

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's the whole challenge of life - to act with honor and hope and generosity, no matter what you've drawn. You can't help when or what you were born, you may not be able to help how you die; but you can - and you should - try to pass the days between as a good man or woman". Lt. General Sam Damon, character in the novel "Once an Eagle" by Anton Myrer

Comments from the Editor

Bill Lamont, Department of Horticulture

This past week we received some much needed rain, although we still need much more to replenish the groundwater supplies. Last week, Mike Orzolek, myself, Dayton Reese, Bruce Dye and Tom Butzler worked on constructing two 17¼ by 36' high tunnels in Potter County as part of the high tunnel extension network throughout the state. One tunnel was constructed at the North Potter High School, which brings a new educational

aspect to the high tunnel educational program. We are busy planting crops in the field at the Horticulture Farm and constructing the two large 17' by 96" high tunnels. Kathy Demchak had been harvesting strawberries out the high tunnels for several weeks and just started to harvest from her plasticulture planting in the field. We will probably be scheduling an in-service training program for the high tunnels in September and will try to pin down a date shortly. I want to thank Tom Butzler for his excellent article "On the Trail of the Squash Bug" and look forward to articles from Dwane Miller and Jim Welshans for the July issue. As always, the Vegetable and Small Fruit Gazette Team encourages your feedback so that we can better serve your needs and address your concerns.

Schedule for Agent Articles

Bill Lamont, Department of Horticulture

July	Dwane Miller and Jim Welshans
August	Eric Oesterling
September	Ron Hostetler
October	Mary Concklin
November	John Esslinger
December	Andy Muza

Regional Sprayer Field Day

Laura McNutt, Berks County and John Berry, Lehigh County

Attention, everyone that uses a sprayer for crop protection!

Program:

Who: several area extension agents, Dr. Fleischer, Bill Hoffman, PDA and industry representatives

What: Regional Sprayer Field Day

When: July 25, 2001 from 1:00pm until dusk

Where: Kutztown Produce Auction and adjacent fields, Fleetwood, PA

Why: field demonstration of side boom, air blast, electrostatic, hydraulic, and backpack sprayers

We will be demonstrating sprayer calibration and crop coverage, in addition to offering extensive core and category pesticide update credits. There will also be a First-On-The-Scene farm safety training. Registration includes the world famous all-you-can-eat sweet corn dinner.

Mark your calendar and be sure to participate in this excellent educational opportunity! Registration materials will follow. Questions? Contact: Laura McNutt, 610-378-1327 or John Berry, 610-391-9840

Penn State and PASA to Hold Tunnel Field Day in July

Eric Burkhart, Graduate Student, Department of Horticulture

Kate Francis, Pennsylvania Association for Sustainable Agriculture

A field day is scheduled for Friday, July 20th at the Pennsylvania State University's High Tunnel Research and Education Facility at Rock Springs, PA. This event is being called "Use of Season Extension and Compost for Sustainable Production of Vegetables and Small Fruit," and will begin at 9 am with an introduction to high tunnels and the high tunnel research facility. It will continue through 3 pm with sessions on high tunnel design and maintenance, vegetable crop production (including culinary herbs), small fruit research, and cut flowers. In addition, special attention will be given to the use of compost and various integrated pest management tactics within tunnels. Ample time will be given both during and after the event for discussion.

Session leaders will include Dr. William Lamont, Dr. Michael Orzolek, Dr. E. Jay Holcomb, Dr. Nyambura Mbugua, Kathy Demchak, Eric Burkhart, Bruce Dye, and Dayton Reese. Lunch and refreshments will be provided, along with an informational packet containing high tunnel design blueprints and research summaries. There is no cost to participants and space is expected to be limited. Interested individuals should contact Kate Francis at PASA 814-349-9856 ext. 2 to RSVP. This event is a collaborative effort between The Pennsylvania State University and the Pennsylvania Association for Sustainable Agriculture (PASA) as part of the PASA 2001 field day series.

On the Trail of the Squash Bug

Tom Butzler, Regional IPM and Horticulture Agent, Clinton County

A squash grower asked the question last year about why bacterial wilt was such a large problem in his field. The grower knew that cucumber beetles transmit bacterial wilt from plant to plant so he took action when beetles were observed in the field. Cucumber beetles are among the first insects to attack cucurbits as the plants emerge and very easy to recognize. The grower had felt he controlled the early beetle population and never had a history with bacterial wilt in his fields. Why the problem now? How can one correctly identify bacterial wilt?

Integrated pest management (IPM) has been around for several decades and is becoming practiced and accepted by growers and consumers. One of the hallmarks of IPM, before any action, is to correctly identify the problem. To confirm diagnosis, one must cut a portion of the stem near a wilted leaf and check for the presence of bacteria in the vascular system by cutting the stem piece in half. Next, one must realign the two cut surfaces, by pressing them together, and slowly separating. The test is positive for bacterial wilt if thin slime strings are seen between the two cut surfaces. Normal sap (e.g., without bacteria in it) will not form a slime string. Try several samples on different plants.

Several plants were tested in the grower's field using this method and no slime string was produced, therefore bacterial wilt did not seem to be the problem. Upon more scouting, a large population of squash bugs was observed. Feeding in colonies, adults and nymphs pierce vines with their needle-like mouthparts. While feeding, they inject a toxic substance into plants. As a result, vines quickly turn black and dry out. This aspect of squash bug damage superficially resembles bacterial wilt symptoms. Initially, squash bugs may be hard to observe in the field, as these bugs characteristically shy away or move to cover when approached. For small plantings, an appropriate and effective control measure would be to pick the nymphs, adults and eggs off the foliage and smash. For larger plantings, an insecticide application may be warranted. Current recommendations can be found in Pennsylvania's *2001 Commercial Vegetable Production Recommendations*.

For additional information on squash bug or bacterial wilt on cucurbits visit the following sites:

http://ipmwww.ncsu.edu/AG295/html/squash_bug.htm

<http://www.ces.ncsu.edu/depts/hort/hil/ag552d.html>

Early Season Soil Pests May Explain Poor Stands

S. J. Fleischer, Department of Entomology

Crops can 'out-grow' early season pests when growing conditions are good, but crops have had a slow start in parts of the state. Cold and/or dry conditions, or highly variable weather, allow insect pests to develop and feed while crops are not growing quickly. Here's a review of some of three early season soil pests (seedcorn maggot, wireworm, white grub) that may be the cause of poor stands. For these three species, rescue treatments applied after the damage is observed are ineffective. If damage is sufficient to justify replanting, a high rate of seed treatment and/or soil insecticide should be applied during the planting operation. If grubs are observed during the tilling prior to planting, populations of two white grubs per square foot may result in economic damage. During the early growth stages of the plants it is best to scout your fields weekly. Concentrate your sampling in areas where plants show poor growth or have failed to emerge and look carefully to see if one of these pests has caused the poor

emergence.

Seedcorn maggot. The adult seedcorn maggot is a fly similar to a housefly, but you are unlikely to see it. The adult is only 5 mm (about 1/4 inch) long, and is more gray in color than a housefly. The damaging larvae or "maggots" are the immature larval stage. They grow from a newly hatch larva up to 1/4 inch long, they are yellowish white, legless, cylindrical, and tapered at one end. This tapered end contains a single hook-like appendage that is part of the mouth. Other than this there are no other visible mouthparts. Pupa are inside a puparium (a hardened skin) which starts as an ivory color and hardens into a reddish brown color. Pupa are also about 1/4 inch long.

These insects overwinter as a pupa in the soil in our more northern climates (farther south all life stages can be found during the winter). Adults emerge in early spring and lay an average of 270 eggs per female in moist soil. Soil containing abundant decaying vegetation is also attractive to the ovipositing female. Exposed peat or potting soil mix of transplants can also serve as attractive sites for females looking for a place to lay eggs. Larvae hatch and crawl to germinating seeds or roots of plants, and complete their development within 2-3 weeks. Several generations per year may occur.

The maggots burrow into the seed, causing seed death or poor germination. Damage tends to be spread throughout the field. The larvae feed on peas, beans, corn, cabbage, turnip, radish, onion, beet, spinach and sprouting potato. Damage can sometimes be avoided by delaying planting until the first generation larvae have pupated. This date varies with locality, but is approximately June 10 for New York State. It takes about 450 degree-days to complete a generation, which is a bit fast for an insect species. In field corn, if you have passed 450 degree-days, you are typically past the 1st generation, and after that soil conditions make it unlikely that seedcorn maggot would be a serious problem. However, in vegetable crops the later plantings of multiple crops can be attacked. Cultural controls include:

- thorough incorporation of organic matter into the soil,
- preparation of seedbeds for rapid germination,
- shallow planting (encourage rapid plant growth and minimize the time the germinating seed is sitting in the soil)
- covering rootball of transplants when transplanting
- planting when soil temperature are warm

This last recommendation is especially effective for transplants. Studies in Indiana with melon transplants have shown that root damage is directly correlated to soil temperature.

Seed treatments applied to the seed at the time of planting should give effective chemical control with minimal amount of pesticide. For some of our crops, we now have the option of transplant application of Admire. For example, transplant application of Admire can be applied to cucurbits for striped cucumber beetle control, and this will also control seedcorn maggot. There are also several materials available for pre-plant

incorporation that control can be applied. Post-applications, soil drenches after the damage is present, are not effective. See the Commercial Vegetable Production Recommendations for specific materials. We try and provide specific recommendations for each crop, but for all crops we review soil pest issues in the introductory material (called Soil pests - their detection and control).

Wireworms. Wireworms are long, slender, hard-bodied, wirelike larvae of "click beetles". They are about 1.25 inches long by 1/8 inches in diameter. The larvae are the damaging stage, not the adults. The adults are called click beetles because of their habit of snapping and flipping their bodies when turned upside down. Wireworms have variable life cycles, depending on the species. Most species take 2 to 5 years to complete their development, so there is considerable overlap of larval sizes; the larger larvae do more damage. One species that is troublesome in potato (*Melanotus communis*; there is no common name) takes 6 years to complete its life cycle. Wireworms overwinter as eggs, larvae, or adults.

As with the seedcorn maggot, wireworms do more damage during cool wet springs, especially in fields following sod or other grasses. They damage crops by devouring seeds in the soil, cutting underground stems and roots, and by boring into the larger stems and roots. Often the seed is hollowed out, leaving only the hull. All crops are susceptible to attack to one degree or another, and particularly susceptible are potatoes, carrots, peas, onions, corn, sweet potatoes, lettuce, melons, beans, cowpeas, and sugar beets.

Plowing or cultivating infested soils in the late summer or fall exposes wireworms to natural enemies. Crop rotation helps reduce wireworm populations; continuous planting of vegetables and field crops, especially potatoes and wheat, tend to increase wireworm abundance. No-till fields may allow wireworm populations to increase over time.

A number of materials are available for wireworm control (see the Commercial Vegetable Production Recommendations). Insecticides can be applied either in the spring or fall when the soil temperature at 6 inches deep is at least 50 F.

White grubs. White grubs are the immature stages (larvae) of June beetles, May beetles, and Japanese beetles. There are over 100 species of white grubs. They have a C-shaped body, a brown head, three pairs of legs, and a slightly enlarged abdomen. Full grown grubs range from 0.75 to 1.75 inches long.

Adults feed on leaves of trees, whereas the larvae feed on roots, particularly bluegrass, other lawn grasses, timothy, corn, soybeans, tubers of potatoes, and other crops. Grubs feeding on roots of corn cause wilting and stunting, and death of the plant if enough feeding occurs. Similar to wireworms, cool, wet springs and areas previously in sod may have heavier infestations.

The life cycles of the more abundant and injurious species may extend over three years. Eggs are laid 1 to 8 inches deep in the soil, especially near woodlands; after 3 weeks

the larvae hatch and begin feeding on roots. During the winter the larvae migrate to deeper portions of the soil.

Crop rotation helps reduce populations. It is best to plant deep-rooted legumes (alfalfa, clover) in rotation with susceptible crops. In some regions a rotation of oats, barley or wheat with clover and corn has been satisfactory. Corn or potatoes may follow clovers but they should not follow grasses in the year of a heavy beetle flight. The most severe damage occurs on crops that follow grass sod. Late summer or early fall plowing destroys many larvae, pupae, and adults in the soil and exposes these stages to predators, which includes many vertebrates, as well as parasitic wasps. Soil insecticides applied for wireworm control may also effectively reduce grubs.

Bug vs. Bug--Biological Control of Aphids with the predatory midge, *Aphidoletes aphidimyza*

Cathy Thomas, Integrated Pest Management
Bureau of Plant Industry, Pennsylvania Department of Agriculture

In the last two issues of Bug vs. Bug, I discussed *Aphidius ervi* and *Aphelinus abdominalis*, two parasites that can be used alone or together to control potato aphid. Potato aphid is the most common aphid species to infest greenhouse tomatoes. Other species found in greenhouse vegetables are green peach and melon aphid. It is important to identify the species infesting your crop before ordering a biocontrol. Aphid parasites are host specific and the appropriate parasite must be applied for timely aphid control. Aphid parasites are effective in searching for isolated aphids, winged aphids and aphid colonies. If you cannot identify the aphid species attacking your crop, consider using a general predator such as *Aphidoletes aphidimyza*.

The predatory midge, *Aphidoletes aphidimyza*, is a general aphid predator, attacking many different species of aphids. It can be used alone or combination with a parasite for rapid knockdown of aphids. This predator is most effective on aphid hot spots (clumped populations). The main benefit to using *Aphidoletes* is its applicability on several crops (peppers, eggplants, cucumbers, etc.) on which any species of aphid occurs.

Life cycle of *Aphidoletes aphidimyza*

Aphidoletes is a predatory gall midge that attacks over 70 different aphid species. The adult midge is about 2.5 mm long, with long legs and a slender body. The adult midge is mainly active at night, lives for about 7 , 10 days, and commonly feeds on honeydew.

After dusk, the female midge deposits her eggs in aphid colonies. She is attracted to aphid colonies by the smell of honeydew. The eggs hatch into a tiny larva (.3 , 3 mm) that searches the leaf and upon finding an aphid injects a paralyzing toxin which also dissolves the body contents. The larva attaches its mouthparts to the aphid and feeds on the dissolved contents. Each larva needs to feed on about 5 aphids to complete its development, however it will kill more if available (up to 65 aphids). Initially the larva is transparent orange, but becomes orange, red, brown or grey, depending on the food

source. In about 7 , 14 days, the larva falls from the plant into the soil, using soil particles to make a cocoon. Within 7 , 10 days, a new adult gall midge will emerge from the cocoon.

Application

- Reduce or eliminate the use of toxic or residual pesticides before introducing *Aphidoletes* or any other natural enemy. This predator is very sensitive to pesticides.
- Release on a preventative basis or introduce at a higher rate (curative) when aphid colonies are first found. (Consult supplier for rates)
- Three to four successive introductions are needed to build a sustaining population of *Aphidoletes*. Augment with new introductions as needed throughout the season.
- When pruning, examine leaves for orange larvae. These leaves should be left in the greenhouse so that the larva can complete the life cycle. All employees should be trained in recognizing this life stage.
- When introducing into the greenhouse, protect predators from ants. Ants feed on honeydew and thus protect the aphid colonies from natural enemies. Install traps for ants.
- Monitor the effectiveness of this predator by looking for aphids that appear to be shriveled and eventually turn brown and/or black and decay. Use at least a 10x hand lens when inspecting.
- In soil cultures, larvae can pupate in the ground and successive generations will occur. This eliminates the need for continual introductions.
- If soil is covered by plastic, there are no appropriate sites for pupation and many will die. Successive generations do not occur and continued releases are required.

Note: The larva enters hibernation (lower temperatures, shorter days), starting in late September unless you add supplemental light (one 60 watt bulb per 30 feet, or 100 watt bulb per 65 feet). If you are growing a fall crop, a better strategy would be the application of a parasite such as *Aphidius ervi* or *Aphelinus abdominalis*.

Aphidoletes aphidimyza products *Aphidoletes aphidimyza* is usually shipped as pupae in a vermiculite carrier. Adults will emerge from pupa when placed in the warm greenhouse. Introduce in plant canopy away from direct sunlight, preferably in early morning or evening near aphid colonies.

Product names from major suppliers of biocontrols:

- Biobest - *Aphidoletes* - system, www.biobest.be or www.bugsandbees.com , 303-661-9546
- Kopperts - *Aphidend*, www.koppert.nl , 734-641-3763
- Syngenta - *Aphido-line a*, Syngentabioline.com, 805-986-8265

This predator can be obtained through most biological control distributors.

Benefits

- Controls all aphid species.
- Can be applied in several crops.
- Excellent searching ability.
- Curative control of aphid colonies.
- Long lasting effect in soil culture or trough culture.

Please phone or email me if there are specific issues you would like me address in this column.

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Colored Mulch: Where Can I Buy It?

Mike Orzolek, Department of Horticulture

Another year has gone by and I have had many growers ask me where can they buy colored mulch; red, blue, and silver or metalized. While research at the Penn State Center for Plasticulture has verified the merits of plastic colors with specific crops, there has been a lag time between Ag plastic manufacturer's production and the availability of commercially mulch film colors. In addition, there has been a consolidation of Ag film producers in the last three years in the United States. Pliant Corporation, Schaumburg, IL 60173, phone , (866) 878-6188 (formerly Huntsman) will have dark blue mulch available next year (2002) in standard width (4 ft.) and length (2,400 to 4,000 linear feet per roll). In addition to the dark blue film, Pliant will also manufacture both red and silver mulches. Ken-Bar Inc., Reading, MA 01867-070, phone - (617) 944-0003 also sells SRM RedÅ, IRT-green and silver on black mulch. Climagro, St-Laurent, Quebec, Canada H4R 1E9, phone , (514) 454-5352 sells white/silver on black and IRT-green mulch. Clarke Ag Plastics, Greenwood, VA 22943, phone - (540) 456-4578 sells a highly reflective silver mulch as does Adcock Manufacturing Corp., Gardena, CA, phone (310) 532-4350. Sonoco Products Co., Hartsville, SC 29550, phone - 803/339-6134 sells the SRM RedÅ and ITR green mulch film. ReflecTek Foils, Inc., Lake Zurich, IL, phone (847) 550-0924 sells a metalized UV reflective film. Keep in mind that colored mulches will bring about two responses; an effect on soil temperature and a reflected light response that will affect plant growth. These two responses are generally independent of each other and dependent the actual color of the plastic mulch. The use of silver or metalized mulch has increased simply because silver repels aphids that

vector many plant viruses. No aphids, generally no viruses.

Keep in mind with this year's dry weather, laying plastic in a field of dry soil maybe flirting with disaster since transplants require near field capacity soil moisture to re-establish normal root development after placement in the field. It may take several days to wet the dry soil under the plastic film of raised beds before transplanting vegetable crops. An acre-inch of water equals 28,000 gallons; careful planning and water management of raised beds with plastic mulch and drip irrigation this year will reap ample financial rewards in 2001. Also, keep in mind that most preplant and preemergence herbicides require water to be activated and effectively control or kill weeds in plasticulture fields.

New Vegetable Herbicides and/or New Labels

Mike Orzolek, Department of Horticulture

There have been several new herbicides for vegetable crop production in 2001 and older herbicides with additional crops added to their label for use by vegetable growers.

Select 2EC from Valent U.S.A. Corp. is now labeled for annual and perennial grass control in strawberries, potato, eggplant, cucumber, pepper, celery, carrot, radish, squash, cantaloupe, watermelon and pumpkin. It was initially labeled for onions, garlic, shallots, tomato, dry beans and peanuts. Use rate is 6 to 16 oz/A. Crop oil should always be added at a rate of one quart per acre when applying with ground equipment.

Outlook from BASF Crop Protection is now labeled for sweet corn and dry beans for grass control. Use rate is 10 to 21 oz/A and can be applied preplant surface, preplant incorporated, pre-emergence and postemergence for additional residual control in corn up to 36 inches tall. Outlook 6EC (dimethenamid-p) contains the resolved isomer of dimethenamid and is used at about 55% of the Frontier use rate. For example, 28 fluid ounces of Frontier would be equivalent to approximately 16 fluid ounces of Outlook

Galligan from Makhteshim-Agan of North America is labeled on globe artichoke, broccoli, cabbage, cauliflower and onions and is oxyfluorfen (Goal) chemistry. It can be used pre-emergence or postemergence in specific situations. Galligan is relatively low in toxicity and environmental impact.

Matrix 25DF (rimsulfuron) from DuPont is labeled for preemergence or postemergence application for potatoes and used at the rate of 1.0 ounce/A controls both grasses and broadleaf weeds. A sister product, **Shadeout 25DF** (rimsulfuron) is labeled for tomatoes and controls the same weeds at 2.0 ounce/A rate.

LeadOff (DuPont) is essentially Guardsman which is marketed by BASF. It contains Frontier (dimethenamid) at 2.33lbs/gal and atrazine at 2.67 lbs/gal. Can be applied preemergence or postemergence at the rate of 3 to 4 pts/A. Controls both grasses, broadleaf weeds and yellow nutsedge. However, some weeds may be resistant to triazines and will not be controlled by Leadoff.

Degree 3.8CS (acetochlor) from Monsanto contains the same active ingredient as Harness but is a new encapsulated formulation of acetochlor designed to extend soil-

residual control of annual grass species. Degree will likely be positioned to compete with other soil-applied corn herbicides in the early preplant market. The release of acetochlor from the encapsulation is triggered primarily by soil temperature, with minimal release occurring until soil temperatures reach 50°F. Applications may be made from early preplant (up to 45 days prior to planting) until corn reaches 11 inches in height. Rates range from 2.25 to 5 pints per acre depending on soil texture and organic-matter content.

NOT CURRENTLY LABELED FOR SWEET CORN.

That's a Berry Good Question

Kathy Demchak, Department of Horticulture

Q. What are the current recommendations for renovation of strawberry plasticulture beds for second-year carryover? (Steve Bogash, Franklin Co. Cooperative Extension Office)

A. Mowing the leaves as low as possible without damaging the crowns, and removing the mowed material, should be done soon after harvest is over. The purpose of this first step is to remove old plant material and disease inoculum and to stimulate healthy growth. If there are many branch crowns (5-8), crown thinning soon after mowing is still recommended, which is done by inserting an asparagus knife or similar object through the crown, removing half. However, recent research indicates that fruit size decreases for the second year whether crown thinning is done or not, meaning the benefits may not be as great as were thought earlier. So, unless many plants are in this crown number range, you can skip this step. Herbicides can be used between the rows for weed control, but not over the mulched beds. Send in a leaf sample for nutrient analysis from the new growth that consists of the first fully expanded leaves after renovation. Trickle irrigate through the summer, and fertigate in 20-30 lbs of N, and possibly other nutrients (depending on the results of the leaf analysis) in late August to early September.

Got a question? Send it to Kathy Demchak, at 102 Tyson Bldg., University Park, PA 16802. You will be credited with the question, or can remain anonymous, as you wish.

Select 2EC Herbicide for Strawberries

Kathy Demchak, Department of Horticulture

The following article appeared in "Facts for Fancy Fruit", the Purdue University Fruit Growers Newsletter, April 11, 2000. One introductory note is that Select would be used for essentially the same uses as Poast, but may have better activity against perennial grasses. Here's the article:

Select 2EC Herbicide Supplemental Label for Strawberry: Source: Richard C. Funt, Extension Small Fruit Specialist, Ohio State University, Columbus. Previously, Prism, which is a post-emergence, selective herbicide for non-bearing strawberry production,

was to be applied no later than one year before harvest. Now Select 2EC (same product as Prism) has been labeled for bearing strawberries and can be applied within 4 days of harvest. At the rate of 6 to 8 ounces per acre, Select 2EC plus a non-ionic spreader can control such grasses as quackgrass, crabgrass, foxtail, and barnyard grass. Generally, grasses need to be 4 to 6 inches or taller for maximum absorption. Grasses should be actively growing, which indicates good soil moisture and temperatures above 55 F. Repeat applications may be necessary. Select can be effective if applied one hour before rainfall. The supplemental label indicates that the use of crop oil with a 17% emulsifier is to be added to the tank mix. Crop oil can cause some injury to strawberry plants at certain temperatures (below 45 F or above 80 F). Ohio State specialists generally recommend a non-ionic spreader rather than crop oil. A non-ionic spreader can be just as effective as crop oil, with less risk of leaf damage; however, Valent Corporation indicates that crop oil can be more effective on weed control and will not accept responsibility for the use of a non-ionic spreader, if control is unsatisfactory to the grower.

More Small Fruit Pesticide Updates

Kathy Demchak, Department of Horticulture

Savey (hexythiazox, Gowan Co.) has a supplemental label for use on canberries. Previously, Kelthane 35WP was the only miticide that could be used, as PA has a 24C label, though this was only for raspberries. It is important to note that Savey must be used early, before mite populations build, as it is effective against the nymphs and eggs but not the adults. If you find you have mites because you noticed a bronzing of the lower leaves, it's too late to use Savey. The rate is 3-6 oz per acre, with a 3-day PHI. Only one application may be made per year.

Diazinon. Early in the year, it was announced that Syngenta and EPA reached an agreement whereby use of diazinon on strawberries would no longer be allowed. However, following a public comment period, EPA reversed the decision, so strawberries will continue to appear on the label after all.

Benlate (benomyl). DuPont requested a voluntary cancellation of all registrations of products containing benomyl. Though not yet effective as this is being written, EPA anticipates granting this cancellation shortly. Stocks in channels of trade may be sold.

Use of Petiole Sap Meters

Kathy Demchak, Department of Horticulture

During late May, Steve Bogash and I had an opportunity to compare some notes and techniques concerning use of our Cardy NO₃-N meters. Since a number of growers have purchased and are using them, I thought I'd share some of our findings on a few points.

1. Calibration. Even though the manufacturer's instructions recommend only a 1-point calibration on a regular basis, using a 2-point calibration before each use is much preferred. It's possible for values to become way off between the times that

the meter is used, and this is likely due to a jostling of the rather touchy calibration dials rather than actual drift of the meter readings.

2. Age of leaves. Most recently fully matured leaves are the ones to use. How do you tell which leaves are the right ones? Those that are full size, and in the process of changing from a immature light green to a mature dark green color are the ones to use. If you err slightly on either side of this, it won't make much, if any, difference in your readings. However, using either very young or very old leaves will make a tremendous difference. N levels are highest in the oldest leaves, and are very low in the youngest leaves.
3. Which part of the petioles? Most times, the N level is the same if you used one end of the petiole vs. the other for your sample, but not always. So, the most consistent values will be obtained if you always chop up the entire length of the petioles, mix the pieces, and take a representative sample from this.

Though petiole sap meters are valuable for N and K level determinations, especially for strawberry plasticulture, complete nutrient analysis should still be used to identify the overall nutrient status of the plants.

Potato Musings

Bill Lamont, Department of Horticulture

The Passing of Al Reeves Maine Potato Breeder

Bill Lamont, Department of Horticulture

Al Reeves, who for the past 25 years was the potato breeder at the University of Maine, died of a massive heart attack at his home on May 5, 2001. Al was a real gentleman and a potato breeder that appreciated both the science and art of breeding potatoes. I enjoyed my conversations with Al at the NE-184 regional potato meetings and at the Potato Association of America (PAA) meetings. I last enjoyed his company at the recent PAA meetings in Florida just prior to his untimely death. He will be missed, not only by those of us who knew him and enjoyed his company but by the potato industry at large.

Potato Late and Early Blight Management for Pennsylvania, 2001

Barbara J. Christ, Department of Plant Pathology

1. **Eliminate sources of disease carryover.** The late blight fungus survives the winter in potato tubers.
 - a. Dispose of all cull potatoes including those originating from loading and unloading of storage, debris mixed in with soil from the storage area, culls removed from seed lots prior to planting or cutting.
Proper disposal includes complete freezing of cull tubers, complete consumption by livestock, burial at least three feet deep to prevent sprouting, or composting.

b. Destroy volunteer plants.

2. **Plant certified disease free seed.** Make personal contact with the seed grower. Ask questions. There is a 1% tolerance allowed for late blight in certified seed. Symptoms are difficult to detect and isolation of the fungus is unreliable. Late blight is not at uniform levels across a production area, therefore, generalizations can not be made concerning levels of blight that may be expected in seed. If there is concern that seed may have been exposed to late blight, there are seed treatments that will decrease the spread of the late blight pathogen and increase plant emergence and stand uniformity. **See the Seed Treatment Section** for Tops-MZ or Evolve. When blighted seed pieces are planted, most will immediately rot and not sprout. However, when contaminated seed pieces (exposed to the pathogen but no symptoms) are planted some will germinate but the sprouts will be killed before emergence, some will emerge with late blight infections, and some will escape disease entirely.
3. **Scout fields and be aware of late blight in nearby areas.** Growers should scout fields twice a week or more especially if there have been several days of fog or rainy weather. Check areas where dew periods are prolonged by natural obstructions, overhanging tree lines can induce ideal conditions for infection. Check areas where it is difficult to get adequate coverage when applying the fungicide. Also, check the early maturing varieties first and more frequently.

Symptoms of Late Blight: Irregular, blackish-brown lesions on stems or leaves. When the relative humidity is high, there should be white mold on these lesions especially on the lower leaf surface or on stems. Be sure to check within the plant canopy on the lower stems. **See "Identifying Potato Diseases in Pennsylvania"** for sale through the Penn State College of Agricultural Sciences Publication Distribution Center, 112 Agricultural Administration Building, University Park, PA 16802 or call 814-865-6713.

4. **Monitor your weather.** Stations monitoring the weather are limited, therefore you must use common sense to be aware of your own weather conditions. Ideal conditions for blight are: day time temperature between 60-75 F and night time temperature between 50-60 F accompanied by fog, heavy dews or rain over a four to five day period. Extended periods of high relative humidity are also important for this disease.
5. **Cultural practices:**
 - a. **Rotate** to fields as far from last years potato fields. This will provide a distance between your crop and volunteer potatoes. Also, we have established that you can reduce early blight severity by increasing the distance between fields even short distances.
 - b. **Hill plants.** Proper hilling will reduce late blight infections on tubers.

c. **Avoid excessive nitrogen.** Excessive vine growth can promote conditions for late blight. However, proper nitrogen levels will reduce early blight susceptibility.

d. **Vine-kill thoroughly** and keep fungicides on plants until the plants are completely dead.

6. **Protect plants with fungicides.** Begin the protectant program when plants are about 6 inches tall or after the first cultivation. If conditions are ideal for late blight early in the season you should tighten your spray schedule to 5-day intervals to protect the newly developed leaves. There are several protectant fungicides available. **See "Specifics of Fungicides to select From"** on page 19. It is wise to have more than one available for use during the season. Some pathogen may become resistant to a family of chemicals or you may run into chemical use restrictions, such as, the amount per acre one can legally apply during the growing season. Categories a-d have efficacy for both early and late blight.

a. EBDC products (Dithane, Penncozeb, Manzate, Polyram and Maneb)

b. Chlorothalonil (Bravo and generic types)

c. Tin- based products (Super Tin, Agri Tin)

d. Copper-based products (Kocide, Champ and others)

e. Fungicides specific for late blight:

1. Cymoxanil (Curzate)

The cymoxanil compound provides the kickback activity from the time of application. The kickback is effective for 24 hours post application.

2. Propamocarb (Tattoo)

Propamocarb has a limited anti-sporulant activity and may be able to hold the infection for several days. However, the infection is not cured.

3. Dimethomorph (Acrobat)

Dimethomorph has an anti-sporulant activity .

f. Strobilurin (Quadris)

Provides excellent control of early blight. Fungicides applied with high-volume boom sprayers are most effective. These should be operated at ground speed of 4 mph or less, using 50-60 gal/A, and with 60-100 psi of pressure. Hollow cone or flat fan nozzles give the best coverage.

7. **Harvest only after vines are dead.** Harvest when the soil is dry. Also, those fields with high incidence of late blight that might have resulted in tuber rot should be harvested last. Also, under situations without late blight when other soft rots are prevalent, harvest those fields last. This will allow rotting potatoes to decay prior to harvest. Do not harvest rotting potatoes. Rogue out blighted tubers at grading. Take every feasible step to keep rotting potatoes out of your storage.

8. **Manage the storage environment to suppress late blight and soft rots.**

Manage storage conditions to promote complete suberization of harvest wounds then lower the temperature to appropriate long-term storage conditions. Do not

attempt to store lots that have greater than 2% blighted tubers. Avoid placing wet tubers into storage. Moisture provides conditions promoting rot. Good air circulation is required to prevent wet pockets. Also, relative humidity should be below 85% to prevent condensation on the tubers.

I. Specifics of fungicides to select from:

Chlorothalonil:

Bravo 500 1.0, 1.5-2.125 pt

Bravo Ultrex 82.5WDG 0.7, 0.9-1.4 lb

Bravo Zn 1.0, 1.5-2.125 pt

Bravo Weather Stik 0.75, 1.0-1.5 pt

Bravo Weather Stik Zn 0.75, 1.0-1.5 pt

Equus 720 0.75, 1.0-1.5 pt

Days to harvest = 7

Interval between applications = 5-10 days

Do not exceed 23 pt of product for Bravo 500, 14.5lb for Bravo Ultrex, 23 pt for Bravo Zn, 16 pt for Bravo Weather Stik and Bravo Weather Stik Zn, or 15 pt for Equus 720. In general do not exceed 12 lb active ingredient of any formulation of chlorothalonil.

Use the lowest rate early in the season and apply the higher rates when vines close between rows, or late blight has been forecasted.

Maneb:

Maneb 80WP 1.5-2.0 lb

Maneb 75 DF 1.5-2.0 lb

Manex 0.8-1.6 qt

Days to harvest = 3

Interval between applications = 5 days

Do not exceed 11.2 lb active ingredient EBDC per acre per growing season.

EBDC materials include Maneb, mancozeb and metiram.

Mancozeb:

Dithane DF Rainshield 0.5-2.0 lb

Dithane F45 0.4-1.6 qt

Dithane M-45 0.5-2.0 lb

Manex II 0.8-1.6 qt

Manzate 75 DF 1.0-2.0 lb

Penncozeb 80WP 0.5-2.0 lb

Penncozeb 75 DF 0.5-2.0 lb

Days to harvest =3

Interval between applications = 5 days

Do not exceed 11.2 lb active ingredient EBDC per acre per growing season.

EBDC materials include maneb, mancozeb and metiram.

Metiram:

Polyram 80DF 1.5-2 lb

Do not exceed 7 applications or 14 lb of product per acre per season. This is an EBDC product and must be within the EBDC limit.

Elemental Copper:

Basicop 3.0-6.0 lb

Apply at first sign of disease and repeat every 7-10 days. Use high rate where disease pressure is heavy or is expected to be so.

Copper hydroxide:

Kocide 101, Kocide DF 1-4 lb

Kocide LF 1.33-5.33 pt

Kocide 2000 0.75-3.0 lb

Champ Formula 2 4.6 F 0.66-2.66 pt

Champ DP 0.66-1, 2.66 lb

Champion WP 1.0-4.0 lb

Tenn-Cop 5E 3 pt

Nu-Cop 50 DF 1.0-4.0 lb

Days to harvest = 14

Interval between applications = 7-10 days

Can be tank mixed with maneb, mancozeb or chlorothalonil. Do not tank mix with insecticides such as Monitor because of reduced efficacy of the insecticide. Do not mix with foliar fertilizers. Do not mix Kocide DF with Diquat. Do not apply on red potato varieties, injury of foliage may occur.

Mancozeb and Copper hydroxide:

Mankocide DF 1.5-5.0 lb

Days to harvest = 3

Do not exceed 74.66 lb of product per crop. Apply at 7-10 day intervals

Triphenyltin hydroxide (TPTH):

Super-tin 80WP 2.5-3.75 oz

Agri Tin 80WP 2.5-3.75 oz

Tank mix with mancozeb (Dithane M45 80 WP, 75 DF or Manzate 200 75 DF or Penncozeb 80 WP, 75 DF), or metiram (Polyram 80 DF 1.5 lb).

Days to harvest = 7

Do not exceed 15 oz/A formulation per season. Apply at 7 day intervals. TPTH combined with MH-30 and some EC insecticides can cause serious crop injury. Some varieties such as Superior and Norland are sensitive to high rates of TPTH.

Cymoxanil:

Curzate M-8 WP 1.25 lb

Curzate 60 DF 3.0 oz.

Curzate 60 DF does not contain mancozeb, therefore, tank mix with mancozeb 0.5-1.0 lb or chlorothalonil. Curzate M-8 contains some mancozeb, additional mancozeb should be added.

Days to harvest = 14

Maximum of 5 applications per season

Interval between applications = 7 - 10 days

Best control of this product is when used on actively growing plants during the first half of the growing season.

Dimethomorph: Acrobat MZ 69WP 2.25 lb

Acrobat 50 WP

Acrobat 50WP does not contain mancozeb and requires a companion protectant product such as mancozeb or chlorothalonil.

Acrobat MZ contains mancozeb, however, tank mix with additional mancozeb

Days to harvest = 14

Maximum of 5 applications per season

Interval between applications = 7 to 10 days

Neither Curzate or Acrobat MZ are intended to be used as a curative. Both will be most effective used in conjunction with a good traditional protectant program which includes the mancozebs, chlorothalonil and copper hydroxides. These two compounds will be most effective when late blight has been spotted within the region and the grower is concerned that he/she has not had appropriate coverage by a protectant and therefore, the crop could have been exposed to the fungus and infection may have occurred. A second scenario is if the grower is concerned about a very rainy period and the forecast is predicting more rain which would wash of the protectant. The compounds are rainfast and would provide protection that could not be provided by the traditional protectant.

Propamocarb:

Tattoo C 2.3 pints

Previcur Flex 0.7 pt, 0.9 pt, 1.2 pt

Days to harvest = 14

Maximum of 5 applications per season

Interval between applications =10-14 days

Do not exceed 11.5 pt per acre per season

Tank mix with mancozeb 0.5-1.0 lb or chlorothalonil

Tattoo C is premixed with chlorothalonil. (30.5% propamocarb and 30.5% chlorothalonil)

Previcur Flex is propamocarb alone with no added chlorothalonil. It is important to tank mix with chlorothalonil or mancozeb.

Tattoo may have activity towards Phythium leak and pink rot.

Azoxystrobin (Strobilurin):

Quadris 6.2-15.4 fl oz

Days to harvest = 14

Maximum of 6 applications per year. Do not exceed 2.88 qt of product per acre. Use in a one to one alteration with fungicides that have a different mode of action. Do not alternate or tank mix with fungicides to which resistance has developed.

Metalaxyl /mefanoxam:

Ridomil Gold/Bravo 2.0 lb

Ridomil Gold/Bravo liquid 27.2 fl oz

Ridomil Gold/Copper 2.0 lb

Ridomil Gold MZ 2.5 lb

Flouronil 2.0 lb

Those growers who store potatoes should consider Ridomil Gold for control of tuber rots such as pink rot and Pythium leak. Please note that it is not effective toward tuber rot caused by late blight. If it is used to control other tuber rots, apply at bloom and 14 days later. Ridomil Gold/Copper should be tank mixed with 0.8 lb a.i. of Maneb, Mancozeb, Metriam, or Chlorothalonil. Ridomil Gold EC and Ultra Flourish were registered as an at-planting soil application for control of pink rot and Pythium leak. Look over the plant back restrictions.

Please note:

If more than one product containing an EBDC active ingredient (maneb, mancozeb, or

metiram) is used on a crop during the same season and the EBDC products allow the same maximum poundage of active ingredient per acre per season, then the total poundage of all these products must not exceed any one of the specified individual EBDC product maximum limits. If the maximum poundage of active ingredient per acre per season is different for these EBDC products, then the total poundage of all these products must not exceed the lowest specified individual EBDC product maximum limit.

New Fungicides:

Gavel 75 WG (zoxamide and mancozeb) will target late blight and early blight.

Omega (fluazinum) will target late blight and white mold.

Flint 50WG (trifloxystrobin) will target late blight and early blight.

II. Seed Treatments:

Maxim (fludioxonil 0.5%) or Maxim MZ (fludioxonil with mancozeb)

Apply at the rate of 0.5 pounds of product per 100 pounds of seed pieces.

Maxim has activity towards Rhizoctonia (black scurf/stem canker), Silver scurf, Fusarium dry rot, black dot and common scab.

Tops MZ (**thiophanate methyl 2.5% and 6% mancozeb**)

Apply at 0.75 to 1.0 pounds per 100 pounds of cut seed pieces.

Tops MZ has activity towards Rhizoctonia (black scurf/stem canker), Silver scurf, Fusarium dry rot, and seed-piece late blight.

Evolve (thiophanate methyl 2.5% , 6% mancozeb and 1% cymoxanil)

Apply at 0.75 to 1.0 pounds per 100 pounds of cut seed pieces.

Evolve has activity towards Rhizoctonia (black scurf/stem canker), Silver scurf, Fusarium dry rot, and better activity towards seed-piece late blight than Tops MZ.

Dithane (8% mancozeb)

Apply at 1 lb per 100 lbs of cut seed.

Tops-MZ-Gaucha (thiophanate methyl 2.5%, 6% mancozeb and 1.25 % imidacloprid)

Apply at 0.75 to 1.0 pounds per 100 pounds of cut seed pieces.

Tops MZ has activity towards Rhizoctonia (black scurf/stem canker), Silver scurf, Fusarium dry rot, and seed-piece late blight. Also there will be the added protection towards aphids and Colorado Potato beetle.

New Seed Treatments:

MonCoat MZ (1.5% flutonil , 6% mancozeb)

Apply at 0.75 to 1.0 pounds per 100 pounds of cut seed pieces.

It has activity towards Rhizoctonia (black scurf/stem canker), Silver scurf, Fusarium dry rot, and seed-piece late blight.

III. In-furrow applications:

Blocker (PCNB) 10 G or Flowable

Apply as an in-furrow 8.5 inch band at a rate of 1.65 lbs per linear 1000 feet of row.

Direct in the furrow over the seed piece and cover. Do not harvest within 45 days of application. Suppresses Rhizoctonia.

Ridomil Gold EC was registered as an at-planting soil application for control of pink rot and Pythium leak. Look over the plant back restrictions.

IV. Integrated Pest Management (IPM):

Another facet to disease management is to select varieties that have some level of resistance. Varieties that are listed as resistant does not necessarily mean the disease will not occur. Therefore all other appropriate management procedures should be followed. However, fungicide usage may be reduced and maintain adequate management of the disease. See the table below for varieties and their susceptibility. The best management of any disease will incorporate scouting, weather monitoring, performing appropriate cultural practices combined with a fungicide program. A fungicide program using protectants for the majority of the applications with one of the late blight specific chemicals for critical periods should do a good job.

Early blight is the second most important foliar disease on potatoes. If fungicides are applied to control late blight than most likely early blight will also be controlled. The best fungicides for early blight control are Quadris, mancozebs, maneb, chlorothalonil and metiram.

Most other potato diseases are managed by a combination of fungicide seed treatments, resistant varieties, manipulating the environment and performing appropriate cultural practices. Manipulating the environment includes proper irrigation management.

V. Varieties suggested for PA and resistance characteristics:

Variety	LB	EB	SC
Atlantic	S	MS	MS
Andover	S	S	MR
Chieftain	S	MS	MR
NYE11-45	S	MS	MR
Elba	MR	MR	MS
Eva	S	MS	MR
Katahdin	MS	MR	MS
Kennebec	MR	MR	MS
Keuke Gold	S	S	R
Norland	S	VS	R
Norvalley	S	S	MR
Norwis	S	S	S
Pike	MR	MR	R
RedPontiac	S	S	S
Reba	S	MS	MR
Russet Norkotah	S	VS	MR
Salem	S	MS	S
Sebago	MR	MR	MR
Snowden	MS	MR	MS

Superior	S	S	R
Yukon Gold	S	VS	MR

LB= late blight, EB= early blight, SC= common scab
R= resistant, MR= moderately resistant, MS= moderately susceptible, S= susceptible
and VS= very susceptible

Upcoming Meetings

Bill Lamont, Department of Horticulture

Regional

August 3, 2001: Pennsylvania Vegetable Growers Association In-State Tour. Contact:
Bill Troxell (717) 694-3596

January 29-31, 2002: Mid-Atlantic Fruit and Vegetable Growers Convention, Hershey,
PA. Contact Bill Troxell (717) 694-3596.

July 20, 2002: Pennsylvania Association for Sustainable Agriculture (PASA) Fruit Day,
Horticulture Research Farm, Penn State University, Rock Springs PA. Contact Kate
Francis (814) 349-9856.