

# The Vegetable and Small Fruit Gazette

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Horticulture Department  
The Pennsylvania State University

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**Tip for the Month--** “That each passing day culminates another successful step climbed in your ladder of life and that your goals become brighter and warmer the longer you strive for them”

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## **Comments from the Editor**

Bill Lamont, Department of Horticulture

Well the rain saga continues!! Even the legendary Joe Pa couldn't control the weather this past weekend for the Temple game but he did seemed to have some pull with the weather gods in that the sun did come out and made for a nice end of the game and day. This growing season has been one for the record books. All we need to top it off is an early frost. Weather is the one factor that we have no control over although we can modify the environment using plasticulture and provide some protection to our crops in the field. We still can't tame the rain, cold or hail which can negatively impact our crops. This is what makes agriculture such a gamble. I look forward to receiving John Esslinger's article for the October issue and would encourage any

agent who has an article they would like to share to send it in to me. I want to thank colleagues from other departments who contributed articles to this issue and I want to encourage others to join us in upcoming issues. If you have an event that you would like to advertise, please send it to me. As always, the Vegetable and Small Fruit Gazette Team encourages your feedback so that we can better serve your needs and address your concerns.

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## Schedule for Agent Articles

Bill Lamont, Department of Horticulture

November	John Esslinger
December	Andy Muza

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## Farmer/Grower Grants from Northeast- SARE

Bill Lamont, Department of Horticulture

Have an idea that you have been wanting to try but haven't had the time or resources? Wish you could compare some new way of doing things with your old way, or experiment with something new? A SARE farmer/grower grant may be just what you need. Many farmers have found these grants helpful, and we encourage farmers who are interested in conducting innovative production and marketing projects are encouraged to apply to the Sustainable Agriculture Research and Education (SARE) program for grant funds for projects starting next spring Applications can address a broad range of agricultural issues such as pest management, soil and water conservation, aquaculture, marketing, grazing, bee health, no-till, pasture management, agroforestry, new crops, and other sustainable farming techniques. Northeast SARE defines sustainable agriculture as agriculture that is profitable, environmentally sound, and good for the community. In 2003, the average grant was about \$5,200; grants are capped at \$10,000.

Any full- or part-time farmer in the Northeast SARE region can apply. The region is made up of Connecticut, Delaware, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia, and Washington, D.C. Applications and more information about the requirements of the Farmer/Grower Grant program are available at 802-656-0471 or on the Northeast SARE web site at [www.uvm.edu/~nesare/](http://www.uvm.edu/~nesare/). Feel free to contact Helen Husher , NE SARE, University of Vermont. 802/656-0554, or 802/223/7923; email [helen.husher@uvm.edu](mailto:helen.husher@uvm.edu)

to find out more information. The proposal deadline is December 8, 2003. (Adapted from Mass. Vegetable Notes Newsletter)

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## **Pumpkin Production in PA- 2003**

Mike Orzolek, Department of Horticulture

Pumpkin production in most years is a challenge and in 2003 it has been the most challenging in the 22 years that I have been at Penn State. Rain, rain, rain along with the cooler than normal weather across the Commonwealth has caused problems from day 1, Delay in planting the pumpkins, lack of weed control, high populations of diabroticities (cucumber beetles), and now diseases - mildews and phytophthora. I have had several calls in the last 7 to 10 days from growers whose fields have been hit with phytophthora. Since there are not many options for effective fungicide applications other than Acrobat and no resistant pumpkin varieties, this disease can be very devastating this time of year if observed in your pumpkin fields. Also, more rain is predicted for September and October of this year. My recommendation for most growers would be to harvest all mature pumpkins that are orange or mostly orange, disease free, with green stems and place them in a dry storage with forced air blowing over/through them for the first two weeks. Be sure that all pumpkins placed in storage are disease free and for insurance, pumpkins could be dipped or sprayed with 150 ppm chlorine prior to being placed in storage. Any phytophthora infected fruit placed in storage has the potential to rot other fruit near it in storage. I also think that leaving pumpkins in the field under our current weather conditions would be hazardous to the health and marketability of the fruit. In talking with growers and traveling in state, I would estimate that many pumpkin fields have 20 to 30% less fruit in 2003 compared to 2002 simply because bees do not like wet, cloudy days and mature female pumpkin flowers are only receptive to pollen for fertilization for 6 hours before they close permanently. What fruit you find in the field this year, you may want to treat like fresh eggs.

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## **Late Season Cucurbit Downy Mildew and Powdery Mildew Control**

Alan MacNab, Department of Plant Pathology

### **Downy Mildew:**

*Symptoms:* These include yellow blotches on the top surface of leaves, and sometime a faint grayish-purple mold on the underside of the yellowish areas. The yellowish areas die quickly resulting in dead spots on leaves, and a ragged appearance of the foliage.

*Forecast:* Downy mildew will appear very soon and will spread northward within Pennsylvania. The disease has been reported in Mid-Atlantic states and likely is already

present in the warmest parts of Pennsylvania. I expect that this disease will be much more prevalent than in recent years. If appropriate fungicides are not used, within a week of symptom appearance, a cucurbit planting could be affected so severely that it may appear to be damaged by frost! So timely fungicide applications are critical.

*Fungicides for control:* Downy mildew is not difficult to control with fungicides. Most cucurbit programs utilizing protectants (eg. mancozeb, chlorothalonil, and copper) likely are providing some control now. With the increased likelihood of downy mildew, growers should now consider some of the materials that have some systemic activity. These include Acrobat tank mixed with a protectant, one of the Ridomil Gold mixture products (Ridomil Gold Bravo, Ridomil Gold MZ, or Ridomil Gold/Copper), and a new one named Pristine.

### **Powdery Mildew:**

*Symptoms:* The white powdery growth on top and bottom surfaces of leaves is characteristic. Most growers can identify this disease.

*Forecast:* This disease appears every year and it is present throughout Pennsylvania at this time. It has appeared later than usual this year due to weather conditions that are wetter and cooler than normal.

*Fungicides for control:* There are many fungicides listed within our current Commercial Vegetable Guide and I will not repeat this information.

The first news is that powdery mildew resistance to the strobilurin fungicides (eg. Cabrio, Flint, Quadris) has appeared in several areas of the United States. This will be of concern to all cucurbit producers, because spores of the powdery mildew fungus are wind borne long distances, thus facilitating rapid spread of strobilurin-resistant populations of the fungus. Where resistance is present, fungicides other than the strobilurin fungicides are needed for control. At present, I do not know of any resistance reports for other powdery mildew fungicides. Therefore, Nova and Procure continue to be good fungicide choices. And we expect that the broad spectrum protectant, Bravo, will continue to be effective; the only problem with Bravo is that it has no systemic properties, which means that spray coverage is critical.

The second news is that micronized sulfur appears to be quite effective against powdery mildew. One point to be aware of regarding sulfur is that it can be phytotoxic. So, although I am suggesting that pumpkin growers try some micronized sulfur on pumpkins this fall (NOTE: Not for other cucurbits yet), I am suggesting only a 4 lb/A rate when using an 80% wettable product (the label indicates a higher rate, but the 4 lb rate worked well in a Long Island, NY, test). In addition, I want to remind growers to carefully read and heed label precautions. There could be some varietal differences in sensitivity to sulfur, and sulfur should not be applied when the temperatures are high (the label says above 95 degrees F, and I would suggest applying the spray at the lowest temperature possible). One micronized sulfur product I am aware of at this time, that is labeled on pumpkin, is: Microthiol Disperse, 80%W from Cerexagri. Benefits from use of sulfur include the potential for relatively good control, including some control on lower surfaces of leaves (possibly from some volatilization), the potential to strengthen our

fungicide resistance management program, and a relatively low cost for a micronized-sulfur application.

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## **New Pumpkin Guide**

Bill Lamont, Department of Horticulture

The Pumpkin Production Guide, published in June 2003, is a must-have for both new and experienced pumpkin growers, serious gardeners, and agricultural advisors. The 152-page guide covers the basics of pumpkin production and cutting-edge research. Twelve chapters offer practical information for preparing the field, evaluating varieties, and choosing the best cultural practices; groundbreaking insight into fruit set and pollination to help growers maximize yields; descriptions for identifying and controlling weeds, insects, diseases, and wildlife pests; ways to maintain postharvest quality; and sample budgets and marketing ideas. Over 115 color photos supplement the text. The Pumpkin Guide, NRAES-123, is available from NRAES for \$39.00 plus \$6.00 S&H (within the continental U.S.). Make checks payable to NRAES; all major credit cards accepted. Contact NRAES for other S&H rates and possible quantity discounts: NRAES (Natural Resource, Agriculture, and Engineering Service), Cooperative Extension, PO Box 4557, Ithaca, NY 14852-4557; phone 607-255-7654; fax 607-254-8770; e-mail [NRAES@Cornell.edu](mailto:NRAES@Cornell.edu); website [www.NRAES.org](http://www.NRAES.org).

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## **Pumpkin and Winter Squash Harvest and Storage**

J. Howell, R. Hazzard, A. Carter, University of Massachusetts

Additional resource: Liz Maynard (Purdue) (Taken from the Mass. Vegetable Notes Newsletter)

Although there are many late fields with immature fruit, pumpkins in some fields are turning orange. If the current warm sunny days continue, more and more fruit will color up in the next several weeks. Pumpkins may need to be held for several weeks before they can be marketed. There can be extra work involved in bringing fruit in early, especially for growers who normally have pick-your-own harvest, but we recommend that growers harvest as soon as crops are mature and store under proper conditions, if it is feasible.

Attention to curing and handling will go a long way toward improving the life of winter squash and pumpkin fruit. In fields where pumpkins are turning orange, it is worthwhile to cut and windrow the pumpkins and bring them in out of the field. This will allow the handles to cure and will protect fruit from insects, vertebrate pests, and diseases. Pumpkins are not marketable if the handle is broken off or dried up. If you need to leave

pumpkins in the field for pick-your-own, cut the handles from the vine to save them from advancing powdery mildew and reduce shrinkage. On some varieties, however, handles shrink after cutting. Ideally, if the timing is right, pumpkins would be cut one to two weeks prior to marketing.

Ideally, pumpkins should be harvested when fully mature, with a deep orange color and hardened rind. However, as long as pumpkins have started to turn color, they will ripen off the vine if held under the proper conditions. While not ideal, this may be preferable to leaving them in the field if conditions are not favorable. If necessary, pumpkins can be ripened in a well-ventilated barn or greenhouse. The best temperatures for ripening are in the seventies or even low eighties during the day. Night temperatures should not drop below the sixties. In a greenhouse, temperature can be managed with ventilation on sunny days. Unless it is quite cool, heat is not likely to be needed if the house is closed up at night.

Often it is not feasible to harvest pumpkins early and store them until they can be marketed, and so they must be stored, in the field. If vines and fruit are healthy, storage in the field can be successful for a few weeks. If the vines die back, damage to the fruit from sun, disease and insects is more likely. In any case, it is important to scout for insects feeding on the fruit and handles, which may include squash bug nymphs or adults, or striped cucumber beetle. Control them with insecticides if damage is evident and look at fruit throughout the field to assess feeding damage on handles and fruits. Squash bug nymphs are gray with black legs and usually group together on the undersides of leaves. Adults are a dull brown and are more likely to feed singly. Cucumber beetles at this time of year are most likely found in flowers, but may also group together on fruit. Both cause unsightly scarring and pitting which can also allow entry of diseases. There is no set threshold, but judge the level of damage and the proportion of fruit with damage. In fields that have a history of *Phytophthora* blight, *Fusarium* fruit rot, or black rot, field storage may increase the incidence of these problems, particularly if we have a period of wet weather or a major storm while fruit is sitting in the field. This has been one of the causes of significant losses in recent years, and one reason that we recommend bringing fruit in as soon as it is mature.

Winter squash is also maturing in some fields. Fruit that are free from disease and haven't been subject to much chilling (below 50°F ) should be selected for long-term storage. Sorting fruit in this manner requires extra labor and may not be economical, but it should not be too difficult to separate bins of squash according to good and poor fields or areas of fields. Fruit from fields where *Phytophthora* is present are not the best choice for storage.

Storage life depends on the condition of the crop when it comes in and your ability to provide careful handling and a proper storage environment. All fruit placed in storage should be free of disease, decay, insects, and unhealed wounds. When harvesting squash and pumpkins, it is important to handle the fruit with care to avoid bruising or cutting the skin. Despite its tough appearance, squash and pumpkin fruit are easily damaged. The rind is the fruit's only source of protection. Once that rind is bruised or

punctured, decay organisms will invade and quickly break it down. Place fruit gently in containers and move bins on pallets. Removal of the stem from squash (butternut, Hubbard, etc.) will also decrease the amount of fruit spoilage because the stems frequently puncture adjacent fruit, facilitating infection. A period of curing after harvest can help extend storage life. This may be done in windrows in the field -- especially with a series of warm, dry days -- or by placing squash in a warm dry atmosphere (70-80°F) with good air circulation, such as a greenhouse, for up to two weeks. This pre-storage treatment permits rapid drying of the outer cell layers, and when combined with a dry atmosphere for storage inhibits infections that can take place at this time. Any clean cuts during harvest are likely to heal over and are no longer a source for injury or infection.

Take care to avoid subjecting squash to chilling injury. Chilling hours accumulate when squash is exposed to temperatures below 50°F in the field or in storage. Injury increases as temperature decreases and/or length of chilling time increases. Chilling injury is of particular concern with squash intended for storage because it increases the likelihood of breakdown. If squash has been exposed to chilling injury it should be marketed first and not selected for long-term storage. Remove squash from the field if temperatures likely to drop below fifty degrees for any length of time.

After curing, move squash or pumpkins to a dry, well-ventilated storage area. Pressure bruises can also reduce storage life, so avoid rough handling, tight packing, or piling fruit too high. Fruit temperature should be kept as close to the temperature of the air as possible to avoid condensation, which can lead to rot. Ideally, the storage environment should be kept at 55-60°F with a relative humidity of 50-70%. Lower relative humidity increases water loss, resulting in reduced weight, and if excessive, shriveling of fruit. High relative humidity provides a favorable environment for fungal and bacterial decay organisms. Under ideal conditions, disease-free pumpkins should have a storage life of 8-12 weeks and butternut squash up to three or four months. Even if it is difficult to provide the ideal conditions, storage in a shady, dry location, with fruit off the ground or the floor, is preferable to leaving fruit out in the field.

As you plan for storage and marketing, keep in mind that the market for pumpkins seems to get earlier every year. Fall decorative displays include pumpkins, and those displays begin showing up as Labor Day approaches. One of the best solutions to early-maturing pumpkins may be finding an early market. With so many late-planted field this year, early pumpkins are likely to be in demand.

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## **Tips for Artificial Drying and Curing of Onions**

*J. vanderHeide*, Cornell Cooperative Extension Agent, Oswego County

Some transplanted onions are harvested and topped when still relatively green and moist and then placed in dryers for quick curing. Unless dryer capacity and the amount of product are carefully matched, the dryer will quickly create conditions of high humidity for several days (favorable for black mold) before onions are cured.

Expose onions that are topped green to lots of airflow ASAP, because green onions contain a lot of moisture. Do not leave green-topped onions in boxes for several days before moving into a dryer.

Undercut onions several days before topping to reduce the amount of free moisture in the bulbs and necks. This way, onions will dry quickly before black mold develops.

To prevent black mold or bacterial diseases from developing in the dryer, temperatures need to be below 82°F.

Ideally, RH of air going into the pile should not be higher than 50%, and RH of air leaving the pile should not be any higher than 80%. If RH of outside air is low, you will not have to add a lot of heat. Airflow should be no less than 3 cubic feet per minute per cubic foot of product.

It will be difficult to dry onions in a dryer on hot humid days, because you will have to add a lot of heat to bring down the humidity of the air going into the pile. In the meantime, pile temperature will rise

Keep an eye on the weather, and postpone harvest a few days if forecasts predict high humidity for the period in which you plan to dry your onions.

The wetter the onions going into the dryer, the fewer should be put into it. No more than 3 boxes away from the plenum. It is better to dry onions in a short period of time and do it right, than to try and be efficient with the forklift and overload the dryer and end up with black mold.

To control neck rot, ideally temperatures need to be 95°F to kill the fungus. But, by using lower drying conditions to avoid black mold and bacterial diseases, temperatures are actually more favorable for development neck rot. However, since neck rot is moisture driven disease, the key is to keep the RH below 80% and use lots of air to dry necks down when drying at these lower temperatures.

Leave 2-3 inches of neck on the bulb to increase your chance of drying down the neck before the fungus grows from the cut surface into the top of the bulb.

(Thanks to Lee Young County Extension Director, Commercial Horticulture Agent Penn State Cooperative Extension, Washington County for sending this article from New York)

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## **Bug vs. Bug - Is it a Parasitoid or Predator?**

Cathy Thomas, Integrated Pest Management Program  
Pennsylvania Department of Agriculture

Of the million or greater insects found throughout the world, only a small percent are actually considered pests. The non-pest species may be beneficial (natural enemies) because they play a large role in regulating pest densities in a natural environment.

Natural enemies can be predators or parasitoids occurring naturally or reared in laboratories and introduced to control pests (biological control). In a field crop situation, natural enemies provide effective pest control, unfortunately broad spectrum insecticides kill predators and parasitoids along with the pest. In greenhouse crops, native beneficials will migrate in if there are no broad spectrum compounds being used and the vents are not screened.

Probably the most well known native predatory insect is the common ladybeetle, *Hippodamia convergens*. Both the adult lady beetle and larval stage feed on soft-bodied insects such as aphids. *Hippodamia convergens* can also be purchased through garden supply catalogs to be used in gardens, crops and greenhouses. The beetles sold through these suppliers are harvested from the foothills of the California mountains, maintained in a dormant state and shipped to customers in the spring or summer.

Many other predators and parasitoids are produced commercially to control pests in greenhouses and field crops. Most of the successes in greenhouse biological control have occurred in the Netherlands and the United Kingdom, mainly because these countries together contain more than half of the world's greenhouse acreage. An important event occurred when Koppert (1967), a cucumber grower, entered the natural enemy business. Koppert is currently the international market leader in the field of biological crop protection. Large scale production of natural enemies takes place in the main facility located in the Netherlands. In addition to Kopperts, there are several other large producers such as Biobest (Belgium), Novartis BCM (England and California) – a division of Novartis Crop Protection and Applied Bio-Nomics Ltd. – Canada's largest producer of biological controls.

Before starting a biological control program, it is important to recognize the characteristics of predators and parasitoids and how they are used for each unique pest management situation.

### **Predators**

A predator kills and consumes many prey individuals as food, and they are usually as large or larger than their prey and quite capable of moving around to search for their prey. Many predators feed on many different insects, mites, and invertebrates.

Predators can be beetles, mites, mantids, flies, and bugs. In addition to ladybeetles, there are many other predators commercially available for introduction into crops.

Green Lacewings (*Chrysoperla carnea*) – this delicate green insect lays eggs on silken stalk attached to the leaf or stem. Eggs hatch into voracious larva (aphid lion) that feed on soft bodied insects, mites and insect eggs. The larva feeds for about three weeks before pupating inside a cocoon attached to the underside of the leaf. Lacewings can be purchased as eggs and some companies will supply in the larval stage.

Predatory Mites – Several species of mites are sold by biocontrol suppliers. The species that is most commonly used on a commercial scale is *Phytoseiulus persimilis*. This mite is used to control two-spotted spider mite in greenhouses and some field crops. Another mite, *Amblyseius cucumeris*, is used to manage thrips on a wide variety of greenhouse crops.

Predatory midge – *Aphidoletes aphidimyza* is a predatory midge used to control aphids. The grower receives the midge in its resting stage (cocoon) which are distributed near the aphid colonies. Adults emerge and lay eggs near aphid colonies. Eggs hatch into larvae that move about the leaf, feeding on aphids. This is a long lasting biocontrol. Another species, *Feltiella acarisuga*, is used for spider mite infestations.

## Parasitoids

Parasitoids or parasitic insects are usually smaller than their prey. One or more parasitoids grows and develops in or on a single host. As the parasitic larva feeds and matures, the host is slowly destroyed. Adult parasitoids (usually wasps or flies) are highly mobile and lay eggs in many pests. Parasitoids attack many different species of pests, such as aphids, whiteflies, caterpillars, leafminers, flies and scales.

*Encarsia formosa* – one of the most common whitefly parasitoids, used in crops such as poinsettias and vegetable crops. This tiny wasp has been used Europe for the past forty years with great success. *Encarsia* adults lay their eggs in the whitefly nymph. As the parasitoid develops inside the whitefly, the nymph appears black. A new wasp emerges from the whitefly nymph through a hole chewed in the dorsum.

*Trichogramma spp.*- One of the most popular and effective controls for caterpillars is the egg parasitoid, *Trichogramma*. These tiny wasps (.9 mm) work by laying eggs (parasitizing) in the eggs of many destructive caterpillar pests. A new wasp will emerge from the parasitized egg. If you are going to use this biocontrol, inspect the crop for the

presence of eggs since this is the life stage that is attacked. *Trichogramma* is not effective against the larval stages.

Grain moth eggs parasitized by *Trichogramma* are glued to small cards and shipped to the grower. The cards are then placed throughout the crop where the wasps will emerge to search the plants. The species available from most biocontrol suppliers include *T. brassicae*, *T. minutum* and *T. pretiosum*.

Before starting a biocontrol program, consult suppliers, pest management consultants or extension personnel for application rates, introduction methods and appropriate species needed for the crop and pest.

For questions on biological control methods and a listing of biological control suppliers a helpful source is the Association of Biocontrol Producers at this website:

<http://www.anbp.org/>

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## **That's A Berry Good Question!!!**

Kathy Demchak, Department of Horticulture

**Q.** Last spring, my plasticulture strawberry plants had branch crowns that were strictly vegetative, with no flower blossoms. I planted my plants in early September, as I usually did. Did I plant too late? (Anon.)

**A.** This happened in quite a few plasticulture plantings across the state last spring. Last fall, as I'm sure you'll recall, it got cold early and then stayed cold. I spoke with Dr. Fumi Takeda at the Appalachian Fruit Research Station in Kearneysville, WV, about this. His thoughts, and I'd agree, were that the branch crowns on the plants were likely actually formed early this spring, too late for flower bud initiation and development to take place, rather than last fall due to the quick cool-down. Planting earlier would certainly help, but you do have to order early, and you'll have more runners to remove. Matted-row plants, on the other hand, were usually loaded with flower blossoms. In that production system, plants were well-established early in the fall due to good moisture levels, and had a chance to initiate flower buds before they went dormant. See the related article below for more information on the growth and development of strawberry plants.

Got a question? Chances are that someone else has the same question, but isn't asking! Send your question to Kathy Demchak, at 102 Tyson Bldg., University Park, PA 16802, or via email to [kdemchak@psu.edu](mailto:kdemchak@psu.edu). You will be credited with the question, or can remain anonymous, as you wish.

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## **The Strawberry Plant**

Elsa Sánchez, Asistant Professor of Horticultural Systems Management and Kathy Demchak, Small Fruit Extension Specialist, Department of Horticulture

The nature of the growth and development of strawberry plants has lead to diverse management practices in strawberry production. Growers use the various development stages and morphological features to their advantage in various cultural systems. Understanding the normal growth habit of the plants can also be useful in determining why something is going wrong.

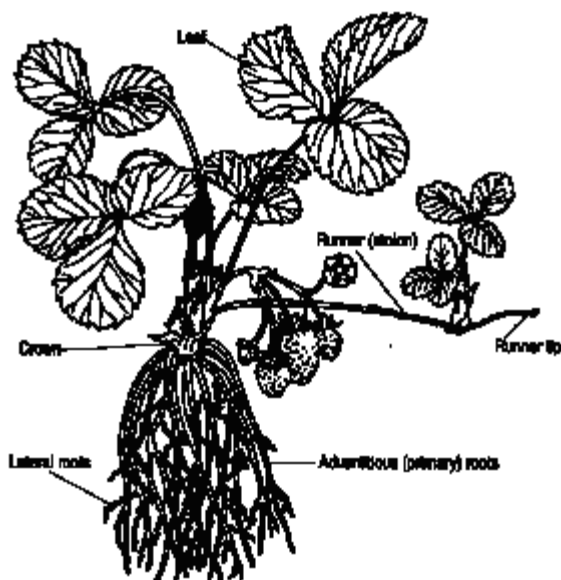
Two main types of strawberry plants are typically grown commercially. They are defined primarily by the time of flower bud initiation and therefore fruiting. Short-day or June-bearing types initiate flowers when days are short, less than 14 hours. Day-neutral types initiate flowers regardless of day length.

### **Short-day or June-bearing types**

These are the most widely grown strawberries in Pennsylvania. As their name suggests, they bear fruit in June. The majority of flower buds are initiated when days are short in fall (late September through early November). Short days in spring (March) do stimulate some flower bud initiation. Short-day types are actually facultative short-day plants in this case meaning that they will initiate flower buds either when days are shorter that 14 hours or when temperatures are less than 60°F.

### **Day-neutral types**

Day-neutral cultivars produce crowns and flower buds soon after planting regardless of day length. Flower buds are initiated throughout the growing season, however, initiation can be inhibited when temperatures are high. Day-neutral types typically produce 3 crops from spring through fall. Plants will begin fruiting mid-May to mid-June resulting in a medium sized crop of medium sized fruit, compared to short-day cultivars. Another small crop is fruited in mid-summer. A third crop is produced late summer, usually beginning in August and ending with the first hard frost. Day-neutral strawberries are sensitive to high soil temperatures and tend to perform better in the northern part of the state. Even in those areas it may be necessary to use a heavy straw mulch to decrease soil temperatures.



**The Strawberry plant. Source: Strawberry Production Guide. NRAES-88. 1998.**

As illustrated in the figure to the above, the strawberry plant is a non-woody perennial made up of a crown, leaves and a root system. Many management practices were developed based on those features.

**Crown:** The crown is a compressed modified stem, where leaves, stolons, branch crowns and flower clusters or inflorescences arise. Branch crowns, as their name implies, are smaller crowns that branch off from the main crown. Plants can have an additional flower cluster for each branch crown formed. Branch crown formation is promoted by the short, cool days of fall, and can also occur in the spring. In the plasticulture system, branch crowns are the primary yield component. For this system, strawberry plugs should be planted late enough in the season (mid-August to early September, depending on location in the state) to discourage excessive runner formation and early enough to promote plant establishment and branch crown formation.

**Leaves:** Leaf size is highly variable. Older leaves usually die during the winter and are replaced by new leaves in the spring. Leaves are produced all season with most production occurring during long-days. Leaf production stops when temperatures are below 32°F in fall and slows when temperatures are above 86°F in the summer. It is important to have a well-established leaf-canopy to provide energy to the plant for flower bud initiation.

**Root system:** Roots are most abundantly produced during the spring and fall and are active until the soil freezes. Strawberry plants have 2 types of roots. Primary roots last more than a season and are attached directly to the crown. They conduct water and nutrients to the above ground parts of the plant. In successive years, primary roots are produced higher on the crown, so an inch or so of soil should be thrown over the plants during renovation to encourage new primary root development. With good care, it is

possible for plants that have made weak growth in the past to recover once a number of healthy new primary roots are produced. The other root types are lateral roots, which live a few days or weeks. Their function is for water and nutrient absorption from the soil. Strawberry plants have shallow root systems. In light sandy soils they penetrate the soil up to 12 inches deep with        of the roots located in the lower 6 inches. In heavy soils roots are found 6 inches deep. Strawberry roots are sensitive to deficient or excess water and high salt levels in the soil in part due to their shallow distribution in the soil. Those issues should be addressed when choosing and preparing a planting site.

**Runners:** Runners are also known as stolons and are the plants' devise for vegetative propagation. Runners form during long days with warm temperatures. For short-day or June-bearing types, runners form when days are over 10 hours long and temperatures are at least 70°F. Runner formation begins in late spring and continues until fall. Formation stops when days are less than 10 hours long and temperatures are freezing. In day-neutral types, the majority of runners are formed when days are long and temperatures are moderate. Runner formation is more sporadic for day-neutral types than short-day types. Only after the development of numerous lateral roots can daughter plants become independent of the mother plant, usually after 2 – 3 weeks of attachment. In matted row production, daughter plants are the primary yield component. Dormant plants should be planted as early as possible in the season to allow them to establish and form runners and daughter plants. Larger daughter plants, those which had more time to develop, have larger crowns and more flower buds resulting in higher yields. Taking good care of renovated plantings in the summer encourages earlier production of runners and establishment of daughter plants, and higher yields the following year.

**Flowers:** Flowers are borne on inflorescences or clusters. The terminal flower opens first and is referred to as the king or primary flower. The king flower yields the largest fruit. Because the king flower opens first it more susceptible to frost than the other later formed flowers. The next flowers open 1 – 2 days after the king flower and continue to open down the inflorescence. Successive flowers produce smaller fruit.

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## Potato Musings

Bill Lamont, Department of Horticulture

## Figuring Your Potato Yields

Bill Lamont, Department of Horticulture

Dig 10 feet of row per sample. Collect at least 5 samples per field. Add up the total pounds dug and divide by the number of samples collected. Refer to the following table to calculate yield. (Use the average sample weight).

Weight in lbs of 10 feet of row	CWT per Acre	Weight in lbs of 10 feet of row	CWT per Acre
10	153.7	21	322.8
11	169.1	22	338.1
12	184.4	23	353.2
13	199.8	24	368.9
14	215.2	25	384.3
15	230.6	26	399.6
16	245.9	27	415.0
17	261.3	28	430.4
18	276.3	29	445.7
19	292.0	30	461.1
20	307.4		

## 2003 Disease Management During Harvest and Storage

Sara R. May and Dr. Barbara Christ, Department of Plant Pathology

The cool wet season in Pennsylvania has provided suitable conditions for many diseases that could become a problem in storage. Even if the proper controls have been implemented to protect plants during the growing season, without careful management during harvest and storage these pathogens can infect and spread rapidly.

### Rots

Bacterial soft rot, Fusarium dry rot, pink rot, and Pythium leak are four serious tuber-

rotting pathogens that cause the most significant losses in storage. These diseases can be brought in on infected tubers or survive on storage debris. Many of them take only a few weeks to destroy a tuber and then spread through the storage pile. Due to excessive moisture periodically throughout the growing season, we expect higher than normal levels of soft rot and pink rot. Two of the main management practices that will reduce losses to these diseases after harvest are allowing tuber skins to mature in the field before harvesting and eliminating free moisture in storage areas. However, *Rhizoctonia* black scurf and silver scurf may be at high levels on the tubers and will increase in severity the longer the tubers remain in the soil. Therefore to avoid these diseases, as soon as skins are set, harvest should begin. If the weather remains wet during the harvest, soil may adhere to the tubers during harvest. This soil will promote conditions for soft rot.

### **Blights**

Due to the amount of rainfall during the planting and early growing season every county in the state reached the threshold for late blight development when plants were young. Late blight has been reported in several regions of Pennsylvania found on both potatoes and tomatoes. For those regions where no late blight has been reported so far, precautions to avoid or reduce late blight infections needs to continue through the vinekill process. Fungicides such as the coppers or Previcur can be tank mixed with a chemical desiccant to protect the plants during the desiccation period. Late season infections even though the disease severity may not be high can result in high levels of late blight tuber rot. If late blight is found to be moderate to high in severity in a field, we recommend harvesting that field last. This will reduce the spread of late blight via equipment to tubers from non-infested fields. Also, tubers that were highly infected will decay in the field and therefore less disease will be brought into the storage. We also recommend not storing tubers from infested fields but rather marketing as soon as possible.

Below is a list of guidelines that can be used during harvesting and storage to help prevent the spread of the diseases mentioned above and to maintain high quality potatoes:

### **Vine killing**

- Vine kill stops tuber growth at the desired maturity, stabilizes the tuber solids, and promotes skin set.
- Mechanical or chemical methods or a combination of the two can be used to kill potato vines.
- More than one application of a chemical desiccant may be required.

### **Disease management**

- Foliar diseases, especially late blight are still a threat as vines begin to die or vine killing methods are implemented.
- These pathogens can spread to tubers and cause problems in storage if they are not controlled prior to harvest.

- Application of a desiccant followed by a fungicide application a few days later is recommended instead of applying the desiccant and fungicide at the same time. This way, thorough coverage of the remaining plant material can be achieved.

### **Skin set**

- Most tuber diseases require a wound to get into the potato. Good skin set greatly reduces the amount of wounding at harvest and increases the storage ability of the tuber.
- Allow for skin set on the tubers in the field for at least 10-14 days before harvesting.

### **Wounding and bruising prevention**

- Check harvesting and transporting equipment to make sure it is working properly and that it causes minimal damage to tubers
- Harvest when the soil is moist but not too wet and when tuber pulp temperatures are around 60-65°F will make the potatoes less susceptible to bruising and wounds.

### **Grading**

- Grade out diseased tubers as quickly as possible. The longer they are mixed with healthy tubers, the higher the chance of disease spread.

### **Healing period**

- Store tubers at about 50-55°F for 10-14 days to allow wounds to heal before placing potatoes into colder storage.

### **Storage**

- Before storing potatoes, facilities should be cleaned thoroughly and inspected. Make sure to check the insulation, fans, humidifiers, and ventilation system. If any of these are in poor condition it could result in losses due to disease.

### References:

Rowe, R.C., Ed. 1993. Potato Health Management. The American Phytopathological Society. St. Paul, MN.

Stevenson, W.R. Loria, R., Franc, G.D., Weingartner, D.P., Eds. 2001. Compendium of Potato Diseases. 2nd edition. The American Phytopathological Society. St. Paul, MN.

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## **Upcoming Meetings**

Bill Lamont, Department of Horticulture

## **Local**

September 9, 2003. Evening Pumpkin Meeting. See the results of one of the Penn State variety trials in Northampton County. Unangst Tree Farms, 7317 Bethlehem-Bath Pike, Bath, PA 18014. Call Emelie Swackhamer at 610-391-9840 for information.

September 19-20, 2003. Passive Solar Greenhouse Workshop: Design, Construction and Year Round Production. Sonnewald Natural Foods, Spring Grove, PA. Contact: Steve Moore ((717)-225-2489 or [sandemoore@juno.com](mailto:sandemoore@juno.com))

September 26, 2003. Fall High Tunnel Workshop at the High Tunnel Research and Education Center, Horticulture Farm, Rock Springs, PA. Contact: Lisa White 814-692-4635.

March 5-6, 2004. Passive Solar Greenhouse Workshop: Design, Construction and Year Round Production. Sonnewald Natural Foods, Spring Grove, PA. Contact: Steve Moore ((717)-225-2489 or [sandemoore@juno.com](mailto:sandemoore@juno.com))

## **Regional**

September 4-5, 2003. First High Tunnel Workshop for Extension Specialist, Agents, and Vocational Agricultural Teachers funded through the NE SARE Professional Development Grant and held at the High Tunnel Research and Education Facility, Horticulture Farm, Rock Springs, PA. For more information contact: Bill Lamont 814-865-7118 or [wlamont@psu.edu](mailto:wlamont@psu.edu).

October 26-29, 2003. Compost Advanced Short Course. Cornell Waste Management Institute, Holiday Inn, Ithaca, NY Contact: (607) 255-1187 or [www.cfe.cornell.edu/wmi](http://www.cfe.cornell.edu/wmi).

January 27-29, 2004. Mid-Atlantic Fruit and Vegetable Conference, Hershey, PA. Contact: Bill Troxell (717)-694-3596 or e-mail: [wt.pvga@tricity.net](mailto:wt.pvga@tricity.net)

## **National**

October 3-6, 2003. American Society for Horticultural Science Centennial Conference, Providence, RI. Contact: ASHS at <http://www.ashs.org> where all registration info is on-line or call ASHS Headquarters at (703) 836-2024.

Great Lakes Fruit, Vegetable and Farm Market Expo, The Grand Center and Amway Grand Plaza Hotel, Grand Rapids, MI. Contact: Hilary Morolla (810) 234-4126.

December 8-12, 2003. National Potato Council Seed Seminar; Cruise, Los Angeles, Calif., to Baja, Mexico. Contact: Oregon Seed Potato Association, [www.oregonseedpotatoes.org](http://www.oregonseedpotatoes.org) or (503) 731-3300.

January 6-10, 2004: National Potato Council 55th Annual Meeting, Cancun, Mexico, Moon Palace Resort. Contact: (202) 682-0333, or [www.nationalpotatocouncil.org](http://www.nationalpotatocouncil.org).

## **International**

December 7-11, 2003. The XVIth World Congress on Plastics in Agriculture. Sheraton Hotel, Algiers. Contact: [sophom@wissal.dz](mailto:sophom@wissal.dz)