UMASS EXTENSION

Vegetable Notes

For Vegetable Farmers in Massachusetts

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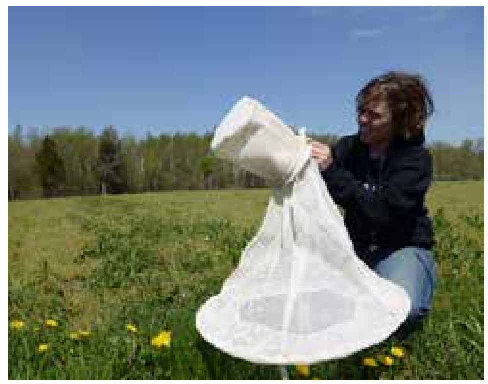
In this issue:

Crop conditions

Field planting continued steadily this week. In northern New England fields have been slow to dry out, but farther south, wet soils have not been a barrier for the most part. The short Mother's Day hot spell boosted crop growth as well as plant sales. Overall, crop growth continues to be slow in response to cool temperatures and cloudy skies. Growers are using season extension tools more than ever, including seeding sweet corn under plastic later than usual, and covering large fields of early brassicas to push them along. Some growers are waiting to transplant early squash, cukes and other fruiting crops, while others are taking the chance that row cover or plastic low tunnels will provide protection from cold or wind. High tunnel greens are also slow. June market goals are looming – whether at the farmstand, farmers market, wholesale accounts, or CSA farmshares - and crops aren't quite keeping up. Asparagus harvest started about a week late but is now in full swing. Rhubarb and fiddleheads are also being harvested. Spring pests are up and running, including maggot flies, flea beetles, spinach and beet leaf miner, and Botrytis – see pest alerts.



It's almost time to start monitoring for ECB, CEW, and squash vine borer. Check your supplies and place orders soon.

The New England Crop Weather weekly report gives GDD from across the five New England states. New England-wide, 12% of sweet corn was planted as of 5/12, and overall corn planting was 15% well behind the five year average. However, the growing degree days are above normal across the region, compared to a 30 year average. If you've been farming more than 20 years, it might be interesting to pull out your records from 25 years ago to look at planting dates. How much have our planting schedules changed in response to earlier springs? Subscriptions to NE Crop Weather report are free.

This season, a collaborative project between UMass, Univ. of Rhode Island and Univ. of Vermont Extension vegetable specialists will provide pest alert information from a transect of on-farm scouting sites from northern to southern New England. This project is funded through the Northeastern IPM Center and is led by Katie Campbell-Nelson (MA), Ann Hazelrig (VT) and Andy Radin (RI). Beginning this week, the Pest Alerts section of Vegetable Notes will include scouting results from these locations. Who knows – the first pest arrivals might come from the north, the south or from over the sea!

Pest alerts

Cabbage Root Maggot: Yellow sticky cards in broccoli, kale and cabbage fields are capturing adult flies in all locations in Table 1. Eggs were found in fields in South Deerfield, Seekonk and Orange, MA. In a broccoli crop in Southeastern, MA, scouting found an average of 9 eggs per plant and one maggot on 5/14/14, so pressure is high in some locations. Maggots were also found in broccoli in Hadley, MA but other locations scouted did not

Table 1. Accumulated Growing Degree Days, base base 4° C, as of 5/14/14 and % emergence of Cabbage Root Maggot. Values based on NEWA Cabbage Maggot model.

Location	Accumulated GDD's (° C)	Emergence
South Deerfield, MA	274	50-75%
Orange, MA	226	25-50%
Waltham, MA	294	50-75%
Seekonk, MA	329	75- 95%
Middletown, RI	307	75-95%
Burlington, VT	215	25-50%

have maggots. Floating row covers provide an effective barrier against this pest. Avoid damage by planting after first flight is over, or 399 accumulated GDD's (base 4° C). See NE Veg Guide for chemical recommendations.

Colorado Potato Beetle: Adults are beginning to move from overwintering locations at field edges, and were seen feeding on greenhouse tomatoes in Burlington, VT. Although CPB may attack young tomato transplants in the field, this is not their preferred host, and plants will generally tolerate some damage. Scout emerging potatoes and transplanted eggplant for adults.

Green Peach Aphids have been reported as a problem on a variety of crops including brassicas, tomato, and pepper particularly in greenhouses where crops were grown through winter. Several biological control options exist, but are more effective when released early, when aphid populations are low. Use the UMass Greenhouse Pest Guide for selecting control options: http://greenhousepestguide.umass.edu/

Botrytis is widespread in vegetable and floriculture greenhouses this spring. Botrytis leaf spot, stem canker, blight, and ghost spot, caused by Botrytis cinerea, is a common problem on greenhouse tomato, and was also found on greenhouse cucumber this week. This pathogen is ubiquitous in the environment, has an extremely wide host range, and prefers to attack senescent and/or injured tissue. Botrytis can be controlled by management of environmental conditions, sound cultural practices, and fungicide applications. See UMass Floricuture Botrytis fact sheets for more details.

Aparagus beetle and eggs on asparagus spear. Photo credit Ward Upham, Kansas State University

Common asparagus beetles are active in asparagus fields in MA. Their distinctive feature is a row of three squarish, cream-colored spots against a blue-black background on each wing cover. Watch for dark brown eggs which are glued, standing on end, in a tidy vertical row along the spears. Adult feeding damage and presence of eggs makes spears unmarketable. Scout fields regularly and treat spears if >10% of the plants are infested with beetles, or 2% have eggs or damage. The daily harvest makes timing difficult; 1 dh products (several pyrethroids) and 0 dh (pyrethrins) are available (see NE Vegetable Guide) and can be used immediately after picking to allow harvest the following day. Modest beetle numbers can be tolerated without crop loss, which may make it possible to avoid insecticide applications during harvest. The spotted asparagus beetle (bright red-orange with black spots) generally becomes active later in the spring. These two beetles have similar life cycles but it is the common asparagus beetle that is most damaging to the spears.

Flea Beetles are actively and rapidly moving into spring brassicas. Injury was observed on 5/12/14 on young cabbage seedlings in South Deerfield, MA. FB was not active last week when brassicas were scouted in Burlington, VT, but warm temperatures over the weekend boosted FB feeding activity. Even the waxy brassicas are susceptible to this pest, especially early in their growth. Spunbonded row covers provide excellent protection if well sealed at edges. Rotate spring crops as far as possible from last season's fall Brassica crops and try to locate fall plantings as far from early successions as possible. See NE Veg Guide for chemical recommendations.

Leafminer on Spinach, Chard and Beets has been reported in Central MA. Scout for eggs and larvae (see article in this issue).

Preparing for *Phytophthora capsici* 2014

Phytophthora blight of cucurbits and peppers caused by *Phytophthora capsici* has become a fact of life for many vegetable growers. In addition to persisting indefinitely in infested fields, the pathogen can also be introduced and spread in irrigation and/or flood waters or by moving infested soil on equipment. Here are some measures that growers can adopt to prevent infestation of clean fields, or to reduce the impacts of Phytophthora blight in fields where it is already present.

Site selection: The pathogen, *Phytophthora capsici*, is soil-borne and will remain in the soil for years, perhaps indefinitely, in the form of long-lasting oospores. It is important to keep track of sites that are contaminated with *P. capsici*. Do not rent land for susceptible crops without investigating the history of disease problems (there are other important soil-borne pathogens as well). Avoid moving soil from contaminated land to clean fields. Use a power washer to remove soil from tillage and planting equipment and tractor tires. Avoid fields with heavy, clay soils that are poorly drained for susceptible crops unless you are prepared to spend time and money to improve soil drainage. Wherever possible, avoid planting susceptible crops in contaminated soil. Practice long rotations and do not grow cucurbits, peppers, eggplant, beans, or tomato for at least five years in fields where disease has occurred.

Water management: *P. capsici* can move through the air during windy storms and hurricanes but is much more likely to move in water and with soil than air. The pathogen is dependent on water to initiate disease and to move it from plant to plant. Disease will always begin in low spots or areas that do not drain readily. Improving drainage in fields can prevent the disease from getting started. It is critical to manage water so that there is never standing water anywhere in fields for longer than 24 hours. Preventive measures that can be taken include:

- Use a V-ripper or other sub-soiling tool between rows, or a deep zone tillage tool in-row, to break up hardpan and encourage drainage pre-plant and as needed during the season, especially after significant rainfall events to speed drainage of water.
- Plant non-vining cucurbit crops (i.e. summer squash) and peppers in dome-shaped raised beds of at least 9 inches height. Use a transplanter that does not leave a depression around the base of the plant.
- Where beds run across the slope, cut breaks in the beds to allow water to drain. Don't allow raised beds to become dams that hold water.
- Clear away soil at the ends of rows. Where raised beds reach the field edge, open up the end of the row to create drainage ditches.
- Make sure any water moving within the field has a way to leave the field - dig ditches if necessary!
- Don't plant susceptible crops in low areas - plant a cover crop, corn or another non-susceptible crop, or leave those areas fallow.
- Check your irrigation system for leaks and fix them - don't allow puddles of water to sit near your irrigation pumps or lines.

Irrigation Sources: *P. capsici* spores can be present in surface water including ponds, streams, and rivers. Late summer irrigation from rivers or streams with contaminated fields upstream can contaminate previously uninfected fields, as well as increase the inoculum load in infested fields. The pathogen can also spread from irrigation ponds that have infested fields draining into them. It is not known if *P. capsici* is able to overwinter in ponds or rivers, so the danger of infection from these sources increases later in the season as the disease develops on fields upstream. Late season floods from hurricanes or tropical storms like Irene are a good opportunity for *P. capsici* contamination. Soil erosion resulting from these storms can also move the pathogen both into surface waters and into adjacent fields. Irrigation sources such as wells and municipal water sources have a negligible chance of *P. capsici* contamination. Sand filtration systems or treatment of irrigation water with copper ions or ozone are often used by greenhouse and nursery growers to eliminate pathogens from recirculating water systems and irrigation ponds. These may not be viable options for vegetable growers.

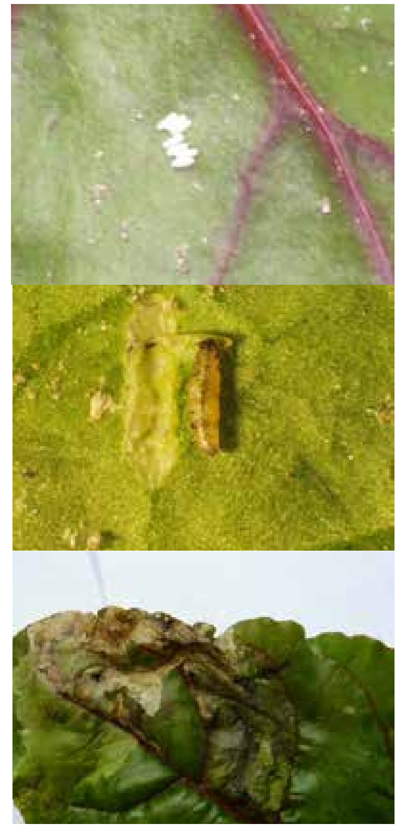
U**Mass research:** The UMass Extension Plant Diagnostic lab is conducting research on the distribution and genetic nature of *P.capsici* populations across MA. The goal of this research is to develop a risk map for Massachusetts farms based on historical occurrences and population structure of the pathogen. The project also includes development of an early detection system based on molecular (DNA) techniques that can detect the pathogen before symptoms develop. Early detection means earlier and more successful treatment. The UMass Vegetable team and the diagnostic lab will also be baiting streams and rivers in the Connecticut River valley for *P.capsici* and other Phytophthora species. Vegetable IPM scouts will be looking for *P. capsici* outbreaks or potential infections in fields with a history of disease after flooding rains. You can help by reporting outbreaks and submitting suspect plants or fruit to the diagnostic lab. Not all cucurbit fruit rots are caused by *P. capsici*, so have your problem confirmed by a diagnostician, and help promote research at the same time!

-This article was written by UMass Extension vegetable and plant pathology specialists. Thanks also to Jude Boucher, UConn Extension and Meg McGrath, Cornell Extension

Leafminer on Spinach

Spinach and beet leafminers are early-season pests that cause damage to early greens. They attack crops and weeds in the plant family *Chenopodiaceae* which includes chard, beets, and spinach as well as the weed host, lamb's quarters. The two fly species are very similar, however, spinach leafminer may also cause damage in Solanaceous crops such as peppers.

Crop damage is caused by the fly larva that burrows and feeds between the upper and lower epidermis of the leaf. Early damage is a slender, winding 'mine' or tunnel, but later these expand and become blotches on the leaves. The fly overwinters as a pupa in the soil and hatches in late-April and May. The adult fly—a small, gray fly 5-7 mm long—lays eggs on the leaves. The small (<1mm), oblong, white eggs, are laid in neat clusters on the underside of the leaves. They are easy to spot if you scout by looking under the leaves. If you find tunnels, pulling the epidermis off will reveal one or several pale, white maggots. When fully grown, maggots usually drop into the soil to pupate. The entire life cycle is 30-40 days and there are three to four generations per season. Typically mid to late-May, late-June and mid-August are peak activity periods. After August, pupae enter overwintering phase and won't emerge until next spring.



From top: Leafminer eggs, larva, and injury on chard

If the plants are infested early and populations are high, the losses from this pest may be great. This may be especially true when eggs on transplants in the greenhouse go unnoticed until planting in the field, resulting in infestations in row-covered crops. Treat when eggs or first tiny tunnels are noticed—see current recommendations below. There are both conventional and organic products available and in both cases an adjuvant is recommended to improve efficacy. See New England Vegetable Management Guide for more details on products (www.nevegetable.org). Some may be registered only for beets, chard, or spinach. Some systemics are registered that may be applied to transplants or to the soil, including a diamide (Coragen) and nicotinoids (Venom), but be sure to observe the longer days to harvest restrictions. Most of the products labeled are for foliar applications. Among the organic products available, spinosad has demonstrated efficacy when applied before egg hatch.

Because leaf miner feeds mostly on one crop family and also on many weeds including chickweed, lamb's quarters and nightshades, weed control and crop rotation are the first line of defense. Row covers can also be used to exclude flies if placed over the crop before flies are active or immediately after planting.

Products labeled for spinach, chard and/or beets (often only 1 or 2 of these) include: (Abamectin (Agri-Mek* 0.15 EC), azadirachtin (Neemix 4.5)OG, bifenthrin (Brigade* 2EC; SPINACH ONLY), chlorantraniliprole (Coragen), cyromazine (Trigard), dimethoate (Dimethoate 4EC; BEETS & CHARD ONLY) dinotefuran (Venom 20SG), emamectin benzoate (Proclaim*), insecticidal soap (M-Pede), permethrin (Pounce* 25WP), Pyrethrin (Pyganic EC5.0), pyrethrins + piperonyl butoxide (Pyrenone), spinetoram (Radiant SC), spinosad (Entrust SC^{OG}). Of these, Coragen (a diamide), and Venom (a neonicotinoid) may be applied to transplants or soil, have systemic activity and a 7 dh interval. See New England Vegetable Management Guide for more details.

-Adapted & updated 2014 by R Hazzard, from Eric Sideman, Maine Organic Farmers and Gardeners Association

Summer nitrogen management

Routine soil tests are not good predictors of nitrogen (N) availability because plant available N fluctuates greatly throughout the season. Sandy soils low in organic matter can leach nitrogen quickly with spring rains. On the other hand, slowly decomposing organic matter, such as a freshly turned-in cover crop, may temporarily tie up nitrogen as it is involved in the decomposition of residual plant material. The Pre-sidedress Soil Nitrate Test can help you determine how much N is available for a crop at critical periods of plant growth. Sidedresses should be made soon after results are received to be sure the plant gets any needed additional nitrogen at the time in its growth when it would be most responsive to it. Consult Table 1 to determine at which crop stage to take a PSNT sample. Sampling instructions can be found at the UMass Soil Testing Lab website .

Having received your PSNT test results, you are now left with questions about how much N to apply and in what form.

Interpreting PSNT results: The PSNT is a tool growers can use to optimize N management, matching crop nitrogen needs to the time of greatest crop growth. The PSNT measures the current level of nitrate-N in the soil to predict the amount of N available for the remaining period of crop growth. The test helps growers avoid the use of excess nitrogen fertilizers, thus eliminating potential run-off and providing higher returns to labor and fertilizer investment. Broadcast and preplant nitrogen applications can be reduced or avoided entirely if nitrogen is supplied to plants at key periods of growth. The test is especially useful for soils that are high in organic matter or have had a cover crop or manure turned under before planting since microbes will be mineralizing organic nitrogen into a plant available form throughout the season. This test has been used successfully with corn, potatoes, peppers, cucurbits and some brassicas.

Table 1. Appropriate crop stages of various vegetables for PSNT sampling and sidedressing with plant available nitrogen.

Crop	Soil sampling time for PSNT	Sidedress N in Lbs/A[y]
Sweet corn	When plants are 6-10" tall	**60-90**
Cabbage Cauliflower Broccoli Brusselsprouts	2 weeks after transplanting	cabbage, broccoli, brusselsprouts: **60** cauliflower: **30**
Celery	2 weeks after transplanting. Sample again in 3-4 weeks	**40** twice 3-4 weeks apart
Lettuce Endive Escarole	2 weeks after transplanting or after thinning (2-4 leaves)	**30-50**
Beets	After thinning (2-4 leaves)	**30**
Pumpkin Winter Squash Cucumber Muskmelon	Before vines are 6" long	pumpkin and winter squash: **40-50** cucumber and melon: **40**
Spinach	2- 4 leaves. Sample again after first cutting.	**30**
Potato	Before plants are 6" tall	**40-60**[z]
Pepper Tomato Eggplant	3-4 weeks after planting. Sample again 3-4 weeks later.	pepper: **50**, and **40** later at fruit set tomato: **30** twice 3-4 weeks apart eggplant: **30-50**

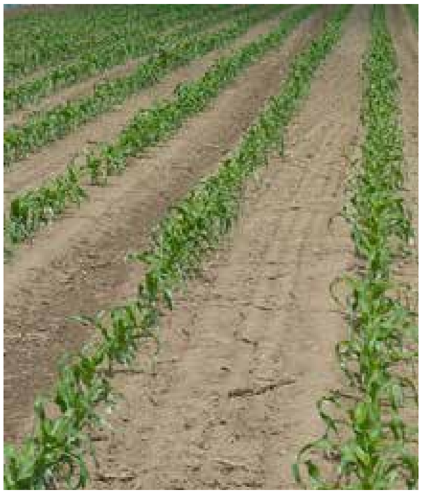
[y] If soils have 0-25 ppm nitrate, apply the full sidedress amount recommended by the New England Vegetable Management Guide. For crops other than sweet corn, at 25-30 ppm nitrate you can cut the sidedress rate in half. Above 30 ppm no additional N is needed and could hurt yields.
[z] Potatoes also need 50-125lbs/A Potassium depending on soil test results.

Adapted from: Rutgers Cooperative Extension Bulletin by J. Heckman, "Soil Nitrate Testing as a Guide to Nitrogen Management for Vegetable Crops" and The New England Vegetable Management Guide.

Research conducted by the University of Massachusetts and Connecticut indicates that an appropriate threshold for most vegetable crops is about 30 ppm nitrate-N (NO3-N), and is 25ppm for sweet corn. Above this level, sidedressing or topdress- ing supplemental N would be of no value and may even decrease yields. As a tool, the PSNT should be used along with a grower's experience and knowledge of their fields. For example, a field high in organic matter will continue to release nitrogen for crop growth throughout the season. Research indicates that for each 1% organic matter, we can expect 20 to 40 lb of N per acre per year to be mineralized when conditions are favorable. The PSNT should reflect the nitrogen release coming from organic matter. Interpretation of PSNT results should be made with regard to weather conditions such as recent leaching rains that reduce available N, or high soil temperatures that increase mineralization and therefore increase available N. Weather conditions should also be considered before making N applications to avoid runoff, leaching and volatilization.

How much should I sidedress based on PSNT results? If soils have 0-25 ppm nitrate, apply the full sidedress amount recommended by the New England Vegetable Management Guide for most vegetable crops except for sweetcorn. At 25-30 ppm nitrate you can cut the sidedress rate in half. Above 30 ppm no additional N is needed and could hurt yields. Consult Table 1 for sidedress rates of specific crops.

What form of nitrogen should I use? Nitrogen is available in a number of forms; consult pages 37-38 of the Nutrient Management Guide for New England Vegetable Production for nitrogen sources. Common sources of fertilizer N include urea, ammonium nitrate, monoammonium phosphate, diammonium phosphate, calcium nitrate and potassium nitrate. Sul-


The best time to take a PSNT sample and sidedress sweet corn is when it is between 6” and 10” tall

phur coated urea is a material which releases N more slowly over a period of several weeks. In the soil, urea is converted by hydrolysis to ammonium, which in turn is converted through nitrification to nitrate, the form of N most available to plants. In warm soils these reactions usually happen fairly quickly if soil pH is over 6.0 and soil moisture and aeration are adequate. For organic growers N sources include: manure, meals and fish and seaweed emulsions, or animal byproducts such as dried blood and feather meal. Not all of these forms are readily available to the crop, and selecting rapidly available forms of nitrogen may be preferable for sidedressing. Nitrate is the predominant form of N taken up by most plants, but any of these fertilizers can be used because they will be converted to nitrate eventually. Many growers use calcium nitrate and sometimes potassium nitrate for topdressing or sidedressing N on crops subject to calcium related disorders, such as tomato and lettuce. When a slow release form of urea is used, only a small amount of ammonium is present at a given time and is unlikely to cause a problem with calcium nutrition, but N may not be available quickly enough to meet the demands of a rapidly growing crop.

How much will the nitrogen cost me? Nitrogen materials vary considerably in price. Be sure to compare materials on a cost per pound of N basis, not per ton of material. Be sure to account for %N content of the product. The way to do this is as follows:

Price per lb N = (price per ton material) divided by (lbs of N in a ton of material). For example, one ton of urea costs $598 and contains 920 lbs N (2000 x 46%N) Therefore cost per lb N = ($598) ÷ 920 lbs N = $0.65/ lb N.

In summary: Nitrogen applications should be timed to meet crop demands. A PSNT should be used to determine the need, if any, for additional N during the growing season. If needed, additional N can be applied by topdressing, sidedressing or injection into a trickle irrigation system. Nitrogen is easily leached from the soil. If this happens, money is wasted and ground water may be contaminated. Large pre-plant broadcast N applications should be avoided. - *Adapted by K. Campbell-Nelson, UMass Vegetable Extension from J. Howell, UMass Extension and Joseph R. Heckman, Ph.D., Extension Specialist in Soil Fertility*

FUNGICIDE RESISTANCE MANAGEMENT FOR CUCURBIT DISEASES

The list of diseases affecting cucurbit crops is long and varied. Some information about the life cycle and resistance profiles of the organisms causing these diseases can guide an effective control strategy. While there is some overlap in the effectiveness of certain materials against the suite of diseases affecting cucurbit crops, there are many cases where the most effective treatment for one disease will be completely ineffective against others. For this reason proper identification of the pathogen is critical for effective control.

Some of these pathogens are developing resistance to fungicides that had given good control for years, but are now almost completely ineffective. Two of the most damaging pathogens of cucurbits in New England, Powdery Mildew (*Podosphaera xanthii*) and Downy Mildew (*Pseduoperonospora cubensis*), are capable of rapidly developing resistance to selective fungicides. Chemical control of these diseases must include a rotational program using both broad-spectrum and selective materials in order to preserve the efficacy of these materials for the long term.

Powdery Mildew (*Podosphaera xanthii*) infections result in fewer fruit and/or fruit of low quality (poor flavor, sunscald, poor storability). The action threshold for starting fungicide applications is one leaf with symptoms out of 50 older leaves examined. Examine both surfaces of leaves. Starting treatment after this point will compromise control and promotes resistance development. An important component of fungicide programs is using materials which can move to the lower leaf surface (systemic or translaminar) because powdery mildew affects both leaf surfaces. Systemic fungicides, due to their single site mode of action, are prone to resistance development in pathogen populations.

Powdery mildew fungi have demonstrated the ability to develop resistance to these classes of fungicides: benzimidazoles (FRAC Group 1), demethylation inhibitors (FRAC Group 3), and strobilurins (FRAC group 11). Avoid using these products in your rotation. Under low disease pressure however, demethylation inhibitors (FRAC Group 3) may be used at the highest labelled rate effectively since they exert a more gradual selection pressure on the organism, as opposed to the high selection pressure exerted by FRAC group 1 and 11 materials.

Quintec (quinoxyfen, FRAC Group 13) (not registered on cucumbers or summer squash) should be used early in the disease cycle then alternated with Torino (cyflufenamid, FRAC Group U6), Procure (triflumizole, FRAC Group 3) or Rally (myclobutanil, FRAC Group 3) plus Bravo (chlorothalonil, FRAC Group M5), or Inspire Super (difenoconazole plus cyprodinil, FRAC Groups 3 & 9). Torino is a new fungicide with a new mode of action that has performed well in research trials. Its activity is limited to Powdery mildew. Fontelis (penthiopyrad) and the Luna (fluopyram) (watermelon only) series are new fungicides in FRAC Group 7 which also includes Endura (boscalid). Strains of the pathogen resistant to boscalid have been detected and there is high cross resistance within Group 7 members. Therefore, Luna and Fontelis should only be used once and in rotation with the more effective chemicals listed above.

Organic materials OMRI listed for control of Powdery mildew do not have a single-site mode of action and so are not likely to select for resistant pathogen strains. These materials include oil (mineral and botanical types, eg JMS Stylet-oil, GC-3 Organic fungicide, Organocide), sulfur (Microthiol Disperss), and copper (e.g. Champ WG). These materials have been found to work well in some studies. Please note that copper and sulfur products can cause phytotoxicity in some cucurbit crops, and do not apply sulfur when temperatures exceed 90° F, as plant injury may occur.

Downy Mildew does not affect fruit directly, but infected leaves die prematurely which results in fewer fruit and/or fruit of low quality. An important resource for determining when to switch from broad spectrum protectant fungicides to the oomycete-specific materials is the NCSU Cucurbit Downy Mildew Forecasting (CDM ipmPIPE) website.

Presidio (fluopicolide, FRAC group 43) has been the most effective fungicide until recently indicating that resistance may have developed. Presidio should be used judiciously with limited applications in a good rotation program and always mixed with a protectant fungicide. Zampro (ametoctradin plus dimethomorph, FRAC Groups 40 & 45) is a new fungicide with good activity against Downy mildew. Other effective materials include Previcur Flex (propamocarb HCl, FRAC group 28), Gavel (zoxamide plus mancozeb, FRAC Groups 22 & M3) (not pumpkin or winter squash), Ranman (cyazofamid, FRAC Group 21) plus protectant, and Tanos (famoxadone plus cymoxanil, FRAC Groups 11 & 27) plus protectant. These systemic materials should be applied only once before rotating to another fungicide in the list above. Both Presidio and Previcure Flex are also effective against late blight on tomatoes and downy mildews on a host of other vegetable crops.

Organic control options for Downy mildew in cucurbits are limited. Copper products are probably the most effective material available to organic growers, but may cause phytotoxicity in some cucurbit crops. Resistance is unlikely to develop towards copper fungicides since they have a complex mode of action and exert low selective pressure. There are also numerous biological and biorational materials labeled for organic production, though their efficacy may be more variable. Check with your certifier for information about which formulations are currently approved for organic production.

Fungicide Resistance Management: Apply targeted fungicides tank-mixed with protectant, broad-spectrum fungicides weekly and alternate among available chemistries based on FRAC code. Add new fungicides to the program when they become available; substitute new for older product if they are in the same FRAC group.

-Do not make sequential applications of high risk (systemic) fungicides within the same FRAC group.

-Alternate or tank mix systemic (high risk, single site mode of action) fungicides with protectant fungicides (low risk, multi-site mode of action). Contact fungicides FRAC codes are designated Mx. Common protectant fungicides include copper, chlorothalonil, mancozeb, or sulfur.

-Systemic chemicals can be alternated among FRAC groups, preferably in tank mixes with the protectant fungicides listed above, and in accordance with label requirements. Make sure that different trade names are not members of the same active ingredient class; resistance to one member of a FRAC group most often results resistance to all other members.

-Apply the most effective fungicide first and then rotate with registered fungicides with a different mode of action.

-Do not make applications of systemic fungicides when disease is already widespread as this encourages resistance development in the existing large pathogens populations.

2013 Fungicide Resistance Management Guidelines for Cucurbit Downy Mildew and Powdery Mildew Control in the Mid-Atlantic & Northeast regions of the United States

Fungicide	Active Ingredient(s)	FRAC Code*	Risk Rating**	REI / PHI***	Powdery Mildew	Downy Mildew
Kocide 3000 or OLF	fixed copper(s)	M1	L	48hr/0days	+	
Microthiol or OLF	sulfur	M2	L	24hr/	++	
Manzate, Dithane or OLF	EBDC	M3	L	24hr/		++
Bravo, Echo or OLF	chlorothalonil	M5	L	24hr/	++	++
Topsin M	thiophanate methyl	1	H^R	24hr/	+	
Rally	myclobutanil	3	M^R	12hr/0days	++	
Procure	triflumizole	3	M^R	12hr/0days	++	
Folicur	tebuconazole	3	M	12hr/0days	++	
Inspire Super	difenconazole + cyprodinil	3 + 9	H	12hr/7days	++	
Ridomil Gold Copper	mefenoxam + copper	4 + M1	H^R + L	48hr/5days		+
Ridomil Gold Bravo	mefenoxam + chlorothalonil	4 + M5	H^R + L	48hr/0days		+
Fontelis	penthiopyrad	7	M - H	12hr/1day	++	
Luna Experience[a]	fluopyram + tebuconazole	7 + 3	M	12hr/	+++	
Luna Sensation[a]	fluopyram + trifloxystrobin	7 + 11	M	12hr/	+++	
Pristine	boscalid + pyraclostrobin	7 + 11	H^R	12hr/0days	++	+
Quadris	azoxystrobin	11	H^R	4hr/1day	+	+
Cabrio	pyraclostrobin	11	H^R	12hr/0days	+	+
Flint	trifloxystrobin	11	H^R	12hr/	+	
Reason	fenamidone	11	H	12hr/		+
Tanos	famoxadone + cymoxanil	11 + 27	L - M	12hr/3days		+
Quintec	quinoxyfen	13	H	12hr/3days	+++++	
Ranman	cyazofamid	21	M - H	12hr/0days		+++
Gavel	zoxamide + mancozeb	22 + M3	M + L	48hr/5days		++
Curzate	cymoxanil	27	L - M	12hr/3days		++
Previcur Flex	propamocarb HCL	28	L - M	12hr/2days		+++
Alliete	aluminum tris	33	L	12hr/12hr		+
Phosphonates	phosphorous acid salts	33	L	4hr/		+
Forum	dimethomorph	40	L - M	12hr/		+++
Revus[b]	mandipropamid	40	L - M	12hr/0days		+/+++
Presidio[b]	fluopicolide	43	H	12hr/2days		+/++++
Zampro	ametoctradin + dimethomorph	45 + 40	M	12hr/0days		++++
Torino	cyflufenamid	U6	M	4hr/0days	+++++	

General Fungicide Resistance Management Guidelines****

FRAC code M fungicides are low risk, protectant fungicides. Use alone, or tank mix with high-risk fungicides to improve control

Always read product labels before use

Select fungicides with at least ++ rating. Rotate among fungicides with different FRAC codes. Tank mix high risk fungicides with FRAC code M product if the product is not formulated with a FRAC code M fungicide.

When resistance is qualitative (FRAC code 1 and 11 fungicides), resistant pathogen strains are completely insensitive and cannot be controlled with the fungicide.

With quantitative resistance (FRAC Code 3 fungicides), pathogen strains exhibit range in fungicide sensitive and efficacy depends on level of insensitivity. Better control can be obtained with high label rates and tight spray intervals.

[a]Luna fungicides are labeled for watermelon only.

[b]Revus is poor on cucumber. Presidio has exhibited poor control when the pathogen originated from the south-east.

Efficacy Ratings: + = poor (not recommended), ++ = poor to good, +++ = good, ++++ = very good, +++++ = excellent

* FRAC code: M = multi-site mode of action (MOA), numbered groups = fungicides with similar MOA

** Risk Ratings: L = low risk, M = moderate risk or H = high risk for fungicide resistance to develop

*** Restricted Entry Interval / Pre-Harvest Interval

**** See fungicide label for specific crops, rates and instructions on use

^{R} = resistance known; (+) control failures detected in the mid-Atlantic and Northeast regions

Fungicides with the same color belong to the same FRAC code

Trade or Brand Names Disclaimer: The trade or brand names given herein are supplied with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension is implied. Furthermore, in some instances the same compound may be sold under different names, which may vary as to label clearances. Andy Wyenandt (Rutgers); Meg McGrath (Cornell); Beth Gugino (Penn State); Kate Everts (Univ. MD); Steve Rideout (VA Tech); Nathan Kleczewski (Univ. DE)

Cultural Practices: Resistance management and fungicide use are not the only effective measures of control for other cucurbit diseases, therefore, consider these cultural practices to avoid disease issues in the future:

-Plant disease resistant cultivars. Select powdery mildew resistant or tolerant seed varieties of squash, pumpkin or muskmelon and downy mildew resistant cucumber.

-Disease-free seed: Always buy seed from a reputable source as Angular Leaf Spot and Scab (*Cladosporium cucumerinum*) are commonly introduced via contaminated seed.

-Rotate fields out of cucurbits for 3 years to avoid Black Rot (*Didymella byroniae*, also called Gummy stem blight), Angular leaf spot, Bacterial wilt, or Plectosporium blight and 4 years or more to avoid *Phytophthora capsici*. Field rotation is not an effective control option for powdery mildew or downy mildew because these pathogens are airborne and infect fields yearly.

-Insect Management: Focus on Striped cucumber beetle management to avoid the spread of bacterial wilt.

-Get proper diagnosis of symptoms if the preventative measures you have taken have failed by submitting samples to a diagnostic lab. UMass Diagnostic Lab: http://ag.umass.edu/diagnostics.

Further Reading regarding other cucurbit diseases: Cucurbit Disease Management Strategies for 2013 (T. A. Zitter, Cornell University) & Cucurbit Disease Scouting and Management Guide (UMass Extension):

-Updated by M.B. Dicklow with credit to A. Cavanagh & Katie Campbell-Nelson, UMass Extension and M. McGrath (Cornell), T. A. Zitter (Cornell), Andy Wyenandt (Rutgers) , Beth Gugino (Penn State), Kate Everts (UnivMD), Steve Rideout (VA Tech, and Nathan Kleczewski (Univ. DE)

Events & classes

UMass Agricultural Field Day

When: Tuesday, July 29, 2014, 10:00am to 4:00pm
Where: UMass Animal and Crop Research Center, 89-91 North River Road, South Deerfield, MA 01373
Come tour the research farm and learn about all of the exciting projects currently underway on a broad range of agricultural topics. A full list of presentations and other details coming soon!

Worker Protection Trainings

When: Wednesday, May 28, 2014, 2:00pm to 4:00pm or Wednesday, June 25, 2014, 2:00pm to 4:00pm
Where: UMass cranberry Station, 1 State Bog Rd, East Wareham, MA 02538
There is a $5 fee for manual. If you have a pesticide license, you do not need this class. Please contact Marty Sylvia by email or at 508-295-2212 x 20 to register or for more info.

Postharvest Handling of Fruits and Vegetables

When: July 7 – August 15, 2014
Where: On-line
UMass Continuing & Professional Education is offering a new 3-credit on-line course, Postharvest Handling of Fruits and Vegetables – From Farm to Table. This course will include an introduction to the environmental and biological factors that contribute to postharvest loss of fruits and vegetables, commercial procedures of harvesting, handling, and storage of horticultural commodities, and specific handling steps for commodities of various plant organs. Small-scale handling practices will be emphasized. This class is part of the Sustainable Food and Farming Online Certificate Program. Fee: $1,113 ($371/credit, 3 credits)

Vegetable Notes. Ruth Hazzard, Katie Campbell-Nelson, Lisa McKeag, Susan Scheufele, co-editors. Vegetable Notes is published weekly from May to September and monthly during the off-season, and includes contributions from the faculty and staff of the UMass Extension Vegetable Program, other universities and USDA agencies, growers, and private IPM consultants. Authors of articles are noted.