

Small Fruit News

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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:

Viticulture Agent Training

Tony Wolf, Virginia Tech
Director, AHS Jr. Agricultural Research and
Extension Center, Winchester, VA.

Thirty Cooperative Extension agents from five southeast US states attended two days of viticulture in-service training in northern Virginia on 11-12 June. The training programs, actually two separate meetings, were sponsored by Virginia Cooperative Extension, the Southern Region Small Fruit Consortium, the Virginia Vineyards Association, and the USDA/NIFA's Specialty Crop Research Initiative's "*Improved grape and wine quality in a challenging environment: An eastern US model for sustainability and economic vitality*" project, directed by Virginia Tech

(<http://www.ares.vaes.vt.edu/alson-h-smith/grapes/viticulture/research/scri-index.html>).

The meeting on 11 June focused on "Steep Terrain Grape Growing" and was conducted at two premier Virginia vineyards: RdV in Delaplane, and Glen Manor Vineyards near Front Royal. Organized by Virginia Tech's Tony Wolf, professor of viticulture, the "Steep Terrain" focus was intended to illustrate some of the benefits and liabilities of grape production on sites with slopes steeper than 15%; some of the

slopes at RdV and Glen Manor approach 40%. Agents joined approximately 150 industry members for the day to learn how vineyard owners Rutger de Vink (RdV Vineyards) and Jeff White (Glen Manor Vineyards) developed and currently manage their vineyards.

There is increased development of vineyards on steep terrain in the piedmont and mountain regions of the southeast, including Virginia, due to several factors. Vineyards in this region often receive more rainfall than desired for optimal vine growth and grapevine canopy development. Unattended, the persistent, vegetative growth can lead to dense, heavily shaded canopy fruit zones that foster fruit rots, other diseases, and reduced fruit and wine quality potential. Growers have dealt with this excessive vegetative growth by using a toolbox of canopy management measures that include leaf and lateral shoot thinning from fruit zones, shoot positioning, and repeated shoot hedging to maintain desirable canopy architecture.

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The labor costs associated with this activity can be enormous. One advantage to moving into steeper terrain sites relates to soil hydrology: steeper sites often have relatively thin soils, and thus relatively low water-holding capacity. Less plant-available water can translate into less vegetative growth which, in moderation, is good for canopy management and fruit/wine quality. Inclined land forms also shed water more rapidly than do flat surfaces, both internally and on the surface. In a similar fashion, inclined slopes tend to 'drain' cold air better than do flat surfaces, which can be of benefit in regions prone to late spring and early fall frosts. Importantly, with increasing land value, vineyard developers are also looking at steeper sites simply because such sites are less easily developed or farmed, and often command a lower land price.

The "cost" of developing steep vineyard sites includes the greater potential of soil erosion, increased development costs associated with land clearing, the potential need to purchase specialized machinery to operate on steep slopes, and increased labor costs to install and annually maintain the vineyard. The day's speakers presented information on resources available through the USDA's Natural Resources Conservation Service, soil mapping services available through commercial soil scientists, equipment vendors offering tracked machinery for added traction and safety on steeper slopes, a discussion on machinery safety, and a discussion on vineyard floor management on erodible sites. Vineyard owners de Vink and White shared their thoughts and experiences with agents and others on their respective quests to produce world class wines. Does the investment pay off? That's difficult to say at this point as neither vineyardist was specific about what the development costs were for their respective operation. However, both the 2010 RdV "Lost Mountain" wine and the 2010 Glen Manor "Hodder Hill" wine were top 12 gold medal winners in the 2013 Virginia Governor's Cup competition. The 2009 Hodder Hill won the coveted Governor's Cup top honor the previous

year. It's short-sighted to say that the vineyard site was the sole factor in the success of these wines. Instead, that quality distinction reflects the attention to vineyard design and management and positive site features which, collectively, increase the odds of delivering high quality grapes to the winery.



Figure1: Rutger de Vink (RdV Vineyards) addresses attendees of the "Steep Terrain" grape growing workshop on 11 June.

The second day of agent training (12 June) was conducted at Virginia Tech's Agricultural Research and Extension Center (AREC) near Winchester. Speakers included Tony Wolf, Sara Spayd (North Carolina State University), and Fritz Westover (Central Coast Vineyard Team [CA]). The goal of the 12 June meeting was to define vine "balance" and explain how balance relates to wine grape crop production, disease management, and wine quality objectives. Agents were also introduced to practical measures that can be used to assess vine balance – both in the pre-plant phase of vineyard design and once the vineyard is established and operational. The morning "classroom" sessions were followed in the afternoon by a hand's-on demonstration of canopy assessment using vines in the AREC research vineyard. Vines were "scored" on the basis of canopy leaf layer number, shoot density, shoot length, cluster exposure, and other metrics. Vine canopy assessment and management remains fundamentally and practically one of the most important areas of

wine grape management in our “challenging” environment.

It wasn’t all work; agents and other attendees were treated to dinner and a social on the first evening and to dinner and local wines on the second evening of training.

Dodder Management in Blueberries

Phil Brannen (UGA Plant Pathology Department)
Mark Czarnota (UGA Horticulture Department)

Dodder (*Cuscuta* spp.) is a parasitic seed plant that is also considered a weed in agronomic situations. If left unattended, it can cause severe growth inhibition, stunting, malformation, and death of blueberry plants (Figs. 1 and 2). Drs. Wendy Zomlefer and Joel McNeal (UGA Plant Biology), Mark Czarnota (UGA Horticulture), and Richard Carter (Valdosta State) helped to confirm dodder in several blueberry fields in South Georgia. Dr. Neal indicated that we definitely have “*Cuscuta compacta* (a dodder), which is known to parasitize blueberries from time to time. It is a wetland species that likes sapling-sized plant species like *Alnus serrulata*, *Aralia spinosa*, *Clethra*, and *Vaccinium* [blueberry]. It’s native to the Southeast and not usually weedy, except for blueberries – unfortunately.”

Dodder is in the morningglory family (Convolvulaceae), so the seeds are about as big as a BB. There are several (8-10) dodder seed in each dodder fruit (pod), and each plant has the potential to produce thousands of seed which are dispersed when the fruit dries and shatters. Dodder is not really considered an invasive (doesn’t really occupy that much undisturbed land), but it is on the federal noxious weed list (an effort to prevent seed movement). It has also been reported that dodder could potentially transfer some disease-causing viruses and phytoplasmas – another good reason to keep fields clean of this plant.

Dodder usually occurs in isolated spots in a field, but these gradually increase if dodder is not controlled; rapid removal is important, as you do not want dodder to produce haustoria (modified roots that penetrate the host plant to absorb nutrients/moisture and which can produce new plantlets) and/or seeds. The hard seed coats have been reported to give long-term survival of dodder seed, as the seed can lay dormant in the field for years and only germinate when conditions are optimum.

Bill Cline (NC State) indicates that dodder is a recurring problem in North Carolina blueberry fields. Bill states that “the seed pods should be collected by carefully pruning out infested branches and bagging to avoid scattering seeds. We have spots at the Castle Hayne station where dodder has recurred every year for the last 25 years, because we made the mistake of letting it go to seed.” If producers identify dodder on blueberry plants, they should immediately destroy the dodder and plant parts which have been attacked. Simply having dodder does not automatically result in plant mortality or require complete plant destruction, but where the plants are inundated with dodder (Fig. 1) or actually dead, this would be the easiest way to remove seeds and infested plant parts from the site. Dodder does not generally penetrate bark, but it will penetrate plant foliage, producing haustoria that embed themselves in the plant tissues. Therefore, in addition to controlling seeds, infested stems and canes must be destroyed in order to keep the haustoria from regenerating to produce a new infestation.

Growers who have been most successful in controlling dodder are the ones who have managed to catch it in the early stages of growth and actually hand-remove the strands; this is labor-intensive but effective, especially when it has just gotten started and is only in a single bush or two. If plant parts or plants must be destroyed, it is best to break down the plants by cutting them up and placing all seed pods in a large trash bag; once removed from the field,

the dodder and infested plant segments should be destroyed by thorough burning. If dodder is left unattended, mechanical harvesters and tractors with spray rigs, sickle-bar pruners, etc. will do a great job of both opening pods and moving seeds from a localized source. In some cases, producers have simply removed plants with a tractor and chain – dragging the plants to the edge of the field and leaving a trail of seeds along the row for subsequent germination; obviously, this is not the recommended “school solution.”

Several preemergence herbicides will likely control dodder from seed. No published research exists on control of dodder seed in blueberry fields with labeled active ingredients. However, products that control morningglory plants from seed will probably work well for dodder management. These products include Karmex (diuron), Chateau (flumioxazin), Solicam (norflurazon), Kerb (proamide), and Princep/Surflan (simazine/oryzalin) combinations. Other products on the horizon, such as Zeus (sulfentrazone) and Alion (indaziflam), also look promising. To insure the best control of dodder, make preemergence herbicide applications in December-January and again in March-April. As with all pesticides, be sure to follow label application instructions.

See the following sites for additional information on Dodder:

<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7496.html>

<http://plants.usda.gov/java/profile?symbol=CUCO2>



Figure 1: Blueberry plant showing signs of dodder.

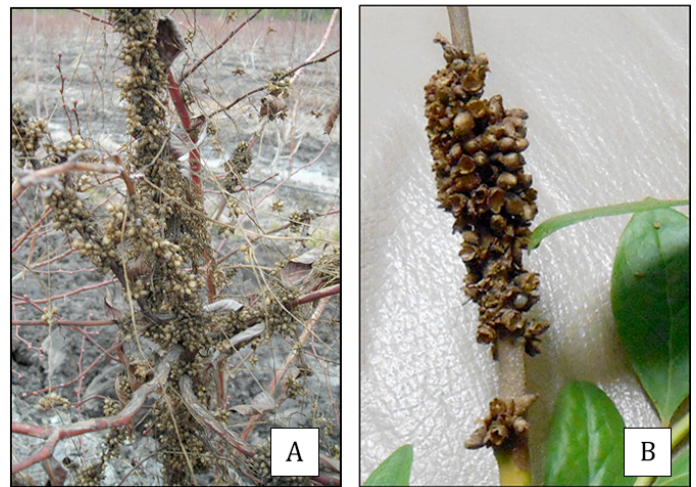


Figure 2: Closeup of blueberry plants showing dodder seed pods (fruit) in winter and early summer. Stems are completely inundated by this parasitic seed plant as seed pods develop and mature (A). By early summer, seed have been released by shatter of the seed pods, and the stems are dead or dying (B) (photo courtesy of Erick Smith, UGA Horticulture).

Introducing Aromella and Arandell - Newest Products of Cornell's Grape Breeding Program

By Amanda Garriss and Tim Martinson
Reprinted from the Appellation Cornell Newsletter



Cornell Grape Breeder Bruce Reisch and enologist Anna Katharine Mansfield announced the release of two new wine grape varieties, Aromella and Arandell, at the Viticulture 2013 conference held in Rochester, New York, on February 7.



Bruce Reisch and Anna Katharine Mansfield

These two new cultivars are the latest in a line that stretches back to Cornell's first named variety in 1906, Goff, and joins recent wine grape introductions including Traminette (1996), Geneva Red (formerly GR7, 2003), and Corot Noir, Noiret, and Valvin Muscat (2006). With thousands of existing wine grape varieties in existence – and over 40 grown in the Finger Lakes alone – why release these two new ones? The answer is that they offer new characteristics not previously available to growers and wineries, expanding the range of products available to the industry.

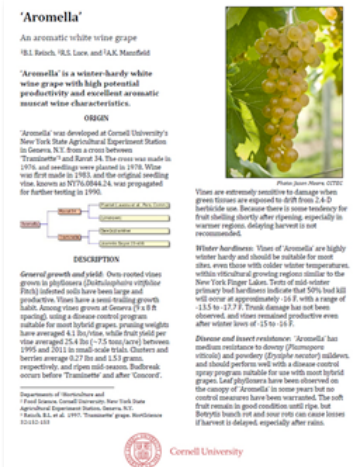
Since the 1980s the breeding program has focused on varieties that reduce the risk of winter damage in cool climate areas, combine winter hardiness with desired wine flavor attributes, and display high levels of disease resistance to fungal pathogens that affect production, especially in non-irrigated Eastern production areas with high rainfall.

So what do these new varieties offer?

Aromella

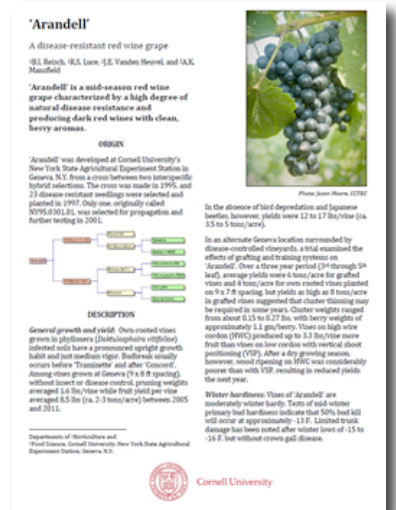
(NY76.0844.24), a progeny of Traminette and Ravat 34 that was crossed in 1976 and has been in testing since the first wines were produced from a single vine in 1983. Producing aromatic white wines that range from 'floral' to 'muscat,' Aromella is highly winter hardy and productive, with own-rooted vines producing 25.4 lb/vine of fruit (about 7.5 T/acre) and pruning weights around 4 lb/vine.

Valvin Muscat produces wines with a similar range of muscat flavors, but Aromella is both more productive and more winter hardy. Detailed information is available in the release bulletin.



Arandell

(NY95.0301.01) resulted from a more recent cross made in 1995 and is the first named cultivar to come out of the 'no-spray' block that Reisch established in the late 1980s. It is



highly resistant to powdery mildew, downy mildew, and *Botrytis*, and combines this disease resistance with good wine quality. It is still moderately susceptible to black rot and phomopsis, and while fungicides have never been applied in Cornell trials, growers should be able to produce clean, ripe fruit with a minimal spray program. It produces dark, red wines with clean berry aromas. Detailed information is available in the release bulletin.

Pre-release testing of these two new varieties has involved not only several years of vineyard observations, but also winemaking, starting with lots made from single vines, and later with larger lots of fruit, using a wide variety of yeasts and fermentation techniques. Winemaking recommendations are included in the Aromella and Arandell release bulletins.

Where did the names come from? In naming new varieties, the breeding program strives for names that are unique, marketable, not already trademarked, easy to pronounce and conjure positive connotations. This time the program took a new approach to naming: crowdsourcing ideas. An appeal for ideas went first to colleagues before spreading to the global wine community (See Cornell's Name that Grape Contest Goes Viral in Appellation Cornell issue 10). Arandell—a portmanteau of "arándano," the Spanish word for blueberry, and the "ell" from Cornell—was suggested by Michael Fleischhauer, a retired computer analyst and wine enthusiast from Juneau, Alaska. Michael Borboa, the export winemaker at Bear Creek Winery in Lodi, California, who is also a songwriter, came up the name Aromella. Arandell and Aromella are the 55th and 56th grape varieties named by the New York State Agricultural Experiment Station and provide exciting new options for growers. Both varieties are available for purchase from nurseries licensed through the Cornell Center for Technology Enterprise and Commercialization (CCTEC) or as virus-tested cuttings from Foundation Plant Services. Also available at the CCTEC site are a Cornell grape variety

comparison chart and posters for Arandell and Aromella.

A complete listing of Cornell varieties released since 1906 and their parentage is available on Bruce Reisch's grape breeding web site.

Acknowledgement. We gratefully acknowledge the funding provided by the USDA Viticulture Consortium-East, the New York Wine and Grape Foundation, the Lake Erie Regional Grape Program, and Federal Formula Funds through the Hatch Act. We thank the previous project leaders, Robert Pool and Thomas Henick-Kling for their contributions to the project, as well as technical support provided by Luann Preston-Wilsey, Patricia Wallace, Pam Raes, John Watson, and Mary-Howell Martens.

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Prime-Ark® Freedom' Primocane-Fruiting Thornless Blackberry

John R. Clark, University of Arkansas

'Prime-Ark® Freedom' is the world's first primocane-fruited thornless blackberry commercial introduction. It is intended primarily as a home garden or local-market plant. In addition to having thornless canes, this new introduction has very large fruits with good flavor, and is very early ripening on floricanes, the earliest of all Arkansas blackberry varieties. Fruit of 'Prime-Ark® Freedom' does not exhibit exceptional postharvest storage potential however, and 'Prime-Ark® Freedom' is not recommended for the shipping market. 'Prime-Ark® Freedom' resulted from a controlled hybridization made in 2004 at the University of Arkansas Fruit Research Station, Clarksville (FRS). The original plant was selected in June, 2007 from a population of 309 plants in a

seedling field at the same location during evaluation of floricanes fruits. It was tested as selection APF-153T.

Yield: Floricane yields of 'Prime-Ark[®] Freedom' are comparable to 'Prime-Ark[®] 45', and can range near that of 'Osage' and 'Ouachita'. Primocane yields have been very disappointing at FRS for primocane-fruiting cultivars, and this is due to very high summer temperatures in recent years. One positive aspect of the reduced primocane production is that this results in substantial yield potential if the canes are retained for the floricane crop the following year. Yield data from a coastal California trial indicated substantial promise for the primocane crop for 'Prime-Ark[®] Freedom' as it appears comparable to 'Prime-Ark[®] 45' in yield in limited evaluations.

Berry size: 'Prime-Ark[®] Freedom' floricanes berries average 9 g in Arkansas, larger than other named varieties including 'Natchez' (see Figure: 1 photos). For primocane berries, weight in Arkansas was slightly less for 'Prime-Ark[®] Freedom' compared to the floricanes fruits of the same cultivar, and was significantly larger than that for 'Prime-Ark[®] 45'. In California, primocane berry weight was observed to be much higher than in Arkansas, up to 16 g.



Figure 1: Photos of 'Prime-Ark[®] Freedom' floricanes fruits, Fruit Research Station, Clarksville, AR.

Maturity date: Floricane first harvest date for 'Prime-Ark[®] Freedom' is very early, up to 9-11 days earlier than the early ripening 'Natchez', and 16-18 days before 'Ouachita'. This exceptionally early floricanes harvest date should make this cultivar very attractive to homeowners and local marketers as it provides very early fruit, earlier than any prior Arkansas thornless blackberry cultivars. Primocane first ripe fruit date has been difficult to fully determine for 'Prime-Ark[®] Freedom' in Arkansas. Observations indicated that first ripe fruit was 18-20 of July on tipped primocanes at FRS although fruit amount was limited, and ripened earlier than an average date reported for 'Prime-Ark[®] 45' of 8 Aug. In California, 'Prime-Ark[®] Freedom' began harvest approximately 10-15 Aug. with harvest extending into early October, an earlier ripening date than 'Prime-Ark[®] 45' of late August to early September.

Flavor and soluble solids (sweetness):

Soluble solids concentration averaged 10.4% for 'Prime-Ark[®] Freedom', slightly lower than 'Prime-Ark[®] 45' (11.4%) and similar to 'Natchez'. Flavor ratings for 'Prime-Ark[®] Freedom' averaged 7.8 (on a 10-point scale, with 10 as best), the same as for 'Prime-Ark[®] 45', higher than for 'Natchez' (7.0) but lower than 'Ouachita' (8.8) and 'Osage' (8.3).

Plant characteristics: Canes of 'Prime-Ark[®] Freedom' are thornless and very erect, similar to 'Ouachita' and more erect than 'Natchez'.

Vigor of 'Prime-Ark®' Freedom' at FRS has usually been rated good, but not excessively vigorous, while in California it was observed to be very vigorous. Floricane bloom dates for 'Prime-Ark® Freedom' were usually earlier than other Arkansas comparison cultivars. This could indicate a lower chilling requirement for this cultivar but that has not been confirmed during the evaluations due to the FRS site being a high-chill location. No orange rust was observed on 'Prime-Ark® Freedom' in any evaluations, even though infected plants were seen within 100-150 ft. of data collection plots in each year of evaluation. 'Prime-Ark® Freedom' berries or canes have not been observed to be susceptible to anthracnose at FRS where a single spray of lime sulfur was applied. Reaction of 'Prime-Ark® Freedom' to rosette/double blossom has not been conducted as this disease did not occur at any of the test sites. It is hoped that it has resistance to this disease as exhibited by other Arkansas thornless blackberry cultivars.

Postharvest evaluations: 'Prime-Ark® Freedom' had lower overall ratings compared to 'Prime-Ark® 45', indicating limited shipping potential. Berry leak was the primary variable that 'Prime-Ark® Freedom' had poor ratings for, with some concerns for soft berries. However, 'Prime-Ark® Freedom' should be acceptable for pick-your-own operations or possibly local marketing where 7-day or longer storage potential is not required.

Plant availability: Virus testing of 'Prime-Ark® Freedom' has been completed by the USDA-ARS in Corvallis, OR, and virus-tested tissue cultures have been provided to tissue culture propagators to begin initial propagation of this new variety. An invitation for licensing has been extended to current University of Arkansas blackberry licensees, and license agreements should begin execution in summer and fall of 2013. Plants of the new variety in limited supplies should be available for order from tissue culture propagators from late summer 2013 into 2014 for spring 2014 delivery.

Strawberry viruses: A reemerging problem

Ioannis E. Tzanetakis, Dept. of Plant Pathology, Division of Agriculture, University of Arkansas System. itzaneta@uark.edu

Are viruses a problem for the strawberry industry? Many will argue that this is not the case as production has moved to an annual plasticulture system. Plants spend minimum time in the ground and there is simply not enough time for viruses to accumulate and cause significant losses.

As in the case of caneberries, strawberry viruses in modern cultivars tend to be symptomless. When two or more accumulate in plants, symptoms that include reduced vigor, leaf distortion, reddening and poor root growth (Fig. 1) become apparent, leading to losses that can reach 100% because of unmarketable fruit or because the cost of labor is higher than the value of the fruit picked. As an example, viruses have caused losses of ~ \$50M in the 2002 and 2003 seasons in California whereas losses across the eastern part of the US for the 2013 season are still being assessed but are estimated in the tens of millions of dollars.

There are four major groups of strawberry viruses based on their mode of transmission: aphids, whiteflies, nematodes and pollen. There are no efficient ways to battle pollen-borne viruses other than avoidance. They tend to appear in pockets where they can cause significant problems but they do not pose a major concern for the industry as a whole. This is also true for nematode-transmitted viruses as nematodes do not move rapidly in the soil and most growers treat soil with pesticides before planting. The two major groups of concern are those transmitted by aphids and whiteflies. During a 10-year study conducted between Dr. R. Martin's lab in Oregon and my lab in Arkansas we were able to map the presence of all major strawberry viruses in the United States. Whitefly-transmitted viruses were

prevalent in California and the upper Midwest whereas aphid borne viruses were found in high incidence in the Pacific Northwest, the East coast and Midsouth.

So what is to be done to avoid virus diseases in strawberry? If the field has a history of viruses it may be appropriate to treat for the vectors that are most prevalent in the area. In general, aphids are the easiest to treat for as they move slowly, they primarily feed on strawberry and they can potentially carry up to nine strawberry viruses. Whiteflies are more difficult to battle as they move rapidly and have a wide range of hosts, providing a potentially constant stream of vectors to the strawberry field.

Still the best way to minimize the impact of virus diseases is to obtain clean plants. Although this will not eliminate the possibility of virus infection in the field; if the transplants are healthy they will establish fast and infection will not have the dramatic effects shown in Figure 1. Using runners from older plants is not a good idea as viruses accumulate, they are not eliminated between seasons. For more information on the subject I list two publications that provide more information on strawberry viruses and their incidence in the United States.

Martin, R.R. and Tzanetakis, I.E. 2006.

Characterization, detection and management of strawberry viruses. *Plant Disease* 90: 384-396.

Martin, R.R. and Tzanetakis, I.E. 2013. High risk strawberry viruses by region in the United States and Canada: Implications for certification, nurseries and fruit production. *Plant Disease*, DOI: 10.1094/PDIS-09-12-0842



Figure 1: Symptoms caused by virus infection in strawberry. Left: 'Chandler' showing reduced vigor and fruit set; middle: leaf distortion and yellowing; right: leaf reddening.

Looking Forward, Looking Back

By Barclay Poling, Extension Strawberry Specialist and Professor Emeritus, NCSU

It's nearly the end of June, and I am still working on my task list from early May. But for growers, right now the important things that must be done are remove the plastic mulch from last season's crop and plow down the old strawberry plants; make your final plant order decision, and be sure to get to get soil samples made for the fields where you will be planting your next strawberry crop.

Ordering plants: Now is the time to place your plant order! But, how will you decide? More Camarosa and less Chandler? Chandler had smaller berry size for many U-pick operations in 2013. What strategy can help you avoid having to deal with so much Chandler fruit getting ripe all at once again in May 2014? How about rain tolerance? Camarosa is supposed to be better, but this year Chandler seems to have performed better. What about yields and yield patterns in your specific locale? As always, remember that each year is different and not a repeat of the past! You might find some food for thought in the comments in the late season advisories on our web site regarding planting decisions for next season

(<http://strawberries.ces.ncsu.edu/author/strawberries/>). For example, the advisory, "Lunch break discussion for Tuesday, June 4," has quite a few candid remarks on varieties this season.

End of the season: Many growers are still in a state of shock from the final roller coaster ride of this season, Tropical Cyclone Andrea. It never occurred to me in late May that we would wind up this very unusual strawberry season with a tropical storm that dumped over 10 inches of rain on farms just east of Raleigh on June 7. What really hurt was how much "really nice" Chandler fruit was still on the bushes, and the weekend of June 7-9 could have been such a savior to this very challenging season. One new grower in a central Piedmont county reported that his average Chandler yield was

0.62 lb/plant, but his goal was 1.2 lbs. A more experienced growers in the Sandhills, Lee Berry, still managed to do nearly 3 lbs. per plant with Camarosa this season, though he comments, "Too bad we had all the rain this year, because I should reaching 4 lbs. instead."

Looking ahead: I somewhat shudder to think about what could be in store for us this fall (will there be a repeat of tropical storms in late Aug/early Sept)? Next spring? I am starting to believe that retiring from active service as of August 12 as NCSU's strawberry extension specialist may not be such a bad idea after all! But I'll still be "out'n about" after August 12. I will keep my desk in the Horticultural Science Department building (Kilgore Hall) at NC State, and I am really excited about undertaking a research project, funded by the NC Strawberry Association, to investigate low tunnel strawberry culture. None of the commercial strawberry plasticulture production in North Carolina is grown under low tunnels at this time, but Dr. Kim Lewers has done some intriguing work on this in Beltsville, MD (see www.ars.usda.gov/Services/docs.htm?docid=23038.) I will be investigating low tunnel culture at one, or possibly two, NC research station locations.

Given how increasingly unpredictable our climate is becoming, I think the time is right to carefully examine how low tunnels, as well as various other plant management strategies may give the grower just a little more control of our strawberry weather issues. How changing weather conditions present major challenges for fruit growers, and how farmers, policy-makers, and researchers, need to be making decisions that are climate-smart was the subject of an article in the June issue of American Fruit Grower. We can also look forward to a presentation on this topic by Dr. Ryan Boyles of the NC Climate Office at the Southeast Strawberry Expo in December.

Implementation of a Virus Management Nursery Program in Nova Scotia

E. Barclay Poling, Strawberry Extension Specialist & Professor Emeritus, Department of Horticultural Science, NC State University

1. Introduction

In just a few weeks I will be traveling up to Nova Scotia with Dr. Guido Schnabel, Plant Pathologist, Clemson, to visit Balamore Farms, Ltd., an 82 acre strawberry nursery in the Great Village region. To say the least, this nursery has been the source of a lot of attention since the start of the 2012-2013 strawberry season, a season characterized by some new and very different plant health issues. We eventually figured out that aphids feeding on strawberry plants in the Great Village area of Nova Scotia were vectoring a virus complex that causes strawberry plants to lose vigor, become stunted, have reduced fruit set and may even cause complete plant death in warmer growing areas like Florida.

In North Carolina, where I had just come out of retirement in August 2012 to work part-time as the state strawberry extension specialist, I started getting calls in September from concerned growers, agents and specialists not just in my state, but growers in Virginia, South Carolina, and several other states were reporting problems with fresh dug plants from a nursery in Nova Scotia (Balamore). The plants were growing off so poorly in some cases that growers elected to pull the plug on these plants, and re-set with plugs in late October and early November. A common denominator with these fresh dug plants was their connection to a nursery production region in Great Village, Nova Scotia.

With the plug plant crop in North Carolina, it was much more difficult to figure out what

was going on in the fall season. Most of the plug plants grown from runner tips sourced from Balamore in Nova Scotia looked normal at setting time, but then we began to see different kinds of issue with these plants show up in the post-plant period. Often, we would see fields of Balamore-sourced plants that had “streaks” of very low vigor plugs. Many of the weakest looking plugs in these plantings were dead by the time of the *Southeast Strawberry Expo* in early November. In my communications with Dr. Chuck Johnson, Plant Pathologist, VA-Tech, I learned of similar postplant problems they were seeing in the Virginia Beach area. Dr. Johnson had found certain root and crown fungal diseases in fresh dug from Balamore. But, none of us were able to really pinpoint what was going on with plug plants sourced from Nova Scotia? Around Thanksgiving I started hearing “horror” stories out of Florida where growers were reporting nearly complete crop failures with bare-roots from two nurseries in Great Village, Nova Scotia. But, it was difficult for the virus disease experts, including USDA virologist, Dr. Bob Martin, to accept that a virus infection could be causing this much damage so soon after planting? Dr. Martin has had a lot of experience with strawberry viruses in the Pacific Northwest over the years, but the decline in plant vigor is more gradual, and reductions in yield associated with Strawberry Mottle Virus (SMoV), for example, is about 30% (Maas, 1998). It simply did not make sense that a virus could be causing reductions in plant stands of more than 80%?

To fast forward to January of this year, it was determined by the first week of January that we did have a virus complex in plant leaf samples sent to Dr. Martin’s lab in Corvallis, OR, just before Christmas. Then, in late March, Dr. Martin, who was the feature speaker at our Plant Health Mini-Symposium in Raleigh on March 27th, announced that a strawberry virus complex

was indeed at the root of the devastating losses experienced by Florida growers this past winter season.

In North Carolina, after a very cold March, we could finally see in April the fuller expression of virus-symptoms in plug plantings of Chandler, Camarosa, and Sweet Charlie from Nova Scotia. Ultimately, yield reductions in North Carolina plugs sourced from Great Village region were in the range of 25 to maybe 50%, but it is hard to say for sure because we had such serious problems with rains throughout most of the harvest season in May. The season came to an abrupt end for many growers when tropical cyclone Andrea hit on June 7-8.

2. *Fact-finding trips to Nova Scotia in late-fall 2012*

Both Dr. Martin and I made fact-finding visits to Nova Scotia late last year. These trips were prompted by the fact that growers from Maryland to Florida were having plant establishment problems with plugs and fresh dug from Balamore Farms, Ltd., Great Village, NS. Dr. Martin’s trip to Nova Scotia from Portland was made at the very end of October – just when Super Storm Sandy hit the east coast! Thankfully, I did not encounter any serious storms when I flew up to Nova Scotia in early December, though I do recall that our plane in Raleigh had to be de-iced early in the morning on December 3rd. Soon after my arrival in the Great Village area (Dec. 4, 2013), I was able to meet a matted row producer, Terry Wenham, who allowed us to look under the straw mulch cover (used for winter protection), to see some very sub-par looking ‘Mira’ strawberry plants. It turned out that Dr. Martin had tested samples of Terry’s plants in the summer of 2012, and he determined that problems were caused by a combination of two viruses, Strawberry Mild Yellow Edge Virus (SMYEV) and Strawberry Mottle Virus (SMoV). Mr. Wenham shared

his lab report with me from Dr. Martin (Table 1). The grower used a method of sampling where he called normal looking plants “healthy” and smaller, stunted Mira plants were called “diseased.” He sent duplicate samples of each group, as well as another matted row variety called Annapolis. It was very interesting to see that the so-called “healthy” plants were negative for SMoV, but were positive for SMYEV. The diseased looking plants were positive for both SMoV and SMYEV.

Table 1 Cultivar name and field ID	Strawberry Mottle Virus (SMV)	Strawberry Mild Yellow Edge Virus (SMYEV)	phytoplasma
Terry Mira healthy sample1	-	+	-
Terry Mira healthy 1	-	+	-
Mira Terry diseased 1	+	+	-
Mira Terry Diseased 2	+	+	-
Annapolis	+	+	-



(2a)



(2b)



(2c)

Figures 2a-c: (2a) Terry Wenham is primarily a Mira strawberry matted row grower in the Great Village region of Nova Scotia (yellow coat). On Dec. 4, 2012, I was able to visit his matted row planting that had been covered in straw mulch in November for winter cold protection. (2b) Photo shows Mr. Wenham and Mr. Joe Cooper, Balamore Farms, Ltd., uncovering Mira plants (planted in spring 2012); and (2c) shows a close up of virus-infected Mira plant.



Figure 3: According to John Lewis, of Perennia, this photo is typical of virus-infected Mira during the spring season. Note that older leaves tend to be a normal green while the newest leaves emerging over the last few weeks are the ones showing the symptoms. These have a generalized chlorosis (yellowing) that is focused more on the leaf margins. Source: <http://www.novascotiastrawberryblog.com/>



(4a)



(4b)

On February 13, 2013, Dr. Chuck Johnson, Plant Pathologist, VA-Tech, produced a report called, *2012-2013 Strawberry Virus "Issue,"* and with this report he included photos (Figures 4a-4b) of strawberry plants in the Virginia Beach and Cheseapeake areas, that he, Roy Flanagan and Watson Lawrence saw on December 19th that were doing poorly, but at that time they were still unsure about the cause(s) of these problems.

As Dr. Johnson noted in his report, "Upon returning to NC, Barclay collected and submitted 7 plant samples to Dr. Martin's lab (on Dec. 17), and found one with SMoV and five with SMYEV. All infected plants were plug plants produced from tips grown by the same nursery (Balamore) in the Great Valley area. Although four of Barclay's samples were Chandlers, one such plant that looked "good" tested negative for both viruses, while

another "good" plant tested positive for SMYEV only."

In Virginia, Johnson and his Extension team submitted 35 samples to Dr. Martin's lab before Christmas, at about the same time I shipped off my North Carolina samples. 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 Balamore nursery in the Great Valley area of Nova Scotia, but infected plug plants from Balamore tips were grown-out by 4 different producers (Table 2).

Table 2: Summary of Virus Assay Results for VA and NC, January 2013

Virus Assay Results from Bob Martin's USDA Lab in Oregon Sorted by Detection of SMoV, then by SMYEV							
Survey Number	Source	Sample	Variety	Source		SMoV	SMYEV
				Tip	Bro-Rt Plant		
1	NCSU	NCSU #1	Camorosa	FEI		-	-
5	NCSU	NCSU #5 (good)	Chandler	Balamore		-	-
16	VA Beach	4B	Chandler	FEI		-	-
25	VA Beach	9A	Chandler	FEI		-	-
19	VA Beach	6A	Chesapeake			-	-
9	VA Beach	1B	Quation			-	-
15	VA Beach	4A	Sweet Charlie	FEI		-	-
40	VA Beach	13D	Albion	Balamore	G+W	-	+
21	VA Beach	8A	Albion/Mitchell Wren	Balamore		-	+
35	VA Beach	12A	Camorosa	Balamore	Aaron's Creek	-	+
42	VA Beach	13F	Camorosa	Balamore	Org.	-	+
41	VA Beach	13E	Chandler	Balamore	Org.	-	+
20	VA Beach	7A	Pungo			-	+
2	NCSU	NCSU #2 (bad)	Benicia	Balamore		-	+
3	NCSU	Rudd #3 (good)	Benicia	Balamore		-	+
4	NCSU	NCSU #4 (bad)	Chandler	Balamore		-	+
7	NCSU	NCSU #7, (Good)	Chandler	Balamore		-	+
31	VA Beach	11A	Albion			+	+
12	VA Beach	2B	Albion	Balamore	Mitchell Wren	+	+
30	VA Beach	10E	Albion	Balamore		+	+
10	VA Beach	1C	Camorosa	Balamore	Aaron's Creek	+	+
37	VA Beach	13A	Camorosa	Balamore	Fresh Pik	+	+
33	VA Beach	11C	Camorosa			+	+
8	VA Beach	A1	Chandler	Balamore	Aaron's Creek	+	+
11	VA Beach	2A	Chandler	Balamore	Aaron's Creek	+	+
14	VA Beach	3B	Chandler	Balamore	Aaron's Creek	+	+
17	VA Beach	5A	Chandler	Balamore	Aaron's Creek	+	+
23	VA Beach	8C	Chandler	Balamore	Aaron's Creek	+	+
36	VA Beach	12B	Chandler	Balamore	Aaron's Creek	+	+
39	VA Beach	13C	Chandler	Balamore	Aaron's Creek	+	+
38	VA Beach	13B	Chandler	Balamore	Fresh Pik	+	+
18	VA Beach	5B	Chandler	Balamore		+	+
28	VA Beach	10C	Chandler	Balamore		+	+
34	VA Beach	11D	Chandler bare root		Bare-rt	+	+
32	VA Beach	11B	Chandler plugs			+	+
13	VA Beach	3A	Festival	Balamore	Aaron's Creek	+	+
29	VA Beach	10D	San Andreas	Balamore		+	+
24	VA Beach	8D	Sweet Charlie	Balamore	Aaron's Creek	+	+
26	VA Beach	10A	Sweet Charlie	Balamore		+	+
27	VA Beach	10B	Camino Real	Balamore		+	+
6	NCSU	NCSU #6 (Bad)	Chandler	Balamore		+	+
22	VA Beach	8B	Festival	Balamore	Aaron's Creek	+	+

011013 Martin Strawberry Virus Assays-VB

Page 1

3. Plant Health Mini-Symposium, March 27th

The main thrust of our discussions in Raleigh on March 27th was to identify nursery management practices that could

reduce, if not eliminate, the damaging effects of viruses and diseases in our strawberry plant supply. From our keynote speaker, Dr. Martin we learned a number of important factors that nurseries must take into consideration with the management of Strawberry Mottle Virus (SMoV) and Strawberry mild edge yellow edge virus (SMYEV).

Strawberry mottle virus. SMoV is probably the most common virus of strawberries and is present wherever they are grown (Tzanetakis and Marin, 2013). SMoV is also aphid-transmitted (*C. fraegaefolii*, several other *Chaetosiphon* species, and the melon aphid, *Aphis gossypii*). However, SMoV is “semi-persistently” transmitted. Severe strains of this virus can cause a decline in vigor and reduce yield by up to 30% Compendium of Strawberry Diseases Second Edition, p. 66).

According to Tzanetakis and Marin (2013), the time between acquisition and efficient transmission is about 1 hr, thus chemical control can be an effective way to minimize spread of the virus in the field.

Strawberry mild edge yellow edge virus. SMYEV is one of the most widespread virus diseases of strawberry in North America. It is spread only by strawberry aphids, which are members of the genus *Chaetosiphon*. These insects must feed on plants containing the virus to transmit the virus by moving to nearby healthy plants to feed. The acquisition and transmission of some viruses may take place in a few seconds, but SMYEV is a “persistent, circulatively transmitted” virus. “Persistent” means that these aphids need to feed for hours or days in order to “get” and spread the virus (as Dr. Johnson pointed out in his excellent article, *Virus Infections in the 2012-2013 Strawberry Crop*, which appeared in the April newsletter of *Small Fruit New*, Vol. 13, No. 2). “Circulative” mean that a virus spreads through the body of an insect once the virus

has been acquired. This virus complex can be moved considerable distances by aphid vectors transported by wind currents. The “good news” about SMYEV is that (like SMoV), “systemic insecticides have also proven useful in its control (Compendium of Strawberry Diseases Second Edition, p. 66).”

4. Vector control in Nova Scotia this Spring

John Lewis, who spoke at our Mini-Symposium and specializes in small fruits with the Nova Scotia Crown corporation *Perennia*, has recently posted an update (May 31st), where he reports, “Controls that have been used so far that seem to be working well are the **Admire soil drench as well as the foliar application**, and Thiodan.” In his blog he mentions that cooperating growers, “have done a tremendous job managing strawberry aphid populations during this time.”

In less than two weeks, both Dr. Guido Schnabel, Plant Pathologist, Clemson , and I will be visiting Balamore Farms, where a great deal of money and effort has already been spent this spring to implement a virus vector control program. We will no doubt touch base with John Lewis to learn more about the success of the chemical control program itself, but I also know from communications that I have received from Joe Cooper since the Plant Health Mini-Symposium (Figure 5), that a lot else has been happening since the end of March!



Figure 5: At the Mini-Symposium, Joe Cooper, Balamore Farms discussed the “aggressive steps” (including a strawberry crop destruct in Great Village region), that he and other strawberry nursery and fruit growers have taken since the Symposium to hopefully prevent any future virus infections from occurring in their nurseries in summer 2013

5. Updates from Joe Cooper since the Mini-Symposium

To assist our understanding of the steps that Balamore Farms have been taking, Joe Cooper sent me a series photos with some very informative captions. In addition, Joe has also sent to me on June 28th a very extensive report that has just come back from the Phyto Diagnostics lab in British Columbia. This is the lab that Balamore has been utilizing since last year to test for both SMoV and SMYEV. In the June 25th report from Phyto Diagnostics you can see that 234 leaf samples submitted (its and 8-page report), and every leaf sample from all tests were negative for SMYEV for every variety in all of their commercial fields (using Elisa method). The only positive was a wild berry sample, which they anticipated would be positive. As Joe VanVulpen, Manager, Balamore Farms wrote to me on June 30th, “Very good results.”

In Mid-May, Joe Cooper sent this email to me, “Our 82 acres of plasticulture strawberry fields have been sprayed with insecticides and herbicides 3 times on April 15, April 27 and May 8. The plastic was lifted and sent to the landfill.” He further wrote, “We are now underway with planting our new strawberry plants for 2013 this week (Mid-

May). Essentially, there has been no green strawberry vegetation in our entire region (Great Village, Nova Scotia) in April and early May 2013 due to a voluntary “crop destruct” that was undertaken by Balamore Farms and all of the strawberry growers in the Great Village area. This should give an adequate break period for viral elimination.”



Figure 6: Carryover plasticulture bed that was destroyed before planting in mid-May.



Figure 7: Planting of new dormant plant stock that began on May 13th

In the foreground of the next picture (Figure 8), you can see an aphid trap. These have been installed in all of the propagation fields at Balamore this season. Each field is being monitored three times/week during the growing season. Three of Balamore Farms employees have been trained by the Nova Scotia Department of Agriculture to identify

aphids and their eggs, and to monitor traps. In addition, employees of *Perennia* are also supporting the aphid scouting operation, and on June 25th, Bridget Wilson, a summer scout with *Perennia*, sent this update (Table 2).

Table 2: Summer Scouting Report

Sample	# STB Aphids	# Other Aphids	# Leaves/ Traps
Plastic mulch	0	12 winged (black)	10
Matted row traps	0	19 winged (black)	10
Matted row leaves	0 nymphs, 1 winged STB aphid	0	60



Figure 8: An aphid trap is shown in the foreground in one of the new plant beds. The scouts cover 82 acres of nursery production. Each field is inspected 3X/week, and reports such as the one shown in Table 3 are produced on a regular basis.

6. Summary - So far, so good!

Well, I feel like we have all been on a tremendous learning curve with this new virus challenge facing the North American strawberry nursery and fruit industry. I have personally let go of all my former notions that viruses are not a big concern in eastern strawberry plasticulture. There is way too much at stake for us not to be front and center on this issue! We have learned from the experts like Dr. Martin what we're up against, and with the support of Dr. Martin and other researchers like Dr. Ioannis E. Tzanetakis, Dept. of Plant Pathology, Division of Agriculture, University of

Arkansas, I am very hopeful that it is possible to develop an effective vector control program for nurseries in Canada, and it appears to me that Balamore Farms is well on its way to turning the corner on this issue. I know that Dr. Schnabel and I are eagerly looking forward to our July 14-16 visit, and we'll surely have more information to share with everyone after that trip on the web <http://strawberries.ces.ncsu.edu>, but, at this time in early July, I think its fair to say, *so far, so good*.

7. Literature cited:

Johnson, Charles. 2013. 2012-2013 Strawberry Virus Issue. <http://www.ces.ncsu.edu/wp-content/uploads/2013/02/021413-CSJ-Strwbry-Virus-email-public.pdf>

Maas, J.L. 1998. Compendium of Strawberry Diseases. (Second Edition), The American Phytopathological Society, St. Paul, MN, p. 66.

Tzanetakis, I.E. and R.R. Martin. 2013. The importance of strawberry viruses. *International Journal of Fruit Science*, 13:184-195.

Blackberry and Raspberry Seasonal Checklist Summer 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

Fruit development.

Rapid primocane growth.

Floricanes senesce.

Pruning and trellising.

Floricanes-fruiting raspberries:

- ✓ May need to adjust primocane numbers if canes are too thick (i.e. remove less vigorous primocanes at their base)
- ✓ Train primocanes to the trellis.
- ✓ Pinch black raspberry primocanes at 2 to 3 ft. to promote lateral growth.
- ✓ *Primocane-fruiting raspberries:*
- ✓ Train primocanes within a trellis to hold canes erect.
- ✓ *Erect blackberry types:*
- ✓ In warm climates with a long growing season, tip the new primocanes when they are about 6-12" below the top wire of the trellis to encourage lateral branching. Continue tipping at monthly intervals to maintain desired branching and height of canopy (laterals should reach top wire).
- ✓ In colder climates, tip primocanes once when they are about 2–3 ft. tall to encourage lateral branching.

- ✓ Prune out spent floricanes after they have produced fruit, do not thin out primocanes until mid-to late winter.
- ✓ Train primocanes to trellis to minimize interference with harvest. Shift trellises or V trellises make this relatively easy.
- ✓ *Trailing blackberry types:*
- ✓ Train new primocanes to middle of trellis, on the ground in a weed-free area, or temporarily to trellis outside of fruiting area (depends on trellis type).
- ✓ Cut back side shoots to 18" (after dormancy in cold climates).
- ✓ Remove spent floricanes after harvest.
- ✓ *Primocane-fruiting blackberries*
- ✓ Tip canes at 3-4 ft to increase branching and fruiting potential.

Weed management

- ✓ Mow along side of row to maintain the width of the bed to 3 to 4 ft.
- ✓ Weed growth can be very vigorous at the same time as the bramble crop peaks.
- ✓ Weed control is best done earlier in the season before harvest commences.
- ✓ Mow middles regularly to allow pickers to move through rows easily.

Insect and disease scouting (these will vary by region)

- ✓ Pay particular attention to the possibility that spotted winged drosophila may be present or arrive in your fields this year. This new pest is very attracted to bramble fruit, particularly later in the season. Consult your local entomologist for updates on scouting methods and occurrences.
- ✓ Scout for insects
 - Spotted winged drosophila
 - Raspberry crown borer (canes girdled and wilt)

- Psyllid
- Two-spotted spider mite
- June beetle
- Japanese beetles
- Stink bugs
- Fire ants
- ✓ Scout for diseases
 - Botrytis
 - Rusts
 - Orange felt (orange cane blotch) (blackberry)
 - Sooty blotch (blackberry)
 - Orange rust
 - Powdery mildew
 - Double blossom (blackberry)
 - Cane blight (blackberry)
 - Powdery mildew

Water management

- ✓ Raspberry and blackberry plants need about 1-2 inches of water/week; this amount is especially critical during harvest.
- ✓ For blackberries (not raspberries) in warmer climates only, consider installing an overhead system for evaporative cooling to reduce sunscald. Turn on once or twice a day from 10 am to 3 pm for short periods of time (approx. 15 minutes).
- ✓ Give plants a deep irrigation after harvest.

Nutrient management

- ✓ Take leaf samples after harvest and send to a clinic for nutrient analysis. Do not fertilize with nitrogen at this time of the year in the northern production regions. Blackberry growers in the south give plants additional nitrogen, check with your local recommendations.

Harvest and marketing

The busiest time of the year for a blackberry or raspberry grower is the harvest season. Each plant needs to be harvested every 2-3 days. For larger plantings, that means fruit is picked from some part of the field every day of the week.

- ✓ Pick blackberries when shiny black for shipping. Those that are dull black are fully ripe and suitable for PYO only.
- ✓ Pick directly into clamshells with absorbent pads, or for PYO use clean cardboard flats, take-home baskets, or sanitize re-usable containers.
- ✓ Keep harvested fruit in shade and move into coolers as soon as possible to lengthen the shelf life of the fruit.
- ✓ Use forced-air precoolers for best removal of field heat.
- ✓ Store at 32 to 34°F and 95% relative humidity.
- ✓ Freeze excess fruit for jam, juice, or wine.

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
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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>

July/August Grower Checklist

- ✓ Harvest is over. Destroy plants now! Plowing and disking under old plants is the best strategy for preventing further spread of aphid borne viruses (e.g. Mild Yellow Edge Virus, Strawberry Mottle Virus). In areas with perennial planting systems (e.g. matted row), there is potential for the virus to spread to new plantings in late summer/fall. If you have matted row plants that are infected with virus, these should be destroyed now.
- ✓ Other immediate field operations: remove and recycle plastic – some growers use tobacco balers to compress the plastic before it goes to the landfill; consider planting a cover crop – with all these rains there is lots of good moisture!
- ✓ Before making the same plant order as last year, critically evaluate the relative profitability of your different markets (U-pick, Ready Pick, and/or Off-farm). For example, if you experienced further decline in U-Pick sales, this may be the time to scale back Chandler production (this variety is primarily a U-Pick variety)
- ✓ If your crop was really late this year, have you considered growing an early ripening variety Sweet Charlie? But, you will have to hurry to place this plant order, as Sweet Charlie supplies may be limited.
- ✓ One thing YOU DO NOT WANT TO DO is go with extra early Chandler planting dates. If Chandler is producing in excess of 100 flowers per plant, your planting date is probably too early – consider a slightly later planting date if you keep running into problems with excess blooms and small berries. Also, early plantings have the undesirable effect of making the crop later in the spring by another 3-5 days (that might mean not being open on a critical weekend).
- ✓ Consider staggering your Chandler plug planting dates over a week's time, so that not all of your crop peaks at the same time. Tobacco growers will typically stagger their planting dates because of tobacco harvest labor limitations – this same idea can be profitably applied by Chandler growers who seem to keep having challenges with extreme crop concentrations that can make it difficult to get fields cleanly picked even in good weather!
- ✓ Another Chandler crop diversification strategy is to consider planting fresh dugs! Fresh dugs can produce an earlier crop than plugs, and fruit size can be very impressive in the early season. You may wish to experiment with California cut-off plants as another interesting strategy for producing larger berries in the mid-season when Chandler plug berry size drops off. It may be worth a try!
- ✓ Camarosa fruit quality was very high in 2013, as were Camarosa marketable yields (on healthy plants). A different selection of varieties can give you more weeks of fruiting, and not so much fruiting in just a short 2 week period!
- ✓ In preparing your plant order, consider the potential water situation for the season ahead – plugs are far more efficient in water utilization than fresh dugs.
- ✓ Don't wait until the last minute to order plants or tips – tips need to arrive one month prior to planting.
- ✓ Soil test in early July. Lime early in the summer to raise pH to 6.0 to 6.2. Incorporate lime when existing beds are broken down.
- ✓ Use overhead irrigate to soften soil as needed and subsoil completely.

- ✓ MAKE A POINT TO STAY IN CLOSE CONTACT WITH YOUR PLANT SUPPLIER THIS SUMMER AND DO NOT BE AFRAID TO ASK FOR PERIODIC REPORTS UPDATES ON PLANT HEALTH
- ✓ Get mist system set up by early August if growing your own tips. Also order soil, trays, and fertilizer.
- ✓ Stick tips by mid-to-late August, depending on location.
- ✓ For planting in mid-Sept (Western NC), apply preplant fertilizer in mid August.
- ✓ Make a fumigation plan, set a schedule, acquire necessary materials. Be sure to allow appropriate plant-back intervals and an additional cushion in case of bad weather.
- ✓ Check out your fumigation rig and do any adjustments and repairs well in advance of fumigation.
- ✓ Renew respirator fit testing (must be current within one year of fumigation.)
- ✓ Attend the Strawberry Preplant Meeting for your area (look for announcements on this website as well as <http://strawberries.ces.ncsu.edu>)

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