The purpose of the initial high-dose fertilization, despite the low crop N requirement by young transplants, is to help the small root system to absorb N more efficiently and accelerate the establishment. This fertilization practice differs from the current university recommendation, which recommends to start from 0.3 lb/acre/d and gradually increase up to 0.75 lb/acre/d based on the crop requirement.

To determine the optimal N fertilization rate during the early season, we evaluated five N rates ranging from 0.2 to 1.8 lb/acre/day for two major strawberry cultivars in Florida (Florida Radiance and Florida Sensation). A field experiment was conducted at the Gulf Coast Research and Education Center in Wimauma, FL. Treatments are described in Table 1.

Raised beds (10-inch high, 32-inch wide at the base, 28-inch wide on the top, and spaced 4-ft apart on centers) were fumigated and covered with black high-density polyethylene mulch using a commercial standard practice on Aug. 19, 2014. Bare-root transplants (G.W. Allen Nursery, NS, Canada) were transplanted in double rows (12-inch apart) with 15-inch in-row spacing on Oct. 9, 2014. Each bed was irrigated through a drip tape placed in the center at 1-inch depth. The drip tapes had emitters spaced 12 inches apart with a flow rate per emitter of 0.25 gal/h. Strawberries were harvested 27 times between Nov. 24, 2014 and Feb. 26, 2015. The experiment was set up using a split-plot design with N rate as the main plot factor and cultivar as the subplot factor. There were four replications, and each plot consisted of 24 plants.

Both cultivars increased the size of "bush" proportionally to the early-season N application rate, and this effect remained noticeable even in the mid-season after all treatments received the fixed N rate of 1 lb/acre/d for over one month (Fig. 1). The increased bush had no impact on the level of disease pressure, but it enabled increased fruit set and marketable yield (Fig. 2). Increasing early-season N application rate increased marketable yield not only during the early season (Nov. –Dec.) but also during the mid (Jan.) and late (Feb.) seasons, suggesting the importance of establishing productive "bush" during the early season. Total marketable yield of 'Florida Radiance' increased linearly with the early-season N application rate, whereas that of 'Florida Sensation' was maximized at 1.4 lb/acre/d and slightly decreased at 1.8 lb/acre/d. This cultivar-dependent yield response to N fertilization clearly suggests that N fertilization must be tailored for different cultivars. For this coming strawberry season, we will continue this project to develop the optimal N fertilization program for not only early season but also mid and late seasons.

Table 1. Nitrogen fertilization treatments tested on two strawberry cultivars, 'Florida radiance' and 'Florida Sensation', at Gulf Coast Research and Education Center in Wimauma, FL in 2014-2015.

	N application rate						
N treatment	Oct. 9 – Oct. 21		Oct. 22 – Dec. 14		Dec. 15 – Feb. 26		Total
#	(lb/acre/d)	(lb/acre)	(lb/acre/d)	(lb/acre)	(lb/acre/d)	(lb/acre)	(lb/acre)
1	0	0	0.2	11	1.0	74	85
2	0	0	0.6	32	1.0	74	106
3	0	0	1.0	54	1.0	74	128
4	0	0	1.4	76	1.0	74	150
5	0	0	1.8	97	1.0	74	171

(Continued on page 15)

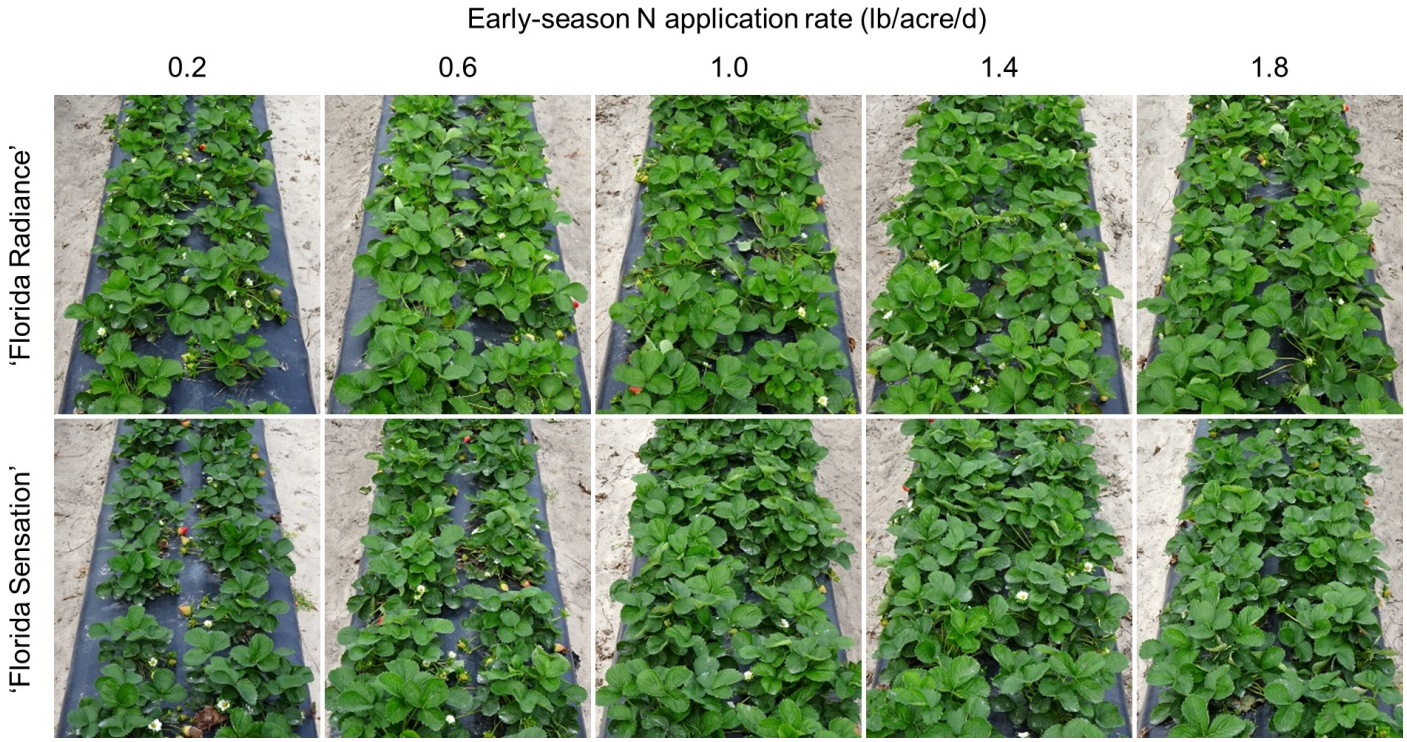


Figure 1. Canopy growth and fruit set of two strawberry cultivars, 'Florida radiance' and 'Florida Sensation', as affected by the early-season N application rate. Photos were taken on Jan. 20, 2015.

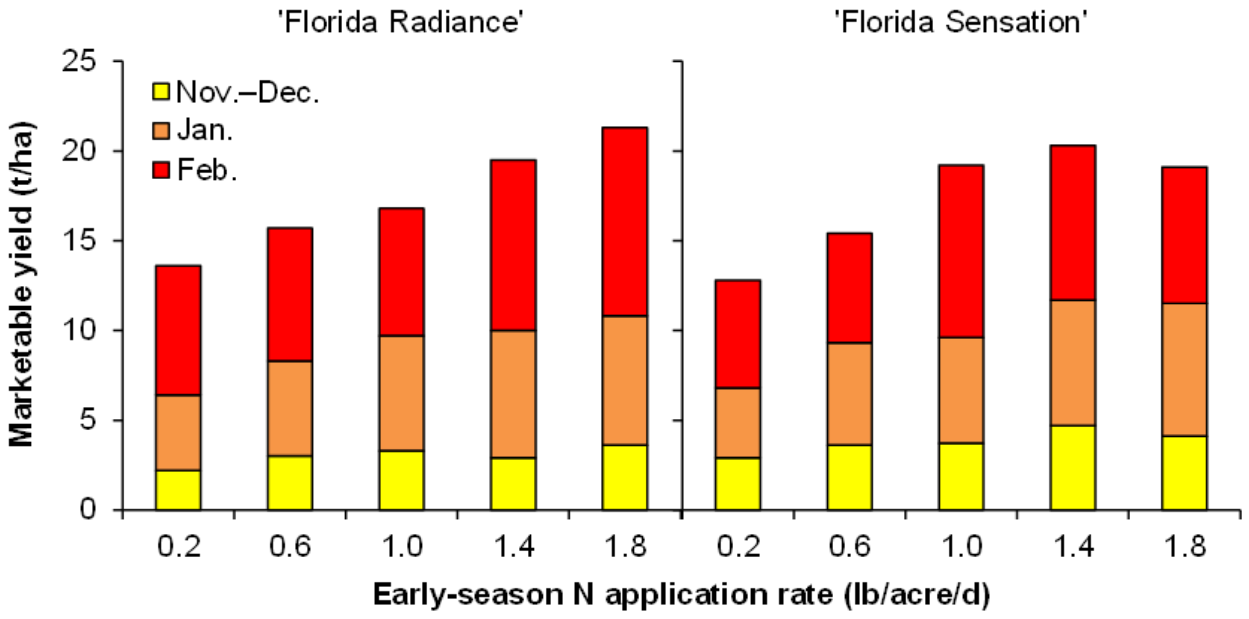


Figure 2. Marketable fruit yield of two strawberry cultivars, 'Florida radiance' and 'Florida Sensation', as affected by the early-season N application rate.

UF IFAS
UNIVERSITY of FLORIDA

UF/IFAS
GULF COAST RESEARCH
& EDUCATION CENTER

Thrips Management in Strawberry
Grower meeting
Tuesday October 20, 2015
12:00-3:00
FSGA 13138 Lewis Gallagher Rd., Dover FL 33527

12:00-12:45	Grower Lunch Sponsored by DuPont
12:45-1:25	"Thresholds, seasonal abundance and resistance monitoring for thrips in strawberries" Dr. Joe Funderburk, Iris Strzyzewski, Danielle Sprague Entomologists, UF, North Florida REC
1:25-1:45	"Species complex and management of thrips in strawberries" Drs. Oscar Liburd, Janine Razze, Elena Rhodes Entomologists, UF, Gainesville
1:45-2:10	Break & opportunity to view thrips and other strawberry pests.
2:10-2:30	"DuPont crop protection products for strawberry" Dr. James Taylor, DuPont
2:30-3:00	Questions, answers and discussion

Please RSVP by Oct. 14 for headcount for lunch to Alicia Whidden at 813-744-5519 ext. 54134 or awhidden@ufl.edu. CEU and CCA credits applied for.

Register today for the

10th Florida Ag Expo

Wednesday, November 4th

www.floridaagexpo.com

UF/IFAS Gulf Coast Research

14625 CR 672, Wimauma, FL

813-634-0000 http://gcrec.ifas.ufl.edu

Come celebrate 10 years of helping growers improve productivity and profitability.

- Guided field tours showcasing the latest research projects, methyl bromide phase-out solutions, new varieties and more
- An educational program packed with information and insights from some of the industry's most respected thought leaders, including UF/IFAS Extension faculty and a distinguished grower panel
- Exhibits offering hands-on previews of the latest products, equipment and services
- The opportunity to exchange ideas and experiences with growers from across the state and beyond
- Many chances to win great prizes from our sponsors and exhibitors
- Ribbon Cutting Ceremony for the GCREC Annex, new addition for the ever-growing staff at GCREC
- Featured presentation by Chef David Bearl informing growers how to make their produce attractive to local restaurants and how to cash in on the "buy local" movement