Small Fruit News
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North Carolina State University • Clemson University • The University of Arkansas
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Small Fruit News Survey

Wayne Mitchem
SRSFC Coordinator

On behalf of the Southern Region Small Fruit Consortium (SRSFC) we would like to ask for your participation in a **brief** and **quick** survey to determine the utilization and benefit of "Small Fruit News". Since the development of the SRSFC the Small Fruit News has been published quarterly as a means to share small fruit crop research and extension program activities of faculty from member institutions as well as other news related articles specific to small fruit industry. Given the evolution of social media and other trends in the dissemination of information the SRSFC was interested in getting feedback from Small Fruit News readers to see if there might be better means to reach our audience. Thank you for taking the time to complete the survey. The link to the survey is given below.

https://www.surveymonkey.com/r/CWV5QS9

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.

In This Issue

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).

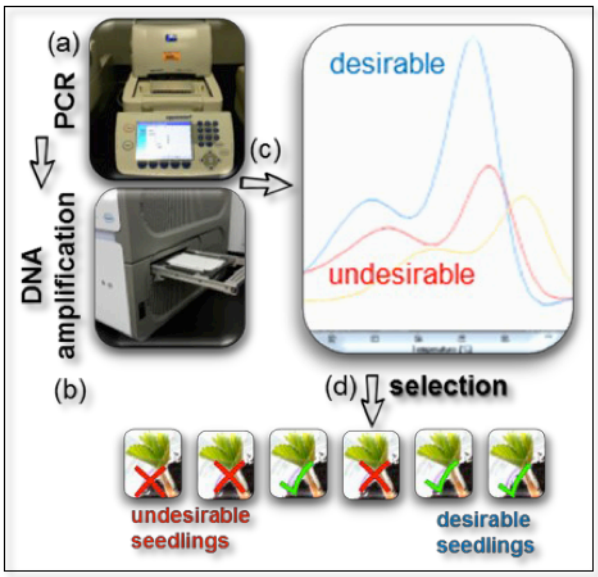


Figure 1: *Molecular and statistical approaches used for genetic analysis at UF/IFAS strawberry breeding program.*

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.

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.

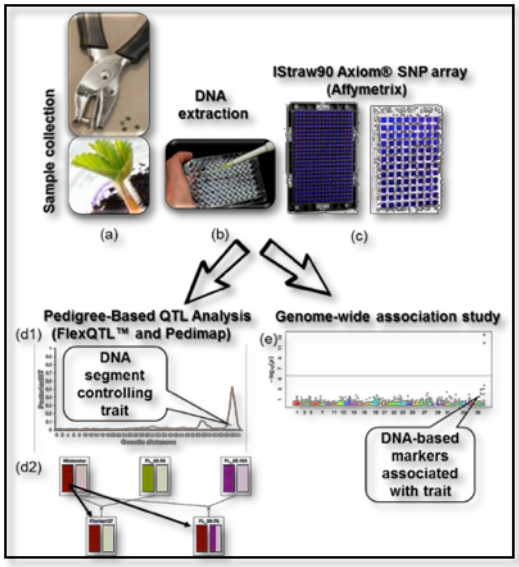


Figure 2: *Stepwise visualization of procedure to utilize DNA-based tools for marker-assisted seedling selection*

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.

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 and total yields.

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.*

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.

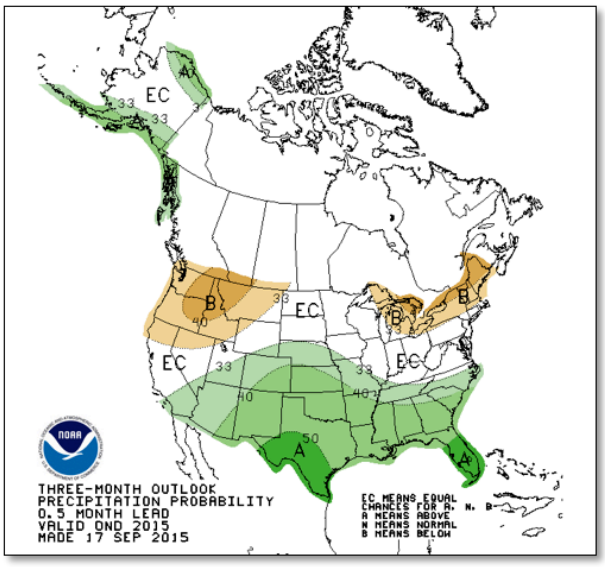
El Niño is Back in the Tropical Pacific Ocean: How will it impact agriculture in the Southeast? And how will it affect strawberry diseases?

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.

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 (^{O}F)	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.

New Technology Helps To Solve The Berry Mechanization Challenge

Christina Herrick

Previously published online in Growing Produce, September 2015

The BIRD device is a wireless data-logging sensor that is similar in size and shape to a blueberry. (Photo credit: Charlie Li)

Blueberry production is a billion-dollar business in the U.S. Although the industry grows every year, a key stumbling block to mass production is labor. More than 70% of fresh-market highbush blueberries are harvested by hand and the issue of labor availability continues to become a greater concern.

A research team from the University of Georgia, as USDA-Agricultural Research Service (ARS), Michigan State University, University of Florida, Penn State University, Washington State University, North Carolina State University, Oregon State University, and Mississippi State University hopes to solve the challenge of

increasing production while making mechanization gentler and affordable.

“During harvest, postharvest handling, and transportation, blueberries will invariably interact with various machine parts or contacting surfaces. These interactions will create bruises and reduce fruit quality,” Changying “Charlie” Li, associate professor of engineering at the University of Georgia says. “In the past, these potential impacts created by mechanical handling could only be evaluated by assessing the quality of blueberries after the handling process due to the lack of effective sensing tools.”

Lialong with Fumiomi Takeda, lead scientist at the USDA-ARS Appalachian Fruit Research Station in Kearneysville, WV, worked to develop the Berry Impact Recording Device (BIRD) as part of a USDA National Institute of Food and Agriculture (NIFA) Specialty Crop Research Initiative (SCRI) project. Li and Takeda’s research also had support from the U.S. Highbush Blueberry Council to improve upon the first-generation BIRD Sensor.

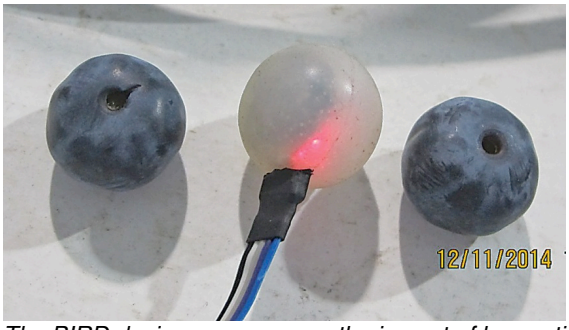
A Sensor The Size Of A Berry

This BIRD device is a wireless data-logging sensor that is a similar shape, size, and weight of a blueberry. This sensor rides along with blueberries through the handling process from mechanical harvesting, packing, and transportation to measure the impact.

Li says the concept of impact sensors is not new. However, none are small enough to use to measure the impact of harvest on small fruit. This is precisely why the BIRD sensor was developed. The sensor measures the impacts the blueberries experience through an accelerometer and microprocessor in the device. The second-generation BIRD sensor has a diameter of 21 millimeters and weighs 6.9 grams.

“Previous studies showed that bruise damage developed on as much as 78% of mechanically harvested highbush blueberries, making the fruit unacceptable for long-term cold storage and fresh consumption,” Li says.

Damaged fruit also opens the skin to postharvest decay and organisms, Takeda says. “Our research effort is directed at relating these impacts to fruit firmness and bruising resulting from a fruit being hit by vibrating rods when it lands on a hard surface,” Takeda says. “Eventually the BIRD technology can be used to predict the degree of quality loss from the impact values it gathers. This means it offers a technology to measure internal bruise damage rapidly and without destroying the fruit.”



The BIRD device can measure the impact of harvesting and transport on soft fruit. Researchers hope to use these sensors as new harvesting equipment is developed. (Photo credit: Charlie Li)

Research Might Pay Off Hugely

Another stumbling block to growers initiating mechanical harvesting of berries is the price of equipment. Part of Takeda and Li’s research is also developing affordable harvest aid equipment.

Li and Takeda are among a group of researchers developing an affordable harvest-aid system and sensor technologies with the help of a SCRI grant. Li and Takeda are taking a multi-disciplinary approach to improving harvest efficiency and postharvest handling of fresh blueberries.

Takeda says the team wants to develop “an affordable self-propelled harvest aid system with ergonomic design that can improve harvesting efficiency more than 10 times compared with hand picking, with better fruit quality, and reduced ground loss (of fruit).”

Paring this new harvest-aid technology with a second- or third-generation BIRD device, researchers and growers will be able to better understand the stress fresh blueberries undergo with these new harvest devices.

Takeda and Li hope this research will reduce harvesting fatigue, ground losses of fruit, and fruit damage, and above all, be affordable for all growers. The research team is also studying genotypes of blueberry varieties to find the best cultivars suitable for semi-mechanical harvesting.

“This has been addressed partially with the recent development of novel highbush blueberry cultivars with crisp-textured (“crispy”) berries, i.e., fruit with qualitatively firmer flesh and/or more resistant skin,” Takeda says.

Takeda says microbial contamination is another concern for growers and consumers.
“We will investigate the potential microbial contamination in both blueberry fruit and mechanical harvesters and determine critical control points along the harvest and postharvest chain,” Takeda says.

Grower Driven
The objectives of this project were identified and developed with input from blueberry growers, packinghouse operators, equipment manufacturers, and Extension agents, Takeda says. In fact, in a recent producer survey, the goals were affirmed.

“Reducing labor and harvest cost is one of the most pressing issues facing blueberry growers, and growers are eager to adopt new harvesting technologies that can reduce cost, improve efficiency and fruit quality, and reduce the fruit losses,” Takeda says.

Ultimately, Li says these projects can’t be successful without grower and equipment manufacturer cooperation. These developments are designed to help the highbush blueberry industry become more sustainable and profitable, he says.

“We strongly encourage growers to be more engaged in the project through workshops and field day demonstrations. We appreciate the support from the growers and we need their continued support,” Li says. “That is the strongest motivation for us to do good work.”

Study Suggests Florida Strawberry Growers Pick Earlier To Pump Up Profit

Paul Rusnak

Previously published online in Growing Produce, November 2015

According to a new **UF/IFAS** study, Florida strawberry growers must produce more fruit earlier in the growing season to keep a competitive advantage in the global market. Florida and California combine to produce 99% of strawberries in the U.S., and Florida ranks as the biggest producer of winter strawberries, with a value of $366 million annually, according to USDA figures.

But growers and UF/IFAS researchers are concerned because the industry faces increasing supplies from Mexico and California and volatile market prices. Mexico has emerged as the major competitor for the Florida strawberry industry, the study says. Fresh

strawberry imports from Mexico reached 360 million pounds in 2014, while Florida production was about 200 million pounds.

To help alleviate those challenges, producers need to start picking in mid-November, instead of early December, said **Vance Whitaker**, a UF/IFAS associate professor in horticultural sciences and a strawberry breeder. This is when domestic supply is low and prices are high, "If they can't do this or lower their costs significantly, it may be difficult for them to stay in business," Whitaker said.

Researchers also found growers need to produce more than they have in the past before the middle of December. After mid-December, yields would ideally be steady and smooth, not having extreme highs and lows into March, Whitaker said. The optimal yield pattern over the season, if achieved, could increase growers' profit by $3,000 per acre, said **Zhengfei Guan**, a UF/IFAS food and resource economics assistant professor and co-author of the study.

Strawberry yield must peak during the first six to eight weeks of the growing season, the study says. Too much supply from Florida later in the growing season will lower prices and reduce profit, Whitaker said.

"This kind of yield pattern will result in price/volume combinations that will increase their profits," he said. "In order to help them do this, we need to develop new varieties and horticultural practices that will help them accomplish these changes in yield patterns." The study is published in the journal ***Agricultural Systems***.

$2 Million Grant To Sweeten Pot For Organic Strawberry Studies

Paul Rusnak

Previously published online in Growing Produce, November 2015

Thanks to a new $2 million federal grant, researchers at the **University of Florida Institute of Food and Agricultural Sciences (UF/IFAS)** will address production constraints for organic strawberry producers.

The grant comes from the **Organic Research and Extension Initiative (OREI)** program, which is administered by the National Institute of Food and Agriculture, a division of USDA.

According to Mickie Swisher, the project will focus on the effectiveness of cover crops as a supplementary weed management technique, used in conjunction with plastic mulch.

The UF/IFAS team also will examine how using cover crops affects other considerations like soil quality, nutrient availability and soilborne plant pathogenic nematodes. In addition, a horticulturist will assess how different strawberry cultivars respond to the use of cover crops, searching for the cultivars that will adapt best to the system. An entomologist will focus on the systems' influence on beneficial insects and on the management of key pests such as **spotted wing drosophila** and two-spotted spider mites.

The ongoing research project is supported by the **Florida Strawberry Growers Association** as well as **Driscoll Strawberry Associates**.

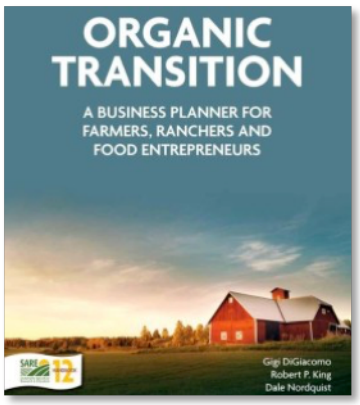
Florida Organic Growers and Consumers Inc. will contribute by coordinating outreach activities during the final year of the grant.

Organic Farming Transition Manual Available

Rosemary Gordon

Previously published online in Growing Produce, November 2015

USDA's Sustainable Agriculture Research and Education (SARE) program recently released a new publication for organic growers. The ***Organic Transition: A Business Planner for Farmers, Ranchers and Food Entrepreneurs*** will walk you through the development of an actionable business transition plan that is suitable for yourself, your management team, or a lender.



The *Organic Transition Planner* is designed to help you explore organic transition strategies and decide whether going organic makes sense for your farm or business. With it you can explore critical questions such as:

- What are your long-term business goals?
- What organic market opportunities are you in a position to exploit?
- How will you acquire the resources you need to make the transition?
- How will you anticipate and deal with challenges as they arise?

The *Organic Transition Planner* contains explanations of key concepts, real-life examples from transitioning farmers, and detailed worksheets covering farm operations, marketing, human resources, and finances. For ease of use, electronic spreadsheets, fillable PDF worksheets, and AgPlan, a business planning software program, are all available online with the *Organic Transition Planner*.

The *Organic Transition Planner* can be used as a companion to SARE's popular business planning guide, ***Building a Sustainable Business: A Guide to Developing a Business Plan for Farms and Rural Businesses***.

USDA Awards $6.7 Million To Stifle Spotted Wing Drosophila

David Eddy

Previously published online in Growing Produc, October 2015

North Carolina State University has won a $6.7 million grant from the USDA to undertake research and grower education efforts aimed at better managing a major new pest that causes hundreds of millions of dollars in annual agricultural losses.

(Photo Credit: Elizabeth Beers, Washington State University)

Under the four-year specialty crop grant from USDA's National Institute for Food and Agriculture, N.C. State University scientists will join with researchers and Extension specialists from across the nation to conduct on-farm tests aimed at finding new ways of effectively dealing with spotted wing drosophila, **a tiny fruit fly that's been causing big problems** since it was first detected in North America in 2008.

They'll also develop tactics and tools for predicting risks from the pest, along with educational materials to help growers make the most economically and environmentally sound management decisions.

N.C. State's collaborators in the effort are from Michigan State, Oregon State, Cornell, and Rutgers universities, as well as the universities of Maine; Notre Dame; Georgia; California, Davis; and California, Berkeley; and USDA's Agricultural Research Service.
Hannah Burrack, an associate professor and Extension specialist at N.C. State University who is a member of *American Fruit Grower*® and *Western Fruit Grower*® magazines' Editorial Advisory Board, is leading the grant-funded effort to develop better ways to manage spotted wing drosophila.

Others from NC State who are participating in the project are Max Scott of the Entomology Department, Zack Brown of the Agricultural and Resource Economics Department, Rhonda Conlon of Extension Information Technology, and Jean-Jacques Debois of the Southern Integrated Pest Management Center.

Burrack emphasized that spotted wing drosophila, (*Drosophila suzukii),* lays eggs in such valuable soft-skinned fruit as raspberries, blackberries, blueberries, strawberries, and cherries. The eggs develop into larvae, leaving the fruit unmarketable.

Marketers who buy fruit from growers to sell to grocery stores "have zero tolerance for spotted wing drosophila infestation in fruit," Burrack said. "If they find a single larva in a fruit, the entire load from that grower will be rejected. Nationally, we estimate that these economic losses to growers on an annual basis are over $700 million a year."

SWD has been recognized as a pest in Asian fruits since the 1930s. "In just seven short years, it's gone from initial detection in California to global-range phenomenon," Burrack said. "It's found everywhere we grow the crops it feeds on in North America, it's widely distributed in Europe, and it's been found in South America. That's a shocking rate of expansion for a pest organism."

Right now, Burrack added, growers have found only two ways of dealing with the insect: They use insecticides, or they cut their growing season short.

"This is neither environmentally or economically sustainable," she says. "We want to bring back Integrated Pest Management to berry and cherry cropping."

In the U.S, insecticide use has grown in host crops by at least 30% in response to spotted wing drosophila's threat, she said.

"Some berry crops rarely received any insecticide applications during harvest, and now they may receive at least weekly insecticide treatments," she said.
Now, growers are forced to spray when the fruit changes color, as that is when SWD attacks, she said.

Still, even the best insecticide treatments may be rendered ineffective under adverse environmental conditions, such as rainy periods, she added. Not only that, SWD is such a prolific reproducer that scientists are concerned the pest may develop resistance to the currently used treatments.

These are among the reasons that Burrack and others involved in the grant-funded project want to help growers reduce their reliance on insecticides for managing spotted wing drosophila.

“The economic impact is important. Berry crops and cherries are worth more than $4.37 billion annually in the United States and are grown on close to 42,000 farms. These crops are high value per acre, and for this reason, they are particularly important components of local-food systems,” she said.

“Our biggest goal is to have things return to a management program that is sustainable both economically and environmentally for our growers, where all the tools effective against spotted wing drosophila are being utilized, and pesticide use occurs only when absolutely necessary.”

Burrack added that postharvest management is an important component of the research. For example: “Sophisticated optical sorting technology is used now, but how can we better use it?”

Clean plants, new detection technologies and National Certification standards

Ioannis E. Tzanetakis - itzaneta@uark.edu

In the last few years there has been a revolution in biology. Large scale sequencing (LSS, also known as next generation sequencing) has made cost-prohibitive, complex studies feasible for a significant number of scientists and biotech companies. In a nutshell, LSS allows for the massive sequencing of any type of organism from animals to plants to pathogens for a cost that is roughly a million times less of what was at the turn of the century.

How does LSS affect the berry industry? Other than the obvious application of genome sequencing, allowing for the better understanding of plant functions, LSS has major implications in diagnostics. USDA-National Clean Plant Network (NCPN) funding has allowed for the implementation of the technology in berry crops. The NCPN-Berries Centers in Arkansas, North Carolina and Oregon are applying LSS when testing new breeding accessions before they are released as new cultivars. This material has the highest health status possible, tested for all known but most importantly unknown viruses that affect berry crops (for more information visit http://virfind.org). Those high quality plants are referred to as generation 1 or G1.

The next step is to ensure that G1 material sustains its health status as it goes though the propagation pipeline in nurseries (Figure 1). Through grants from the USDA-Plant Pest and Disease Management and Disaster Prevention Program blueberry, *Rubus* and strawberry have drafted guidelines for Pathogen-Tested Certification Programs for Nursery Stock Production Systems (for more information visit http://www.ncpnberries.org). The guidelines are currently under review in pilot studies in Michigan, Oregon and Washington. The goal of these studies is to test the feasibility of the guidelines and alter them as needed so as to be user-friendly to the nursery industry but still adhere to scientific facts and state regulations. The final product will harmonize the State certification guidelines using a systems-based approach and best management practices; being a real world, 21st century roadmap for easier movement of planting material between states that agree to follow the guidelines.

How will this benefit the end user, the producer? I value our efforts as the ultimate insurance policy: If material leaves one of the NCPN-Berries Center it will have the seal of the

healthiest planting material possible. If we safeguard its trip through the propagation pipeline, applying best management practices and regular testing, there is almost certainty that issues as those observed with blackberry or strawberry in the past few years will be a memory of the past.

A new forum for discussion of all issues related to berry pathology can be found at: https://www.facebook.com/berrypathology

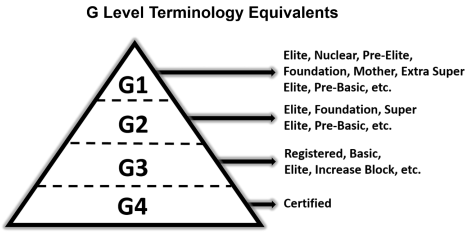


Figure 1: *Terminology used as planting material in moving through the propagation pipeline.*

IR-4 Update for Small Fruits

Roger B. Batts, Field Research Director,
NCSU IR-4 Field Research Center

Pest control can be challenging for specialty crop growers, primarily because of the limited number of available products. Pesticide manufacturers generally will not allocate the funding for the needed research and registration fees associated with bringing a product to the specialty crop market. It is a simple matter of 'return on investment'. One current estimate on the cost of bringing a pesticide to market, from molecule identification to retail packages on a shelf, is between 150 and 300 million dollars. With this type of investment, manufacturers want to register products in markets that will recoup these costs and generate as much profit as possible before its patent expires. For most products these markets are corn, soybean, small grains, and to some extent, cotton. Specialty crop registrations, even if desperately need, are difficult to obtain.

Noticing this disparity of tools, USDA established the IR-4 Project, in 1963, to help with this. For more than 50 years IR-4 has assisted in specialty crop pest control by working with the growers, manufacturers, other specialty crop stakeholders, and US EPA to identify and register needed products. The IR-4 Project helps reduce the manufacturer's cost of registration by conducting a portion of the required trials and coordinating the data submission to US EPA if the manufacturer agrees to add the specialty crop to the product label. These trials are primarily residue trials, but may also include product performance trials. IR-4 also is granted a fee waiver at EPA on data that they submit, so there is additional incentive for manufacturers to pursue registrations in specialty crops through IR-4. The IR-4 Project is seen as a model government/industry/grower association. The consumer is also a big winner from this arrangement. With better pest control, more product is protected, resulting in lower costs to the consumer for healthy fruits and vegetables.

The relationship of IR-4 to the small fruit industry has been a long and successful one. According to the IR-4 database, over 400 product/crop registrations for small fruits have come through IR-4. In this update, the focus will be on registrations since 2010 and the status of current small fruit projects at IR-4.

<u>Recent Small Fruit Registrations</u>

Since 2010, IR-4 data has led to more than 20 product/crop registrations for small fruits. Some of these may be labeled in specific states or regions. Carefully read the label prior to using any product.

Crop	Activity	Trade name	Common name	Primary pest
Blueberry	Fungicide	Indar	Fenbuconazole	Exobasidium
Blueberry	Fungicide	Proline	Prothioconazole	Mummy berry, phomophsis, leaf spot
Blueberry	Herbicide	Stinger	Clopyralid	Weeds
Blueberry	Herbicide	Chateau	Halosulfuron	Nutsedge
Blueberry	Herbicide	Matrix	Rimsulfuron	Weeds
Blueberry	Herbicide	Zeus	Sulfentrazone	Nutsedge
Blueberry	Insecticide	Sivanto	Flupyradifurone	Aphids, blueberry maggot
Blueberry	Insecticide	Exirel	Cyantraniliprole	Gall midge
Caneberry	Herbicide	Matrix	Rimsulfuron	Weeds
Caneberry	Insecticide	Intrepid	Methoxyfenozide	Leaf rollers, apple moth
Grape	Fungicide	Torino	Cyflufenamid	Powdery mildew
Grape	Fungicide	Mettle	Tetraconazole	Powdery mildew, botrytis
Grape	Herbicide	Trellis	Isoxaben	PHI reduction: 156 to 60 days
Grape	Herbicide	Zeus	Sulfentrazone	Nutsedge
Grape	Insecticide	Tolfenpyrad	Tolfenpyrad	Moths, beetles, leafhoppers
Strawberry	Fungicide	Protexio	Fenpyrazamine	Botrytis
Strawberry	Fungicide	Fontelis	Penthiopyrad	Botrytis
Strawberry	Fungicide	Actigard	Acibenzolar	Leaf spot
Strawberry	Herbicide	Zeus	Sulfentrazone	Nutsedge
Strawberry	Insecticide	Beleaf	Flonicamid	Aphids, lygus
Strawberry	Insecticide	Clinch bait	Abamectin	Fire ants
Strawberry	Plant growth regulator	Apogee	Prohexadione calcium	Reduce runner growth

<u>Recently Established Tolerances for Small Fruits</u>

US EPA is required to establish a maximum residue level (mrl), also known as a 'tolerance', that is allowed to be present on a food crop. Most of the trials conducted by IR-4 are focused on developing residue for US EPA review and tolerance establishment. Currently, several IR-4 submitted packages have received tolerances. After tolerance establishment the manufacturer can add the crop to their product label.

Crop	Activity	Trade name	Common name	Tolerance date
Blueberry	Herbicide	Poast*	Sethoxydim	June 2015
Blueberry	Herbicide	Prowl H_2O	Pendimethalin	December 2015
Caneberry	Herbicide	Prowl H_2O	Pendimethalin	December 2015
Grape	Herbicide	Chateau	Halosulfuron	September 2015
Strawberry	Herbicide	Dual Magnum	s-Metolachlor	July 2015

*Poast is labeled for use in blueberry. This project was conducted to reduce the PHI from 30 days to 7 days.

<u>Small Fruit Data Packages Currently at EPA</u>

As of January 2016, the following IR-4 data packages are at US EPA, pending tolerance establishment. The Pesticide Registration Improvement Act (PRIA) requires EPA to set a deadline for tolerance establishment for each data package submitted. These are listed in the table below.

Crop	Activity	Trade name	Common name	PRIA date
Blueberry	Herbicide	Fusilade	Fluazifop	August 2017
Caneberry	Herbicide	Fusilade	Fluazifop	August 2017
Caneberry	Herbicide	Chateau	Flumioxazin	December 2016
Strawberry	Herbicide	Fusilade	Fluazifop	August 2017
Strawberry	Herbicide	Reflex	Fomesafen	December 2016

<u>Small Fruit Data Packages Ready to Submit</u>

Several IR-4 data packages for small fruits are ready to submit to US EPA. Submission timing depends on several factors. There are documents required by EPA for submission, and IR-4 must receive these signed documents from the registrant in order to make a submission. Also, IR-4 plans submissions so that all studies with the same active ingredient which are completed at approximately the same time are submitted in one submission. IR-4 may also coordinate with the registrant's next planned submission. This facilitates the effective use of resources by EPA for reviewing IR-4 packages. In addition, IR-4 has a partnership program with Canada, where trials are carried out in both counties and the submission is made to both EPA and PMRA concurrently to allow

registration in both countries. If there are regulatory concerns or EPA has identified a data gap for an active ingredient, this may impact the timing of the IR-4 submission.

Crop	Activity	Trade name	Common name	Submission date (Tentative)
Blueberry	Fungicide	Fontelis	Penthiopyrad	September 2015
Blueberry	Herbicide	Quinstar	Quinclorac	August 2014
Blueberry	Herbicide	Trellis*	Isoxaben	February 2016
Blueberry	Herbicide	Alion	Indaziflam	October 2015
Blueberry	Herbicide	Velpar**	Hexazinone	March 2016
Blueberry	Insecticide	Tolfenpyrad	Tolfenpyrad	December 2016
Caneberry	Fungicide	Fontelis	Penthiopyrad	September 2015
Caneberry	Herbicide	Alion	Indaziflam	October 2015
Caneberry	Insecticide	Exirel	Cyantraniliprole	December 2015
Caneberry	Insecticide	Fujimite	Fenpyroximate	March 2015
Grape	Herbicide	Assure II	Quizalofop	TBD
Strawberry	Insecticide	Tolfenpyrad	Tolfenpyrad	December 2016
Strawberry	Insecticide	Exirel	Cyantraniliprole	December 2015

* Trellis project designed to gain use in bearing crop.
**Velpar project was conducted to establish a 50 d PHI.

Current IR-4 Small Fruit Projects
Current IR-4 small fruit projects are listed below. At this stage of a project lots of field work, lab work, analysis and documentation has to be completed, so a proposed submission date would be extremely tentative.

Crop	Activity	Trade name	Common name	Purpose
Blueberry	Insecticide	Closer	Sulfoxaflor	Plant bugs, leaf hoppers
Blueberry	Insecticide	Delegate	Spinetoram	Spotted wing drosophila
Blueberry	Insecticide	Fujimite	Fenpyroximate	Mites, white flies
Caneberry	Herbicide	Stinger	Clopyralid	Weeds
Caneberry	Herbicide	Trellis	Isoxaben	Gain use in bearing crop
Caneberry	Herbicide	Poast	Sethoxydim	Reduce PHI to 7 days
Caneberry	Insecticide	Closer	Sulfoxaflor	Stinkbugs
Caneberry	Insecticide	Tolfenpyrad	Tolfenpyrad	Spotted wing drosophila
Grape	Herbicide	Select Max	Clethodim	Grass weeds
Grape	Insecticide	Pounce	Permethrin	Import mrl for Canada grapes
Grape	Insecticide	Delegate	Spinetoram	Spotted wing drosophila
Strawberry	Herbicide	Stinger	Clopyralid	Reduce PHI to 2 days
Strawberry	Insecticide	Belt	Flubendiamide	Reduce PHI from 8 to 1 day

Some useful IR-4 links:
IR-4 Home page: http://ir4.rutgers.edu/
IR-4 Food Crops Program: http://ir4.rutgers.edu/food.html
IR-4 Food Crops Database: http://ir4app.rutgers.edu/ir4FoodPub/fullSearch.aspx
Project Request Form: http://ir4.rutgers.edu/FoodUse/FOODRequestForm.cfm

Are You Wasting Your Money on Ineffective Sprays?

Guido Schnabel, Clemson University

Disease management is on every grower's mind during the production phase of small fruits. While many diseases occur only occasionally and are crop specific, gray mold caused by the fungus Botrytis cinerea is the big exception. The spray program for most small fruits is geared toward gray mold control; it is the one disease you can count on every year. The pathogen causes blight on leaf, flower, and crown tissue and most importantly leads to fruit rot. Infection is favored under wet conditions with temperatures in the 70's. Besides actively causing disease during the growing season, the fungus leads to disease after harvest, either during storage, transit, in the store, or after purchase by the consumer.
Besides captan and thiram, there are many other classes of site-specific fungicides available for the control of gray mold disease in the United States. They are grouped into FRAC codes and it is recommended to alternate them within a single season for resistance management and to achieve maximum preharvest and postharvest protection.
Unfortunately, Botrytis produces resistance to fungicides more quickly than any other plant pathogen and the Botrytis we are dealing with in the South is no exception. In fact, resistance to multiple FRAC codes does occur quite frequently and there is a very good chance that some of the products you have been spraying are no longer effective.

The Schnabel lab at Clemson University in conjunction with the Southern Region Small

Fruit Consortium (www.smallfruits.org) offers a service that provides growers with optimized spray recommendations. The test covers the most important FRAC codes for gray mold control, including FRAC 1, 2, 7, 9, 12, 17, and 19. Growers, agents or specialists from Consortium member states (GA, NC, SC, TN, VA, AR) may send samples for testing free of charge to the Clemson lab. Instructions on where to send samples and how to collect samples can be found at www.peachdoc.com (go to strawberry using bottom page link). The assay typically takes a week to conduct (depending on the quality of the samples submitted) and we try our best to get a report to you without delay. Funds from the Consortium are sufficient for 45 assays (locations) and we typically like to run 10 samples (=isolates) per location. Gray mold from all small fruits are welcome. For more information contact Dr. Guido Schnabel; schnabe@clemson.edu.

Blackberry and Raspberry Seasonal Checklist
Winter 2015-16

Gina Fernandez, Small Fruit Specialist
North Carolina State University

This checklist was originally developed for blackberry growers in North Carolina. Many of the items apply to raspberry production as well. You may have to adjust your work activities either earlier or later depending on your location. For more detailed information, check the Southern Region Integrated Bramble Management Guide and the Southeast Regional Bramble Production Guide at: http://www.smallfruits.org/SmallFruitsRegGuide/index.htm.

Check the items off as they get done. This list is very general, but should help get you to think about what types of activities occur at various times of the year. If you would like other items to be added to this list, send them to me and I will add them next time.

WINTER

Plant growth and development

- ✓ Plant is not visibly growing during the winter months although many blackberries will retain their leaves through the winter
- ✓ Some differentiation is occurring in the flower buds
- ✓ Low chilling cultivars can break bud in January after adequate winter chilling. You can monitor chilling hours accumulated in eight states in the eastern US by accessing this site: http://www.ncclimate.ncsu.edu/cronos/blackberry/index.php
- ✓ Developmental stages for IPM guide:
- ✓ Dormant
- ✓ Delayed dormant (swollen bud) to green tip

Pruning and trellising

- ✓ Pruning should occur in **late** winter. *The unseasonably warm temperatures we are experiencing in mid December 2015, are not a good reason to get the pruning done early.* Pruning can stimulate growth. We have several more months to go before we want to see any type of growth!
- ✓ Make trellis repairs after plants have defoliated but before pruning and training.
- ✓ Erect types
- ✓ Prune out the spent floricanes
- ✓ Tie canes to wires in a fan shape
- ✓ Cut lateral branches back to 8-12”
- ✓ Thin canes to 6-8 canes/ hill (4 ft spacing)
- ✓ Trailing types
- ✓ Prune out spent floricanes
- ✓ Tie or weave canes to wire so that they do not overlap
- ✓ Prune side laterals to 12-18”
- ✓ Thin canes to 6-8 hill (6-8ft spacing)
- ✓ Primocane fruiting raspberries and blackberries

- ✓ Prune (mow) primocane fruiting types to ground level

Weed control

- ✓ Check the Southern Regional Bramble integrated Management Guide for recommendations. www.smallfruits.org
- ✓ Many summer weed problems can be best managed in the fall and winter using preemergent herbicides. Determine what weeds have been or could be a problem in your area. Check with local extension agent for cultural or chemical means to control these weeds.

Insect and disease scouting

- ✓ Check the Southern Regional Bramble integrated Management Guide for recommendations. www.smallfruits.org
- ✓ Scout fields for insect and disease damage and remove those canes
- ✓ Remove wild blackberries and raspberries by the roots if they are within 600 ft of your planting during the winter

Planting

- ✓ Take soil tests to determine fertility needs for spring plantings.
- ✓ There are some new raspberry and blackberry cultivars available each year. If you have not tried them or it is not know how they will do in your region, it is best to order a small quantity to see how well they will perform in your area
- ✓ For larger growers, prepare list of cultivars for 2017 plantings and order now. Smaller quantities of plants can be order in early 2016 for spring 2016 planting
- ✓ A commercial small fruit nursery list at http://www.fruit.cornell.edu/berry/nurseries/

Water management

- ✓ Make repairs to irrigation system (check pumps, lines, etc)
- ✓ Plants generally do not need supplemental water in winter

Marketing and miscellaneous

- ✓ Order containers for next season
- ✓ Make contacts for selling fruit next season
- ✓ Attend grower meetings:
  - The **2016 North American Raspberry & Blackberry Conference** will be held in Williamsburg, VA. http://www.raspberryblackberry.com/for-growers/2016-annual-conference/
  - **Southeast Regional Conference and Tradeshow**, with sessions on blackberry
  - January 7-10, 2016, at the Savannah International Trade and Convention Center http://www.seregionalconference.com
  - The 2016 NCCBRGA meeting will be Friday February 19 in Shelby. For more information contact Daniel_Shires@ncsu.edu

For more information on growing caneberries see:
http://www.smallfruits.org/
http://rubus.ces.ncsu.edu/

Social Media links:
Twitter: @NCTeamRubus
Facebook : Team Rubus
Blogs: http://teamrubus.blogspot.com/

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