UMass Extension
Vegetable Notes
For Vegetable Farmers in Massachusetts since 1975

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In this issue:

Colorful cauliflower. Photo K. Campbell-Nelson

Crop conditions

Plenty to fill up farm stands now! Sweet corn harvests have begun on several farms, and summer squash, zucchini and cucumbers are coming on in earnest along with peas, lettuce, radishes, fennel, scallions, kale, cauliflower, broccoli, Napa cabbage, beets, carrots, and Swiss chard. At this time last year, many were exhausted running and hauling irrigation pipes around their farm just to keep crops alive during the drought, and now we're dealing with a more typical New England summer. Frequent rains and warm, humid weather are making for long leaf wetness periods and perfect conditions for the spread of plant diseases, and while the heat is helping plants that were hit by hail over the last weeks grow plenty of new foliage, these damaged plants are particularly susceptible to infection if left unprotected. Two of the big guns whose development in the region largely relies on airborne transport of spores on storm fronts—cucurbit downy mildew (CDM) and late blight of tomato and potato—were both confirmed in neighboring states over the past week; late blight strain US-23 on potato in Erie Co., NY and CDM on cucumber, also in Erie Co., NY as well as locations in New Jersey and Pennsylvania. Late blight spores are a little heavier and therefore travel more slowly than cucurbit downy mildew, so if you're crunched for time, focus on protecting cucurbits first. See the Pest Alerts section for more information about each of these diseases. We've also included a couple of tables on materials for early blight and late blight in tomato and potatoes, and an article on using copper effectively for managing these and other diseases.

Pest alerts

Allium:

Fusarium basal rot was confirmed on shallots from Essex Co., MA by the UMass Diagnostic Lab. If confirmed, rotate away from alliums for at least 4 years, protect plants from insect, fertilizer, mechanical, or other injury and store bulbs at 4°C/39°F to minimize postharvest losses

Beans:

Mexican bean beetle adults and eggs but still no larvae were reported this past week in Worcester and Barnstable Cos. MA, Providence Co., RI and in Stuben Co., NY. in snap bean. See article this issue for more on managing this pest.

Brassica:

Cabbage root maggot second generation peak flight is occurring now (http://newa.cornell.edu/index.php?page=cabbage-magot) which means that most eggs will be laid and hatch over the next week-10 days. This generation of cabbage maggot usually does not cause significant damage to brassicas; it is the 3rd generation that may cause damage again in the fall. Damage from the first generation is being reported now on hakurai turnips as they are being harvested in Franklin, and Barnstable Cos., MA.

Cross-striped cabbage worm was not reported in western MA until August 6th last year, but has already been spotted in Barnstable Co. on the Cape this week.

Cucurbits:

Anthracnose was diagnosed on Cobra slicing cucumber in Franklin Co., MA today. C. orbiculare is both seed- and soil-borne. The pathogen survives between crops in infected crop debris, volunteer plants, or weeds of the cucurbit

Anthracnose on cucumber. Hairy black setae are visible on the surface of the leaf with a 20X lens as opposed to sporangiaphores on the bottom of the leaf in the case of downy mildew.

family. It can be spread by cucumber beetle feeding, as well as by splashing water, workers, and equipment. Frequent rains, warm temperatures (74-78° F), and high humidity favor the development of anthracnose. The fungus does not require a wound for infection to occur.

Cucurbit downy mildew: Fields in Hampshire, Franklin, Norfolk, Bristol, and Barnstable Cos., MA were scouted for this disease, and despite several rumors, it has NOT been confirmed in MA. The forecast risk of spread for this disease is low to moderate over the next 2 days and a preventive spray is warranted especially on cucumber, melon and watermelon which are most susceptible.

Bacterial Wilt vectored by striped cucumber beetle is widely reported in MA, VT, RI and Long Island. Manage this pest by managing striped cucumber beetle.

Powdery mildew has quickly spread from 2 weeks ago in RI in a field of zucchini and summer squash. It has also been reported in Long Island, but not yet in MA.

The circle of life--squash bug eggs, nymph, and adults. photo K. Campbell-Nelson.

Striped cucumber beetle larvae were surprisingly causing stunting and damage in the stems of stressed winter squash in Franklin Co., MA. Several growers have reported transplanted cucurbits struggling this year due to unfavorable weather, but direct seeded cucurbits doing well.

Squash vine borer (SVB) trap counts are still high in historically high pressure fields (Table 1) and eggs are now being found in NH as well as MA. See this factsheet by Alan Eaton for more information and learn about the pest lifecycle in order to be manage it before the borers get into stems (making it impossible to reach them) https://extension.unh.edu/resources/files/Resource004198_Rep6024.pdf Learning to identify the eggs of SVB will help to determine the time to apply insecticides to the base of plant stems. Gypsy moths are being caught in SVB pheromone traps at this time as well.

Squash bug adults and eggs were reported in CT and NH this past week, and nymphs have now hatched and were found in Norfolk and Franklin Cos., MA. Often treatment for SVB targeting the base of the plant will also have an effect on adult squash bugs, keeping them from climbing up the plant.

Cucumber beetle larvae is about 1 cm long with 3 legs in the front, a dark head and dark tail. Photo: G. Higgins

Squash vine borer egg, 1mm. photo: K. Campbell-Nelson

Table 1. Squash Vine Borer trap captures week ending Wednesday 7/13/2017

Location	SVB Weekly Total
MA	
Falmouth	20
Easton	25
Deerfield	6
Millis	4
Sharon	71
Leominster	6
Berlin	34
Westhampton	3
NH	
Litchfield	10
Hollis	4
Mason	0

Tomato:

Septoria and other foliar pathogens such as **leaf mold** (typically found in greenhouses and tunnels) are now being reported on field tomatoes in RI and NY respectively. Chlorothalonil has not been very effective as a protectant against leaf mold, but better control was reported from using Inspire Super and Milstop by a grower in NY.

Potato:

Late blight is now in Erie Co., NY in potato. Spores travel approximately 30 miles with each storm. Track progression of the disease here: http://usablight.org/map. Begin spraying for LB now, if you have not already started, and

Un-treated Norland Red potato variety with hopper burn right, and other varieties without hopper burn left. photo taken in 2015 by: M. Zeufele.

consider mixing in a targeted material such as Ridomil, Ranman, Revus, Presidio, or Previcur Flex among others. **See tables on page 4 for fungicides that can be used to control late blight and/or early blight on potato or tomato.** These tables were created by Cornell Extension for NY growers, but these materials are labeled for use in MA as well. For organic growers who depend on copper for preventive controls, see the article this issue on using copper effectively. Several forecasting and decision support systems are available for growers--read about them in the June 8th, 2017 Vegetable Notes article on Disease Monitoring and Forecasting Tools.

Dickeya: We have a correction to make: Dickeya was confirmed on Yukon Gem potato last week, not LeHigh. A second sample was confirmed this week on Kennebec potato from a different farm in Franklin Co., MA. Seed from both samples was from the same distributor.

Sweetcorn:

European corn borer damage is now being reported in some untreated fields in Norfolk Co., MA. Even though trap captures from the first generation have been low for ECB, damage is being reported in corn being harvested now. We are approaching the second generation flight at 1400GDD base 50F (likely next week). See Table 2.

Carrot seed moth found in corn earworm traps are not a pest of corn. Photo: buguide.net

Corn earworm Trap captures are fairly low in silking corn (Table 3), though with more storms, numbers are expected to rise especially starting near the southern coast. Carrot seed moths (not a pest) are being seen in these traps (see photo).

Western Bean cutworm: is a pest of corn and dry beans in New York, and we are just starting to monitor in MA and NH. The first moth was captured in a trap in NH this week.

Multiple

Potato leafhopper is miserable in MA, NH and RI this year on beans and potatoes. In untreated fields in Norfolk Co. MA, PLH feeding on red-skinned varieties has caused hopper burn across fields seemingly overnight while more resistant varieties are holding up better (photo). Other hosts include alfalfa, beans, peanuts, many woody ornamentals, raspberries, strawberries, cucumber, apples, grapes, celery, rhubarb, and clover. With so many reserves, multiple treatments will be required to ensure this pest is controlled over the season. Be sure to rotate between modes of action when using insecticides and avoid materials with high toxicity to bees once crops are blooming (such as now).

Table 2. Accumulated Growing Degree Days: 1/1/17 - 7/12/17

Location	GDD (base 50°F)
Western, MA	
Amherst	1113
Westfield	1187
South Deerfield	1075
Central, MA	
Leominster	1142
Stow	1213
Eastern, MA	
Sharon	1193
Seekonk	1193
Ipswich	1072
Falmouth	995
Hollis, NH	1120
Burlington, VT	1150
Newport, RI	1018
Castleton, NY	1231

Table 3. Corn pest trap captures, week of 7.5.17-7.12.17

Location	ECB Weekly Total	CEW Weekly Total	Spray Interval for CEW
Western, MA			
Amherst	2	-	-
Sheffield	0	73	*4 days*
Whately	1	0	*no spray*
Central, MA			
Leominster	1	0	*no spray*
Eastern, MA			
Falmouth	1	-	-
Millis	0	1	*no spray*
Sharon	0	1	*no spray*
Swansea	2	46	*4 days*
Dover	0	-	-
Seekonk	11	13	*no spray*
NH			
Litchfield	0	5	*5 days*
Hollis	0	0	-
Mason	0	3	*6 days*
Washington County, NY	1	0	*no spray*
Albany, NY	0	0	*no spray*

European corn borer (ECB), Corn earwom (CEW)

Fungicides labeled for use in TOMATO for early and late blight disease management, 2017.

Name	Diseases	FRAC Group	REI	PHI	Rate/A
Curzate 60 DF	Late blight	27	12 h	3 d	3.2-5 oz
Forum	Late blight	40	12 h	4 d	6.0 fl oz
ProPhyt or OLP	Late blight	33	4 h	0 d	4 pt
Presidio	Late blight	43	12 h	2 d	3-4 fl oz
Ranman 400 SC	Late blight	21	12 h	0 d	2.1-2.75 fl oz
Ridomil Gold Bravo SC	Late blight	4	48 h	5 d	2.5 pt
Zampro	Late blight	45 + 40	12 h	4 d	14 fl oz
Zing!	Late blight	22 + M3	12 h	5 d	36 fl oz
Ariston	Late blight, Early blight	27 + M3	12 h	3 d	1.9-3.0 pt
Cabrio	Late blight, early blight	11	12 h	0 d	8-16 oz
Catamaran	Late blight, Early blight	M5 + 33	12 h	0 d	5-7 pt
Flint	Late blight, early blight	11	12 h	3 d	2-4 oz
Gavel 75 DF	Late blight, early blight	22 + M3	48 h	5 d	1.5-2 lb
Previcur Flex	Late blight, early blight	28	12 h	5 d	0.7-1.5 pt
Quadris F or OLP	Late blight, early blight	11	4 h	0 d	6.2 fl oz
Quadris Opti	Late blight, early blight	11 + M5	12 h	0 d	1.6 pt
Reason 500 SC	Late blight, early blight	11	12 h	14 d	4.0- 8.2 fl oz
Revus Top	Late blight, early blight	40 + 3	12 h	1 d	5.5-7 fl oz
Tanos 50 DF	Late blight, late blight	11 +27	12 h	3 d	6-8 oz
Bravo Weather Stik or OLP	Late blight, early blight	M5	12 h	0 d	1 3/8 – 2 ¾ pt
Champ or OLP	Late blight, early blight	M1	48 h	0 d	1.3 pt
ManKocide	Late blight, early blight	M3 + M1	48 h	5 d	1-3 lb
Dithane DF Rainshield	Late blight, early blight	M3	24 h	5 d	1.5 lb
Endura 70 WDG	Early blight	7	12 h	0 d	2.5-3.5 oz
Inspire Super	Early blight	3 + 9	12 h	0 d	16-20 oz
Priaxor	Early blight	7 + 11	12 h	0 d	4-8 fl oz
Quadris Top	Early blight	11 + 3	12 h	0 d	8 fl oz
Rhyme 2.08 SC	Early blight	3	12 h	0 d	3.5-7 fl oz
Scala SC	Early blight	9	12 h	1 d	7 fl oz
Serenade Opti	Early blight	44	4 h	0 d	14-20 oz
Sonata	Early blight	44	4 h	0 d	2-4 qt
Switch 62.5 WG	Early blight	9 + 12	12 h	0 d	11-14 oz
Ziram	Early blight	M3	48 h	7 d	3-4 lb

Fungicides labeled for use in POTATO for early and late blight disease management, 2017.

Name	Diseases	FRAC Group	REI	PHI	Rate/A
Curzate 60 DF	Late blight	27	12 h	3 d	3.2-5 oz
Forum	Late blight	40	12 h	4 d	6.0 fl oz
Omega	Late blight	29	12 h	14 d	5.5 fl oz
ProPhyt or OLP	Late blight	33	4 h	0 d	4 pt
Ranman 400 SC	Late blight	21	12 h	0 d	2.1-2.75 fl oz
Ridomil Gold Bravo SC	Late blight	4	48 h	5 d	2.5 pt
Zampro	Late blight	45 + 40	12 h	4 d	14 fl oz
Zing!	Late blight	22 + M3	12 h	5 d	36 fl oz
Ariston	Late blight, early blight	27 + M3	12 h	3 d	1.9-3.0 pt
Cabrio Plus	Late blight, early blight	11 + M3	24 h	3 d	2.9 lb
Catamaran	Late blight, early blight	M5 + 33	12 h	0 d	5-7 pt
Gavel 75 DF	Late blight, early blight	22 + M3	48 h	5 d	1.5-2 lb
Gem	Late blight, early blight	11	12 h	7 d	3.8 fl oz
Headline	Late blight, early blight	11	12 h	3 d	6-12 fl oz
Previcur Flex	Late blight, early blight	28	12 h	5 d	0.7-1.5 pt
Quadris Opti	Late blight, early blight	11 + M5	12 h	0 d	1.6 pt
Reason 500 SC	Late blight, early blight	11	12 h	14 d	4.0- 8.2 fl oz
Revus Top	Late blight, early blight	40 + 3	12 h	1 d	5.5-7 fl oz
Super Tin 80 WP or OLP	Late blight, early blight	30	48 h	7 d	1.87 oz
Tanos 50 DF	Late blight, late blight	11 +27	12 h	3 d	6-8 oz
Bravo Weather Stik or OLP	Late blight, early blight	M5	12 h	0 d	1 3/8 – 2 ¾ pt
Champ or OLP	Late blight, early blight	M1	48 h	0 d	1.3 pt
Elixir	Late blight, early blight	M5 + M3	24 h	7 d	1.2-2 lb
ManKocide	Late blight, early blight	M3 + M1	48 h	5 d	1-3 lb
Polyram	Late blight, early blight	M3	24 h	3 d	2 lb
Dithane DF Rainshield	Late blight, early blight	M3	24 h	5 d	1.5 lb
Endura 70 WDG	Early blight	7	12 h	0 d	2.5-3.5 oz
Quash	Early blight	3	12 h	1 d	2.5-4.0 oz
Polyram 80 DF	Early blight	M3	24 h	3 d	2.5-4.0 oz
Priaxor	Early blight	7 + 11	12 h	0 d	4-8 fl oz
Quadris Top	Early blight	11 + 3	12 h	0 d	8 fl oz
Rovral 4F or OLP	Early blight	2	24 h	12 d	1-2 pt
Scala SC	Early blight	9	12 h	1 d	7 fl oz

--Fungicide tables for management of early and late blight disease management created by:
Darcy Telenko, Extension Vegetable Specialist, Cornwall Cooperative Extension, Cornell Vegetable Program.

USING COPPER FUNGICIDES

Copper products play an important role in disease management in both conventional and organic fields. They are the most effective controls for most bacterial diseases. In organic production, copper products are the main protectant fungicide used in the control of diseases caused by oomycetes such as late blight and downy mildews. There are more copper products becoming available, and it is helpful to understand the differences and benefits of different active ingredients and formulations. Solubility, phytoxicity, human health risks, impact on soil ecology, labeled crops and diseases, and efficacy are important considerations in using particular copper products.

How copper works

When copper (Cu) is mixed with water, copper ions (Cu2+) are released into solution. Modern copper products typically use insoluble or "fixed" forms of copper, creating a suspension of copper molecules in the spray solution. These undissolved copper particles persist on plant surfaces after the spray dries and copper ions are released from these deposits each time the plant surface becomes wet. The gradual release of copper ions from the copper deposits provides residual protection against plant pathogens present on the leaf surface. Copper ions kill pathogens primarily by destroying cell membranes and proteins and by disrupting protein synthesis. Since the mode of action of copper targets such fundamental components of living tissues, it affects a wide range of plant pathogens including bacteria, fungi, and oomycetes, but can also damage plant cells and be toxic to humans and other non-target organisms. Achieving the best control without injuring plant foliage and fruit depends on the concentration and rate of release of copper ions on the leaf surface, which is determined largely by the solubility of the copper formulation.

Solubility

Less soluble (fixed) formulations release copper ions more slowly. This slow-release lowers the risk of phytotoxicity and provides longer residual activity. The following are low-solubility active ingredients: copper oxide (e.g., Nordox), copper hydroxide (e.g., Kocide, Champ), copper oxychloride (e.g., COCS and BadgeX2), and copper octanoate (copper ions linked to fatty acids to form a soap, e.g., TennCop, Cueva).

More soluble formulations act rapidly but have higher risk of phytotoxicity and shorter residual activity. Basic copper sulfate and copper sulfate pentahydrate are highly soluble.

Metallic Copper Equivalent (MCE)

Product labels list percent active ingredient (eg., 23.8% copper oxychloride or 98% basic copper sulfate), but this doesn't tell you the actual metallic copper by weight, as the formulation also impacts the total copper present. Look for the "metallic copper equivalent" listed below the active ingredients to determine the amount of actual copper by weight. A product with 40% metallic copper has 0.4 lb metallic copper per lb of product. The range in MCE among products is vast, ranging from under 1.8% to over 50% copper by weight, so it is important to consider the MCE because the effectiveness of a copper spray is highly correlated to the amount of copper applied.

Effects of pH, Spray Additives, and Weather

- Under acidic conditions, copper solubility and the potential for phytotoxicity increases. Spray solutions should be kept above pH 6-7, depending on the formulation, to prevent excessive amounts of copper ions from being released and possibly damaging fruit and foliage.
- Adding maneb or mancozeb to copper products as a tank mix increases the release of copper ions in solution. There are pre-mixed products (e.g., ManKocide) available, or growers can make their own mixtures. This may be especially helpful for controlling bacterial diseases such as bacterial speck, spot and canker of tomato.
- Using an approved adjuvant or 'sticker' may help the product to be more rainfast, but when used with the highly soluble copper sulfate formulations, can cause phytotoxicity.
- Finely ground compounds will be more active than coarser ground materials because the smaller particles result in better coverage of the leaf and are less likely to be removed from the leaf by wind and rain.
- Copper can accumulate to high levels on plant tissue when sprayed repeatedly to cover new growth and there is no rain. In this situation, after a rain event, a large amount of copper ions may be released leading to phytotoxicity.
- The risk of plant injury increases when the spray solution dries slowly due to cool wet weather, as the duration of ac-

tive release of copper ions on the leaf is increased.

- Always read the label instructions. When mixing, follow the tank mix partner instructions.
- For each product, application rates vary with crop and disease. The recommended rate for a given crop may have a 2-fold difference between the high and low rate. Higher rates are recommended when disease pressure is high or conditions are especially favorable. Most products are labeled for a wide range of vegetable crops.

Safety

Human Health Hazards. Eye exposure is the most serious risk associated with using copper hydroxide. Eye damage can be irreversible. There is moderate risk from skin contact, ingestion and inhalation. Products vary in EPA hazard rating, most are "Warning" or "Danger" but Badge SC has a lower risk "Caution" label. The greatest health risk is to the person who mixes and sprays the material. Proper protective equipment must be worn when handling or applying copper products as with any pesticide or fertilizer. The required protective equipment is specified on the label and usually includes: long-sleeved shirt and long pants, chemical resistant gloves made of any waterproof material such as polyethylene or polyvinyl chloride, shoes plus socks, and protective eyewear. Though not usually required, you may also want to consider wearing a respirator or dust mask, especially for mixing dry formulations. Dry product sometimes comes in a paper bag that has a tendency to leak out of the seams and needs additional containment such as a plastic bin.

Restricted Entry Interval (REI). Most copper products have an REI ranging from 24-48 hours, which means that workers are not allowed to go into treated fields to pick fruit or do any other field work for that duration of time. Plan your spray and harvest schedule to accommodate your marketing needs as well as the REI. Fruit may need to be polished before marketing, to remove the blue residue left on fruit.

Environmental Hazards. Some farmers have expressed concern about copper toxicity in the soil or with respect to soil microbes and earthworms. Additionally, copper can be very toxic to fish and aquatic organisms, if drift and run-off occur. This should be a concern in sandy, acidic soils or near surface water. Copper is actually an essential plant micronutrient and, in New England, it is more often deficient than excessive in soils. The amount found naturally in soils in MA ranges from 0.1 to 8 ppm while nationally soils range up to 200 ppm. Crops remove less than 0.1 lb/A copper per year. Copper usually accumulates on the soil surface where it becomes chemically bound to organic matter and clay minerals. In acidic soils, the solubility of copper increases and toxicity or run-off may occur. An application of 1 lb of active ingredient per acre is estimated to raise the copper levels about 0.5 ppm. A single application of Nu Cop at 2 lb per acre with 77% active ingredient adds about 1.5 lb copper per acre to the soil, or could raise the concentration in the soil by 0.5 to 0.75 ppm. Therefore, the level of copper in soil would increase slowly over time, except in perennial planting systems such as apple orchards. In annual rotational systems, where copper applications might only be made every 4-6 years, copper accumulation is less of a concern. Nonetheless, copper use is regulated and certified organic farmers in the US are required to restrict their use of copper products. Regular soil tests should be taken and copper levels in the soil should be monitored.

Managing blights in organic tomato and potato using copper

Copper-based fungicides are labeled for use in organic systems and have demonstrated effectiveness in preventing late blight. Copper fungicides do not kill infections that are already present; they must be used preventatively in order to effectively protect plants from initial infections. Most pathogens have latent periods, when the plant is infected but does not show any symptoms. Thus, when symptoms appear, it is too late to protect the crop effectively–especially with late blight. Some strains of late blight are more aggressive than others and this will also influence the efficacy of copper spray programs. Regular applications of copper will also help protect tomatoes from early blight and Septoria leaf spot, which can progress rapidly and cause plantings to produce far less than their full yield potential.

Several copper products are OMRI-listed for use in certified organic production and are registered for use in Massachusetts including: NuCop 50DF, Badge X2, Basic Copper 53, and Cueva. Check the OMRI website for updates or consult your certifier. As with insecticides, dry formulations are more commonly approved for use in organic systems. Note that OMRI approval is for specific formulations, and there are often multiple formulations with the same trade name (eg. Badge X2 and Badge SC, of which only Badge X2 is OMRI approved).

High Tunnel and Greenhouse Considerations

- Read the label to be sure that a product is not restricted from use in the greenhouse. Many copper products are.

- The same protective gear and restricted entry interval would apply.
- Apply with sides open for ventilation.
- Most labels require that in addition to the standard REI, an eyewash station and notice of eye risk should be available for 7 days after application.
- If you suspect late blight, have the disease identified. Fulvia leaf mold, powdery mildew, and Botrytis gray mold or ghost spot are common diseases in high tunnel tomatoes and can look very much like late blight.
- If tomatoes (or other crops on which copper is used) are grown in the same area year after year, and copper is used, build-up in the soil is more likely. Include copper levels in your annual soil testing. Rotate to other crops!

-- S.B. Scheufele and R.Hazzard. Adpated from T. Zitter & D. Rosenberg, Cornell Plant Pathology, E. NY Commercial Horticulture Weekly Vegetable Update. June 26, 2013.

MEXICAN BEAN BEETLE MANAGEMENT

Mexican bean beetle adult, eggs and larva (left to right).

On farms where Mexican bean beetles have historically been a problem, we are now seeing adults and eggs—now is the time to be releasing biological controls, which can be very effective at helping to manage this pest. Mexican bean beetles may be pests on snap beans, lima beans, and, more recently, soybeans. While they are not a pest on every farm, some farms report significant damage from these insects and have to take action to prevent crop loss. Populations often build up when beans are grown close to the farm stand year after year, to be available for PYO customers or CSA members. Using a combination of cultural and biological controls can reduce the need for insecticides in these sensitive areas.

Mexican bean beetle (MBB) adults are coppery brown with black spots. They look very much like large ladybeetles and in fact are closely related – but unlike lady beetles they feed on leaves, not other insects. Adults spend the winter in hedgerows and move into fields in June. Shortly after adults arrive in a bean field, they lay yellow-orange egg masses on the underside of bean leaves in clusters of 40 to 50. These hatch into bright yellow, spiny, oval larvae, which feed, molt several times as they grow, and pupate on the underside of leaves. Feeding damage from adults and larvae can reduce yield and injure pods if numbers are high. There are 2-3 generations per season, usually increasing in numbers with each generation. Populations are usually less abundant on early plantings and may not build to damaging levels until August.

Cultural Control

- Promptly destroy crop residues after harvest to reduce overwintering populations.
- Maintain wide, clean headlands and brushless wood edges.
- Avoid sequential plantings in close proximity.
- Row covers can be used to exclude beetles until harvest, or for as long as it is practical.
- Reflective metallic and white plastic mulches have been shown to significantly reduce beetle densities and feeding damage relative to black plastic or bare ground.

Mexican bean beetle larvi parasitized by Pediobious

Biological Control

Pediobius foveolatus is a commercially available biological control agent for MBB control and has a good track record in the mid-Atlantic states and among New England growers who have tried it. *Pediobius* (pronounced "pee-dee-OH-bee-us") is mass-reared and sold by the New Jersey Dept of Agriculture and is also available from other beneficial insect suppliers. This small (1-3 mm), non-stinging parasitic wasp lays its eggs in MBB larvae. Wasp larvae feed inside the MBB larva, kill it, and pupate inside it, forming a brownish case or 'mummy'. About 25 adult wasps emerge from one mummy. Adult wasps will emerge from mummies within 2-3 days of

receipt. The parasitoids are shipped to farms as mummies or as adults.

Pediobius is suited to our succession-planted snap bean crops. The first bean planting serves as a 'nurse crop' to establish the population of *Pediobius* that will be hard at work in successive plantings all summer. Control continues and in fact gets better as the season progresses and successive generations of the wasp emerge and search out new bean beetle larvae. Planning 2-3 releases at 7-10 day intervals will help ensure good timing and coverage on several plantings. After a release in the first planting, it is advisable to leave that planting intact for a while, until the new generation of wasps has emerged from their mummies.

As with any biological control, make releases as soon as the pest is present, not after it has built up to damaging numbers. The New Jersey Dept of Agriculture Beneficial Insect Rearing Laboratory recommends two releases, two weeks in a row, coinciding with the beginning of Mexican bean beetle egg hatch. Wasps will lay their eggs in larvae of any size, but it is best to target the newly-hatched young MBB larvae. This will give control before damage has been done. Thus, timing is important. Watch for eggs and time the shipment for the first hatch of eggs into larvae. If in doubt about the timing of the hatch, release as soon as you see the eggs – if you wait for the larvae you may be playing catch-up. The release rate should be at least 2000 adult wasps per field for less than an acre, or 3,000 per acre for fields of one acre or more. Mummies are frequently shipped in screen bags. Simply secure to the underside of a bean plant. IPM Laboratories recommends 160 mummies/A, split between 2 releases for light infestations, 640 mummies/A, split between 2 releases for heavy infestations and for the home garden, a minimum of 10 - 15 mummies. Like beans, *Pediobius* wasps are killed by frost so annual releases are necessary.

Plan ahead by contacting a supplier to inform them of your expected release dates and acreage. Contact information for New Jersey source: Tom Dorsey, 609-530-4192; address; NJDA, Phillip Alampi Insect Lab, State Police Drive, W. Trenton, NJ 08628. http://nj.gov/agriculture/divisions/pi/prog/beneficialinsect.html. You'll also get advice on how to use the wasps from this office. Pediobius is also available from the following suppliers:

Beneficial Insectary Inc., www.greenmethods.com, 800-477-3715

IPM Laboratories, NY, 315-497-2063. Call to place orders early in the week (Mon-Wed)

ARBICO Organics, 800 -827-2847, http://www.arbico.com/. Order online; orders ship on Wednesdays ONLY, minimum 7 day processing.

Chemical control

Treatment with an insecticide may be warranted to prevent economic losses. A suggested threshold level is to treat when defoliation exceeds 20% during pre-bloom or 10% during pod development. Several conventional and organic insecticides are labeled for use against bean beetle. Be sure to get coverage of lower leaf surfaces. Kaolin clay (Surround) may be used on seedlings and young plants to deter feeding and egg laying. For more information on chemical control options, see the New England Vegetable Management Guide and the Cornell Resource Guide for Organic Insect and Disease Management.

Controls for potato leafhopper may also be needed in many bean crops, and could have harmful effects on *Pediobius*, especially on adult wasps. If releasing *Pediobius*, avoid sprays shortly before or after releases; apply treatments to a succession planting 5 days before release.

-- Susan B. Scheufele, Amanda Brown, Ruth Hazzard. Updated for 2017 by Lisa McKeag.

Events

2017 Twilight Barn Meeting

When: Wednesday, July 19, 2017 - 5:30pm to 9:00pm

Where: Walnut Hill Farm, 39 Koebke Rd. Dudley, MA

Please join us for a wonderful event and dinner. We will discuss some innovative practices adopted by farmers in recent years. This years Twilight Meeting will be hosted by the Koebke family in Dudley. Come and join us for a great educa-

tional event and dinner!

2017 Twilight Meeting Agenda

5:30 - Registration and Social - 6:00 - Welcome and Farm Tour

6:50 - MDAR Commissioner John Lebeaux

7:00 - Recent Innovative Practices on the Farm- Panel Discussion Moderated by: Carl Majewski (UNH Extension), Participants include 3-4 farmers, Kate Parsons (NRCS), and Dr. Masoud Hashemi (UMass).

7:50 - Massachusetts Farm Energy Program (MFEP). Gerry Polano (MDAR).

8:00 - Massachusetts Nutrient Regulations Updates. Hotze Wijnja (MDAR).

8:10 - Southern New England AgrAbility Project. Joyce Meader (UConn Extension)

8:15 - RMA Update. Tom Smiarowski and Paul Russell - 8:20 - NRCS Update, Bob Purcell - 8:25 - FSA Update, Kip Graham

8:30 - Dinner and Social - 9:00 - Adjourn

For more information and to RSVP, please contact Masoud Hashemi at (413) 545-1843 masoud@umass.edu or Kelly Kraemer at (413) 545-5221 kkraemer@umass.edu.

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Vegetable Notes. Katie Campbell-Nelson, Lisa McKeag, Susan Scheufele, co-editors.

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