Small Fruit News

Volume 13, No. 2 April 2013

North Carolina State University • Clemson University • The University of Arkansas
The University of Georgia • The University of Tennessee
Virginia Polytechnic Institute and State University

SPECIAL REPORTS:

Southern Region Small Fruit Consortium Awards $$106,406 in Grants for 2013

Tom Monaco, Coordinator, SRSFC

The Steering Committee of the Southern Region Small Fruit Consortium (SRSFC) awarded $101,406 in research and extension grants at their annual meeting held January 2013 in Savannah, GA.

Fifteen research proposals totaling $73,472 were funded and six extension proposals for a total of $28,434 were funded. Also $4,500 was awarded to the extension efforts in updating the IPM/Production Guides.

The IR4 Performance program provided a half match to one research and one extension proposal which added $3,750 in additional funding so the total amount funded for 2013 was $110,156.

Research projects funded for 2013 include:

2013-01 Southern Region Strawberry Variety Testing Program. Pattison, Poling, Johnson, Smith, Rollins $5,000

2013-02 Influence of fruit coating on Drosophila suzukii oviposition and development and implications for field use. Burrack, Swoboda $5,000

2013-03 Epidemiological Applications to Manage Anthracnose Crown Rot of Strawberry in the Southeast. Louws, Adhikari $5,000

2013-04 Postharvest Evaluation of Small Fruit after Application of Fruit Coatings. Perkins-Veazie, Fernandez, Burrack $5,000

2013-05 Evaluation of blueberry (Actinium spp.) cultivars for susceptibility to replant disease associated with ring nematodes (Mesocriconema ornatum). Noe, Brannen, Jagdale $5,000

In This Issue

2013-06 Determining Optimum Nitrogen Nutrition Management for Off-season High Tunnel Plasticulture Strawberry Production for Arkansas and the Southeast. Garcia, Johnson, Kirkpatrick $4,972

2013-07 Identification of Blueberry mosaic virus vector(s) and analysis of virus distribution and population structure in the United States. Thekke-Veetil, Tzanetakis, Garcia, Schilder, Martin, Polashock $5,000

2013-08 Determination and inheritance of firmness and texture of the 'crispy' trait in the Arkansas blackberry breeding program. Clark, Salgado-Rojas $5,000

2013-09 Effects of co-infection with Blueberry red ringspot virus and Phytophthora root rot on symptom severity, plant vigor, and yield in southern highbush blueberry. Scherm, Williford $5,000

2013-10 Eriophyid Mite Management for Suppression of Blueberry Necrotic Ring Blotch Disorder: An Emerging and Significant Disease of Southern Highbush Blueberries. Brannen, Horton $5,000

2013-11 Vegetation-free Strip Width in Blackberry. Jennings, Mitchem, Monks $4,500
2013-12 Assessment of Ochratoxin A Contamination in Wines Produced from Vitis vinifera Grapes in the Southeastern U.S. Glenn, Brannen, Lockwood, Nita, Bolton $5,000

2013-13 Evaluation of Preemergence Herbicides for Annual Weed Control in Young Blueberry Fields. Czarnota $4,000

2013-14 Can we use long cane raspberries to advance the season of raspberry production in the southern United States? Phase II. Harvest and post harvest evaluation. Fernandez, Perkins-Veazie $5,000

2013-15 In vitro anti-inflammatory potential of phenolics from digested and absorbed Georgia-grown blackberries. Pegg $5,000
Extension projects funded for 2012 include:

2013 E-01 Strawberry growers control gray mold in light of widespread fungicide resistance. Schanbel, Fernandez-Ortuno $5,000

2013 E-02 Regional Coordination of Strawberry Plasticulture Extension Activities. Poling, Pattison, Chester-Davis $5,000

2013 E-03 Determining the Optimum Time for Leaf Sample Southeastern Blueberries. Lockwood, Joines, Cline, Brannen $5,000

2013 E-04 Development of a web-interface for grape and apple regional risk assessment system. Nita, Yoder, Sforza, Peery, Knight, De Wolf $4,934

2013 E-05 Balanced Pruning in Muscadine Grapes. Spayd, Poling $5,000

2013 E-06 Herbicide Weed Control in Annual Plasticulture Strawberries. Straw $3,500

UGA Department of Plant Pathology Research Results in Additional Cultural Management Recommendations for Bacterial Leaf Scorch (Xylella fastidiosa)

Phillip M. Brannen,
Harald Scherm,
Renee Holland
University of Georgia

Many southern highbush blueberry varieties are susceptible to bacterial leaf scorch, a lethal disease caused by the bacterium Xyllella fastidiosa. The bacterium infects the xylem (water-conducting tissue) of plants, thereby reducing water flow to the growing tissues and resulting in a scorch symptom (Fig. 1). The

bacterium is transmitted to the plant by certain leafhopper species while they feed on blueberry shoots. There are currently no reliable management options for this disease on susceptible cultivars.

Figure 1: *Bacterial leaf scorch of blueberry symptoms. Leaf margins are scorched, and the leaves eventually abscise to produce a skeletonized plant that dies over time. Stems are often yellowed.*

Two important cultural management recommendations have recently been derived from a two-year research project (Holland 2013). For one research objective, the question of whether apparently healthy cuttings from symptomatic plants could result in disease spread was addressed. In this research, asymptomatic softwood cuttings were collected in June or September from plants with symptomatic shoots elsewhere on the bush.

The resulting young plants did not generally show symptoms, even after two years in the field (actually in screen houses to prevent insect spread of the disease). However, about 5% of the plants (1 in 20) were positive for the Xyllella bacterium, indicating that these plants were carriers and that they would eventually succumb to the disease. In fact, some showed symptoms intermittently during the two-year period.

The take-home message is that when softwood cuttings are taken in the summer for propagation, they must be collected from healthy plants. Even apparently healthy-looking cuttings that come from plants that are not healthy as a whole may result in spread of this pathogen and others, such as viruses (e.g. red ringspot). In addition, new more aggressive strains of the pathogen could be introduced from imported plants. If workers are "skimming" for cuttings, it is best that they only work in areas with 100% healthy plants, and they need to be trained as to the importance of their jobs to the overall health of the blueberry industry.

In a second objective, a question that has frequently been asked by blueberry producers was addressed: can early-stage infections in bacterial leaf scorch-affected plantings be pruned out by removing shoots that are just starting to show symptoms? A related question is whether more seriously affected plantings can be cured by flail-mowing or severe-pruning plants to ground level at the end of the season when symptoms are most apparent. Whether or not these strategies would be successful depends on where the bacterium is located in plants at the time of pruning. For example, if the bacterium had already moved through the xylem to points below the cut, pruning would be of no value.

Research from this project has shown that the bacterium distributes quickly within plants once the first symptoms become apparent, rendering attempts to remove infections by pruning or mowing ultimately useless. Three southern highbush blueberry fields natur ally infected with bacterial leaf scorch were sampled to determine the distribution of X. fastidiosa in different tissue types, from the top of the plant down to the stem base and the roots (Fig. 2). In each field, 10 asymptomatic plants as well as 10 plants each with light, moderate, or severe symptoms of bacterial leaf scorch were selected in September or October – when symptoms were most pronounced. Xylem sap was extracted from stem or root segments located at different sites (small upper stems through roots) on the symptomatic and asymptomatic plants, and concentrations of X. fastidiosa in the sap were determined.

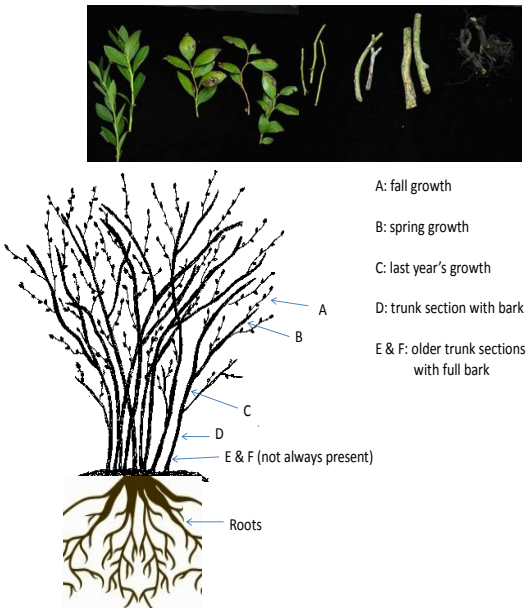

Figure 2: *Stem and root sections used for xylem sap sampling to detect Xylella fastidiosa in naturally infected southern highbush blueberry plants in the field.*

The bacterium was not detected in the top sections (youngest growth) and roots of asymptomatic plants, but it was sometimes detected at low levels in middle and base stem sections of such plants (see example from one of the fields in Fig. 3). In plants with light symptoms, the bacterium was readily detected in all stem sections (top, middle, and lower) as well as in roots, indicating that X. fastidiosa spreads quickly as symptoms become apparent. To reiterate, bacterial concentrations were highest in middle and lower stem sections. In plants with moderate and severe symptoms, bacterial concentrations were highest in middle and lower stem sections as well as in roots, indicating that the pathogen accumulates in the roots over time.

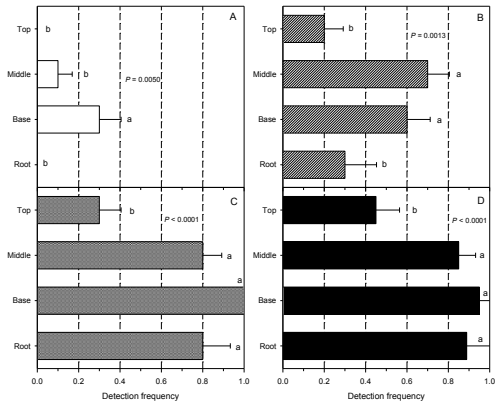

Figure 3: *Detection frequency of Xylella fastidiosa, as determined by real-time quantitative PCR, in different stem sections (top to bottom of plant) and roots of Bluecrisp southern highbush blueberry from asymptomatic plants (A) and those having light (B), moderate (C), and severe (D) bacterial leaf scorch symptoms. Values are means and standard errors.*

Because the bacterium is already present in lower sections of the plant when symptoms first become apparent, selective pruning is not a suitable management practice for removal of bacterial leaf scorch infections. Similarly, because of the presence of the bacterium in the roots of moderately or severely affected plants, radical flail mowing of such plantings will also be ineffective in eliminating the disease. Prior to this research being conducted, some innovative producers tried severe pruning as a management method. Early results were encouraging, as new shoots did not initially show symptoms. However, these new shoots eventually developed scorch symptoms, and plant death followed. This research explains why this is the case. Pruning, although of value for horticultural reasons, will not be an effective management tool for bacterial leaf scorch, and we now more fully understand the reasons for this unfortunate fact.

Collaborators on this project included Danny Stanaland, John Ed Smith, James Jacobs, and Elvin Andrews.

Literature Cited

Holland, R. M. 2013. Location, transmission, and impact of Xylella fastidiosa in southern highbush blueberries. M.S. thesis, University of Georgia, Athens.

A Crash Course On Virus Disease Control

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Not all people are aware that plants can be infected by viruses. Still, plant viruses account for losses in the billions of dollars every year. There have been several cases where a virus epidemic has disseminated crops in vast areas and the most frustrating part from a grower's standpoint is that there is not much to do once a plant is infected.

Let's start from the basics: What is a virus? A virus is an obligate parasite consisting of nucleic acids (RNA or DNA), proteins and in some cases, lipid membranes. The key term here is 'obligate'. Viruses cannot function outside a living cell. If the host dies, the virus goes with it. Thus, in nature viruses have co-evolved with their hosts to keep a fine balance between virus replication and survival, and survival of the host to sustain infection through dormant seasons of the host. This is definitely the case in the majority of plant-virus interactions. Viruses have evolved to co-exist and most have minimal impact on their hosts. With new technologies developed in the last few years we know for a fact that plants are infected with several viruses but in most cases no definite symptoms are observed. These are what we refer to as 'resident' or 'latent' viruses.

But there are also cases where viruses cause severe plant disease and even death. This is truly an imbalance in the system. The majority of the scientific community agrees that viruses that kill their hosts are probably accidental introductions, as they die out along with their hosts. There are rare cases where viruses can mutate to cause less severe symptoms allowing for their survival in a particular host.

As we learn more about viruses and virus diseases we have come to realize that, at least in berry crops, the majority of disease are not caused by a single virus but rather by the combination of two or more viruses. In the past, scientists were able to identify the 'easy' viruses, entities that were easy to isolate and manipulate. With the new technologies that have been developed, we now realize that the knowledge of the past only accounts for the tip of the iceberg in terms of what causes virus diseases in berry crops. A clear example is blackberry yellow vein disease (BYVD). Until the turn of the century people assumed that symptoms were caused by Tobacco ringspot virus (TRSV). Although TRSV is found in some plants, the majority of symptomatic plants are free of the virus. Also, TRSV does not cause symptoms in single infections in most modern blackberry cultivars. We now know that BYVD is caused by complexes, with more than a dozen viruses that may contribute to the symptoms. BYVD can be caused by various combinations of these viruses, and in all cases observed to date, there are at least two and up to seven viruses involved.

Management strategies of virus diseases are based on resistance, control of vectors or elimination of viruses from propagation material. Resistance is based on the premise that viruses are identified by their hosts as invaders at the genetic level that results in some step in the virus life cycle being blocked. Given that most virus disease in berry crops are caused by complexes it is a challenging undertaking to develop multiple virus resistances. If symptoms are expresses in the presence of multiple viruses then plants need to be able to recognize all or most of those entities. If a single pathogen causes disease it is easy to screen and identify resistant sources. However, in berry crops, resistance sources have not been identified for most of the viruses.

Resistance to multiple viruses is more challenging as different combinations need to be introduced to plants and the reaction to each virus needs to be evaluated. When breeders work with thousands of accession, the challenge is obvious.

Vector control can be a good alternative but knowledge of the epidemiology and transmission of viruses is necessary for the implementation of a successful control program. There are four different modes of transmission when it comes to viruses and their vectors: a. non-persistent; b. semi-persistent; c. circulative and d. circulative propagative. What do those terms mean? In the non-persistent transmission, virus acquisition and transmission takes place in few seconds or minutes and the vector losses the ability to transmit in minutes. In the case of semi-persistent viruses the vector needs to feed on the source plant for several minutes or even hours, but once the virus is acquired it may be able to transmit from hours to days. The latter two modes of transmission are more complicated as vectors need hours or even days of feeding on infected material to acquire the virus. Then, they are unable to transmit for hours or even days as the virus need to pass though vector membranes to make it back into the salivary system. However, once acquired, they are able to transmit for days, weeks or even the life of the vector. In the case of circulative propagative viruses, the virus actually infects the vector and in certain cases, it has been proven that they can move to the next generation though infection of the egg.

But why is this important to know? The secret to an effective control regime lies in the knowledge of how viruses are vectored. In the cases of the circulative viruses the answer is straight forward, since there are days between when a vector acquires a virus before it can transmit, allowing for ample time to control the vector. Control will probably eliminate the vector before it is able to move viruses to adjacent plants. How about the case of non- and semi-persistent transmission? This presents a major challenge: Let's assume the case of a non-persistent virus. The vector transmits the virus after short feeding time. A control agent applied to the foliage may change the vector behavior (e.g. the composition of the plant sap has changed) such that the vector does not settle down, but rather moves from plant to plant, thus increasing the number of plants that it infects. If no control was applied only a single plant would be infected. This situation is very specific and changes depending the environment, the control agent/chemical and of course the virus/vector combination. Without this information the grower may use valuable resources for vector control and that leads to increased virus spread.

Breeding for vector resistance can be effective at controlling all viruses transmitted by the vector. Probably the best example of this in all of plant virology, is the success of aphid resistance in virtually eliminating the spread of the raspberry mosaic complex, a group of three aphid-transmitted viruses. Even though successful in North America for more that 50 years, the original source of aphid resistance has been overcome by new biotypes of the aphid and this resistance is no longer effective. In Europe, the resistance was overcome much more quickly and now multiple aphid resistance genes have been overcome. It must be remembered that if we look at a complex like BYVD, there are multiple types of vectors involved (eriophyid mites, whiteflies, nematodes, thrips and pollen, which makes breeding for vector resistance a monumental task. Also, in most cases, vector resistance has not been identified in the berry crops.

The easiest and most effective control is planting clean material. Many growers propagate their own stock for planting new fields. Whereas this appears to be an easy and cost-effective approach it can have devastating results. Plants may appear normal but this is not uncommon when infected with one or two

viruses. When placed in the field, viruses are transmitted between plants and complexes develop, plus additional viruses may be vectored into the field and a field decline may become apparent shortly after planting. Even if there are no apparent symptoms, virus infection may account to a 5-20% yield loss. Establishing a field with virus-tested plants does not mean that they will never get infected. As a law of nature, all organisms from bacteria to amoebas to plants and primates get infected by viruses. A field with clean plants will stay productive for more time and yield better than a field with infected plants, providing growers with better quality product and better yields.

There have been several cases where growers move self-propagated plants to new areas and introduce new pests to new environments. The introduction of a few Prunus trees infected with Plum pox virus has cost the tax payers hundreds of millions of dollars. Citrus greening is another example of how the inappropriate movement of plant material can cause losses of colossal proportions. So when growers plant their next field they need to recognize the extra investment of virus-tested plants not only in terms of profitability of the newly planted field. But, also in terms of protecting existing fields on the same farm or in the area from the introduction of new viruses that could jeopardize production. It is certain that the return of this investment will be greater that the risk of disseminating viruses.

'Flavorfest' – A New Strawberry Variety from ARS

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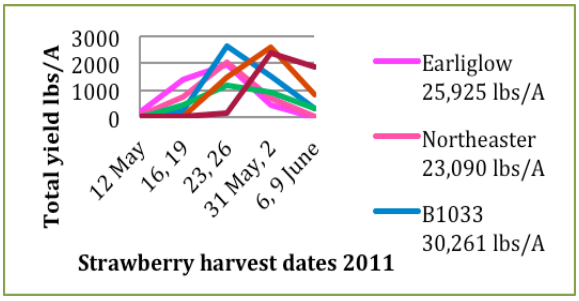
The Agricultural Research Service announces the release to nurseries and propagators of the new short-day variety, 'Flavorfest', previously tested as B1033. 'Flavorfest' fruit have excellent flavor, are large, bright red, and appear distinctively plump. 'Flavorfest's long mid-season fits well among the fruiting seasons of our other anthracnose-resistant cultivars, Earliglow, Northeaster, Allstar, and Ovation. Fruiting season in plasticulture at Beltsville, MD, is similar to that of 'Chandler,' in that it is longer than most other cultivars and peaks at the same time. 'Flavorfest' is expected to be best adapted to the mid-Atlantic and adjacent areas. Flavorfest' has consistently performed as a top-yielding, large-fruited selection in the plasticulture production system at Beltsville. 'Flavorfest' also has performed well for two Maryland growers using the matted-row production system. 'Flavorfest' plants are vigorous and propagate well. Like other Beltsville varieties, 'Flavorfest' does not require high levels of nitrogen fertilizer to provide high yield. Derived from a cross pollination of B759 by B786, 'Flavorfest' survived seedling screening for red stele resistance. In field evaluations, 'Flavorfest' has shown no susceptibility to anthracnose crown and fruit rot. 'Flavorfest' is resistant or tolerant to most of the stem and leaf diseases. Percentage of 'Flavorfest' fruits showing Botrytis fruit rot, when harvested from untreated fields, is similar to or lower than other currently available mid-season cultivars grown in the Mid-Atlantic. To purchase plants, contact your favorite nursery or Dr. Kim Lewers, USDA/ARS, at Kim.Lewers@ars.usda.gov



Virus Infections in the 2012-2013 Strawberry Crop

By Chuck Johnson,
Extension Plant Pathologist, VA Tech.
Edited from his article distributed to VA Extension Agents; NCSA also published articles on this issue in the January-February 2013 newsletter.

Within four to six weeks of planting last fall, a number of strawberry producers in Virginia (and other growers in the Southeastern and Mid-Atlantic U.S.) began noticing poor growth in their fields, sometimes in spots within fields, sometimes in virtually the entire field. Older leaves sometimes turned bright red in color, while the edges of leaves around the crowns of plants, and/or emerging leaves, showed a distinct yellowing, which sometimes developed into patterns of marginal necrosis (i.e., dead tissue along the margins of leaves). Roots and crowns of most of these plants showed no sign of fungal infection. Initially, the cause of these problems was thought to perhaps involve soil and/or fertility conditions, such as low soil moisture and/or pH, boron toxicity, or fertilizer burn, perhaps associated with weather and/or errors in custom-blended fertilizers. However, similar problems were observed in Florida, NC, and other southern states, including Virginia.

Because of the widespread nature of these symptoms, and an apparent association with bare-root plants or tips from the Great Village area of Nova Scotia, Dr. Barclay Poling of NCSU travelled to the area in early December to visit with Canadian strawberry plant growers and Extension staff. While there, Barclay was told that apparent strawberry virus symptoms had started showing up in fields of some strawberry cultivars in Great Valley in October (about the same time we started getting reports of problems). The Canadians had not had this problem before, and brought in Dr. Bob Martin, a USDA-ARS small fruit virologist located at Oregon State University, to help determine the cause. Dr. Martin is the top expert, as far as I know, on small fruit/strawberry viruses. He collected plant samples in early November to take back to Oregon for laboratory testing, and his results were received while Barclay was in Canada.

Dr. Martin found Strawberry Mild Yellow Edge Virus (SMYEV) and Strawberry Mottle Virus (SMoV) in samples from several matted row varieties. Barclay noted that he had never before seen strawberry viruses to be a problem. Barclay also noted that Chandler plants in Canada looked healthier than other varieties he saw, such as Camarosa and Winter Star. Upon returning to NC, Barclay collected and submitted seven plant samples to Dr. Martin's lab, and found one with SMoV and five with SMYEV. All infected plants were plug plants produced from tips grown by one nursery in the Great Valley area. One plant that looked "good" tested negative for both viruses, while another "good" plant tested positive for SMYEV only. Dr. Martin also tested 20 strawberry samples from Florida and found SMYEV and SMoV in 15 (75%).

Agents in the VA Beach area also collected plant samples from strawberry growers in their area and sent the samples to Dr. Martin just before Christmas. Most of the samples (15 or 43%) were the Chandler variety, but other varieties that were tested included Albion, Camarosa, Camino Real, Festival, San Andreas, and Sweet Charlie. Of the 35 samples sent, 86% were infected by SMYEV, 69% with SMoV, and 66% with both viruses. Only 17% were non-infected. All of the infected plants were originally sourced from the one nursery in the Great Valley area of Nova Scotia, but four different vendors grew out tips from that same nursery.

Based on all this information, Virginia strawberry producers [and those in other states as well] with plants originally sourced from anywhere but the one nursery in the Great Valley area of Nova Scotia should not worry about possible virus infection, because, as far

as I know now, no 2012-2013 plants produced from any other source have tested positive for a strawberry virus. Unfortunately, most of the plants tested so far that "traced back" to the one nursery have been infected by SMYEV, and usually SMoV as well. Growers with plug plants may not know where their plant supplier purchased the strawberry tips that were grown-out into plugs, and should check with their supplier.

Although this is our first experience with virus problems on strawberry, SMYEV and SMoV are very common around the world, and often occur together and with other viruses. In fact, it may be that they only cause significant problems to strawberry growers when they occur together. Yield losses (probably when 100% of plants are infected) can be expected to range from 0% to 30%, and can differ among strawberry cultivars and also depending on which "strain" of each virus may be present. These viruses are usually only a problem in matted-row strawberry production, where plants are in the field for a much longer period of time and plantings are not destroyed at the end of each growing season. Heat treatment combined with meristem tip culture usually eliminate viruses from strawberry genetic material before tips are grown out for plugs or bare root transplants.

All of the virus-infected plants diagnosed this year had SMYEV, which is a "persistent, circulatively-transmitted" virus spread by some (but not all) aphids – Chaetosiphon fraegolii (the strawberry aphid), C. thomasi, and C. jacobi. "Persistent" means that these aphids need to feed for hours or days in order to "get" and spread the virus. However, "persistent" and "circulative" mean that a virus spreads through the body of an insect once the virus has been acquired, and once an aphid has the virus, the virus remains in the aphid through most or all of its life. If a grower only has a small percentage of infected plants in fields with low to moderate aphid populations, promptly spraying an insecticide that kills aphids quickly should be more likely to kill the insects before they can acquire and transmit viruses like SMYEV. Some more "good news" about SMYEV is:

It infects no weeds or crop plants other than strawberry (wild and cultivated).
It is only supposed to be a problem when other viruses are also present.

Most virus-infected plants diagnosed so far also had SMoV, which is also aphid-transmitted (C. fraegaefolii, several other Chaetosiphon species, and the melon aphid, Aphis gossypii). However, SMoV is "semi-persistently" transmitted, which means that aphids can "get" and transmit the virus within only a few minutes as they probe infected plants and then move to nearby healthy plants. However, aphids also "lose" the virus within a few hours as they probe plants, potentially slowing the initial rate of virus spread if most of the plants that aphids probe are healthy, such as when only a low percentage of plants in a field are infected. In addition to wild and cultivated strawberry, SMoV also infects several Chenopodium species, including lambsquarters. Aphid control programs are also supposed to be effective in reducing SMoV spread in strawberry fields.

Summary and Actions to Take

1. Growers with fields that "look good" and contain plants that weren't sourced from the one nursery in the Great Valley area of Nova Scotia should NOT be "at risk". One cautionary note: because these viruses are both transmitted by aphids, it is possible that active aphid populations in Virginia strawberry fields could cause "secondary spread" from infected to non-infected plants in the same field or in nearby fields (I doubt anyone knows exactly how close "nearby" is). However, given the time of year we're in, I think this situation should be rare.
2. Plants that were sourced from the one nursery of concern are likely to be infected by one or both viruses. Plants traced back to other nearby sources in Nova Scotia could be involved, but not as far as we know at this time. However, it's important to

remember that apparent symptoms of plant virus infection can be very misleading. Sick plants may have similar symptoms, yet can be suffering from very different causes, none of which may involve virus infection.

3. Growers should ensure they are doing everything that they can to minimize stress on their crop, even they know that their plants are infected. This could significantly improve their outcome this growing season. My experience with viruses in another crop (tobacco) suggests that factors such as production practices and weather conditions could have a major impact on apparent damage and yield loss. The factors that come to my mind for strawberry are frost protection, fertility, and irrigation/moisture stress.
4. There is no cure for plant virus infection. Once infected, plants are infected for life, and every cell in an infected plant will eventually contain virus. There are no "silver bullets" or miracle cures, despite what some may claim. Infected plants can't be saved, although growers could see some improvement in their appearance and growth between now and harvest. We don't know why that is, so we don't know how to promote it.
5. Growers with infected plants should focus on preventing spread to healthy plants. Since we can't test every plant, the safest assumption is that apparently symptomatic plants are infected, while those that "look good" aren't, even though we know this isn't always true. Therefore:

    - If almost all the plants in a field are stunted and symptomatic, applying an insecticide will not help them. The only possible benefit from such a spray would be to minimize possible spread to nearby healthy strawberry fields. Treating severely infected fields that are isolated is unlikely to produce any benefit whatsoever.
    - If enough plants in a field look to be worth saving, application of a systemic insecticide should be an effective treatment to prevent or minimize spread of these viruses. Scientists disagree to some extent on the effectiveness of this approach, but the plant pathology literature suggests treating can reduce further disease spread. Remember that this only works if there are aphid populations in the field. If there are no aphids, what is an "aphid-killer" going to accomplish? Growers may consider treating to prevent aphid populations from developing this spring as a type of "insurance," but an alternative approach that should be cheaper and more environmentally friendly would be to scout fields more closely for aphids so that a crop is treated only if when determined necessary.
    - If you decides to treat, the systemic insecticides need to be applied at least 14 days before bloom to avoid injuring pollinator populations. Recommended insecticides include imidacloprid (Admire Pro for drip, Provado for foliar applications) and thiamethoxam (Platinum for drip, Actara for foliar spray). There may also be some generics labeled for strawberry that have the same active ingredients, but may be cheaper.

6. All strawberry plants should be destroyed after this season's harvest is completed, to avoid potential carry-over of SMYEV and SMoV. Although some growers consider carrying strawberry plants over from one season to another, 2013 looks to be a very poor year for this. Leaving potentially infected plants in the field this summer risks virus spread into next years' crop. Fields in matted-row production should be monitored for potential virus incidence as well.
7. Don't be too discouraged. This virus situation is yet another plant disease problem in strawberries tied to transplants that look healthy, but aren't, but it should be "containable" to this year. Those involved in

strawberry plant production in Nova Scotia are aggressively working to correct their virus situation. Southern region strawberry research and extension folks are meeting with national experts and Canadian representatives in late March to plan methods to avoid a repeat of this past fall.

First Results of 2013 Monitoring for Fungicide Resistance in the Gray Mold

Pathogen *Botrytis cinerea*
Dolores Fernández-Ortuño and Guido Schnabel
Clemson University

Gray mold caused by the fungus *Botrytis cinerea* is probably the most economically important disease of strawberry worldwide. Infection of strawberry flowers is caused by spores and results in fruit decay. Fruit infections begin as small, firm, light brown lesions that enlarge quickly and fruit become covered with a gray fuzzy mass of spores followed by a soft rot. Gray mold disease can easily spread during periods of rainy and cool weather, heavy dews, or high relative humidity.
Chemical control of gray mold is essential to prevent fruit decay before and after harvest but resistance in *B. cinerea* to key fungicides is emerging. Therefore we started an extension program at Clemson University, which provides farm-specific fungicide resistance profiles. In our laboratory, fungicide sensitivity assays are performed that allow the distinction of sensitive from resistant isolates. During the 2011/2012 growing season we collected gray mold from commercial fields in Arkansas, Florida, Georgia, Kansas, Maryland, North Carolina, South Carolina, and Virginia. From each field we collected spores from ten berries (called a sample) and confirmed that the gray mold fungus was resistant to multiple chemical classes. The majority of the samples analyzed contained fungus that was resistant to Topsin M and Pristine. Half of the samples had a significant portion of fungus that was resistant to Scala and Elevate fungicides. Resistance to Rovral and Switch was rare (**Figure 1**).

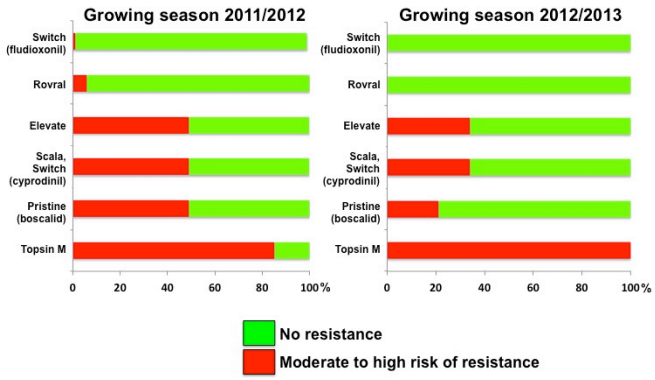


Figure 1: *Percent of samples with resistance to fungicide (red) collected from 8 states.*

This season we are providing the same service to strawberry growers and so far, we received samples from Georgia, Maryland, North Carolina, South Carolina, and Virginia. Fungicide resistance is still present and virtually all samples are resistant to Topsin M. In contrast to last year, however, resistance to Pristine has not been found that often. Only every 5th sample on average is resistant to Pristine. Rovral and Switch remain to be great options against gray mold disease but remember that Rovral is restricted to one application prior to bloom (**Figure 1**).
If you are are a strawberry or blackberry grower and you are interested in getting your farm-specific resistance profile to identify ineffective fungicides, send us around 40 dead strawberry (or blackberry) flowers or collect spores from newly infected, decaying fruit with a cotton swab. We need about 10 to 15 of those swabs (each from a different fruit and each fruit from plants far enough apart to represent an acre or so). Make sure that you only collect the fungus spores, do not touch the fruit (**Figure 2).** Mail the flowers or the swabs to Guido Schnabel, Clemson University, 114 Long Hall, Clemson, SC 29634 and tell us the origin of the sample, your name, and e-mail so that we can send you the report electronically. Upon receipt, we need about 3 (for cotton swabs) to 5 (for flowers) working days to get a report to you outlining farm specific gray mold management recommendations.

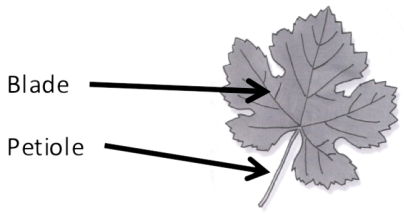
Figure 2: *How to collect spores from strawberries affected with gray mold using cotton swabs.*

Petiole Analysis for Vineyards

David W. Lockwood
Plant Sciences, University of Tennessee

Before the vineyard is planted, extensive soil sampling is a valuable way to determine the need for lime and several nutrients essential for good vineyard performance. Once the vineyard has been planted, the primary value of routine soil testing is to monitor soil pH, which will affect nutrient availability to the vine. Tissue analysis should be used to determine the actual nutrient status of vines. Both are components of a good nutrient management program for established vineyards and should be combined with observations of vineyard performance (leaf color, shoot growth, crop load, weather) and records of vineyard performance from previous years to give a reliable guide for fertilizer applications.

What to Sample:
Reliable results from tissue analysis depend on collecting the proper plant tissue at the appropriate time. For bunch grapes, the leaf petiole is generally used for analysis; however, some labs use leaf blades or entire leaves. Differences exist between the nutrient content of these plant parts. Therefore, always follow the instructions given by the lab that will perform the analysis.



Uses of Tissue Analysis:
Tissue analysis can be used as a troubleshooting tool to confirm or deny a suspected nutrient problem in vines or as a way to monitor nutrient levels in vines to anticipate problems (deficiency, toxicity, imbalance) before they become yield or quality limiting. Frequently, by the time a nutrient disorder becomes visible, considerable losses in regards to yields or fruit quality may have already occurred. These losses will continue to occur until the nutrient problem has been resolved.

Troubleshooting: Sampling to investigate a suspected nutrient problem can be done at any time throughout the growing season when leaf symptoms are present. Petioles should be collected from “affected” and “normal” vines of the same variety/rootstock growing in the same general area. Only one variety of grapes should be included in a sample. Leaves free of insect or disease injury should be collected from the same general location on all vines sampled. Remove the leaf at the point of attachment to the shoot on the vine. Separate the leaf and petiole, discard the leaf blade and put the petiole in a clean paper bag and stored in a clean, dust-free area to air dry prior to shipment to the lab for analysis. The number of petioles to collect for a sample will depend somewhat on the size of the petioles and may range from about 60 to over 100. Only a couple of petioles should be collected from a single vine.
Monitoring the nutritional status of a vineyard over times is perhaps the most valuable usage of tissue analysis. By sampling the same blocks of vines over a period of years, trends in nutrient composition can be identified and potential problems can be addressed before fruit quality and yields are adversely impacted.

In the Southeast, the preferred time for collecting petiole samples is at full bloom, defined as when 50 to 70% of the calyptras (caps) are off. The petiole should be taken from the leaf that is opposite the basal cluster on a shoot. Samples collected at this time may provide a more accurate indication of nitrogen, boron and zinc levels than samples collected at a later date. In the case of nitrogen, sampling at full bloom will allow corrective applications to be applied during the same growing season. If questions arise concerning the results of the full bloom petiole analysis, a second test with samples collected at veraison may be warranted. The sufficiency ranges for "full bloom" and "veraison" samples are different.

Grape vine shoot at bloom (left) and veraison (right) with appropriate leaf for sampling circled. (Please note that the three smallest leaves appear flat in this illustration, whereas on the actual shoot they would be curled in towards the shoot tip.)

Figure taken from PNW622, "Sampling Guide for Nutrient Assessment of Irrigated Vineyards in the Inland Pacific Northwest."

Sampling at veraison is recommended in some areas. In this case, the petiole from the youngest mature leaf (generally about the 5th to 7th leaf down from the growing tip) should be selected. Veraison sampling may provide more reliable information regarding the status of potassium and magnesium than full bloom sampling. This sampling time is used for applications of nutrients after harvest or during the following growing season. It may be more difficult to get good samples at veraison than at full bloom since the leaves have been exposed to potential insect or disease damage for a longer period of time and because shoots may have been topped to keep them from shading the fruiting zone of the vine, making selection of the most recently matured leaf impossible.

Sample Collection Tips:

The quality of a sample collected for analysis has a direct bearing on the accuracy of the results received from the lab doing the analysis and may reflect the greatest source of error associated with tissue analysis. Regardless of when samples are collected, following certain guidelines in obtaining them is essential for getting results that are representative of the vineyard as a whole:

1. Delay sampling until vines begin to bear fruit.
2. Sample each variety/rootstock combination separately.
3. Sample vines of the same age.
4. Sample only "healthy" leaves. Avoid those damaged by insects or diseases.
5. Avoid or sample separately areas of the vineyard showing obvious growth differences.
6. Collect samples from the same relative positions on the vines and on both sides of the vines.
7. Collect only a couple of petioles per vine.
8. Collect 60 to 100 petioles per sample. A larger number will be desirable for varieties having small petioles.
9. Restrict sample size to not over 10 acres, less on uneven land.
10. Sample prior to a pesticide application, not shortly after one.
11. Avoid collecting petioles from outside rows or end vines on rows.
12. Put petioles in clean paper (not plastic) bags and allow to air dry in a clean, dust-free site before sending them to the lab. If the petioles are dirty or dusty, briefly rinse them in distilled or deionized water shortly after they have been collected. Do not let the petioles soak in the water as nutrients will be leached out. Likewise, do not wash dried

petioles. Spread out petioles on a clean, dust-free surface and allow them to air dry before placing them in paper bags.

13. Make sure sample bags are clearly identified for the lab and keep a copy of the key for your records.
14. Make a map showing where each sample was collected so that you will be able to treat areas of the vineyard based on their needs.
15. If a recent soil sample (within the last 3 years) has not been taken over the area where petiole samples were collected, do so as this will be necessary to properly understand petiole analysis results. Although the correlation between soil test results and actual nutrient composition of the vine may be poor, soil pH will have an influence on the availability of nutrients to the vine and can, therefore, be useful in interpreting tissue analysis results.
16. Keep the results of petiole analysis and soil test results for future reference. Include observations on shoot length; leaf color and crop load with lab test results as they all should be used in formulating a fertilizer program. Results from the lab should be compared to sufficiency ranges for various nutrients to identify sources of concern. Graphing results of analysis over a period of years is useful in detecting trends in nutrient concentrations.

With the high investment involved in establishing and maintaining a vineyard, petiole analysis is a valuable tool to aid in recognizing the full potential of the vineyard.

Alion Herbicide Cleared for Use in Grape Vineyards

Wayne Mitchem,
Extension Associate,
NCSU, Clemson Univ., UGA, Cooperatively
Department of Horticultural Science

Alion is a preemergence herbicide developed for use in perennial fruit crops by Bayer Crop Science. It was registered for use in apple and peach orchards in 2012 and a supplemental label has been issued by Bayer for use in grape vineyards. The active ingredient in Alion is indaziflam which the first member of entirely new herbicide chemistry family thus prompting the creation of herbicide “Group 29” for cellulose synthesis inhibitors by the Weed Science Society of America.

In field trials conducted in NC and SC over the past few years Alion has provided broad spectrum, long lasting residual control of annual broadleaf and grass weeds. Unlike other recently registered products, Chateau and Matrix, Alion has NO postemergence activity, it is purely a preemergence herbicide.

Alion can only be used in vineyards established 5 years or longer. It cannot be used in vineyards planted in soils containing 20% or greater gravel content or applied around vines planted in sand soils. The use rate for Alion is 5 fl. oz/A which can applied once in a 12 month period. Alion cannot be used on grapes grown in Georgia or Florida. In order to control emerged weeds Alion should be tank mixed with a non-selective postemergence herbicide like glyphosate, paraquat, or Rely.

In order to maximize performance, Alion should be applied as a delayed preemergence application. This program consists of a non-selective postemergence herbicide application just prior to bud break to control winter weeds followed by Alion tank mixed with a non-selective postemergence herbicide application when summer weeds are 1 to 3” tall. In western North Carolina the second application including of the Alion tank mix would generally be applied in early to mid May thus providing

residual annual broadleaf and grass weed control through the summer. Alion will not control or suppress bermudagrass, Johnsongrass, or nutsedge species.
The supplemental label for grapes can be viewed at www.cdms.net

Picture 1: Peach orchard in the fall following a May application of Alion applied at 5 fl. oz/A

Strawberry Plant Health Meeting Held on March 27, 2013 – Debby Wechsler, Executive Secretary, NCSA

(Article reprinted from The Strawberry Grower, April, 2013 Vol. 20 No. 3, with photos and captions provided by Dr. E. Barclay Poling, Professor, Emeritus, NC State University)

What can be done to reduce the incidence and damaging effects of viruses and diseases in the strawberry plant supply? This question was on the minds of the more than 60 people who participated in a Strawberry Plant Health Mini-Symposium and Discussion held on March 27 at the NCSU University Club in Raleigh. This meeting arose out of a discussion held at the Southeast Strawberry Expo last November. Attendees came from near and far, and included representatives from the nurseries in Canada, California, Virginia, and North Carolina, from the Florida Strawberry Growers Association, and programs in California, Washington state, and North Carolina, NCSA board members research/extension specialists from Oregon, North Carolina, Virginia, South Carolina and Nova Scotia, and more.
The lead speaker was Dr. Bob Martin, USDA-ARS Corvallis, Oregon, who has played a key role in identifying the cause of stunted plantings in Florida, North Carolina, South Carolina, Virginia, and other states within our production region. (Articles on this were published in The Strawberry Grower in the December, Jan-Feb and March issues.) A widely acknowledged expert on strawberry viruses, Dr. Martin had tested samples of plants sent to him and determined that problems were caused by a combination of two viruses, Strawberry Mild Yellow Edge Virus (SMYEV) and Strawberry Mottle Virus (SMoV). As is often the case with viruses, plants with one virus were asymptomatic; they had to have both. The two viruses are aphid-vectored. Dr. Martin also explained a similar outbreak that had occurred on the West Coast a few years ago and how it had been overcome and discussed how to to prevent problem from reoccurring in the nursery situation and protocols and practices for monitoring and testing for both virus and aphids.

Dr. Barclay Poling then described how the new and mysterious symptoms were investigated by a multistate team of extension, researchers and growers (Figures 1 & 2).

Figures 1a & 1b: *In a late fall visit to Great Village, Nova Scotia (12/3-12/5/12), Dr. Poling was able to see the strawberry nursery runner tip beds of Joe Cooper (shown in photo on left). Dr. Poling, Joe Cooper and Perennia's Horticulturist and Plant Inspector, John Lewis, also walked the Balamore Farms fresh dug bare-root fields on the same day; and , in the fresh dug field of Winterstar™ ('FL 05-107'), Dr. Poling noted extreme symptoms of leaf yellowing, stunting, and leaf distortion (photo on right)*


Figures 2a & 2b: *Within 4-6 weeks of planting last fall, a number of strawberry producers in Virginia and North Carolina and South Carolina, began noticing poor growth in the fields. The photo on the left was taken by Chuck Johnson, Extension Plant Pathologist, VA-Tech in Virginia Beach on 12/19/12. The photo on the right (2b) was taken by Dr. Poling of another Chandler plug field in North Carolina on 3/26/13, just the day before the Plant Health meeting in Raleigh (3/27/13). This particular field in Knightdale, NC, was planted in Chandler plugs on 9/27/12, and after noticing the poor growth of some plants in the field just before Thanksgiving, Dr. Poling sent leaf samples off to Dr. Martin's lab in Oregon just before Christmas. The results of laboratory testing showed that the smaller plants in this field tested positive for Strawberry Mild Yellow Edge Virus (SMYEV) and Strawberry Mottle Virus (SMoV). The larger plants in this field were positive for SMYEV, but negative for SMoV.*

Attendees heard from Certification and plant stock management programs in several states and Nova Scotia, and from nursery producers in California, Virginia, Prince Edward Island, and Nova Scotia about their programs and production systems. Joe Cooper of Balamore Farm, a nursery producer from the area of Nova Scotia where the virus complex emerged, spoke of the aggressive steps that he and other strawberry growers in the area are taking to assure that the same problems do not occur in 2013 plantings and to monitor and test their fields (Figure 3).

Figure 3: *Joe Cooper, Balamore Farms (standing next to flip-chart), discussed the "aggressive steps" (including a strawberry crop destruct in Great Village region), that he and other strawberry nursery and fruit growers are taking to hopefully prevent any future virus infections from occurring in their nurseries.*

While viruses were a main topic of conversation, the importance of other plant-source-related disease concerns, including anthracnose and angular leaf spot, was also acknowledged.

Several speakers described the National Clean Plant Network (NCPN), including Dr. Erich Rudyj, the overall head of this relatively new federal program (see http://nationalcleanplantnetwork.org/). Dr. Martin leads the Berries section of the NCPN, and both the NCSU Micropropagation Unit and Repository at NCSU, led by Dr. Zvezdana Pesic-vanEsbroeck and Dr. Martin's USDA-ARS center in Oregon are clean plant centers for berries. NCPN subgroups are already working on developing best practices to assist the caneberry and blueberry nursery industry.

The final discussion focused on "Where do we go from here?" Many participants spoke in favor of ongoing and open communication among the many stakeholders in the strawberry plant nursery, including across state, regional and national lines; nursery representatives in particular were interested in enhancing communication and information sharing among themselves. An executive summary of the meeting will be developed and made available.

Further discussions will likely occur at the Southeast Strawberry Expo in December.

This meeting was funded by the Southern Region Small Fruit Consortium; the lead planning committee consisted of Dr. Powell Smith, Clemson University (who chaired the meeting), Dr. Barclay Poling, and Dr. Zvezdana Pesic-vanEsbroeck of the MPUR.

Dual Magnum Herbicide Granted 24(c) for Use on Caneberry and Blueberry in NC

Wayne Mitchem, Extension Associate &
Katherine Jennings, Research Assistant Professor

A label has been issued allowing Dual Magnum to be applied in North Carolina caneberry and blueberry plantings as a directed spray. In order to use Dual Magnum in these crops growers will have to acquire a label by visiting www.farmassist.com to set up an account and agree to terms outlined by Syngenta. In order to legally use Dual Magnum in these crops growers must have a 24(c) label on site. Dual Magnum use rates in blueberry range from 0.67 to 1.33 pt/A while caneberries may be treated with 1 to 2 pt/A. Only one application is allowed per year and the lower rate should be used around young plants to mitigate the potential for crop injury. Dual Magnum has a 28 day PHI.

This label provides growers with another option for preemergence control of annual grasses like crabgrass, goosegrass, foxtail sp., fall panicum, and broadleaf signalgrass. Dual Magnum also controls pigweed species, including Palmer amaranth, galinsoga, nightshade, carpetweed, and Florida pusley. One of Dual's most significant attributes is the fact that it will provide some preemergence control of yellow nutsedge.

Growers need to remember that Dual Magnum has no postemergence activity and will have to be tank mixed with another herbicide once weeds have emerged.

Blackberry and Raspberry Seasonal Checklist Spring 2013

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 you progress through the season. 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.

Plant growth and development

- Plants deacclimate quickly
- Bud differentiation (additional flowers formed)
- Bud break
- Flowering
- Primocane emergence

Pruning and trellising

- Finish pruning and make sure all floricanes are tied to the trellis before budbreak.
- Rotate shift trellises to horizontal position before budbreak; rotate to upright position immediately after flowering.

Weeds

- Weed growth can be very vigorous at the same time as the bramble crop peaks. Don't let weeds get out of control.
- Weed control is best done earlier in the season before harvest commences.
- Hand-weed perennial weeds in and around plots.

Insect and disease scouting

- The period of time in the spring when the plant is flowering is the most important season for control of insects and diseases. Know what your pests are and how to control them.
- The SRSFC IPM guide is a great source for up to date recommendations. http://www.smallfruits.org/SmallFruitsRegGuide/Guides/2012/2012BrambleSprayGuide.pdf
- The latest information on Spotted Wing Drosophila information can be found at various sites including Dr. Hannah Burracks blog http://ncsmallfruitsipm.blogspot.com/

Water management

- Bramble plants need about 1"-2" water/week. This amount will be especially critical during harvest.

Nutrient management

- Drip application 60-80 lbs/acre
  - Spring
    - N 15 lbs/acre March 1
    - N 10 lbs/acre March 15, April 1, April 15
    - N 5 lbs/acre early May
  - After harvest
    - Remainder of N recommended for the year

Marketing and miscellaneous

- Service and clean coolers.
- Make sure you have enough containers for fruit in the coming season.
- Prepare advertising and signage for your stand.
- Contact buyers to finalize orders.
- Hire pickers.
- Prepare signage for field orientation; it is easier to tell pickers where to go if rows are numbered.

NOTE: NC Cooperative Extension will be taking over the Blackberry and Raspberry Information Portal in 2013. The site will have essentially the same material, but a new look. Here is a direct link to that site http://rubus.ces.ncsu.edu/

There will also be an NC Cooperative Extension Entomology Portal that will host information for small fruit growers, a link will be provided through the Rubus portal listed above.

Strawberry Seasonal Checklist

E. Barclay Poling
Professor Emeritus & Small Fruit Specialist
North Carolina State University

This checklist was originally developed for growers in North Carolina. You will have to adjust your work activities either earlier or later depending on your location. For more detailed information, check the Southern Region Integrated Strawberry Management Guide and the Southeast Regional Strawberry Plasticulture Production Guide at: http://www.smallfruits.org/SmallFruitsRegGuide/index.htm

March/April
Grower Checklist

- ✓ In late winter (now) assess any possible problems with winter injury in your crop. (See article at right).
- ✓ Control weeds or ryegrass in aisles with herbicide if you have not done so already.
- ✓ Complete leaf sanitation before the onset of new growth from the crown – this can help to reduce grey mold and angular leafspot (ALS) pressure in a cool/wet spring season.

- ✓ When new leaf growth begins, pull up side crowns and leaves caught under plastic.
- ✓ Make sure irrigation systems for frost protection and drip are ready for use. Check your frost alarm and test your thermometers.
- ✓ Hook up drip within one week after new growth has started. Make first N fertilizer injection.
- ✓ Scout fields NOW for mites, insects, and diseases. Botrytis, anthracnose, powdery mildew, aphids, thrips, mites, and clippers will be your primary pest problems at this time. Send suspicious-looking plants to the clinic for diagnosis ASAP.
- ✓ Check for fungicide-resistant botrytis in your fields by sending 20 to 40 dead strawberry blossoms to Clemson's lab for evaluation – they can tell you which fungicides have lost efficacy for you. (http://ncsu.edu/enterprises/strawberries/2012/03/29/collecting-and-mailing-gray-mold-samples-for-fungicide-resistance-testing)
- ✓ If your plants were sourced out of the Great Village, Nova Scotia region (check with your plug supplier if you are unsure), be sure to read the article on pages 4-6 and follow recommendations. If you decide to treat for strawberry aphids be sure to apply the systemic insecticides at least 14 days before bloom to avoid injuring pollinator populations.
- ✓ Try to get pest and disease problems under control with dormant, pre-bloom, and pre-harvest sprays. Customers don't like to see sprayers in the field when they are picking, and a few early sprays can be more effective than a lot of late ones. Some fungicides can only be used in the pre-bloom period.
- ✓ Check the 2013 Southern Region IPM Guide for Strawberries for current information on the most effective fungicides for disease control in the pre-bloom and bloom periods; try to avoid fungicides for which grey mold resistance may be a problem. Find it at www.smallfruits.org.
- ✓ Monitor weather forecasts closely.
- ✓ Bookmark the new Strawberry Growers Information website http://strawberries.ces.ncsu.edu (this replaces the "Portal") – this site is an excellent source of strawberry weather information as well as pest updates
- ✓ Send in leaf samples every 14 days and adjust fertility accordingly. Drip as needed.
- ✓ Apply straw mulch in aisles.
- ✓ Place two hives of honeybees per acre near your field.

Getting ready for harvest time

- ✓ Order signs, Strawberry Time booklets and other promo materials and from NCSA now. (See pages 10-11).
- ✓ Schedule picking and sales labor.
- ✓ Develop, write down, and implement food safety and crisis management plans.
- ✓ Train workers in farm and food safety practices. Train workers that interact with the public in customer relations.
- ✓ Order porta-potties and emphasize proper sanitation for farm laborers.
- ✓ Check with your buyers to make sure they are ready for your berries.
- ✓ New growers: make sure your customers know where you are and when you will start picking. Consider running an ad a couple of weeks before harvest to remind them that you will have berries.
- ✓ Get stand ready for sales as season approaches. Tidy up around stand.
- ✓ Have scales checked by NCDA well before needed.
- ✓ Check inventory for supplies: picking containers, quart baskets, flats, etc.

- ✓ When berries are ready, put out signs on roadsides to direct customers to your fields. Start the season!

Small Fruit News
Volume 13, No.2 April 2013

Editor and Contributor Tom Monaco

Published is four times a year. Small Fruit News is available on the Southern Region Small Fruit Consortium (SRSFC) web site www.smallfruits.org.

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