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Small Fruit News

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In this issue

Special Reports:

Exobasidium Fruit and Leaf Spot: An Emerging Concern on Blueberries in the Southeast.

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Exobasidium fruit and leaf spot has been an infrequent and geographically dispersed disease of blueberries in the Southeast. However, during the 2011 season, we have had frequent reports of the disease on rabbiteye and highbush blueberries. The fruit stage of this disease was first identified in 1997 in North Carolina. It has been observed throughout the Southeast, and is related, in its causal agent, to red leaf disease that occurs on lowbush and highbush blueberries as far north as Canada; however, the disease cycle and pathogen species involved likely differ between the two diseases, necessitating additional research on the etiology of the disease.

Though scattered, where Exobasidium leaf and fruit spot occurs it can cause significant losses (60-70% in specific locations), primarily because affected fruit are unmarketable, and it is difficult to remove all berries with this symptom from the packing line. To date, we have rarely observed Exobasidium on southern highbush cultivars in Georgia, but that does not mean that southern highbush plants are resistant or immune. In fact, the disease was quite severe on the southern highbush cultivar Legacy in North Carolina in 2011, where it has historically been a disease of both rabbiteye and northern highbush. Symptoms on rabbiteye blueberries in Mississippi have been so severe and recurrent as to cause fields to be abandoned.

Symptoms. Spots on fruit average ¼ inch in diameter, and are circular and generally regular in appearance (Figure 1). They do not protrude, but may be sunken and are sometimes tinged with a red color. The diseased fruit tissue is generally green and unripe, extending roughly 1/8 inch toward the berry center. The spots on berries can occasionally show sparse white fungal growth. Exobasidium-affected berries can be eaten, but they are extremely chewy where the spot occurs. Although the fruit spots do not rot or become necrotic, they do not ripen well and remain firm and green.

Light green leaf spots (approximately ¼ inch in diameter) occur on the upper side of infected leaves (Figure 1). Leaf spots are often pure white on the leaf underside due to a thin, dense layer of fungal growth. Affected areas are slightly thicker than surrounding tissue, and become necrotic with age.

To see more images of symptoms on fruit and leaves of southern highbush and rabbiteye cultivars, go to: http://ncblueberryjournal.blogspot.com/2011/07/exobasidium-fruit-and-leaf-spot.html

Causal organism. The cause of Exobasidium fruit and leaf spot is currently considered the fungus *Exobasidium vaccinii*. The problem with this taxonomy is that there are multiple fungal species which are currently grouped under this name, i.e., it describes a species complex. Members of *E. vaccinii* are best known to cause the aforementioned red leaf disease on lowbush and highbush blueberries, a systemic disease that cannot be controlled by use of fungicides and for which it is recommended to remove and destroy symptomatic plants by burning. At this

time we assume that fruit and leaf spot is caused by a different pathogen within this species complex, and that the disease observed in the Southeast is not systemic, hence we DO NOT recommend destruction of Exobasidium fruit and leaf spot-infected plants. Fungi within the *E. vaccinii* species complex are also listed as the causal organism for azalea leaf gall, a common disease in southeastern gardens and ornamental nurseries.

Exobasidium vaccinii produces banana shaped, clear spores (basidiospores, a form of sexual spore) which are unequally tapered at both ends; there are usually 2-6 of these produced on each round basidium, and some can have a wall across the spore (Figure 2). The fungus may also produce clear conidial (asexual) spores. Spores may be more readily observed on leaves than on fruit. County extension offices can diagnose this disease, either directly through in-office examination or through shipment to extension diagnostic clinics. Microscopic observation of the spores can be used to confirm the diagnosis.

Disease cycle. At this point the epidemiology and life cycle of the disease have not been clarified. It is assumed that the disease has a one-year cycle (i.e., unlike the red leaf pathogen does not persist systemically within the plant), and that the pathogen overwinters on or in infected bud scales and/or on or in the bark. Infection occurs in the spring, and late-season leaf flushes do not show additional spots. With the *E. vaccinii* that causes leaf galls on azalea, the spores produced from leaves blow or wash to flower or leaf buds to infect anew, but symptoms of galling do not occur until the following spring; to what degree this is similar or different for the disease on blueberry needs to be researched in detail.

Cultural controls. (1) Select sites which encourage air flow and low humidity. Exobasidium is generally more prevalent in plantings which are either surrounded by trees (reduced air flow) and/or next to areas of high humidity (i.e., ponds or low spots where water stands). It is likely that poor air flow, slow drying conditions, and high humidity contribute to an increase in disease severity.

(2) Use proper pruning and cane renewal to open up the canopy to allow for better fungicide penetration and air movement (drying). It has been observed that symptoms are most severe in the interior of the bush. This likely relates to poor air movement, high humidity, and possibly poor spray penetration.

Chemical controls. We know little about managing this disease, apart from a one-year field trial at Mississippi State University conducted by Dr. David Ingram (Table 1). In his trial, Pristine performed best against both the leaf and fruit spot phases of the disease, followed by Elevate. In general, where plants are treated with an effective fungicide program, we have not observed the disease at significant levels. At this time it is not known when infection occurs, but since we often first observe it at harvest, we can assume it occurs sometime between leaf and bloom emergence and harvest. For azaleas, which also are infected by an *E. vaccinii* fungus to produce a leaf gall, application of fungicides at just before leaf emergence and 10 days later gives sufficient control. In areas where the disease has previously occurred, additional applications during the cover sprays may be warranted to further reduce disease levels. In Dr. Ingram's trial, fungicides were applied according to label rates for blueberry, beginning at first budbreak with applications applied at weekly intervals until petal fall; this period roughly corresponds to the period for azalea management, but he utilized more than two applications for this trial. The DMI fungicide Indar did not provide significant control in the Mississippi trials, but it did numerically reduce disease over the untreated plants. For azaleas, other DMI materials (myclobutanil and triadimefon) are recommended, so we can hypothesize that Indar (fenbuconazole) or Orbit (propiconazole) may possibly suppress the disease in blueberries.

Based on the limited information we have available at the moment, the following is recommended as a tentative means of managing the disease: (a) apply Pristine at 10% leaf or flower bud break, whichever occurs first (corresponds with the first mummy berry application), (b) apply Indar + Captan, or Orbit (or generics) + Captan, for the next two applications. (c) alternate these materials until petal fall – essentially the mummy berry program. If there is risk of Botrytis blossom blight development, Elevate or CaptEvate may also have good activity against Exobasidium leaf and fruit spot, again based on the one Mississippi trial. Additional application of Pristine during early berry development may also be of value. Essentially, a good mummy berry and rot and leaf spot fungicide program may suppress this disease. We do see an anecdotal correlation between poor or nonexistent fungicide programs and an increase in this disease over time. Producers who treat for other diseases may

subsequently manage this disease as well, but we need additional research before we can fully understand the timing and fungicides that will work best for Exobasidium fruit and leaf spot control.

Host resistance. There is no information at this time relative to resistance among rabbiteye, highbush, or southern highbush cultivars. In azaleas, resistance has been observed, and the same may be true in blueberry, but there is no data at the moment to support this premise.

References.

Cline, W.O. 1998. An Exobasidium disease of fruit and leaves of highbush blueberry. Plant Disease 82(9):1064.

Caruso, F.L., and Ramsdell, D.C. eds. 1995. Compendium of Blueberry and Cranberry Diseases. American Phytopathological Society, St. Paul, MN.

Ingram, D. M. and Braswell, J. 2009. Evaluation of Fungicides for the Management of Exobasidium vaccinii in Rabbiteye Blueberry. IR-4 report (unpublished).

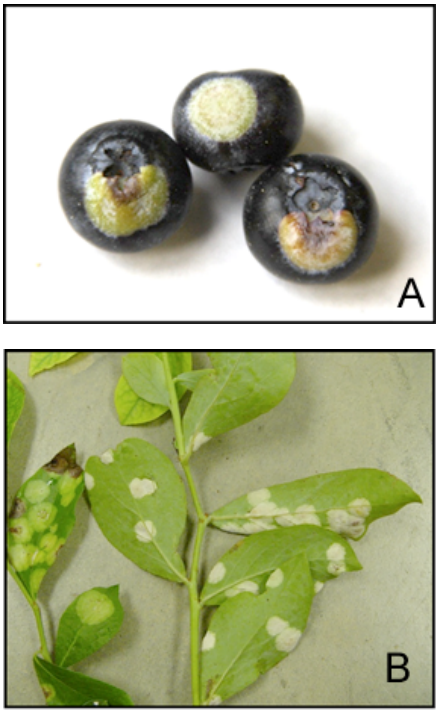

Figure 1. Symptoms of Exobasidium fruit (A) and leaf spot (B). *Fruit symptoms are green, firm spots and blotches that do not mature with the rest of the berry. Leaf symptoms are light green spots on the upper leaf surface which are white or lighter green on the lower surface (photos courtesy of Eddie McGriff, University of Georgia, and David Ingram, Mississippi State University).*

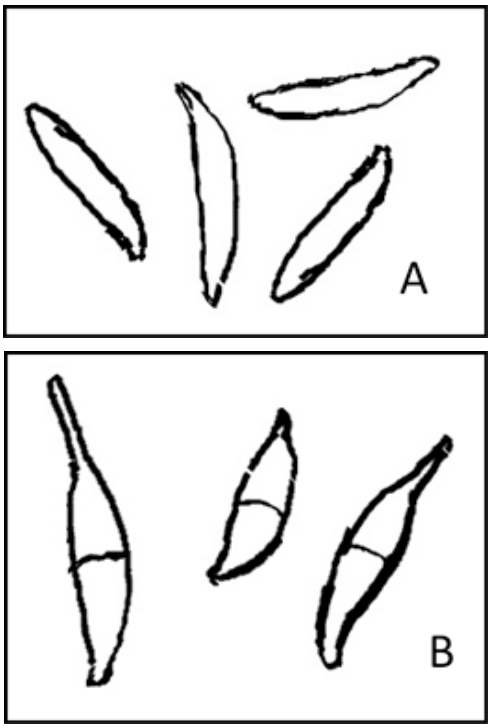

Figure 2. Conidia and basidiospores of Exobasidium vaccinii. *Two spore types can be produced by members of the E. vaccinii species complex, asexual conidia (A) and sexual basidiospores (B). Basidiospores often occur without the septations shown.*

Table 1: Influence of fungicides on incidence of Exobasidium fruit and leaf spot on rabbiteye blueberries, Sumrall, MS, 2009 (data courtesy of David Ingram, Mississippi State University).

Leaf infection (%)x	Fruit infection (%)y	Treatment
Pristine	1.0 dz	5.0 c
Elevate	7.2 cd	6.2 bc
Indar	12.0 bc	10.0 bc
Switch	12.0 bc	8.2 bc
Prophyt	11.0 bc	7.2 ab
Serenade	16.0 ab	11.0 ab
Prophyt + Serenade	9.2 bc	8.0 bc
Phostrol	13.0 bc	14.0 ab
K-Phite	21.0 a	22.0 a
Untreated Control	16.0 ab	15.0 ab
LSD (0.05)	7.43	8.81

x Percentage of total leaf area affected (severity) was visually estimated on each of five treated plants.
y Percentage of berries with at least one spot (incidence) was visually estimated on approximately 100 fruit on each of five plants.
z Means in a column followed by the same letter are not significantly different according to Fisher's Protected Least Significant Difference Test (P = 0.05).

Can Raspberries be Picked Pink for Fresh Markets?

Reprinted from the North American Raspberry and Blackberry Association Newsletter (www.raspberryblackberry.com)

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Raspberries are the most perishable of the temperate fruit crops. If you set them on your kitchen counter, you can watch the mold grow within 24 hours. This fruit's delicate nature is due to its fragile structure, where drupelets are connected together by only a few trichomes (fruit hairs), no cuticle is present, and gray mold (*Botrytis cinerea*) can set up spores during bloom and produce fuzzy gray fruit as the berries are ripening.

While raspberry fruit mostly produce ethylene from the fruit calyx (the part of the fruit that remains on the plant), there is a small amount of ethylene, the fruit ripening hormone, present in many varieties. This actually can pose an advantage for fruit growers producing raspberries in the warmer parts of the season. Fruit at the pink or even pink-yellow stage will often detach from the calyx with minimal tugging.

We initiated a small test in 2010 to investigate the ability of raspberries to attain full ripeness if harvested unripe. These fruit were harvested in August and September from plants grown in high tunnels at the Upper Mountain Research Station, Laurel Springs, NC. Temperatures within the tunnels were above 85°F for approximately 4 hours per day. Unripe and ripe raspberries were picked at weekly intervals for the tests, over a 3 week period, and one to 2 clamshells per cultivar and ripeness were used for the study.

Raspberries were picked into ½ pint clamshells and transported at 5°C in refrigerated ice chests (Kooltron) to Kannapolis, and held at 39 °F for 6 days. Subsamples were removed at day 0 to check firmness, color, sugars, and acidity. Subjective ratings were taken after storage by checking each berry for softness, leak, and mold. The overall color of the fruit within the clamshell was determined subjectively as 0 (light red) to 3 (dark purple red). Percent saleable fruit was determined by using the relationship of color to percent (where rating of 0 was 100% saleable to 3 was 0% saleable).

Surprisingly, even fruit picked considerably unripe (yellow-pink) achieved full color, soluble solids content, acidity, and flavor (tasted at random) after 6 days storage (Table 1). The biggest disadvantage of picking unripe berries was a depression in berry size of 4 to 20%, depending on variety and relative ripeness at harvest. What was clear from ratings was that fruit picked pink was much firmer and less leaky than berries picked at the normal commercial fresh market ripe stage (Table 2). The amount of moldy berries was slight (less than 10%), due to a rigorous fungicide spray program and the protective effect of the tunnels from moisture and wind. We hoped that berries varieties known to turn dark red after storage, such as Joan J, would be less fully red if picked pink prior to storage. In fact, we found that color could not be slowed enough, with fruit reaching full color as soon as 2 days at 39° F after harvest. Figure 1 illustrates the change in color of 'Culivar' in ripe and unripe berries at 0, 5 and 10 days after harvest.

Flavonoids are compounds are compounds that are associated with health benefits, and higher levels in fruit are good (citation). Flavonoids in raspberry include the anthocyanins that give raspberries much of their red color, along with other colorless phenolic compounds. In raspberries picked before full ripeness, flavonoid content was decreased by 5-15% after storage. The slight loss in flavonoids in the less ripe fruit was made up in the better appearance and firmness of the raspberries.

Harvesting raspberries at the pink stage is possible. We did not observe significant problems with composition and flavor, and early picking improves the number of marketable fruit. However, harvesting less ripe fruit is likely dependent on air temperature (detaching

raspberries is difficult in cool weather), and will require more attention and training of pickers during harvest than pulling off fully ripe berries. Although we were did not determine optimal temperatures for picking unripe berries in this study, the ability of raspberries to fully color up and soften may depend greatly on having a production environment where temperatures are at 75° F for at least 4 hours.

Table 1. Comparison of raspberry fruit harvested unripe (pink) or ripe (red) before and after storage at 4C, averaged for Joan J, Nantahala, Caroline

Variant	Days	Unripe	Ripe	Mean
Total phenolics	0	2858	2866	2862
(mg/kg gallic acid equivalents)	6	3090	3144	3117*
Total anthocyanin	0	508	530	519
(mg/kg cyan-3-glucoside equivalents)	6	510	589	550*
FRAP (Ferric reducing antioxidant potential)	0	28.6	26.8	27.7
(umol/g trolox equivalents)	6	28.5	28.8	28.6
Soluble solids content (%)	0	11.2	10.9	11.1
	6	11.9	11.7	11.8
Titratable acidity (%)	0	1.23	1.26	1.24
	6	1.05*	1.19*	1.12*

Means separated within column and days 0,6 using student's t-test, P<5%

Table 2. Comparison of raspberries picked unripe (pink) or ripe (red) after storage at 4C for 6 days

	%Leaky berries		%Soft		%Saleable color	
Variety	Unripe	Ripe	Unripe	Ripe	Unripe	Ripe
Autumn Britten	1a	42b	48ab	93a	43b	7b
Caroline	8a	19a	61a	86ab	47b	33ab
Nantahala	2a	37b	38b	75b	67a	47a
Mean	3a	33*	49	82*	52	29*

Means separated within column among cultivars, by letter (P<5%) using REGWQ, and between columns within a comparison using student's t-test
Means separated within column and days 0,6 using student's t-test, P<5%.

Figure 1. Ripe and unripe 'Nantahala' raspberries at harvest (top), and after 8 days storage (bottom). Ripe fruit are on left and unripe on right.

2011 Southeast Strawberry Expo!

The 2011 Southeast Strawberry Expo will be November 6-8 at the Sheraton Imperial Hotel in Durham, NC. This is the Southeast's leading event for strawberry producers. Please help get the word out to growers in your area.

Detailed information and a registration form may be found online at http://www.ncstrawberry.com/docs/ExpoRegistrationWeb.pdf. To request printed brochures to distribute, contact the NC Strawberry Association, info@ncstrawberry.com or 919-542-4037. Or, send names and addresses of growers to the NC Strawberry Association to have brochures sent out directly. There is a discounted registration rate for extension/university personnel.
To make hotel reservations, call the Sheraton Imperial at 919-941-5050. Be sure to mention

"Strawberry Expo" when you call to receive the special Expo rate of $85/night, guaranteed through October 17.

Expo Highlights

Workshops: Novice growers will be especially interested in the "Getting Started in Strawberry Plasticulture" workshop on Nov. 6, led by two experienced growers and NCDA Regional Agronomist David Dycus. A concurrent workshop "Promoting Your Farm with Social Media and the Web" offers an intensive exploration of how growers can most effectively use the web and social media such as Facebook, YouTube, and Twitter to promote their farms. Agents are also welcome to sign up for these workshops.

The **Expo Farm Tour** on the afternoon of Nov. 6 will visit Buckwheat Farm and DJ's Berry Patch in Apex and Porter Farms & Nursery in Willow Springs, NC. All these farms are in rapidly developing areas, offering both challenges and opportunities. The tour will end with a dinner and wine tasting at Adams Vineyard, very near Porter Farms. The vineyard is operated by Quincy Adams, a past member of the NC Strawberry Association. Quincy raised strawberries for about 12 years, stopping in the early 2000s. The Adams farm has been in the family since the 1700s. Adams Vineyards grows its own muscadine grapes and fruits on the property, where tobacco was previously grown. They produce and bottle all of their wines at the winery.

General session speakers: Dr. Bill Turechek of the USDA Agricultural Research Service, a leading researcher on developing improved diagnostics and approaches for managing angular leaf spot in strawberry nursery production, will be a lead speakers on Monday morning, Nov. 7. Dr. Turechek has been a research plant pathologist at the US Horticultural Research Lab in Fort Pierce, FL and recently moved to Beltsville to be acting Research Leader of the Food Quality Laboratory of the Plant Sciences Institute. His presentation will be on "Trials and Tribulations of Managing Angular Leaf Spot: A continuing saga". Angular leaf spot was a big problem for many growers this year. Strawberry breeder Jeremy Pattison will provide an update on the breeding program on Tuesday, Nov. 8. Grower Spotlight speakers are NC growers Mark Waller and Curtis Smith.

Educational sessions at the Expo will include both Production and Marketing topics. Production topics include Disease, Insect, and Weed Management; Fumigation, Non-Fumigation Alternatives, and Fumigant Regulations; Organic Strawberry Production, and Row Covers and Weather Management. Marketing/Management sessions include A New Crop Insurance Program for Strawberries, A Roundtable on how to let customers know the season has started, Strategic Thinking for Market Development, and "the Power of Recipes." Attendees will have the opportunity to receive respirator fitness and fit testing, which the fumigation regulations require on an annual basis.

Informal networking: One of the most important aspects of the Expo is the opportunity to talk informally with other attendees. In 2010, Virginia Beach Extension agent Cal Schiemann and helpers went all-out to provide the hospitality (can we ever equal his thin-sliced, home-cured ham?), and the hospitality room was full of conversation each night. We've lined up a big room again this year, and NCSA president Michael Beal is taking up the challenge as host. The social hour at the end of sessions on Monday also returns, with a live auction to raise funds for the NCSA's Scholarship Fund. And there will be an early morning Q&A discussion session on Tuesday, for attendees of the new grower workshop and others who find that they came out of the Monday sessions with lots of questions.

The Changing Face of Fumigation and Options to Grow Strawberries without Fumigants

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(www.strawberry.com)

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Most strawberry growers in the Southeast and surrounding States use pre-plant fumigants to manage soilborne problems such as weeds and pathogens that cause root or crown rot problems. The last 5 years have introduced a lot of uncertainty for strawberry growers with regard to fumigation due to the progressive decrease of methyl bromide supplies and new fumigation labels. This article is a response to many

questions and concerns growers have expressed as they continue to transition to other fumigants or consider growing the crop in without fumigants.

Alternative Fumigants: Many growers have experimented with alternatives fumigants compared to methyl bromide + chloropicrin formulations. Numerous growers have converted their system to these alternatives after experimenting on smaller sections of their strawberry land. Likewise, our program has participated with multiple agents and other University programs to conduct large on-farm trials looking at the alternatives. Overall, most growers have had success making the alternatives work well. Each alternative has limitations. More precise management is needed with regard to soil preparation, ideal soil moisture requirements, application methods and plant-back intervals. The best product or combination of products depends on the history of known problems on each farm. The main alternatives and their relative efficacy to manage specific problems are listed in Table 1.

New Label Requirements: In 2011, growers had to comply with new fumigant labels as part of Phase I of the new Risk Mitigation Measures (RMM) for soil fumigants. Phase II will start in 2012. Many growers were concerned about buffer zones this year. However, note that the buffer zones for the older fumigants will not take effect until 2012. The buffer zones are in effect for Midas and Paladin since they came through the same regulatory process and recently received approval in the USA. The RMMs are listed in table 2. Future training programs will be schedule at the Strawberry Expo and in regional meetings to help growers, agents and consultants learn about the new label requirements. Contact Frank Louws if you would like a training program in your region.

Farming Without Fumigants: Many growers are uncertain about the future use of fumigants on their farms, particularly on farms surrounded by houses or other live-in structures. Thus, there has been an increased interest in growing strawberries without the use of annual fumigation. In most cases, such a decision requires a farming systems management plan that integrates best management practices (BMP) and integrated pest management principles (IPM). Most farms have problems with weeds and soilborne diseases. The main disease problem is called black root rot (BRR). In some cases, Phytophthora crown rot may appear and this requires special considerations highlighted in other articles. BRR can result in up to 20% to 40% loss of yield on land with a history of strawberry production. When considering strawberry production without fumigants, there are many considerations. The benefit of fumigation decreases from the east to the west in North Carolina based on regional experiments and grower experience. For example, several experiments in the mountains of western NC showed limited advantage with fumigation whereas there is typically a high benefit to fumigation in the eastern coastal plain region. Northern production regions may benefit less from fumigation compared to Southern States. A key farming systems decision to farm without fumigants is the capacity to include crop rotation. The pathogens and weeds favored by strawberries build up with yearly use of the land for strawberries and crop rotation will break the biological cycle of many pests. A 2- 4 year rotation is ideal. Another beneficial practice is to use summer cover crops prior to planting strawberries. In general, a legume/grass mixture suited to the region is ideal. The cover crop can suppress weed pressure and higher organic matter content can be suppressive to BRR problems. In addition, cover crops and other organic amendments enhance soil physical and chemical properties that are beneficial as compared to continuous production of strawberries. Cover crops can been grown and managed without excess plant residue problems when it is time to form the beds. Crop rotation has been successfully complemented with the use of compost. Additional information is available at request and several growers have transitioned their farms into these more complex, but successful farming systems.

We have been doing considerable work evaluating the use of registered fungicides and herbicides (in cooperation with weed scientists) to determine the level of success that can be achieved with well timed soil applications of these products compared to fumigation. Although this work is in progress and some very promising results have been achieved, further research is needed. To date, the overall body of data suggests this approach will offer modest benefit – better than not fumigating at all but not as good as a broad spectrum fumigant product(s). For example, Switch (TM; Syngenta) can be used as a pre-plant dip offering suppression of Fusarium and Rhizoctonia problems (as well as anthracnose). Ridomil Gold (TM, Syngenta) can be drip applied prior to or 7 days after planting or phosphonate fungicides (multiple products available) can be used as a preplant dip/drench or foliar or drip applied in the

field to manage Pythium and Phytophthora problems. These products can be reapplied during critical growth stages in the spring. Finally, QoI fungicides such as Abound (TM; Syngenta) can be drip applied during critical plant growth stages to help suppress Rhizoctonia pressure. Weeds can be managed with registered herbicides, minimizing the size of the planting hole (especially if bare root plants are grown) and the use of hand weeding. If nematodes are a problem, some new products are coming to market that can be drip applied. Thus, for growers not able to fumigate, a series of products may offer some advantage to help manage soilborne diseases and weeds as part of an overall IPM plan.

Current research that started in Japan, then the Netherlands, California and Florida, with preliminary results in North Carolina, is a method known as biological soil disinfestation (BSD) or anaerobic soil disinfestation (ASD). Briefly, soil organic matter is added in the form of green manure or other highly digestible organic matter (some have had good success with molasses). The organic matter is incorporated into the beds and the beds are covered with plastic (usually VIF) and then flooded for a period of time. Soil bacteria begin to digest the organic matter and when combined with the high moisture content, the soil conditions become anaerobic. This creates a condition where various fermentation products are made and these toxins, as well as the low oxygen content, kills weed seeds and many types of pathogens. After a certain time (3-6 weeks depending on the temperatures), the plastic can be punched to allow aeration and strawberry plants can be field set. Preliminary data in strawberry production systems has shown high promise and more work is underway. Growers interested in doing this type of work on their farm should contact Dr. Frank Louws.

Work has also been done using mustard meal (MM). The meal is incorporated into the beds and then the beds are watered to activate the MM resulting in gases that directly kill pathogens and weed seeds. IN addition, the MM seems to favor certain types of soil microorganisms that further suppress soilborne problems. This work is ongoing at multiple programs in the USA and elsewhere with promising results.

Summary: The use of fumigants has changed rapidly in recent years due to the phase out of methyl bromide and implementation of new label requirements. Several options are available to growers who decide to not use fumigants. This generally requires the substitution of management for inputs. For example, rather than using a fumigant as a farm input, growers need to be aware of the pest complexes on their farm and manage crop rotation patterns, field preparation procedures, cover crops, other soil amendments, and the judicious use of fungicides, herbicides and other selective products. Components of these options must be managed and integrated into a farm-specific plan that often requires several years to develop and implement. Novel ideas are emerging including BSB/ASD and use of MM. Several growers have accomplished such plans for their farms. There is a lot of research on many components and several programs do farming systems work. However, future progress will require the cooperative efforts of growers, extension, researchers, consultants, private industry and other stakeholders to advance the productivity and profitability of strawberry production systems.

Risk Mitigation Measure	2011	2012
Good agricultural practices (GAPs)	•	•
Restricted use (new measure for metam sodium/ potassium & dazomet only)	•	•
New handler protections including changes to respiratory protection, tarp cutting/removal and worker reentry restrictions	•	•
Fumigant management plans and post application summaries	•	•
Buffer zone distances, credits, and posting		•
Emergency preparedness measures		•
Difficult to evacuate sites		•
Notice to state lead agencies		•
Safe handling information	•	•
First responder, community outreach and certified applicator training	•	•
Rate reductions and use site limitations	•	•

Table 1: Relative efficacy of currently registered fumigants or fumigant combinations for managing soilborne nematodes, diseases, and weeds[1]

Product	Rate per Broadcast Acre	Nematodes	Disease	Nutsedge	Weeds: Annual
Telone C35[3] (1,3-D + chloropicrin)	35 gal	+++++	+++++	+	+++
Telone C35 + VIF[3]	See comments below	+++++	+++++	+++	+++
Metam sodium[2] (MS)[3]	75 gal	++	+++	+	++++
Chloropicrin[3]	150 lb	+	+++++	—	—
Pic-Chlor 60[3] (chloropicrin + 1,3-D)	150 lb	+++++	+++++	+	+++
Chloropicrin + MS[3]	150 lb + 75 gal	++	+++++	?	++++
Midas 50:50 (iodomethane + chloropicrin)[3, 4]	160 lb	+++++	+++++	+++++	+++++
Paladin (dimethyl disulphide + chloropicrin) approved for AZ, GA, MI, NC, NM, OH, SC, TN, TX, VA	35 – 51.3 gal	++++	++++	++++	+++[5]

[1]Each of the fumigants listed in this table has performed well in regional trials. Some alternative fumigants may need to be complemented with herbicides or hand weeding depending on weed pressure. Methyl bromide can only be used in response to specific pest problems listed in the 2012 Critical Use Exemption (CUE), and it is not available to new strawberry growers (only to qualified existing growers). Because of methyl bromide's high cost and diminishing supply, this fumigant is distributed as a 50:50 formulation with chloropicrin. It is recommended that the rates of MB be reduced for use with virtually impermeable film (VIF); thus, the regular recommended rate of 400 lb methyl bromide per broadcast acre would be reduced up to 300 lb per broadcast acre with VIF on land with a history of strawberry production.
[2]Metam sodium can be Vapam, Sectagon, or other registered formulations.
[3]Refer to the "Herbicide Recommendation" section of this guide for directions pertaining to herbicide applications.
[4]Reduced rates can be used with VIF. VIF must be used for the Midas 50:50 rate of 160 lb/treated acre. Various formulations of Midas are available.
[5] Paladin has low efficacy on certain small seeded broadleaf weeds and grasses.

Table 2: New risk mitigation measures for Phase I (2011) and Phase II (2012). Modified from http://www.epa.gov/opp00001/reregistration/soil_fumigants/soil-fum-train-material.html.

Blackberry Flavor: Improvement is the Key to Fresh Market Expansion

Reprinted from the
North American Raspberry and
Blackberry Association
Newsletter (www.raspberryblackberry.com)

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We believe the key to further expansion of consumption of fresh-market blackberries in the US and world revolves primarily around quality, with flavor an important aspect of quality. Most folks are aware that fresh blackberry markets and consumption have undergone tremendous growth in the last 10 years in the US and Europe, along with some expansion in other areas of the world. This change is due to a number of factors, including expanded production and marketing efforts, consumer interest in health benefits of the entire berry product category, improved post harvest handling, and improved varieties. When one looks closer at North American production as marketed thru shipping channels in the US, in 2010 just over 70% of the blackberries were from Mexico (mainly November and into June), and the remainder were from several production regions of the US (late May until early autumn) (information from USDA-Agricultural Marketing Service reporting). When one examines this growth period and the production regions more closely, it is evident that variety option has played a key role. The single-most important variety impact has been with the Brazilian variety Tupy in Mexico. We suggest the Mexican production expansion would not have occurred with the prior-grown variety Brazos, primarily due to flavor and other quality limitations. Tupy is sweeter and has much better post-harvest life than Brazos, plus the plant management system to allow production in this no-chill region has been further defined for reliable production. For domestic production, the Arkansas varieties Navaho and Ouachita (along with contributions of a few other varieties developed in the UA program) have been the primary varieties in the South, while these plus Driscoll Strawberry Associates proprietary varieties, and USDA releases Chester Thornless, Obsidian and Onyx have contributed to expansion in the western states. All of these varieties offer improvements over pre mid-1980s options, and production of these improved varieties (better postharvest handling, increased sweetness) began in the early 1990s and continues to expand.

Blackberry Flavor

Flavor of blackberries is usually broken down into four categories:

-Sweetness
-Tartness
-Aromatic flavors
-Astringency and bitterness

Two other flavors, salty and piquant (pungent), are not components of blackberry flavor. We would like to share some comments on these categories of flavor.

Sweetness. This flavor component is broadly understood to be the most important component to consumers of blackberries. If there is any one factor that has driven blackberry consumption expansion, most would agree that berries in the shipping and local markets these days are sweeter than in the 1980s and before. Tupy is sweeter than Brazos. Navaho is sweeter than Shawnee. There are other comparisons. Likewise, if there is one factor alone that is likely to expand fresh blackberry consumption further it is improved sweetness.

Sweetness is one of the first sensations when a blackberry is tasted, as is tartness. That is a key reason that the sweetness and tartness are so important; they make such a big and early impact on blackberry eating pleasure (or lack!).

What are some factors that affect sweetness of blackberries? First, as mentioned above, variety has a substantial impact on sweetness. Each variety has genetic limits on soluble solids potential. Navaho and Ouachita are almost always 10.5% or above while Chester Thornless is commonly 8 or 9%. Blackberries also differ in acidity. From a breeding standpoint, there are two approaches to increase the sweetness of berries. The first and most important approach is to hybridize (cross) two high soluble solids parents. The intention is to select offspring that are as highand preferably higher than the parents in soluble solids content. The second approach is to breed for lower acidity, which can give a sweeter taste than a comparable soluble solids level with normal or high acidity. The former approach is likely the better one but the latter has merit. Both have been explored and achieved in the University of Arkansas breeding program.

Maturity has a huge impact on berry sweetness. We all know the very ripe berries, usually referred to as "dull black", are sweetest. But, these have minimal to no postharvest handling potential. It would be preferable to have high soluble solids achieved when berries are just coloring well. This has been achieved at times in breeding, but is rare and not currently incorporated into any commercial varieties that we know of. Blackberries do not gain in soluble solids after harvest since there are no starch reserves to break down into sugars; the perception of being riper after storage is usually due to reduced acidity after harvest (and this does not always occur) along with a softer texture.

Other contributing factors in sweetness are plant health and crop load. A key to plant health is having healthy floricane leaves (on floricane-fruiting cultivars) which provide a substantial amount of the sugars that make berries sweet. What hinders leaf health? There are a number of factors, but commonly seen factors include winter injury (resulting in less healthy, smaller, and fewer leaves), disease, excessive crop (resulting in fewer and smaller leaves – the early developing berries are getting most of the energy of the plant), and to a lesser extent plant nutrition. One of the most striking examples of excess crop leading to reduced leaves and extreme tartness has been with the variety Natchez. This variety has large berries, and apparently the plant intends to make its berries large even if resources (such as leaves and thus sugars) are limiting. Lack of photosynthetic resources will result in very tart, albeit large, Natchez berries. Ironically, Natchez has very high cropping potential, and must be managed carefully (particularly in dormant pruning) to make sure high-quality, sweet berries develop. Finally, environment appears to play a factor in berry sweetness. We have observed repeatedly that rainy periods combined with reduced sunshine hinder maximum berry sweetness. This could be from dilution of sugars with extra water, plus reduced enzyme activity to develop aroma and flavor compounds.

What is a good target sweetness level? In general, most consumers perceive a "sweet" berry as one with soluble solids of 10% or higher. If we had cultivars that consistently had 12% or more soluble solids, blackberries would be even easier to sell. This can be achieved in breeding, again by using high soluble solids parents, and maybe that "early ripe" berry with high soluble solids can be achieved.

Tartness. "Sour", "battery acid", or just plain "bad" are terms used to describe tart blackberries. As a consumer there is nothing more disappointing that buying attractive blackberries that are disappointingly tart. Only moldy or excessively leaky berries outdo tartness in lack of desirability. Not everyone wants to add sugar or other sweeteners to fresh blackberries. Much of our discussion of factors affecting sweetness pertains to tartness. Genetics, maturity, plant health, and environment all play a role in tartness. One challenge in breeding blackberries for higher perceived sweetness by reducing acidity is that berries with reduced acidity can taste flat or simply lack flavor. We have seen numerous individuals sample "low acid" blackberries, only to find the flavor unacceptable although the sweetness level was more than adequate. Balance appears to be the rule.

Aromatic flavors. The flavor components of a blackberry extend beyond sweetness and tartness however, and the real "flavor" can be greatly impacted by the aromatic or compounds that give the true sensation of flavor. And, the interaction of sugars and acids play a key role in the expression of flavor. Although not fully documented, there are at least six to ten major

aromatics in blackberry flavor, with possibly hundreds more individual compounds in blackberry contributing to flavor. Most would agree that genetics plays the major role in blackberry flavor components. Among the varieties grown in North America, the Oregon-developed blackberries have the most pronounced flavor, with Marion being so distinct it has its own category of products. The eastern blackberries are usually grouped differently, and do not have as distinct a flavor profile as the *Rubus ursinus* and red raspberry-derived western flavors. And, the genetic differences extend beyond simply the flavors of these two categories, with the western varieties usually trailing in cane type, less winter hardy, and not as capable of postharvest handling as compared to eastern genotypes. The most innovative work in breeding for combining eastern and western flavors is ongoing with Dr. Chad Finn with USDA-ARS in Corvallis, OR, where he is combining the flavors and plant architecture of these distinct types.

Other than genetics, which factors play a role in blackberry flavor? Again, crop load, plant health, environment, weather, all play a role, but less than that of genetics in flavor development. In tasting Arkansas varieties and breeding selections in locations with warm days and cool night temperatures (lower than the warm summer nights in Arkansas), it is noteworthy how the flavor profiles are distinctly better with the cooler evening temperatures. Again, sugars play a pivotal role, both in providing the base for aromatic compounds, and enhancing flavor perception. Finally, berry maturity plays a key role in aromatics, with the levels being highest in fully ripe berries.

Astringency and bitterness. These flavor components are lumped together here as they are often related to some degree in blackberries. In general, bitterness is “tasted” on the tongue, while astringency if often described as a “feeling” of dryness or puckering. These “flavor components” often are detected later in the eating process than tartness and sweetness, and noticed more towards the back or sides of the mouth. JRC remembers over 30 years ago in an enology (wine) class of hearing the professor explain that astringency caused the precipitation of salival proteins and the resulting dry feeling in the mouth. At the time that explanation seemed humorous, but it is very true; factors involved include the compound or compounds and salival flow of the individual. Yes, we vary in our salival flow, and this can affect how astringent we perceive a blackberry to be! Worse, we also vary in both amount and types of bitter receptors on our tongue! In parading dozens of individuals by various blackberry genotypes, and listening to their responses when asked about astringency and bitterness, it is easy to determine that we humans vary in our perception of these flavor components.

Unfortunately, when bitterness and astringency are mentioned, the connotation is usually negative – we think we prefer little of either in a blackberry. However, some of the most important antioxidant or nutraceutical compounds in blackberries are what cause these flavor sensations. Chemically, these are grouped as flavonoid phenols such as flavanols. If we reduce these health-giving compounds too low a benefit to consuming the berries is minimized.

Genetics plays a substantial role in the levels of these compounds, although this has not likely been formally investigated. JRC remembers that in the development of Prime-Jim® that bitterness was particularly noted in some evaluations. A further concern was that this trait would be transmitted strongly to progeny. At the same time, breeding for reduced astringency in table grape skins was ongoing in Arkansas, again not sure how the trait was inherited, and one of the largest seedless berries in the program had pronounced skin astringency. Prime-Jim® turned out to do fine as a parent, not always passing on a strong bitterness, while the astringent seedless grape parent always seemed to impart a high level of this trait to its progeny. Therefore, selecting away from bitterness and astringency can be done in blackberry, and improvements can be made quite easily. It is not fully understood what impact environment, maturity or plant health have on bitterness and astringency in blackberries.

Can a blackberry with a substantial bitterness be successful? Yes! Most would agree that the most widely planted fresh market blackberry in the world, Tupy, has a very noticeable bitterness. However, its sweetness (which is usually noticed first) catches the consumers attention and helps reduce the notice of bitterness; plus we vary as individuals in the degree of bitterness we notice.

Interest in flavor in fruits is at an all-time high. Everywhere we turn, flavor is an increased focus with breeding programs, marketers, shippers, and usually growers. High flavor table grapes, varying acidity and flavor component nectarines and peaches, increased flavors in blueberries

and strawberries, all are examples of what is at the forefront of competition among fruits. Fortunately, blackberries in the commercial market are immensely better than they once were, and are getting better! We all need to keep a focus on flavor as we grow the blackberry market.

E. Coli Outbreak on Oregon Strawberries

Reprinted from the NC Strawberry Association Newsletter (www.ncstrawberry.com)

On August 10, Oregon Public Health (OPH) officials identified fresh strawberries from an Oregon strawberry farm as the source of a cluster of *Escherichia coli (E. coli) O157:H7* infections. Of the 15 cases that have been confirmed, four were hospitalized, and one elderly woman died from kidney failure resulting from the infection. They all fell ill between July 10 and July 29 and their ages ranged from 4 to 85. A few additional cases are still being investigated.

The Oregon Public Health's communicable disease section worked with county public health officials and the Oregon Department of Agriculture to track the infection cases and "trace back" to the source. "If someone gets sick, we ask questions about everything from what they've eaten, to whether they've been to common gatherings, to whether they've been swimming in a particular place, and then out of this we try to find commonalities," said the director of OPH. "The commonality among these cases has been strawberries at roadside stands and farmers' markets supplied by this one farm last month."

Pinpointing the farm was not easy since the farm sells its strawberries to a wide array of secondary vendors, who in turn sell them at local fruit stands, where they're really not labeled and differentiated from those of other farms.

Investigators were eventually able to link the implicated products to a single farm, Jaquith Strawberry Farm. While most Oregon strawberry growers raise primarily for processing, this well-respected 35-acre, fourth-generation farm focuses on fresh market. It sells PYO and wholesales its strawberries to buyers who then resell them at roadside stands, farm stands and farmers' markets. As of August 15th, 35 vendors and 53 locations where the potentially contaminated berries were sold in northwest Oregon had been identified. Jaquith recalled its products and is cooperating fully with the investigation.

Oregon public health officials tried to limit the area of concern by pointing out that the following were not affected:

- Berries other than strawberries;
- Strawberries sold since Aug. 1;
- Strawberries sold outside a specific region (which they defined);
- Strawberries picked at Jaquith Strawberry Farm's U-pick field;
- Strawberries sold in supermarkets.

Health officials urged consumers who may have purchased strawberries grown on this farm to throw them out. Strawberries that have been frozen or made into uncooked jam were of particular concern. (Cooking kills *E. coli O157:H7* bacteria, so cooked jam was safe.)

This is thought to be the first *E. coli O157:H7* outbreak linked to strawberries, although the bacteria has been associated with many outbreaks involving fresh produce, as well as undercooked meat. In 2006, an outbreak caused by another Shiga toxin-producing strain of *E. coli,* O26, was linked to strawberries or blueberries in Massachusetts, according to the Foodborne Illness Outbreak Database.

On August 17, deer feces at the farm were confirmed as the likely prime source of the pathogenic *E. coli* which contaminated the berries. Six samples of deer feces were found to have pathogenic *E. coli* with an exact genetic match to the outbreak strain. Deer have been the source of other produce related outbreaks, most notably in apple cider production.

For many Oregon growers, it is a common practice (and required by GAPs certification) to have workers monitor fields for deer feces during fieldwork and harvest and remove any droppings seen from the field. There has been speculation that perhaps the exceptionally wet weather experienced in the Pacific Northwest this year may have encouraged the spread of the organism from the deer feces to the fruit.

OPH officials worked hard to define the limits of the problem, to emphasize that the affected fruit were no longer on the market, and to underscore that this was an isolated incident (see the bulleted list to left). The media also cooperated fully in this effort. Oregon fresh market growers report little impact on their sales.

Grower Matt Unger, who also sells everbearing strawberries into the fall commented, “Our sales didn’t dip at all. And we didn’t get anywhere near as many questions from customers as we thought we would.” He noted that this kind of contamination would not just be a problem for fresh-market growers: many processing strawberries are frozen and go directly into products like ice cream without ever being cooked. (In this situation, however, the farm grew exclusively for fresh market.)

Southeastern growers are fortunate that this incident did not happen during our own harvest season, but may get questions from concerned customers in the spring.

Lessons from this outbreak

- Even a good farmer can have a food safety incident.
- Even small farmers can have a food safety incident.
- If an incident occurs, it is important that growers cooperate fully with the investigation.
- •Deer are a food-safety concern – they don’t just wreak havoc on plants and plastic.
- The ability to track sources and sales of fruit is crucial to identifying sources of infection and ruling out fields, growers, or sales dates that are not implicated. Any grower who wholesales any amount of fruit should try to work out a viable system of record keeping and traceback. Oregon, which licenses produce resellers, will be looking closely at such traceback issues. The investigation revealed the weaknesses in its current system, and the practice of resellers (often unlicensed) selling produce as their own was apparently widespread and added confusion.

A few resources

- **NC Market Ready** (google it; the URL is long!) has many resources for growers and consumers.
- The U.S. Food and Drug Administration has a new, consumer-oriented, user-friendly website, **www.foodsafety.gov** with handling recommendations, info about foodborne illnesses, and recall notices and alerts.
- A **Produce Safety Alliance** was created by the new Food Safety Modernization Act. Anyone can join its working committee or sign up for a listserv at http://producesafetyalliance.cornell.edu.

Blackberry and Raspberry Seasonal Checklist Fall 2011

Gina Fernandez, Small Fruit Specialist, North Carolina State University

FALL

Plant growth and development

- ✓ Primocanes continue to grow, but slow down
- ✓ Flower buds start to form
- ✓ Primocane leaves senesce late fall

Harvest

- ✓ Primocane harvest continues until frost

Pruning and trellising

- ✓ Spent floricanes should be removed asap
- ✓ Optimal time to prune is after the coldest part of the season is over. However pruning can start in late fall if plantings are large (late winter for smaller plantings).
- ✓ Start trellis repairs after plants have defoliated

Weed management

- ✓ Many summer weed problems can be best managed in the fall and winter using preemergent herbicides. Determine what weeds have been or could be a problem in your area. Check with your states agricultural chemical manual and local extension agent for the best-labeled chemicals to control these weeds.

Insect and disease scouting

- ✓ Continue scouting for insects and diseases.
- ✓ Remove damaged canes as soon as possible to lessen the impact of the pest.
- ✓ Check the Southern Regional Bramble integrated Management Guide for recommendations. http://www.smallfruits.org
- ✓ **Also check out Hannah Burrack’s blog. She posts timely information on insects of interest. http://ncsmallfruitsipm.blogspot.com/**

Planting

- ✓ Growers in warmer areas (e.g. extreme southeastern NC) can plant in December. Preparations for winter planting should have already been made. If you have questions about winter planting please contact me at the above email address.
- ✓ Prepare list of cultivars for next year’s new plantings. Find lists of nurseries at http://ncsu.edu/enterprises/blackberries-raspberries/?page_id=1496

Fertilizer

- ✓ Take soil tests to determine fertility needs for spring plantings.

- ✓ Non-nitrogenous fertilizers are best applied in the fall to established plantings.
- ✓ If soil is bare, plant an overwintering cover crop (e.g. rye) to build organic matter and slow soil erosion.

Marketing and miscellaneous

- ✓ Order containers for next season
- ✓ Make contacts for selling fruit next season

Make plans to attend Grower meetings! Blackberries and raspberries are part or all of these programs.
The 2012 North American Raspberry & Blackberry Conference will be January 16-18, 2012 in Sandusky, Ohio, in association w/Ohio Produce Growers and Marketers Association.
http://www.raspberryblackberry.com/local.cfm?doc=webdocs/ConferencePreview.htm
Caneberry session at the 2012 GA Fruit and Vegetable conference in Savannah GA. Jan 5-7, 2012

Key Resources:
Southern Region Integrated Bramble Management Guide and the Southeast Regional Bramble Production Guide:
http://www.smallfruits.org/SmallFruitsRegGuide/index.htm

Blackberry and Raspberry Grower Information Portal:http://www.ncsu.edu/enterprises/blackberries-raspberries

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

Quarterly Strawberry Growers Checklist

E. Barclay Poling
Professor Emeritus & Small Fruit Specialist

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

September-October

- ✓ Plant Camarosa plugs about 5-7 days ahead of Chandler in Piedmont regions – Camarosa needs earlier planting than Chandler, especially in colder fall/winter seasons like the last two. Planting Camarosa earlier in the NC Piedmont and coastal areas may do more to Enhance overall crop performance than trying to rely on winter row covers to correct for off-target planting dates.
- ✓ If further south (e.g Charleston, Savannah) be cautious about overreacting to an exceptionally cold December in 2010 by planting too early in 2011. Remember it could also be a warmer than normal season this fall and winter. Growers in these mild winter areas can easily end up with an excessive number of branch crowns and too many berries per plant if they plant too early.
- ✓ Prepare your Fumigant Management Plan as required by the new regulations. Don't wait until the last minute. Make sure you have required respirators, fit testing, and signs.
- ✓ Install a "blow-out tube" on fumigation rig – this is an important safety measure in case pressure builds up excessively in the nitrogen tank.
- ✓ Before the fumigation season, pressure-test your fumigation system using only nitrogen (a special connector can be obtained to do this).
- ✓ Make sure that the knives on fumigation rig are open and filters are clean.
- ✓ A minimum three-week plant-back period is required for most fumigants, Be sure to consult the fumigant label and to clarify with your supplier any questions you have about required plant-back period. It is very risky to attempt transplanting before the minimum plant-back requirement for the fumigant you are using has been met.
- ✓ Composted manure can be applied before bed-making in late summer, but do your homework before applying any new type of compost: What is the nutrient content? Any heavy metals? What will be the N release pattern? Get advice from your extension agent on issues related to usage of any animal manures in strawberries.
- ✓ Plant ryegrass before you punch holes

for plants. The recommended seeding rate for ryegrass broadcast for strawberry plasticulture prodution is only 25 lbs. You are only covering half of the area with seed, so this rate would be equivalent to 50 lbs per acre.) Heavier seeding rates will result in very thick and luxuriant stand that often have to be sprayed twice to get it to lay down.

- ✓ Set up deer fence even before the ryegrass germinates.
- ✓ Set up overhead irrigation system. Check pump, pipes, and nozzles.
- ✓ Check plants as they come in for insects and diseases. Control if necessary. Get diagnosis if disease is suspected; notify plant seller of any problems.
- ✓ Irrigate fresh dug plants 9 am–5 pm for 7–12 days. Irrigate plugs five hours first day, three hours second day, and two hours third day. (More may be needed if weather is hot and sunny.)
- ✓ Check for dead plants and reset ASAP.
- ✓ Watch for pest injury, including deer.
- ✓ Fall irrigate as needed to keep soil from drying out.
- ✓ Hand weed emerging winter weeds.
- ✓ Make plans to attend the Strawberry Expo November 6-8 (See page 2).

- ✓ Go to your local NRCS (Natural Resources & Conservation Service) office and apply for conservation programs. One progam (NC only?) offers a substantial cost-share for row covers.

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