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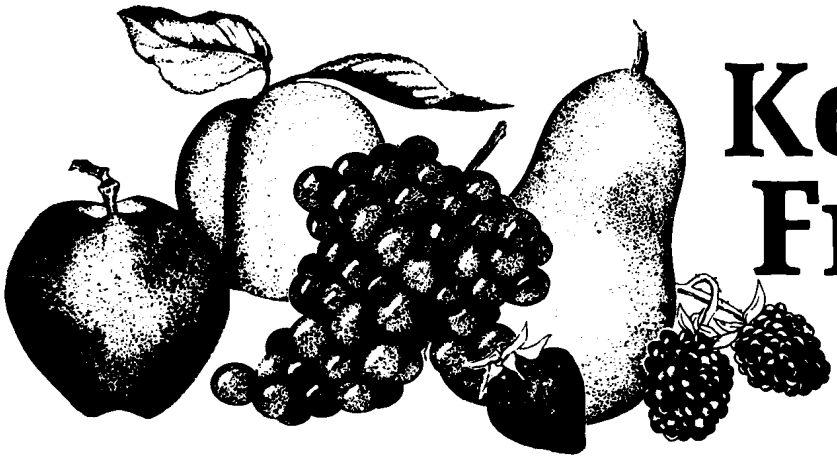

Kentucky Fruit Facts

Research & Education Center
P.O. Box 469, Princeton, KY 42445

April 2000 (4-00)
Prepared by John Strang and Jerry Brown, Extension Horticulturists; John Hartman, Extension Plant Pathologist; Ric Bessin, Extension Entomologist; Tim Woods, Extension Agricultural Economist; Chris Nelson, President KVS; Tom Priddy, Agricultural Meteorologist; John Strang, Editor, Marilyn Hooks and Elizabeth Griffin, Secretaries

Fruit Facts can be found on the web at: http://www.ca.uky.edu/HLA/fruifact/

Fruit and Weather Situation

Currently most of the state is under a mild drought with some areas showing moderate drought conditions. We are in pretty good shape agriculturally for the coming season and in better shape than we were last year at this time. As a side note rainfall for the period from February 1999 to February 2000 is 10.81 inches below normal. The La Nina is expected to die down between now and June based on warming in the equatorial Pacific. However, if La Nina hangs around until mid-summer drought conditions will probably prevail.

Past climatology shows a **tendency for tornado frequency** to be greater in La Nina winters and early springs. Storms come out of the southwest, redevelop over the southern Plains and head up towards the Ohio Valley or Great Lakes. They draw on Gulf of Mexico warmth and moisture and produce heavy rains and thunderstorms and, often, severe weather in the lower Mississippi Valley and Gulf States. During the spring, the threat gradually shifts north into the western Tennessee and Ohio Valley Regions. Given the recent shift of the coldest water relative to normal at the surface to the central Pacific, **we should be especially wary this spring**. Colder water there usually means storms come ashore further south on the West Coast. These storms redevelop east of the Rocky Mountains and bring severe weather outbreaks. On the positive side these storms will enhance our precipitation.

At this point bloom development is about 10 days to two weeks earlier than normal. (Strang, Priddy, Brown)

Meetings

Apr. 15 - Kentucky Nut Grower's Association Meeting, Hardin County Extension Office, Elizabethtown, KY. Meeting begins at 10:00 a.m. EST and includes a graft wood exchange and a plant auction. Contact Tom Evans, 270/826-8953 or Les Wilmoth 270/369-7493.

Apr. 18 - Commercial Apple IPM and Blackberry Production Meeting, Dana and Trudie Reed, Reed's Apple Valley Orchard, Paris KY, mkt. phone 606/987-6480 and Wayne Shumate's Wind Stone Farms, Carlisle, KY. See program and directions below.

Apr. 20 - Vegetable Diseases - Strategies to Avoid Them, How to Recognize Them When You Get Them and What to Do About It + Fruit & Vegetable Insects, Pests, and Beneficials - Explore Their Life cycles and How to Control Them, Kentucky State University Farm, Frankfort, KY. Contact 502/564-5871.

Apr. 25 - Migrant Conference - Legal Aspects of Migrant Employment and Immigration Issues, Fayette County Extension Office, 1140 Red Mile Place, Lexington, KY. This conference is geared for those that employ migrant workers. Speakers will be Rehim Babaoglu, a Memphis attorney recognized as an expert

on immigration law and Congressman Romano Mazzoli, coauthor of the Immigration Reform and Control Act. For more information and to register go to www.mc.uky.edu/scahip/mnc.htm or contact Brenda Franey 606/257-5582.

May 19-20 - Gourd Classes, First Baptist Church (May 19) and Sixth Annual Kentucky Gourd Show, First Baptist Church, 101 West Main Street, Taylorsville, KY (May 19-20). Contact Spencer County Cooperative Extension Office 502/477-2217 or E-mail klilly@ca.uky.edu

June 5-7 - Heartland Wine School, Ohio State University, Columbus, OH. The Heartland Wine School is a joint project of Purdue University, Michigan State University, and the Ohio State University and was created in response to requests for a regional opportunity to train winery personnel in classic wine making principles. Extensive tasting sessions will complement the presentations. Register early to be sure your place is guaranteed - space is limited and will be allocated on a first-come–first -serve basis. To obtain a registration packet contact Roland Riesen, OARDC, Department of Horticulture $ Crop Science, 1680 Madison Ave., Wooster, OH 44691. Phone 330/263-3685. E-mail:riesen.1@osu.edu

Jun. 22 - Commercial Apple IPM Meeting - Site to be arranged.

Jan. 8-9, 2001 - Annual Fruit and Vegetable Grower Meeting, Holiday Inn North, Lexington, KY. Contact John Strang 606/257-5685.

Commercial Apple IPM and Blackberry Production Meeting, April 18

Dana and Trudie Reed's Apple Valley Orchard, 239 Lail Lane, Paris, KY phone (606)987-6480 and Wayne Shumate's Windstone Farms

Directions to Reed's

Follow US 27/68 to Paris and turn left at the 2nd light onto the by-pass (at Dairy Queen). Continue on 27 N when Hwy. 68 splits off. About 5 miles from the split (past Custom Wood) turn left on Townsend Valley Rd. and travel 2 miles. Just before the 2nd bridge turn right onto Lail Lane, which is a gravel road. Drive slowly 0.8 mile to the end of the road to the Apple Barn.

Directions to Shumate's

From Reed's Orchard drive back to Hwy. 27 and the Paris by-pass. Turn left on the by-pass an follow it until it dead ends on Hwy. 68. Turn left on Hwy 68 and go through Millersburg past a Citgo gas station, which will be on the left. One mile past the Citgo gas station turn right on Hwy 386. Travel 5.4 miles and turn right on State Road 13. After approximately .4 miles you will pass Reynolds Springs Farm and the next lane on the left will be Wayne Shumate's farm.

Program

9:30 A.M.	EST Dana and Trudie Reed's Apple Valley Orchard Apple Round Table Discussion led by John Schlei, President of the Kentucky State Horticultural Society.
10:30	Apple Disease Situation - John Hartman
10:50	Apple Insect Management - Ric Bessin
11:10	Honey Bee Management and Pollination - Ric Bessin and John Strang
11:30	Apple Thinning - John Strang
Noon	Lunch will be available at cost for those that preregister. The cost will be in the $8.00-10.00 range. **Preregister by calling Mary Ann Kelley at 270/365-7541 between 8:00 AM and 4:30 PM CST weekdays by April 14 and give her a count for the Apple IPM meeting at Reeds's Orchard.**
1:30 P.M.	Wayne Shumate's Windstone Farms Blackberry Varieties and Culture - John Strang
2:00	Blackberry Disease Management - John Hartman
2:20-2:40	Blackberry Insect Management - Ric Bessin

Questions? John Strang 606/257-5685.

All UK Cooperative Extension Service Meetings are open to everyone.

Recommendations to Counteract Last Years Drought

Last summers high heat and water stress reduced fruit crop transpiration and cooling for metabolic processes, reduced tree nutrient uptake, and consequently reduced photosynthesis. As a result less nitrogen and carbohydrate were stored in the trees. Thus, there is less available for flowers this season. Early growth is sustained primarily using stored carbohydrates and nitrogen until the leaves take over and photosynthesis provides the carbohydrates for leaf and shoot growth. These reserves provide 1/3 to 2/3 of the building materials for new growth.

This season it is particularly important to maintain a good fungicide and insecticide spray program to protect young leaves and maximize photosynthesis. Good weed control practices should also be used to reduce competition for water and nutrients.

On apples a foliar application of feed grade urea at **5**

lb/100 gal. or 5 lb/acre should be applied in every spray between pink and first or second cover when the temperature is below 80° F. If the temperature is **above 80° F a rate of 3 lb/100 gal. or 3 lb/acre should be used to avoid burning the leaves.**

Dr. Dave Ferree's work in Ohio has shown that four to eight urea sprays in this time period consistently increases fruit size on Red and Golden Delicious apples by 7% in normal years. These sprays are cheap and produce a measurable, although not visually apparent increase in fruit size. This size increase will bump all fruit up one box size. The increase in fruit size even occurs on trees that show foliar nitrogen levels over 2% later in the season. Urea nitrogen applied at this time is used immediately by the spur leaves, but does not increase shoot growth. Foliar applications of urea should not be applied after second cover, because they can decrease red and yellow fruit coloration at harvest. Urea should not be applied to peach trees, because they lack an enzyme that enables the tree to utilize the nitrogen.

It's also a good idea to make foliar applications of boron (Solubor or its equivalent at 1 lb/100 gal. or 2 lb/acre) at pink and petal fall. Check compatibility of mixing urea and boron with insecticides and fungicides and order of mixing on pesticide labels. (Strang)

Early Season Insect Management

Chemical recommendation changes for 2000

Losses - We no longer are allowed to use **Penncap-M 2 FM** on fruits (even old product is prohibited). Penncap-M can still be used on soybeans and a few vegetable crops.

New Products - **Danitol 2.4 EC** has just been labeled for use on apples. This is a pyrethroid insecticide/miticide that is labeled for control of codling moth, leafrollers, rosy apple aphid, tarnished plant bug, Japanese beetle, plum curculio, European red mite and others. This is being promoted as an alternative to OP insecticides for early, mid, and late season use. Since this is a pyrethroid, my concern is the impact on beneficials and the likelihood of resurgence.

Pink Stage:

Monitor for tarnished plant bug and aphids. Control them if necessary. Aphid threshold is 5% of the terminals with live rosy apple aphids, or 50% of the terminals with other aphids.

Hang codling moth pheromone traps. These should be several rows into the orchard on the SW quadrant of a tree. Try to hang the traps as high as you can, but make them convenient to inspect.

Mite control. If you are using **Apollo** or **Savey**, they need to be applied by the pink stage. Do not use any combination of Apollo or Savey for two consecutive years, switch to another type of chemistry such as Agrimek after bloom or **Pyramite** during the summer. Development of mite resistance has become a problem with these products.

Bloom:

Do not use insecticides during this period.

Petal Fall:

Treat for plum curculio with either **Imidan** or **Guthion**.

Codling Moth:

When the fifth moth is caught in the trap, begin recording degree days. Control of codling moth in orchards relies on three tools; regular examination of the trees and fruit (termed scouting), pheromone trapping, and the use of weather monitoring and degree day models.

Traps should be put out at the pink stage of bud development. Every month, pheromone lures need to be replaced. Codling moths can be distinguished from other insects in the traps by their bronze wing tips.

Initial trap catches in the early spring are termed biofixes. This information will be used to predict when egg hatch will occur and synchronize insecticide sprays. In commercial IPM orchards, inclusion of an insecticide in the cover sprays is recommended as long as pheromone trap catches exceed an average of five moths per trap per week.

The biofix for the codling moth is the starting date of the first sustained flight of male moths captured in pheromone traps. Generally, this is when the fifth moth has been captured in the trap. A few moths often emerge very early in the spring ahead of the rest. Using the fifth moth as the biofix better represents when the majority of the codling moths begin to emerge. This usually occurs just after petal fall. Codling moth traps need to be examined daily in order to know exactly when the biofix occurs. After the biofix has occurred, degree days are calculated on a daily basis and a running total is kept. The codling moth has a 50°F threshold temperature. These degree day accumulations are compared with the target values in the following table.

DD	Target	Action taken when target reached
250	Egg hatch begins.	An insecticide spray is recommended. If codling moth are abundant (more than 10 per trap per week), a second spray may be necessary 7 to

		10 days later.
1000	When 1st generation moths may begin to fly.	Use their emergence as the next biofix.
1300	2nd gen. egg hatch.	An insecticide spray is recommended. If codling moth are abundant, a second spray may be necessary 7 to 10 days later.

(Bessin)

Managing Strawberry Fruit Rot Diseases

In Kentucky, strawberry fruit rot diseases can be most devastating. Gray mold, caused by the fungus Botrytis cinerea, is the most common, but leather rot, caused by the fungus Phytophthora cactorum is also important. Since neither disease is easy to manage, cultural and chemical controls are best used in combination to manage strawberry fruit rots.

Fruit rot management. It is important to manage gray mold during bloom. If Botrytis is controlled effectively during bloom, the need for fungicide applications during harvest is greatly reduced or eliminated. Botrytis mainly infects strawberries during the bloom period, although fruit rot symptoms resulting from these infections may not appear until the berries ripen. The fungus can colonize old flower petals that remain attached to the berries and begin fruit infections as the berries approach maturity.

Cultural practices. Be sure to use a good straw mulch to reduce berry contact with soil and lessen fruit rot, especially leather rot. Where feasible, pick up and destroy all dead plant materials such as leaves, petioles, and runners. Avoid excessive overhead watering. For leather rot, provide good drainage so that water puddles do not appear in the field.

Chemicals for gray mold. Beginning at early bloom, spray with a fungicide about once per week until late bloom. The final bloom spray should come when about 90% of the blooms have opened. In some seasons, the bloom period for strawberries can be extended, especially during cool weather. Fungicides such as Benlate, Topsin-M and the new fungicide Elevate are good choices for commercial growers. Since Botrytis can develop resistance to these fungicides, they are best used in combination with captan or thiram. Captan or thiram can be used alone, but are not as effective as the fungicide combinations. Home gardeners would use captan. Fungicide sprays should not be needed after bloom, thus problems of fungicide residue on the fruits can be avoided. There is little benefit from applying fungicides for gray mold fruit rot control during harvest. Ronilan can no longer be used on strawberries, and Rovral use is only limited to first bloom, and thus is not listed in our spray guide.

Chemicals for leather rot. For leather rot management, Aliette and Ridomil are both cleared for use. Ridomil needs to be applied before bloom and after harvest, whereas Aliette can be used during bloom and during harvest. Captan and thiram can also reduce leather rot, but are not as effective as the other fungicides. In any case, fungicides for leather rot are not very effective if the field is poorly drained or if straw mulch is not used.

For more detailed information on strawberry fruit rot management, obtain a copy of ID-94, “Kentucky Commercial Small Fruit and Grape Spray Guide 2000,” available at Kentucky County Extension offices. (Hartman)

KVS Legislative Initiative A Success

On March 21 in a floor vote in the Kentucky Senate, House Bill 663 was passed. The bill will go to the Governors office for signing into law and the bill will take effect on July 15, 2000. This bill is the result of the hard work of many individuals in the KVS and in the House and Senate. Now there is the possibility of seeing wineries open for business in dry territories, to see wineries freed from the industrial zoning classification, to allow for wineries to be able to ship their wine to consumers, and to enjoy a 4-year extension of the 9% wholesale tax exemption on wines made from out-of-state fruit and juice. (Nelson, Strang)

Blackberry Outlook

Many native Kentuckians have fond memories of going into the woods in their younger days to pick blackberries. Some Kentucky berry customers still occasionally wistfully reminisce about the sweet berries that they use to carefully pluck from between the thorns, and even the snakes that were encountered when picking wild blackberries.

Adventure aside, however, Kentucky’s commercial blackberry production can’t seem to meet state demand. “Everything we pick, we sell,” commented Jamae Pyles of Bray Orchards and Roadside Market in Bedford. This sentiment is held by berry producers across the state. Whether sold as pick-your-own, in retail stores, or at farmers markets, demand is strong for blackberries in Kentucky.

Bramble Demand Strong

Nationally, demand is on the rise for fresh and processed blackberries and other bramble crops such as red raspberries. Oregon’s Willamette Valley produces over 80% of the nation’s bramble crops, and a 1993 Oregon State University publication noted rising sales and prices for cane berries like blackberries and red raspberries. These trends have continued nationally into 2000.

“Local fresh high quality berries will increase demand in most farm communities (in Ohio),” notes Dick Funt, a

small fruit production expert at The Ohio State University. The demand outlook for Kentucky is very similar. Demand in farm communities will continue to increase, but producers nearer population centers should have an added marketing edge. Regardless of location, many of Kentucky's blackberry growers report plans to either expand production or replace older stands over the next two years.

Producers should not discount the impact of import berries upon their local markets. According to Funt, recent years off-season imports into the Columbus, OH market have a positive impact on the local fresh market. The off-season supply has apparently helped increase local season demand by teasing the consumer's palate for the arrival of the fresher local berries.

High Quality Demanded

Even with the memories of wild blackberries in some minds, consumers usually prefer today's larger cultivated blackberries. Consumers demand a high quality berry, one that appears fresh and is attractively packaged.

Fresh market producers are often able to virtually name their price for high-quality, fresh berries. This is especially true when product is properly presented. Retail and farmers market blackberries are best marketed in clear plastic, one-pint containers of freshly picked product. This allows for optimal consumer consideration.

New cultivars released by the University of Arkansas and others over the past ten years have especially caught the eye of many producers and the palate of many consumers. Field and quality trials are expanding in Kentucky to identify the best producing and tasting of these varieties.

Untapped Markets

Kentucky producers have the benefit of having many untapped market channels for in-season bramble crops. Most blackberries are currently marketed via traditional market channels, but other channels exist for fresh market blackberries. Kentucky's produce auctions serve as one example of an existing channel that offers much promise for fresh market outlets. Furthermore, larger grocery retailers often consider featuring in-season, local berry crops.

"We haven't even begun to realize the full market potential for fresh market brambles in Kentucky," says UK Extension marketing specialist Dr. Tim Woods. Woods and others believe that Kentucky's strength will be to continue to fill the fresh market niche, but he doesn't totally discount the long-term potential for value-added processing of the crops. Indeed, the USDA's Economic Research Service notes "strong increases in consumption" nationally for frozen blackberries and other brambles apart from the fresh market in the October 1999 Fruit and Nut Outlook.

People Love Blackberries

Brambles such as blackberries are not an easy crop to establish. There is a significant startup cost, demanding management, and time lapse of more than two years after establishment before a full crop can be harvested. But economically and anecdotally, blackberries can be a successful addition or expansion for Kentucky growers.

"People love blackberries," says producer Yvonne DePoister of Three Spring Farms at Big Clifty. It's true that a handful of consumers might still yearn for the wild blackberries picked with Grandpa. But those memories aside, a continued demand for high quality commercial berries offers promise for producers willing to invest the time and capital into further developing Kentucky's blackberry market.

Vegetable Production Guide for Commercial Growers Now Available on The Web

The 2000-2001 Vegetable Production Guide for Commercial Growers (ID-36) has just been completed and is now available on the Web. This 128 page guide has been divided up into 22 separate files for quick and easy downloading and printing; any or all sections can be printed and will appear identical to the printed publication. Readers will need to have downloaded the free Acrobat Reader utility in order to see and print these files. You can link directly to the ID-36 at:http://www.ca.uky.edu/agc/pubs/id36/id36.htm

This revised guide now includes an introductory section on marketing options with a table containing marketing concerns for tobacco growers considering commercial vegetable production. There have also been extensive additions to and revisions of all vegetable variety, disease control, weed control and insect control tables.

It will be a month or so until the printed version is available through the local County Extension Offices.

Frost Protection Strategies

During the 1980s and 1990s spring freezes frequently reduced the peach crop in the Southeast and also affected peach production in the northern and mid-Atlantic states. For the peach grower, methods and effectiveness of frost protection depend on the kind of freezing weather forecasted. The grower must recognize whether a radiation or advective freeze is predicted. This information will dictate the type of frost protection strategy he/she will use.

Radiation freezes are typical of hoar or black frost conditions where wind speeds remain below 5 mph and heat loss to the atmosphere is rapid due to clear skies. An inversion develops with cold air of 30-200 feet deep settling just above the ground. Air around the inversion boundary is warmer than the underneath cold air layer that surrounds the peach trees. Cold air will also move or drain to lower elevations under these conditions. Thus, the coldest air can be channeled away from orchards with proper orchard planning and layout. Also, frost protection methods will often be successful under these conditions.

Advective freezes occur when a cold front moves in with sustained winds greater than 5 mph. Cold air in these fronts are usually 500-5000 feet deep and inversions do not develop. Mixing of air is infeasible as warmer air is not available. Cold air drainage and frost do not occur under these conditions. Freeze protection is difficult during advective freezes.

What should a grower do to protect his peach crop from freeze damage? When planning an orchard, growers should always consider the orchard site first. Site selection is critical in helping reduce cold injury to future crops during radiation freezes. The orchard should be on an elevated site in relation to the surrounding topography and air should drain easily away from the orchard without impediment such as brush, trees or adjacent hills. The orchard location should also be in area that fruit has been grown successfully in the past. Some high, well-drained sites can still be "frost pockets" due to cold air drainage on a regional scale (e.g., multi-county). If there is no commercial peach production in your area, then this may be the reason why.

After site selection, careful variety selection will also minimize crop losses from both radiation and advective freezes. The variety you plant should have a good cropping history in your area. Quality varieties often fail to crop consistently due to early bloom from either too low a chilling requirement or too low a heat requirement after chilling for the region of production. Some varieties also produce fewer flowers per shoot such as Topaz, many nectarines and California varieties. Excessive bud loss to cold reduces production in these type of varieties in marginal freeze years. Other varieties such as Encore and Contender produce large numbers of flower buds and thus tend to have better crops in most freeze years.

After orchard establishment, cultural practices can save a significant portion of one's crop in radiation freezes and can be beneficial even in some advective freezes. Orchard floor management is a key component of frost protection. Absorbing solar heat by the soil provides a heat source for the orchard during a freezing event. Research has shown that the least reflectivity (highest absorbency) of incoming solar energy occurs on a wet, bare soil (8-9% reflectivity). Wet, sand (9%) and dry, bare soil (9-12%) are slightly more reflective; whereas, dry sand (18-28%), dry cultivated soil (20-25%) and high (>2 inches), wet grass (22%) are even less efficient in absorbing heat. The worst situation for absorbing solar radiation occurs in high, dry grass (31-33% reflectance). These solar reflectivity percentages have corresponded well to temperature readings made at 5 feet above ground in orchards. Orchards with bare, firm moist soil usually were the warmest at 5 feet during radiation freezes. Orchard temperatures above moist, shredded ground cover were 0.5 ^{O}F colder, followed by moist, closely mowed grass (1 to 3 ^{O}F colder), dry firm soil (2 ^{O}F colder), cultivated soil (4 ^{O}F. colder), and high ground cover (2 to 4+ ^{O}F colder).

These research data suggest that growers should maintain a closely mowed orchard floor middle in late winter/early spring in areas such as the Southeast and during the spring in more colder regions. Good weed control in the row middles, flail mowing of prunings and chemical mowing of the drive middles in late winter in southeastern orchards should maximize solar radiation absorbency before freeze events occur in the spring. Wetting the soil 24-48 hours prior to a freeze event to help the soil absorb solar energy may also be beneficial if evaporative cooling will not become a problem.

Other cultural practices which delay bloom or the dehardening of flower buds help protect peach flowers from both radiation and advective freezes. Delaying bloom with fall applied ethephon chemicals and GA's has been successful in eastern growing regions. Ethephon also increases the heat requirement of buds after chilling has been reached. This effect tends to delay dehardening of the flower buds, thus keeping them cold hardy longer into the spring. However, ethephon can excessively thin buds and thus far, lacks a registration for use as a growth regulator for peach in the Southeast.

Dormant oils also have been used successfully to delay bloom in peach. Both Superior dormant oils and degummed soybean oil (still under test) have worked at concentrations from 6 to 15%. Rates above 10% can be phytotoxic to buds as well as expensive to use and may also exceed the label rate, thus the benefits must be carefully weighed against the risks.

Experimental work with peach interstems and the Asian Prunus Virus (APV) have shown significant bloom delay in the Southeast for many cultivars. Some high chilling peach selections have consistently delayed scion bloom 3-4 days when budded as an interstem. In contrast, very few rootstocks delay bloom and that delay is usually 1 or 2 days. The APV can delay bloom 4-10 days in many varieties simply by inoculating the tree via chip or T-budding. These bloom delays are more pronounced in the Southeast where bloom periods are often protracted. Currently, this work is still under study due to possible negative interactions that may occur if another virus such as Prunus Necrotic Ringspot Virus infects an APV tree.

A very effective method of maintaining cold hardiness in peach flower buds is to dormant prune as late as possible up to petal fall. Unpruned trees have produced marketable crops in severe freeze years due in part to the increased hardiness of the buds and the extra buds left on the unpruned tree. This pruning practice would be logistically impractical for larger growers, but in those larger operations pruning the earlier blooming or more cold tender varieties last would be prudent.

Canopy management can also have an effect on winter hardiness of peach buds. Excessive shading (<30% sunlight) of fruiting wood during the summer reduces the winter hardiness of the buds. Summer pruning should be seriously considered in orchards where fruit quality and excessive tree vigor are problems, since an important side benefit would be hardier flower buds going into the winter.

After a grower has selected the best sites, varieties and cultural practices, his/her orchard still is at risk of losing its crop from radiation or advective freezes. From here, the next level of frost/freeze protection requires significant capital input. Proven technological options for freeze protection are wind machines (with or without heaters) and overhead irrigation. If this frost protection technology is properly used, the capital investment in it should pay for itself under good market conditions.

Wind machines provide frost protection by warming the air in the orchard by disrupting (mixing) the colder air of an inversion layer that settles below warmer air during radiation freezes. Properly aligned wind machines can increase the amount of acreage covered per machine and thus increase their efficiency. During radiation freezes, orchard air temperatures often are increased from 1 to 4 ^{O}F using wind machines. In addition, during calm radiation freezes when wind speeds drop below 2 mph and dewpoints are low, skyward exposed buds radiate heat quickly and cool up to 4 ^{O}F colder than the air temperature. A wind machine in this situation lessens this bud cooling which could occur unnoticed if only orchard air temperature is monitored. Wind machines begin to lose effectiveness when winds approach 5 mph as air mixing is occurring and advective freezing conditions become more likely. In colder regions, wind machines can also be used to protect buds from killing winter temperatures if radiation freeze conditions are present.

Orchard heaters add heat to the orchard, but they also require considerable maintenance and expense when advective freezes and large acreages are involved. For radiation freezes, the decision to use heaters should depend partly on how deep the inversion layer is and how high up is the critical non-lethal temperature is in the inversion. The smaller the air volume under the inversion and the shorter the height to the above, non-lethal temperatures in the airmass, the less heat energy is needed to raise the temperature above the critical lethal temperature in the orchard. Under radiation freezes, when no wind machines are used and winds are calm, heaters can be very effective as long as they are small enough not to create an updraft that breaks through the top (warmest part) of the inversion.

Overhead irrigation has been used successfully with strawberries and blueberries to release heat to the buds and leaf tissue by constantly freezing water (heat of fusion) upon them. Success with peaches has varied; however, due in part to evaporative cooling, application patterns, and structural damage. During radiation freezes, applying (=freezing) water at a rate that maintains the bud above the critical lethal temperature (usually <32 ^{O}F) is easier to do than when advective freezes are present. Advective freezes usually are associated with strong winds and dry air or low dewpoints which are conducive to evaporative cooling and irregular water application patterns. More damage can be done than protection provided if these conditions occur, since more than 7.5 times as much water must be freezing than which is evaporating to get a net gain in heat. Furthermore, either stopping the irrigation before the bud temperature is above the critical lethal temperature or irrigating too long can lead to bud kill or structural damage from scaffold breakage.

To successfully frost protect peach trees with overhead irrigation, the experience of other growers is the best source of information for the novice. There are numerous reports and papers on irrigation installation and operation for frost control, but each reported method has to be tailored to the grower's operation (e.g., water source, pump size, acreage, tree height and training system) to work effectively. Once this has been worked out, growers have been able to protect peach flowers down to 22 ^{O}F in the Southeast during radiation freezes as long as the irrigation is not turned off before the ice melts freely or the web bulb temperature is above the critical lethal temperature. Protection from advective freezes can be less effective depending on whether sufficient water can be applied to compensate for low dewpoints (evaporative cooling) and wind (irregular dispersal pattern).

Lastly, many chemicals have been advertised as frost protectants, but few if any have demonstrated consistent or predictable results. These chemicals generally fall into several groups. They are seaweed extracts (GA's plus micronutrients), ethylene glycol

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(antifreeze) formulations, anti-ice nucleating agents (bactericides, copper), osmotic regulators (calcium, sugars) and others such as vitamin E plus glycerol. Most of these products affect some physiological or structural component of the flower bud, but more testing of their efficacy under the many different environmental conditions that occur during radiation and advective freezes is still needed.

Frost protection has become (or should be) a necessary component of the eastern peach grower's management plan. Increased production costs and lower profit margins have made crop losses to freezes a serious business risk. Implementing some of the strategies listed above may reduce the risk of growing peaches in regions with spring freeze problems. (Gregory Reighard, Clemson University, Clemson, South Carolina)

Receiving Fruit Facts Electronically on the Internet

Fruit Facts is available on the web in the pdf format. To get notification of the monthly Fruit Facts posting automatically and approximately two weeks earlier than it would normally be received via mail, you can subscribe to the UK College of Agricultures's Majordomo list processor.

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is: owner-fruitfacts@ca.uky.edu

John Strang, Extension Horticulturist