UF | UNIVERSITY of FLORIDA | IFAS EXTENSION

Berry/Vegetable Times

June 2010

Calendar of Events

July 31 & Aug. 1 Florida Small Farms and Alternative Enterprises, Osceola Heritage Park Conference Center, Kissimmee. For more information visit: http://smallfarms.ifas.ufl.edu/.

Aug. 17 & 18 FSGA Agritech Educational Sessions and Trade Show. Trinkle Building, Plant City. For more information contact the FSGA. www.flastrawberry.com.

Sept. 7 Tomato Institute, Ritz Carlton, Naples. For more information go to http://www.floridatomatoes.org/.

Nov. 10 2010 AgExpo at GCREC. For more information go to http://gcrec.ifas.ufl.edu/.

Feb. 11, 2011. Strawberry Field Day at GCREC. More details to come.

Feb. 8-11, 2011 North American Strawberry Growers Association and North American Strawberry Research Symposium Joint Meeting. Tampa. For more information go to www.nasga.org.

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From Your Agent

Spotted Wing Drosophila Fly Now Found in Blueberries

The spotted wing drosophila fly (SWD), *Drosophila suzukii*, has now been found in blueberries in Hillsborough County. Back at the 2009 Agritech, Dr. Jim Price had warned strawberry growers to be on the lookout for the coming season and several days later it was found to be here. Dr. David Dean, of the Fruit Fly Laboratory in Palmetto, found SWD in early August 2009 in Hillsborough County and now it has spread to 23 counties in the southern part of the state in under 45 weeks (see additional article by Jim Price and Curtis Nagle in this issue, Page 5).

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Nematode Management and Soil Fumigant Research

J.W. Noling[1] , Andrew MacRae[2] and Alicia Whidden[3]
[1]CREC, [2]GCREC, [3] Hillsborough County Cooperative Extension Service

What a season! Easter has come and gone and the double cropping season is about over. In driving around the area, it is clear that there is a lot of double cropped strawberry planned for the fall. There are even some fields in which a third crop of strawberry on the same plastic is planned for the fall. In general, most growers who double cropped strawberry last year seemed to have done quite well. In some fields where nematodes became a problem in the 2nd crop, weed growth in the middles and many of plant holes seems to have been the causal issue for increasing nematode populations. In other cases, the drip tape and the nonuniform delivery of a drip applied fumigant was the culprit. We can not over emphasize the season long need for weed control and the need for a clean, functional drip tape as nematode management

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SWD is one of two drosophila that can damage intact fruit. Dr. Price in an earlier Berry/Vegetable Times article told us how fruit are attacked. Usually fruit flies affect only fruit that are overripe or have some type of skin damage. SWD can damage thin skinned fruit that has no opening. This is done by the female fly, that has a serrated ovipositor and can cut a hole in the fruit then deposit an egg. When the egg hatches the larva eat the fruit pulp and can cause a sunken area to form. Besides the larvae being in the fruit, decay organisms can enter the hole that was cut and cause fruit rot.

Dr. Dean has reported finding SWD in strawberries, blueberries, Surinam cherry, orange Jessamine fruit, red mulberry and believes it can also go to elderberry. In the northwest part of the country last year, cherries and blueberries were severely affected. We have been lucky this strawberry and blueberry season not to have had much fruit damage from SWD. Even though we had a record breaking cold winter it did not get rid of SWD. This fly is originally from Japan and is very cold hardy. In the future this is a pest we will need to watch out for.

Two IFAS researchers that will be watching out for SWD in the future will be Dr. Jim Price for strawberries and Dr. Oscar Liburd for blueberries. As Dr. Price said in a talk he gave on SWD, "The bottom line on spotted wing drosophila is that it will become permanent and can't be ignored. We will be able to manage it and it will not be devastating".

Have a good summer,

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considerations in these double cropped fields. Run and clean the irrigation periodically and don't let the fennel, grasses, nightshades, and pigweeds get six feet out of control.

We know there are a lot of growers who are in the final stages of constructing the production plan for next year and because of this, there are a number of things we would like to share with you which might be of help in making those decisions. The first thing we would like to share with you is to describe an encounter we had with EPA officials who were conducting a training exercise for state inspectors summarizing the new fumigant label requirements forthcoming this fall, including buffer zones, fumigant management plans, and air monitoring programs among a myriad of other label changes. Inclusive to classroom type training exercises was a GCREC field tour and demonstration this past April that Andrew MacRae largely put together. He did a fine job. For the drip fumigation demonstration, it is appropriate that we thank Hendrix and Dail (Jimmy Moden) and Dow Agrosciences (Jerry Nance) who were kind enough to construct a 'state-of-the-art' drip fumigation station which allowed us to describe the drip fumigation process and essential backflow and delivery components of the injection system. During the field presentation, I described how drip fumigation had expanded in acreage, particularly as a necessary nematode management component for double cropping and sting nematode control. Some time later, after lunch, I was pulled aside and asked by EPA whether drip fumigation under 'holey' plastic was not a label violation when the fumigant label states a '*mandatory tarp seal is required'* for application of this fumigant product. My response was to ask them whether a plastic tarp was present and whether it was not performing at least a marginal seal of the plant bed. They were quick to indicate that this was not their intent, nor did they believe that a truly functional seal exists with as many as 20,000 /acre open planting holes in the plastic mulch from the previous year's strawberry plants. Needless to say, as the various fumigant labels are being rewritten by the chemical manufacturers and which must then be approved by EPA before they appear on cylinders as early as December 1, 2010, I think it is safe to say the days of drip fumigating holey plastic are over (after December) unless a new system of covering the bed top with new plastic is developed for some fumigants (i.e., Telone). We are hoping we might be in a position to evaluate a new mulch laying and gluing system this fall prior to drip fumigation in double cropped fields. Stay tuned, because if you have interest, we may need some candidate fields in which to test the new system.

Methyl Bromide Alternatives

This past season, a number of methyl bromide alternative fumigants and gas impermeable mulch films were evaluated in grower demonstration trials. Hopefully you were able to view and compare treatments in some of the trials we put out this past fall. The fumigant treatments evaluated generally included Telone C35 (35-42 gpa); Midas 50/50 (125 lb/a); Pic Clor 60 (300 lb/a); Dimethyl Disulfide with Chloropicrin (Paladin) (60 gpa); and Telone InLine (35 gpa). All rates being expressed as per treated acre while use rates per acre are computed as 62.5% of treated acre rates. None of the fumigants listed above faired poorly in any of trials. The extraordinarily cold winter in central Florida this past year resulted in a significant reduction of approximately 45% from average strawberry crop yields from the previous year. For the majority of an 8 week period (January + February), soil temperatures at 5 inches persisted at levels below 60 F. The combination of unseasonably cool air and soil temperatures slowed growth significantly. The protracted cold weather and needs for repeated overhead irrigation for cold protection, resulted in reduced plant growth and fruit production, and of fruit produced, resulted in significant amount of cull fruit during January. Fruit production did not begin in earnest until early February, at which time a glut of fruit was observed in the market. This was a tough year for strawberry field research in Florida. In general, we did not see meaningful differences between shank applied fumigant treatments under new plastic this past year.

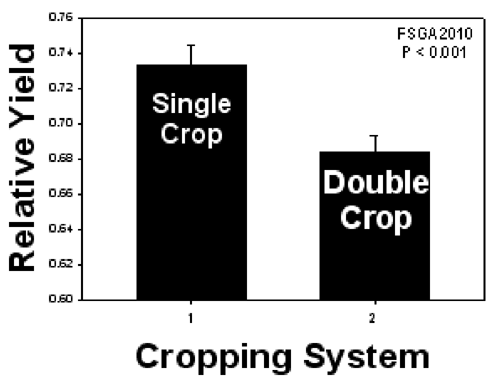
This past year we also continued our research focus on drip formulations of some of the alternative fumigants. We focused on the drip fumigants metam sodium (Vapam), Telone EC, and Telone Inline applied as one of nine different combinations of crop termination treatments in the spring after the initial crop of strawberry, followed by a stale bed fallow treatment during the summer, and concluding in fall with another preplant drip fumigant treatments. These studies were initiated, out of necessity, because of 2008-09 strawberry market conditions and needs of strawberry growers to reduce production costs. Thinking about production levels achieved this year and the degree to which growers are again planning double cropping bring on the experience of déjà vu. Due to low yields obtained following the atypical and unseasonably cold temperatures which persisted during January 2010 and beyond, we were not able to characterize fully the impacts (positive or negative) of double cropping. The data do indicated that overall yields within the double crop treatments were significantly lower than yield obtained with shank or drip applied fumigants under new plastic (Graph 1). We were able to show a soil heating effect, a type of solarization treatment during the summer off-season. Temperature probes installed into stale-beds on east and west bed shoulders and bed center locations demonstrated that soil temperature at 12 inch depth could attain temperatures of 100 to 110°F on a daily basis. These results suggested that crop termination treatments with either metam sodium, Telone EC, or Telone Inline did not necessarily have to be 100% effective to provide nematode control within strawberry plant beds. The results from other trials again demonstrated strawberry yield enhancement with the addition of a second drip per bed, particularly as a way in which to enhance the fumigation effect of the drip fumigant. Additional research is required to validate the fumigant, horticultural, and economic benefits of the drip fumigants and additional drip tape. Regardless of fumigant or number of drip tapes per bed, to maximize lateral spread, growers should plan on a fumigant injection period to deliver 125 to 150 gal/ 100 linear feet of row. This equates to at least 13,500 gallons or about 50% (0.50) of a broadcast acre inch of water (1 acre inch is 27,154 gallons water).

Remote Sensing

For the past five years we have toyed around with different camera platforms in which to take pictures of strawberry plants. Some of you have observed us with the long telescopic rods or 6 ft helium balloons, the cameras mounted to wing spars on airplanes or mounted on an old motorized bicycle cart, or even strapped to a cage on a big 30 ft forklift to take aerial pictures. This year we decided to intensify our efforts and acquired an old FarmAll 140 which we set up with 9 inch tires on 4 ft centers and then constructed the platforms for GPS, cameras and computer (Figure 1). The tractor mounted camera is being used to scan strawberry rows to provide estimates of green canopy cover against a backdrop of black plastic mulch covering the raised bed. We are fortunate that in the last few years we have been able to quantify strawberry yield losses with the plant stunting effect caused by sting nematode. Preliminary finding look pretty good. Strawberry yields from commercially hand harvested large plots have been well described by yield index values we derive from assessment of plants of different sizes within the same plots. Using plant stunting and counts of different plant sizes, we have conducted chemical treatment evaluations in over 50 commercial fields with recurring histories of sting nematode problems. In these fields, we have been able to develop accurate maps of nematode distribution, crop yields and loss indices associated with the different fumigant treatments. We will be continuing the field scale evaluations this fall because we really believe the methodology is capable of providing growers considerable guidance and quantitative performance data in which to recommend the various alternatives to methyl bromide soil fumigation for nematode management. Much of the final end-of-season remote sensing surveys we conducted this past spring are still being analyzed, so any further discussion of the results will have to wait for a subsequent newsletter or AgriTech seminar.

Traffic Pan Research:

Much of the performance inconsistencies of methyl bromide alternatives is currently thought to be attributed to and limited by the presence of plow pans or traffic pans (8-18”) underlying many, if not all, Florida strawberry fields. In general, this dense compacted layer begins just below the deepest tillage implements used in the field. Previous research has demonstrated that some fumigant gases do not diffuse through the impermeable layer to depths where sting nematodes reside. If the traffic pan is not destroyed, then at least part of the overall soil population of sting nematode survive to migrate upwardly into the bed and cause irresolvable damage to the strawberry crop. This is what we think and we’re sticking by it. In March we acquired, with the greatly appreciated help and assistance of Hendrix and Dail (Jimmy Moden), a 36 inch subsoiler from Georgia. Fortunate for us the subsoiler was also plumbed to deliver soil fumigants into deep soil (Figure 2). With the subsoiler, our objective is to destroy the compacted layer and introduce the fumigant below the traffic pan at the same time. In the trials we have completed so far, Telone II (12gpa) has been applied during either the first or second ripping pass to a depth of 20 inches with the ripper shanks spaced on about 12 inch centers. After injection, the field is then cultivated and rolled, and overhead sprinklers run to provide a surface water seal. By coupling deep injection of Telone (1,3-D) with the subsoiling to destroy the compact, gas impermeable traffic pan, we believe we will address and remediate the single most important soil factor causing significant performance inconsistency with the alternative fumigants in sting nematode infested fields. I think we should also mention that we are still looking for nematode fields with interested cooperators to test the hypothesis and the application equipment.



Graph 1. Relative strawberry yields computed from an average plant size assessment of plants grown on new plastic following soil fumigant treatment (single crop) compared with strawberry grown as a second crop after strawberry (double crop) following application of a drip fumigant under holey plastic. FSGA 2010.

Figure 1. New tractor (1964) and remote sensing equipment being used to characterize and map sting nematode distribution and damage by row within strawberry fields.

Figure 2. Subsoiler being used to destroy highly compacted, subsurface traffic pan and to deliver fumigants 20-24 inches deep into soil. Authors would like to acknowledge gratefully that the subsoiler was provided courtesy of Jimmy Moden, Hendrix & Dail, Palmetto, FL.

Current Status of Spotted Wing Drosophila in Florida

J. F. Price and C. A. Nagle, GCREC

Dr. David Dean, entomologist in the Florida Department of Agriculture and Consumer Services, Division of Plant Industry (FDACS DPI) fruit fly laboratory in Palmetto, maintains records of spotted wing drosophila

(Continued on page 6)

occurrence throughout Florida. This work is adjunct to DPI responsibility for monitoring and mitigating the larger, long experienced, tephritid fruit flies such as Mediterranean fruit fly.

Figure 1 incorporates a map of the southern two-thirds of our peninsula and depicts the locations of spotted wing drosophila (SWD) encountered so far. Although the map covers only a portion of Florida, trapping takes place over much of the state and more will be established into the panhandle soon. No SWD have been discovered elsewhere in Florida. Additionally, we know of no discoveries of SWD in the eastern US outside of Florida.

Dr. Dean emphasizes caution in interpreting data from his map. There are areas in Florida where many finds have occurred and others where few have occurred (see the patterns of yellow dots). Numbers of finds are products of not only the presence of SWD, but also the intensity of trapping in that area. This means that one should not conclude that there many SWD around Tampa Bay and few in Highlands County. There are more traps around Tampa Bay than in Highlands County. The reason for the disparity is that in the tephritid fruit fly program, specialists intensify their investigations around likely areas of tephritid fruit fly entry…seaports, major airports, and travelling population centers.

The first SWD flies were trapped in Florida in August 2009 and we became concerned for our strawberry crop. The long period of extreme cold this winter likely saved considerable problems in our berry production. The first strawberry field to be known with SWD was discovered late in the season. There have been a few finds of SWD in blueberries and

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Drosophilidae, Drosophila suzukii Finds by County

	County	Count of Total	Sum of Total
1	BROWARD	23	120
2	CHARLOTTE	1	1
3	CITRUS	1	1
4	COLLIER	5	5
5	DADE	51	175
6	DESOTO	1	1
7	HARDEE	1	1
8	HENDRY	1	2
9	HERNANDO	2	4
10	HIGHLANDS	2	3
11	HILLSBOROUGH	183	768
12	INDIAN RIVER	1	1
13	LAKE	1	1
14	LEE	5	13
15	MANATEE	19	98
16	MARTIN	1	1
17	ORANGE	1	1
18	OSCEOLA	1	1
19	PALM BEACH	17	113
20	PINELLAS	28	44
21	POLK	2	3
22	SARASOTA	22	102
23	ST. LUCIE	1	1
	Grand Total	370	1460

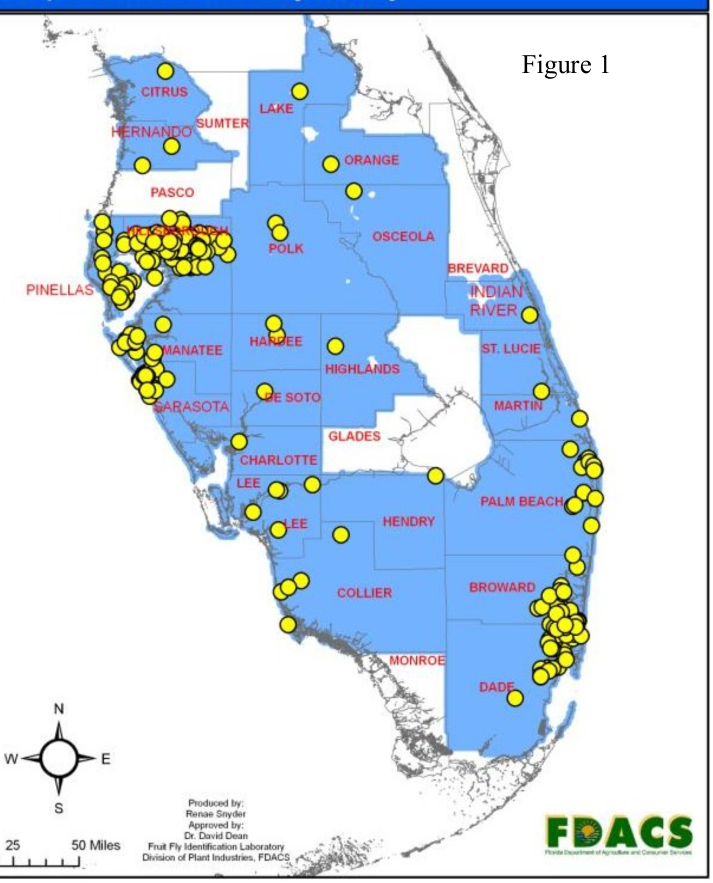

Figure 1

REV. 5/20/2010
REV. 5/07/2010
REV. 4/30/2010
REV. 4/23/2010
REV. 4/19/2010
REV. 4/09/2010
3/18/2010

LEGEND
= County Boundary
= Drosophila suzukii find

0 12.5 25 50 Miles

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blackberries, but no big losses. This insect is a cool weather pest and likely will remain at low levels in our environment until fall.

If Florida experiences a mild winter next season, then the outcome for berry growers probably will be different from their experiences this year. Regardless of the winter and its impact on SWD, we believe that tools are available to manage the problem in strawberries next season without major losses.

Tomato Bacterial Speck and Spot: an update on the bacterial speck outbreak of 2010

Gary Vallad, Pam Roberts, and Jeff Jones
GCREC, SWFREC, and Dept. of Plant Pathology, respectively

With summer at our doorstep, it's hard to believe we just dealt with one of the coldest and wettest winters on record. The unprecedented weather not only reduced transplant establishment, plant vigor, and yields, but set the stage for one of the largest outbreaks of bacterial speck caused by *Pseudomonas syringae* pv. *tomato* seen in nearly two decades. Tomato production in Collier and Hendry Counties were most severely affected with early planted fields exhibiting severe foliar blighting and large stem lesions (Figure 1). Fields planted in February and later appeared to fare better; that is they were not impacted by the large stem lesions. Bacterial speck severity on tomato varied in Hillsborough, Manatee, and Hardee Counties, with moderate foliar symptoms in early planted material (January through early February) and only minor symptoms in later planted materials. None of the severe stem lesions were observed in Hillsborough, Manatee, or Hardee Counties. Whether *P.s. tomato* alone accounted for the unusual stem lesions, either exacerbated by the unusual weather or associated with another pathogen remains unclear. Under such extreme conditions, it is not unusual to find opportunistic microorganisms (or weak pathogens) that are not commonly associated with plant disease, but are exploiting plant tissues compromised by injury or stress.

Pseudomonas syringae pv. *tomato* could be considered the cool weather cousin to *Xanthomonas perforans* (formerly called *Xanthomonas axonopodis* pv. *vesicatoria* or *Xanthomonas campestris* pv. *vesicatoria*) the causal agent of bacterial spot. Bacterial speck is favored by high relative humidity and temperatures of 64 to 75 °F, however the bacterium can still persist at temps as high as 85 °F (as it currently is in many fields throughout Hillsborough, Manatee, and Hardee Counties). Bacterial spot is favored by temperatures above 75 °F in addition to high relative humidity. Symptoms of both bacterial speck and spot affect the foliage, stems, petioles, inflorescent tissues and fruit of tomato, and can be tricky to differentiate in the field. Foliar symptoms of both consist of small circular lesions that can coalesce under ideal conditions leading to general blighting of foliage. Bacterial spot lesions are generally brown with a greasy appearance when the relative humidity is high (Figures 2 and 3). Bacterial speck lesions are often dark brown to black, lack the greasy appearance, and often surrounded by a discrete chlorotic (yellow) halo (Figures 2 and 3). However, this chlorotic halo is not always diagnostic, as it is typically associated with mature bacterial speck lesions and may develop slower depending on environmental conditions and cultivar susceptibility. Also, leaves severely affected by bacterial spot often develop a general chlorosis that usually leads to blighting and can lead to some confusion. Don't be fooled by the disease name, as bacterial speck lesions can be as large or larger than bacterial spot lesions; however, the margins of speck lesions are usually more angular than spot

(Continued from page 7)
lesions. Bacterial speck and spot are more clearly differentiated by fruit symptoms. Fruit lesions of bacterial speck are slightly raised (or sunken), generally much smaller (1/16 in.) than those of bacterial spot, are quite superficial, and do not crack or become scaly as those associated with bacterial spot (Figure 4).

Disease management for bacterial speck and spot is very similar, and requires an integrated approach for best results:

1. Rotate tomato fields to avoid carryover on crop residue. Neither bacterium survives long in the absence of host material; however, *P.s. tomato* is able to survive in crop residue for an extended period (up to 30 weeks in some studies).
2. Eliminate any volunteers and weed species (especially solanaceous weeds) that can act as a reservoir. *Pseudomonas syringae* pv. *tomato* can survive on the leaves and roots of both.
3. Start with clean, healthy transplants preferably produced in facilities removed from tomato and pepper production. Both *X. perforans* and *P.s. tomato* are seed-borne, which allows for the movement of strains on a global scale. Both pathogens can persist on tomato leaves without causing symptoms.
4. Refrain from handling tomato plants when foliage is wet to minimize the spread of either bacterium in the canopy and throughout the field or greenhouse.
5. Apply bactericidal pesticides as necessary (refer to Table 1, Page 10). When applying copper-based bactericides, mix with mancozeb for the control of copper resistant strains, which are prevalent among both pathogens.

Exclusion is the best tactic for the management of bacterial speck and spot on tomato. The goal of implementing field rotations, destroying infected debris, volunteers, and weeds, and using disease-free tomato transplants is to minimize the amount of inoculum in the field at the beginning of the season. Refraining from field activities when the plant canopy is wet and making timely application of bactericides reduces the movement of bacteria throughout the plant canopy and field. Bactericides, like most fungicides, are preventative by nature. Unfortunately, even the best bactericidal treatment offers only limited protection when environmental conditions are favorable for rapid disease development, especially during periods of heavy, wind-driven rains, further stressing the need to implement tactics that exclude both pathogens.

Figure 1. Tomato plant exhibiting abnormal stem lesions and extreme foliar blighting associated with the bacterial speck outbreak in Immokalee, FL. Photo credit: G. McAvoy.

Figure 2. Tomato leaves exhibiting symptoms of bacterial speck (left) and bacterial spot (right). Note chlorotic halos and angular nature of bacterial speck lesions. Photo credit: G. Vallad

Figure 3. Tomato leaves with symptoms of bacterial speck (left) and bacterial spot (right). Note prominent chlorotic halos surrounding bacterial speck lesions.
Photo credit: G. Vallad.

Figure 4. Fruit exhibiting symptoms of bacterial speck (left) and bacterial spot (right). Photo credits: J. Jones (left) and G. Vallad (right).

Table 1. Products labeled for the management of bacterial spot and speck on tomato. Ordered by FRAC group according to mode of action. Be sure to read a current product label before applying any chemical. **Page 10**

Chemical (active ingredient)	Fungicide Group[1]	Maximum Rate / Acre / Applic.	Maximum Rate / Acre / Season	Min. Days to Harvest	Remarks[2]
(copper compounds) Many brands available: Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	M1	**SEE INDIVIDUAL LABELS**		1	Mancozeb enhances bactericidal effect of fix copper compounds. **See label for details.**
Cuprofix MZ Disperss (mancozeb + copper sulfate)	M3 / M1	7.25 lbs	55.2 lbs	5	See label
ManKocide (mancozeb + copper hydroxide)	M3 / M1	5 lbs.	112 lbs.	5	
Tanos (famoxadone + cymoxanil)	11 / 27	8 oz	72 oz	3	**For the suppression of bacterial spot only.** Do not alternate or tank mix with other FRAC group 11 fungicides.
Agri-mycin 17 Ag Streptomycin Bac-Master Fire Wall (streptomycin sulfate)	25	200 ppm	-	-	For transplant production only. Many isolates are resistant to streptomycin.
Serenade ASO Serenade Max Rhapsody (*Bacillus subtilis* strain QST 713)	44	See label	See label	0	Mix with copper compounds, see label for details. OMRI listed.
Actigard (acibenzolar-S-methyl)	P	0.75 oz	4.75 oz	14	See label for details.
Regalia SC (Extract of *Reynoutria sachalinensis*)	P	1% (v/v)	6 apps. per year	0	Add a surfactant such as Nu-Film®P at 0.02% (v/v). Limit of 6 apps. per year. Do not apply in excess of 2 Qts/A 7 days prior to harvest. See label for details.
AgriPhage (bacteriophage)	NC	2 pts /100gal.	-	0	See label for details. OMRI listed.
OxiDate (hydrogen peroxide)	NC	1:100 dilution	-	0	See label for details. OMRI listed.
Sonata Taegro (*Bacillus* sp.)	NC	See label	See label	0	Mix with copper compounds, see label for details. OMRI listed.
Trilogy (Neem oil)	NC	See label	See label	0	See label for details. OMRI listed.

[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.

SNSV (formerly TSV) in strawberries

Catalina Moyer, Vance M. Whitaker, and Natalia A. Peres, GCREC

It is well known to growers that much of the stock of 'Florida Radiance' planted during the 2009-10 season was virus-infected. What is not so obvious is whether or how much the presence of strawberry necrotic shock disease (SNSV) in 'Florida Radiance' impacted the performance of this variety. So what have we learned from past seasons?

For many years, SNSV was thought to be caused by a strain of tobacco streak virus (TSV). However, a study published in 2004 found that strawberry necrotic shock disease is caused by a different virus and not by a strain of TSV. The name "strawberry necrotic shock virus" (SNSV) was then suggested for this virus instead of TSV, and thus, the acronym SNSV is used hereafter.

SNSV apparently causes no symptoms in commercial cultivars. Grafted susceptible indicator strawberry plants (*Fragaria vesca*) may show a severe necrotic reaction in new leaves; however, these symptoms are temporary, and the new growth appears normal and healthy. Depending on the virus isolate, symptoms on the plant indicator may also include chlorosis, stunting, and leaf malformation.

SNSV has been reported in the U.S., Australia, and Israel. Although commercial cultivars are symptomless, reduction of yield and runner production has been reported. Dissemination of this virus occurs through seed, pollen, or thrips. This virus has a wide host range, and host plant species near strawberry fields can serve as sources of inoculum. The most practical way to minimize the risk of infection on commercial fields is to use clean plant material (tissue cultured and virus tested) and to follow best management practices for insect and weed control. However, once this virus is within a fruiting field, there is no means of control, as it is transmitted by pollen.

At the end of the 2008–2009 strawberry season, serological tests confirmed the presence of strawberry necrotic shock virus (SNSV) in research fields at the University of Florida Gulf Coast Research and Education Center (UF GCREC) and some commercial strawberry farms. Cultivars that tested positive for SNSV included 'Strawberry Festival', 'Sweet Charlie', 'Florida Radiance', and 'Florida Elyana'. However, yields were not noticeably different than those from previous years. Thus, it was assumed these were new infections of SNSV that were transmitted in Florida; however, the hypotheses that the plants were infected in the nurseries could not be dismissed because plants were not tested early in the season.

During the 2009–2010 strawberry season, leaf samples were collected from seven cultivars and eleven nursery sources at three times during the season. Samples from the UF GCREC research fields in Wimauma and from a selected grower's field in Dover were tested for SNSV using the ELISA method. The first samples were collected in November and December to determine if plants were already infected upon arrival from the nurseries. Samples of 'Florida Radiance' from all nursery sources grown at both locations tested positive for SNSV. Only one nursery source was tested for the other newly released cultivar, 'Florida Elyana', and it was also found to be positive. SNSV was not detected in samples of the cultivars 'Strawberry Festival', 'Camarosa', 'Treasure', 'Camino Real', or 'Sweet Charlie' from any of the sources tested. Samples from the same plants were collected again during the middle and end of the strawberry season to determine if the virus was spreading through the fields. The last sampling was conducted during the first week of April. SNSV was confirmed in 'Florida Radiance' from all nursery sources and in 'Florida Elyana' from the one source previously noted. In addition, 'Strawberry Festival' plants from two sources were positive in the UF GCREC fields. Despite the presence of SNSV in 'Florida Radiance' in the grower's field since the beginning of the season, yields did not seem to be affected, and SNSV was not detected in other cultivars planted nearby. This indicates that transmission and infection by SNSV does not progress rapidly in strawberry fields. However, it is possible that the colder-than-normal winter temperatures during the 2009–10 strawberry season may have prevented a more rapid spread of SNSV.

There was some conjecture that the bullet-shaped fruit produced by 'Florida Radiance' early in the season was caused by the virus, but this is extremely unlikely. It is most plausible that this fruit deformity was exacerbated by the unseasonably hot weather early in the season. Planting this variety later (after Oct 10th) may help avoid these symptoms in the future.

There is no evidence that the presence of SNSV in 'Florida Radiance' caused a decrease in yield or any other symptoms. However, since this virus can spread within fields and since it could possibly cause symptoms in combination with another virus, caution should still be exercised and material monitored closely in nursery fields.

International Issues and Growing Concerns for New Nematode Problems In the Florida Strawberry Industry

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We got through another season and we don't need to belabor how hot it was early and how persistently cold it became later. In addition to production levels near half of what is typically observed, the death and destruction caused by sting nematodes was obvious in many fields. The damage observed would likely have been higher if a warmer season had prevailed. In addition to sting nematodes, we also observed a number of fields in which late season problems appeared to be caused by or at least associated with root-knot nematodes, presumably the northern root-knot nematode, *Meloidogyne hapla*.

Meloidogyne hapla is referred to as the northern root-knot nematode because it commonly occurs in cooler environments. It is however also found in the tropics and subtropics, usually at cool and high elevations. The nematode's host range is wide and encompasses a diverse group of over 2,500 herbaceous plant species in approximately 500 genera, but does not include most grasses and grains. Root galls induced by *M. hapla* are usually small compared to the other root-knot nematode species prevalent in in Florida. In addition to galling, typical symptoms on strawberry parasitized by *M. hapla* include plant stunting, reduced runner production, depressed yields, shortened life of the plantings. Previous research has also demonstrated the importance of secondary infection caused by other disease pathogens penetrating the root system via wounds, and that these secondary invaders are often more important than direct damage caused by root-knot nematodes.

Meloidogyne hapla is a common nematode pest of strawberries in the northeastern United States where the nematode reduces crown vigor and fruit yield oftentimes <u>without</u> producing diagnostic aboveground symptoms. This is not to say that in Florida, above ground symptoms are always observed. During the course of this past season we recovered root-knot nematode from soil and root tissue from a number of different fields. Dramatic levels of decline were not always evident. In one field, at season's end, however, we observed strawberry plants collapsing under droughty conditions, which were associated with high soil densities of a *Meloidogyne* species (we did not confirm species as *M. hapla*). *M. hapla* is however thought to be the only root species hosted by strawberry.

In general, root-knot nematode can only move relatively short distances in soil. In most instances, they are spread into new areas as hitch hikers in soil or on equipment between fields or within infected plant materials which are then transported great distances and then planted to soil. The presence of *M. hapla* should be of concern to us here in Florida since it is known to reside within imported bare-root transplants and because it has been demonstrated to over summer readily and increase in number over time on strawberries and other plant hosts. Sanitation, accomplished by identifying and eliminating *M. hapla* from planting stock is probably the single most important nematode management tactic. Rotation with nonhost species has been reported to be effective, although successful use of rotation requires knowledge about the host status of a large number of plant species, including a wide variety of weeds. Previous research has also identified a number of highly resistant strawberry genotypes, and if needed, can provide a readily exploitable source of resistance to *M. hapla*.

In general, most plant-parasitic nematodes are controlled by preplant fumigation. We are fortunate that due to routine soil fumigation, nematodes (sting or root-knot) are typically not observed to be a significant problem in Florida strawberry except where problems of fumigant misapplication occur. Other problems (which we can only speculate at this moment) have also occurred when infected transplants from Canadian nurseries were set into fumigant treated soils, which offer a very favorable environment for the population increase of the introduced root-knot nematodes. Greater problems obviously can occur when soil densities of endemic (resident) populations are augmented by the addition of those nematodes within infected root tissues on incoming bare-rooted transplants from Canada.

We don't know if most Florida growers are aware that the Telone® products (Telone II, Telone C-17, Telone C35, Inline, Telone EC) will only be available for the next two growing seasons in Canada. After November 2011, these Telone products will no longer be registered and will not be available for sale or use in Canada. The loss of Telone in Canada was ultimately decided by the manufacturer, Dow AgroSciences, who simply decided the Telone business in Canada was not big enough to support product reregistrations costs demanded by the Canadian government. The question now becomes, What will Canadian strawberry nurseryman do to manage nematodes? The most immediate concern is relying upon other less nematode effective fumigants, which would then promote a potential increase in numbers of nursery fields and overall numbers of incoming nematode infected transplants.

The use of certified planting stock (bare -root transplants produced in fumigated fields) combined with soil fumigation of fruiting fields has been the primary management technique for plant diseases, weeds, and nematodes on strawberries. During the past 40 years, the use of soil fumigation had become an accepted practice for many commercial strawberry transplant producers in Canada. The practice, particularly when methyl bromide was used, greatly improved plant growth and runner production. It also served to minimize international transport of nematode pests to various U.S. locations. Currently, *M. hapla* is not considered a "quarantine pest". Canada however must meet US nematode requirements for potato cyst nematodes as by USDA APHIS protocol 1-14 Nursery Stock Restrictions Manual 04/2010-36 PPQ. This manual effectively says that articles for planting (except seeds, unrooted cuttings) and articles collected from the wild, must be accompanied by a phytosanitary certificate containing an additional declaration that the articles offered for importation were grown on land that has been sampled and microscopically inspected by the plant protection organization of the country of origin and found to be free from the potato cyst nematodes *Globodera rostochiensis* and *Globodera pallida*:

We will point out at this time that we believe it is possible that the soil sampling report that each Canadian nurseryman must acquire for phytosanitary certification for potato cyst nematodes could be expanded voluntarily to include counts of *Melodiogyne hapla* and other species if present. A voluntary expansion of the USDA APHIS phytosanitary certification program in Canada to insure that fields are also *M. hapla* free would offer some assurance to Florida growers that the plants purchased from certified growers are not only true to variety, but apparently free from significant nematode pests besides the potato cyst nematode.

It is not clear to us how widely distributed *M. hapla* is in the Canadian strawberry nursery industry. Specific information on current nematode occurrence in strawberry nursery fields in Canada would be helpful for Florida growers who would want to consider the risk of importing new nematode problems into their fields, particularly after the loss of Telone next year in Canada. It is also not clear how widely distributed *M. hapla* currently is in Florida strawberry acreage. Further research and surveys may be needed to determine the significance of the problem, document possible interaction with other soil pathogens and the environment, and to determine the role played by unsanitary imported transplants in compounding nematode problems for Florida growers. This survey would provide important background information for planning and administering nematode management strategies in strawberry fields in both Canada and Florida. It is possible that in years to come, strawberry growers who travel to Canadian nurseries to inspect purchased plants may want to demand phytosanitary inspection to include testing for nematodes within nursery fields from which runners have been grown prior to digging and shipment to Florida. Without post plant chemical measures, there remains no effective means of managing nematode populations and their damage once introduced.

Notes on Cultural Practices: Effects of Shoot Pruning on Tomato Yield and Bacterial Leaf Spot

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Bacterial Spot and Early Shoot Pruning
Bacterial spot is one of the most troublesome diseases in tomato. This disease is caused by several bacteria in the Xanthomonas genus and it is favored by warm, humid weather conditions, but often initiated by episodes of wind-driven rain. On the leaves, infection begins when the bacterium enters the plant through natural openings and wounds where it multiplies within plant tissues (Picture 1). Within three to four days, the first symptoms, water-soaked lesions, can be observed on lower leaf surfaces. Lesions can enlarge and coalesce causing extensive leaf chlorosis and defoliation. All aboveground tissues are susceptible to the disease, including fruit. Control of bacterial spot relies on cultural exclusion of the pathogen from production areas, use of resistant cultivars, and diligent application of copper-based bactericides. The presence of infected tomato volunteers and weedy hosts are common sources of local inoculum. Infected seed and transplants are also a mechanism of long distance movement.

The use of copper-based bactericides can offer some level of control, except under the most extreme weather conditions. A dithiocarbamate (either maneb or mancozeb) is routinely combined with copper-based bactericides to enhance bacterial spot control, but reduces the fungicidal activity of the dithiocarbamate.

Most growers of round tomatoes in Florida perform shoot pruning on their crops during the early part of the growing season to reduce the number of unwanted lateral branches. This practice usually occurs between 2 and 4 weeks after transplanting (WAT) and it could be accomplished once or twice during that period by removing shoots from ground level up to the primary fork below the first flower cluster. Previous research showed that for some tomato cultivars, shoot pruning increased early yield, whereas other studies found no response or reduced growth and yields. Some growers and scientists think that shoot pruning could be a potential practice to reduce bacterial spot infection because: a) it reduces the amount of foliage near the soil that could serve as an initial point of entry for the bacterium, and b) it changes architecture of plant canopies thus changing air and moisture flow through the leaves. Additionally, shoot pruning costs about $50/ acre, which is a significant expense for tomato production. The objective of this study was to determine the effect of early shoot pruning on the severity of bacterial spot, and on the growth and yield of different tomato cultivars.

Field Studies

Two field trials were conducted in the Spring and Fall 2009 at the Gulf Coast Research and Education Center of the University of Florida in Balm, Florida, using standard tomato production practices (e.g. soil fumigation, mulching, drip irrigation). Tomato seedlings in the four-true-leaf stage (8 inches tall) were transplanted in single rows and 2 inches offset of bed centers. Planting in-row distance was 18 inches. The study had the combination of two tomato cultivars, two bacterial spot inoculation regimes, and three shoot pruning programs. The tomato cultivars were 'Tygress' and 'Security-28', which are resistant to the tomato yellow leaf curl virus. Shoot pruning levels were heavy and light, and a non-pruned treatment was added. Light pruning was defined as carefully removing by hand only two to three lateral buds ("suckers") from the main stems from ground level to 6 inches high, whereas heavy pruning was defined as the removal of all the lateral buds and stems up to 6 inches high. Early shoot pruning occurred between 3 and 4 WAT. Bacterial spot treatments consisted of non-inoculated plots and plots inoculated with a suspension of X. perforans strain XT4 (1 x 106 cfu/mL), which was applied to the foliage with a conventional backpack sprayer at 5 WAT at a volume of approximately 15 mL per plant.

Plant heights were determined at 3 and 6 WAT and tomato fruit were harvested twice (10 and 12 WAT) in the mature green stage and graded following current market standards as extra-large and marketable fruit of all categories. Fruit yield from the first harvest (10 WAT) were considered early fruit weight, while the summation of the two harvests (10 and 12 WAT) was the seasonal fruit weight. For bacterial spot, plots were monitored for disease and rated for severity at 7 and 9 WAT in the spring trial, and at 9 and 11 WAT in the fall trial using the Horsfall-Barratt scale, a non-dimensional 12 point scale, to assess the percentage of canopy affected by bacterial leaf spot. Disease severity values were converted to mid-percentages and used to generate area under disease progress curve (AUDPC).

Plant height and bacterial spot severity. Shoot pruning did not affect tomato plant height at 3 and 6 WAT, regardless of cultivars and bacterial spot inoculation (data not shown). Bacterial spot inoculation increased disease severity based on AUDPC of 1445 (an average disease severity of 41%) in inoculated versus an AUDPC of 821 (an average disease severity of 29%) in non-inoculated plots averaged across both seasons (data not shown). Disease severity was greater at the end of the spring trial in comparison to the end of the Fall 2009 trial (65% and 35%, respectively). Inversely, initial disease severity was much greater in the fall study (24% disease severity in non-inoculated plots) than the spring trial (1.5% disease severity in non-inoculated plots). 'Tygress' was more susceptible to bacterial spot than 'Security-28', exhibiting 20.4% more disease on average.

Early tomato fruit weight. Early extra-large fruit weight was affected by tomato cultivars and the inoculation of bacterial spot, but not by pruning programs or the interaction among factors. 'Security-28' had the highest early extra-large fruit weight with 5.1 ton/acre, which was more than 2.5 times higher than that obtained with 'Tygress' (Table 1). Tomato plants inoculated with bacterial spot reduced their extra-large fruit weight by 31% in comparison with those non-inoculated with the bacterium. Pruning programs resulted in extra-large yields ranging between 3.4 and 3.6 ton/acre. Early marketable fruit weight was influenced by the interaction between cultivars and pruning programs, and separately by the inoculation of bacterial spot (Table 1). There were no differences on early marketable fruit weight among the combinations of 'Security-28' and the three pruning programs, which averaged 6.9 ton/acre of fruit. At the same time, all pruning programs in plots planted with 'Tygress' did not differ among each other, while having significantly lower marketable fruit weight at 10 WAT than the 'Security-28' and pruning combinations. Tomato plants in plots inoculated with bacterial spot decreased their marketable fruit weight at 10 WAT by 25% in comparison with the non-inoculated plants.

Seasonal tomato fruit weight. The cultivar by bacterial spot inoculation interaction affected the seasonal extra-large fruit weight. However, other main factors and interactions were not significant. The highest seasonal extra-large fruit weight was obtained in plots non-inoculated with bacterial spot and planted with 'Security-28' (11.1 ton/acre), followed by the combination of 'Security-28' and bacterial spot inoculation (Table 2). There was no effect of the bacterial spot inoculation on the seasonal extra-large fruit weight obtained in plots planted with 'Tygress'. All three factors individually influenced the seasonal marketable fruit weight of tomato. Non-inoculated plots produced 21% higher seasonal yields (18.1 ton/acre) in comparison with plants inoculated with bacterial spot (15.0 ton/acre). When comparing pruning programs, there was no difference between light pruned plants and the non-pruned control for seasonal marketable fruit weight, regardless of tomato cultivars (Table 2). However, heavy pruning did reduce seasonal yields by 10% in comparison with the non-pruned control.

Summary

These results indicated that light shoot pruning did not improve tomato yield of total and extra-large marketable fruit. At the same time, this practice did not reduce bacterial spot severity on 'Security-28' and 'Tygress' tomato leaves. In contrast, heavy pruning reduced seasonal marketable yields in comparison with non-pruned plants. It is possible that other cultivars may benefit from shoot pruning, as the tested cultivars are newer hybrids introduced to the market for their resistance to tomato yellow leaf curl virus. Data also emphasized the impact of bacterial spot on fruit production, especially the production of early extra-large fruit, and the importance of selecting varieties with improved tolerance to bacterial spot when disease pressure is high. By eliminating light shoot pruning from routine cultural practices, tomato growers can save up to $50/acre, which might translate into near $2 million per year in savings for all the planted areas in Florida.

Picture 1. Bacterial spot lesions on the lower surface of tomato leaves and a view of a severely-infected tomato field (Credits: G.E. Vallad).

Table 1. Effects of early shoot pruning levels, tomato cultivars, and bacterial spot inoculation on early extra-large and total marketable fruit weight. Spring and Fall 2009, Balm, Florida.

	Early extra-large fruit weight[z]		Early marketable fruit weight
Pruning		**Pruning x cultivar**	
	ton/acre		ton/acre
Non-pruned	3.5	**Non-pruned, 'Security-28'**	7.4 a
Light	3.6	**Light, 'Security-28'**	7.1 a
Heavy	3.4	**Heavy, 'Security-28'**	6.3 a
Significance (*P*<0.05)	NS	**Heavy, 'Tygress'**	4.4 b
Cultivar		**Light, 'Tygress'**	3.7 b
'Security-28'	5.1 a	**Non-pruned, 'Tygress'**	3.4 b
'Tygress'	1.9 b		
Significance (*P*<0.05)	*	Significance (*P*<0.05)	*
Bacterial spot		**Bacterial spot**	
Non-inoculated	4.2 a	**Non-inoculated**	6.4 a
Inoculated	2.9 b	**Inoculated**	4.8 b
Significance (*P*<0.05)	*	Significance (*P*<0.05)	*

[z]Values followed by the same letter in the same column do not differ statistically at the 5% significance level. NS and * = non-significant and significant, respectively.

Table 2. Effects of early shoot pruning levels, tomato cultivars, and bacterial spot inoculation on seasonal extra-large and total marketable fruit weight. Spring and Fall 2009, Balm, Florida.

	Seasonal extra-large fruit weight[z]		**Seasonal marketable fruit weight**
Cultivar x bacterial spot		**Pruning**	
	ton/acre		ton/acre
Non-inoculated, 'Security-28'	11.1 a	**Non-pruned**	18.2 a
Inoculated, 'Security-28'	8.1 b	**Light**	17.4 ab
Non-inoculated, 'Tygress'	7.0 c	**Heavy**	16.3 b
Inoculated, 'Tygress'	7.5 c	Significance (*P*<0.05)	*
Significance (*P*<0.05)	*	**Cultivar**	
		'Security-28'	18.3 a
		'Tygress'	15.0 b
Pruning		Significance (*P*<0.05)	*
Non-pruned	8.4	**Bacterial spot**	
Light	8.3	**Non-inoculated**	18.1 a
Heavy	8.4	**Inoculated**	15.2 b
Significance (*P*<0.05)	NS	Significance (*P*<0.05)	*

[z]Values followed by the same letter in the same column do not differ statistically at the 5% significance level. NS and * = non-significant and significant, respectively.

FLORIDA AG EXPO

Mark your calendars for the next Florida Ag Expo scheduled for Wednesday November 10, 2010. This year's expo will include a Growers Roundtable regarding —Current Issues Facing the Vegetable Industry. In addition speakers will include the new Sr. Vice President of IFAS, Dr. Jack Payne and Congressman Adam Putnam (schedule permitting). Other highlights will include field tours, vendor shows and much more. Registration is always free and should be available in the next few months at http://flaagexpo.ifas.ufl.edu
or call (813) 634-0000 for information.