UMASS EXTENSION

Vegetable Notes

For Vegetable Farmers in Massachusetts

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In this issue:

Crop conditions

Disease pressure has leapt this week, with the arrival of cucurbit downy mildew and spread of late blight. Generally, fruiting crops are coming on strong but some farms are seeing poor fruit set in eggplant and others are seeing uneven ripening in tomato. Early greenhouse tomatoes have been taken down. Seedings of carrots, beets, turnips and rutabagas for fall harvest are up. The big fall Brassica plantings are established, and successions of direct-seeded greens are going in. Butternut and pumpkins are sizing up. Weeds, especially grasses, have been difficult to manage this season. Generally soils are dry and irrigation is needed to keep soil moisture even. Scouting is critical at this time of the season. It's the bountiful time of year when all the summer crops are coming in, but also a time when insects, diseases and weeds are very active and quick response is needed. Good harvests and strong market demand at retail and wholesale levels have helped restore some optimism and pulled some growers out of the feeling that this is one the worst years they've seen in a long time.

Late blight lesions on tomato foliage

Pest alerts

Late blight has been confirmed in several new locations in Massachusetts and is now widespread with a few severe outbreaks in unsprayed u-pick cherry tomato fields. New reports were confirmed in Franklin and Middlesex County, MA and Onondaga and Wyoming Counties in NY on tomato. New reports of late blight on potato came from Steuben County, NY and Aroostook County, ME. Tomato samples across the US and potato samples from neighboring states of ME, NJ and NY that have been identified to genotype were all identified as strain US-23, meaning that this strain CAN infect both tomato AND potato and both crops need to be protected. Inoculum sources are present in both eastern and western MA as well as neighboring states and weather conditions continue to be conducive to disease development, with long periods of leaf wetness associated with overnight dew. In MA, fungicide applications should be made on a 5-7 day spray interval and should include both protectants and targeted oomycete (late blight specific) chemistries. Track disease progress, including updates with new confirmed reports in MA and New England, at USA BLIGHT. Fees for late blight diagnosis for farms have been waived this year so if you suspect you have an infected plant contact the UMass Plant Diagnostic Lab at 413.545.3209

At this time it is very mportant to take action in order to protect your tomato and potato harvests. Follow these key management practices:

- Once symptoms are confirmed, destroy infected plants and maintain a weekly spray program to help prevent the spread of this disease to other fields and farms.
- Products with chlorothalonil, mancozeb or copper are good protectants and are also effective against early blight. In

organic fields, use only OMRI listed copper products. Continue to use protectants, however, since they are not effective once symptoms have been observed, they should be tank-mixed with LB targeted fungicides.

- Targeted fungicides for late blight on tomato or potato include Ranman (PHI 0), Previcur Flex (PHI 5), Presidio (PHI 2), Revus (PHI 1), Revus Top (PHI 1), Forum (PHI 4+), Ridomil Gold Bravo (PHI 5). Pre harvest intervals (PHI) listed here are for tomato; potato PHI's range from 3 to 14, check label. Curzate has a short residual but stronger curative properties (PHI 3+) if that is needed.
- Mefanoxam (Ridomil Gold, products are often mixed with broad-spectrum) is effective for US23 which so far is the primary strain present in New England, NY and NJ. However, recent samples have not been identified by genotype yet, and some genotypes are resistant.
- If potato tubers are adequate size or vines have already senesced, vine kill (with chemical or mowing) to reduce the risk of tuber infection with LB.

Tomato powdery mildew

Powdery Mildew on tomato is widespread in greenhouses and in some fields. Symptoms are similar to those on cucurbits (though tomato PM cannot infect cucurbits or vice versa), with initial symptoms appearing as small, white, fuzzy spots. It can appear similar to late blight, especially on the underside of leaves. Diagnostic confirmation is important before selecting a fungicide.

Cucurbit downy mildew (CDM) was confirmed in Worcester County, MA on squash and cucumber this week. In the past week additional reports of CDM have also been confirmed in New York, Pennsylvania, Delaware, and across the southern and Midwestern states. As of August 8th, the CDM IPM-PIPE disease forecast model predicts a HIGH Risk for cucurbits in New England (except ME). Look for round, yellow leaf spots on the upper surface, and angular lesions bearing brown spores on the underside. Cucurbit growers in this region should consider applying fungicides containing oomycete-specific materials, in combination with a broad-spectrum protectant. Use different chemistries on successive DM sprays to avoid resistance development. Organic growers should employ a preventative spray program using any OMRI approved copper product. See July 25 issue for product list.

Cucurbit downy mildew symptoms on upper (left) and lower (right) leaf surfaces

Verticillium wilt has been confirmed on Eggplant. Growers should practice a 4-5 year crop rotation of non-host crops, including a cereal crop to reduce fungal inoculum. Infested plants should be gathered and destroyed. No good source of resistance is available in eggplant cultivars. One control measure is the grafting of eggplant onto Verticillium resistant tomato rootstocks in the greenhouse. Other management options include fallowing, soil solarization, or biofumigation with brassica (mustards, rape) crops grown as a green manure.

Rhizoctonia Pod Rot was confirmed on yellow beans causing dark brown lesions making the beans unmarketable. Some cultivars have resistance. Rotate leguminous crops with a cereal or pasture crop (avoid beets and potatoes which increase inoculum). Fungicides can manage Rhizoctonia pod rot on young seedlings if applied as a seed treatment or soil drench (Blocker, Maxim 4F). Fungicide applications later in the crop cycle have little effectiveness.

Melon aphid has been reported in cucurbits. This species can build up under hot, dry, dusty conditions so they may have outpaced natural enemies during the heat wave in mid-July. Look on the underside of leaves for light to dark green coloring with distinctive black cornicles ('tail-pipes') at the end of the abdomen. Feeding causes yellowing, puckering, leaf curling, and leaf death at high numbers, along with shiny honeydew deposits and buildup of sooty

mold. Some cultivars or crops are dramatically more susceptible than others. Control is warranted if >20% of runners have aphids and numbers are increasing. Good coverage is needed for control. See NE Vegetable Guide http://nevegetable.org/crops/insect-control-7

Thrips have moved into late Brassicas. Check underside of leaves for brown scar tissue which develops after thrips injury to epidermis. Thrips injury can reduce vigor, growth – and yield. Apply insecticide if thrips are present. Selective products will conserve aphid predators, much needed in fall Brassicas. Spinosyns also control caterpillars and flea beetles. See New England Guide for more products.

Flea beetle has returned on fall brassica plantings. Protect the crops when they are young and reach the action threshold of 1 beetle/plant on average.

Spotted Wing Drosophila. Most monitoring locations across the state are now reporting SWD captures with numbers steadily increasing in many locations. There are still a few locations (mostly away from commercial fruit production) where no SWD have yet been caught (e.g., Arnold Arboretum). However, there are other non-farm locations where SWD are being caught. Surrounding states are reporting increased trap captures, too. Traps near commercial fruit production are showing increasing populations in border areas around the fields, but levels of fruit infestation vary. It is best for individual farms to monitor their fields with traps and sample their harvested fruit regularly to be sure of it's quality prior to sale. Frequent and thorough harvest (daily if possible), and not allowing fruit to fall to the ground (if possible) are still important principles. Transport harvested fruit as quickly as possible to refrigeration. Spray recommended materials (organic or conventional) on a tight schedule (5-7 days). (8/2/13, Sonia Schloeman, UMass Fruit Extension)

Sweet corn report

Sweet corn has bounced back; the harvest gap is over. Corn earworm flights are unusually low for this time in the season – many locations had 0, and none were over 5 moths per week. European corn borer flight dropped this week at all locations. Peak flight for the second generation has passed. These trap counts drive decisions about spray intervals on silk. No spray is needed where ECB is <12 moths per week and CEW is 0 or 1. Other locations call for a 5 or 6 day interval based on CEW counts. Growers are reporting satisfaction with their control using diamide products (Belt, Coragen) as well as mixtures of diamides with pyrethroid (Besiege, Voliam Xpress). Fall armyworm is present at some locations. Scout whorl for FAW, emerging tassels for ECB and fall armyworm, and watch for storms moving northward from mid-Atlantic states that might carry corn earworm. Watch for sap beetle on silks.

- L. McKeag and R. Hazzard, University of Massachusetts Vegetable Extension

Table 2. MA Corn Trap Counts 8/1/13 - 8/8/13

Location	Total ECB reported	CEW Nightly Average	CEW Weekly Total	Spray interval on silk
CT Valley				
South Deerfield	3	0.4	3	*6 days*
Sunderland	0	0	0	*no spray*
Hatfield	0	0	0	*no spray*
Hadley-1	4	0	0	*no spray*
Hadley-2	5	0.1	1	*no spray*
Feeding Hills	1	0	0	no spray
Central & Eastern MA				
Spencer	1	0	0	*no spray*
Tyngsborough	5	0	0	*no spray*
Lancaster	1	0.1	1	*no spray*
Concord	0	0.3	2	*6 days*
Sharon	6	0.7	5	*5 days*
Millis	1	0.7	5	*5 days*
Northbridge	0	0.3	2	*6 days*
Rehoboth	18	0.6	4	*5 days*
NH				
Litchfield	39	0.4	3	*6 days*
Hollis	4	0.4	3	*6 days*
Mason	8	0.4	3	*6 days*

Plectosporium blight of cucurbits

Be on the lookout for Plectosporium blight on pumpkins, summer squash, and zucchini, as we are seeing instances of this disease around the state. Scout for this disease early and apply protectant fungicides when the disease first occurs—thorough coverage of foliage, vines, and fruit is necessary for good control. Broad-spectrum fungicides used for other diseases should provide control.

Plectosporium blight caused by *Plectosporium tabacinum* was first observed in Tennessee in 1988 and has since been reported throughout pumpkin growing regions of the United States. It has become common in New England over the past decade.

Plectosporium tabacinum is a common fungus in the soil and on decaying plant material and its growth is favored by warm, wet weather. The spores are spread by rain-splash and wind. Plectosporium blight is known to cause damage to a variety of cucurbit crops in Europe and Asia, but the strain present in the U.S. seems to primarily damage pumpkins, summer squash, zucchini and a few varieties of gourds. No resistant cultivars of pumpkins have been reported. More recently it has shown up on *Cucurbita moschata* (butternut family) and *Cucurbita maxima* (Hubbards, buttercup, giant pumpkins, etc), so it is possible that the US strains are jumping species and will become a threat to previously resistant crops. In wet years, which favor disease development and spread, crop losses in no-spray and low-spray fields can range from 50 to 100%. Fortunately, this disease is easily recognized and can be effectively managed.

Description and Monitoring. Lesions are small (<1/4 inch) and white. On vines, petioles and leaf veins, the lesions tend to be diamond to lens-shaped, while on fruit and leaves lesions are usually round. The lesions increase in number and coalesce until most of the vines and leaf petioles turn white and the foliage dies. Tiny spores are formed in lesions on vines, stems, fruit, leaves and leaf petioles. Severely infected vines become brittle and will shatter if stepped on. Early in the infection cycle, foliage tends to collapse in a circular clump before damage becomes more universal throughout the field. These circular patterns can be easily detected when viewing an infected field from a distance. Numerous fruit lesions produce a white russeting or raised scabs on the surface and stems that render the fruit unmarketable.

Plectosporium blight on zuchinni stems

To scout for Plectosporium on younger plants, part the leaves of the canopy and look at the main vine of the plant that runs along the ground. In mature plants, look for symptoms on stems, petioles and fruit. Plectosporium blight is favored by warm, rainy weather. The fungus can overwinter on crop residue and can persist in the soil for several years. Plectosporium has not been reported to be seed-borne. The fungus can be spread long distances by wind-dispersal of spores as well as in infested soil on equipment moving between fields.

Cultural Management

- Incoporate crop residues immediately after harvest to hasten decomposition of infected vines and fruit. This is especially important with succession plantings of summer squash and zucchini
- If Plectosporium blight occurs use a 2 year rotation out of all cucurbit crops
- Choose sunny, well drained sites for cucurbit production

Chemical Controls. If this disease has been a problem on your farm, initiate preventative fungicides when weather and crop conditions are favorable. Otherwise, scout and at first signs of disease, apply fungicides every 7-10 days, or less frequently under dry conditions unfavorable for disease. Thorough coverage of foliage, vines, and fruit is necessary for good control. The Strobilurin (QoI) fungicides Flint (trifloxystrobin), Cabri (pyraclostrobin), and Quadris (azoxystrobin) will control Plectosporium but should not be used repeatedly as the pathogen will develop resistance. Unfortunately, the stroblurins are not effective against black rot (Didymella bryoniae), or against powdery mildew because both are resistant. Apply a protectant fungicide such as chlorothalonil (Bravo) or mancozeb (Dithane) mixed with or following a strobilurin. Rotate with difenoconazole plus cyprodinil. In organic fields, OMRI-listed copper products may be used to suppress this and other late-season cucurbit diseases.

Products labeled for Plectosporium:

azoxystrobin (Quadris): 11 to 15.5 fl oz/A. (1 dh, REI 4h, Group 11). Do not rotate with other Group 11 fungicides.

azoxystrobin plus difenoconazole (Quadris Top): 12.0-14.0 fl oz/A. (1 dh, REI 12 h,Groups 11 & 3).

chlorothalonil (Bravo Weather Stik): 1.5 to 2.0 pt/A (0 dh, REI 12h, Group M5).

difenoconazole plus cyprodinil (Inspire Super): 16 to 20 fl oz/A. (7 dh, REI 12h, Group 3 & 9). Apply in sufficient

volume to achieve thorough coverage.

mancozeb plus copper hydroxide (ManKocide): 2.0-3.0 lb/A. (5 dh, REI 48 h, Groups M3 & M1). Do not apply in a spray solution having a pH of less than 6.5 or tank mix with Aliette.

pyraclostrobin (Cabrio EG): 12 to 16 oz/A. (0 dh, REI 12h, Group 11). Do not rotate with other Group 11 fungicides such as Quadris or Flint.

trifloxystrobin (Flint): 1.5 to 2.0 oz/A. (0 dh, REI 12h, Group 11). Do not rotate with other Group 11 fungicides such as Quadris or Cabrio.

Where trade names or commercial products are used, no company or product endorsement is implied or intended. Always read the label before using any pesticide. The label is the legal document for product use. Disregard any information in this newsletter if it is in conflict with the label.

--Updated by M. Bess Dicklow, Susan Scheufele & R. Hazzard, UMass Extension. Thanks also to information from Jude Boucher of UConn. Coop. Ext.

PEPPER FRUIT ROTS

Harvests of peppers have begun this season, with growers bringing in their first hot peppers and green bells, that will soon ripen to red, orange, yellow, or dark eggplant-purple. These colorful fruits are susceptible to lesions and rots that can make them unmarketable. Frequently, these blemishes are a result of sunscald, which can occur when the fruit is not protected by foliage, creating sunken white or brown lesions, and making fruit vulnerable to secondary infections. Secondary pathogens like Alternaria can infect areas wounded by insect feeding, and aphids can introduce diseases such as Cucumber mosaic virus. Other pepper fruit rots such as anthracnose are caused by pathogens that may be controlled with fungicides. It is important to identify whether the pepper fruit rot is physiological, insect derived, bacterial, or fungal in origin before selecting a method for control. Below is an overview of some of the principal pepper fruit rots.

Blossom-end Rot is not a disease but can be confused with symptoms of fruit rots caused by fungi or bacteria. It is caused by a localized calcium deficiency. Hot, dry periods followed by large applications of water or low transpiration during periods of high humidity can result in the plant not being able to take up calcium quickly, or in calcium being diverted away from fruit. With this disorder, the blossom end of the fruit develops brown to black, dry, sunken, leathery areas.
Management. Rapid plant growth, low soil potassium and calcium, or excess magnesium and nitrogen levels, high salinity, root damage, and high relative humidity all predispose plants to Blossom-end Rot. The best way to avoid Blossom-end Rot is by careful irrigation to maintain even soil moisture and prevent dry-out of the root zone, with balanced fertilization to ensure steady plant growth. Applications of lime to the soil or foliar sprays of calcium chloride or calcium nitrate may be helpful in correcting deficiencies. Cultivars differ in their susceptibility to blossom-end rot.

Sunscald with Alternaria infection

Alternaria fruit rot generally occurs in fruit having a previous injury. The *Alternaria* species responsible is a weak pathogen and rarely spreads in harvested fruit. The fungus has been reported on a wide range of fruits and vegetables. Lesions may develop at growth cracks, wounds, or on tissue that has been damaged by chilling, sunscald, calcium deficiency, insect injury, or heat. As the disease progresses, lesions enlarge and become sharply sunken. The lesions eventually become covered with a dark green to black mold.
Management. Avoid conditions that predispose pepper fruit to infection in the field and during harvest. Select cultivars that provide good shading of developing fruit.

Cucumber Mosaic Virus can cause severe losses in vegetables, legumes, and ornamentals. The virus is distributed worldwide, has a host range of more than 1,000 species, and is non-

persistently transmitted by at least 75 species of aphids. Host plants include both mono- and dicotyledonous plants, including many weed species. Symptoms of CMV vary with viral strain, pepper genotype, and environmental conditions. Symptoms can consist of necrotic specks, line patterns, or ringspots; stunting, chlorotic mosaics, narrowing of leaves and reduction in leaf size. Fruit symptoms include irregular ripening, wrinkled or bumpy appearance, a pale green coloration, and sunken, necrotic lines or ringspots. The severity of CMV infection is closely related to plant age at the time of infection. Plants infected at a young age typically develop severe symptoms while mature pepper plants tend to develop resistance to CMV and often remain symptomless or have less severe symptoms.
Management. Resistant and tolerant pepper cultivars are available, however resistance provides protection against only a small number of viral strains. Cultural practices that delay the introduction of CMV include aphid management in greenhouse transplants, elimination of weed hosts, timing pepper planting to avoid main periods of aphid migration, and the use of reflective mulches to deter aphids. Insecticides are not recommended since CMV transmission occurs too rapidly for insecticides to be effective.

Bacterial Leaf Spot caused by *Xanthomonas campestris* pv. *vesicatora* (Xcv) is the most common and most destructive disease of peppers in the Northeast. This disease is present wherever tomato and peppers are grown. BLS usually affects only foliage but can cause damage to fruit. On leaves, the spots are generally brown, circular, and water soaked, and do not have concentric zones or a prominent halo. Most fruit on plants infected with BLS will drop early because of defoliation associated with the disease. Fruit that isn't dropped can be damaged and misshapen due to increased sun exposure. When symptoms on the fruit do occur, they start as pale-green, water-soaked areas and eventually become raised, brown, and rough.
Management. Select cultivars with genetic resistance to the races present in New England(races 1, 2, and 3). Start with certified disease-free transplants or seed. Use fungicide-treated seed or treat seed with hot water (122°F for 25 min). Rotate with non-solanaceous crops for at least one year and keep field clean of solanaceous weeds. Overhead irrigation can spread disease. Practice good sanitation and avoid working in fields when bacterial diseases are present and the fields are wet. Apply appropriate bactericides or combination pesticides. In general, bacterial diseases of field crops are difficult to control with pesticides; copper/mancozeb solutions are most effective. When a significant amount of disease is present, pesticides are usually not effective.

Soft Rot in pepper is caused by at least five genera of bacteria; the most aggressive and important soft rotters are *Erwinia carotovora* subsp. *carotovora* and *E. chrysanthemi*. Soft rot can occur in the field before harvest and can be spread at harvest (and into storage) by workers, contamination of harvest containers or packing equipment. Symptoms of soft rot start as water-soaked lesions which rapidly spread and develop into deterioration of the fruit into a slimy, foul smelling mass. The bacteria responsible for soft rot produce cellulolytic and pectolytic enzymes that rapidly break down cells walls.
Management. Avoid conditions that predispose pepper fruit to infection in the field and during harvest and do not harvest in wet conditions. Maintain a free chlorine concentration of at least 100 ppm and pH 6.0-7.5 in wash water and allow fruit to dry after washing.

Early Anthracnose symptoms on pepper

Anthracnose is caused by several species of the fungus *Colletotrichum*. The disease is widespread and common in areas where moisture conditions promote disease development. Anthracnose also affects eggplant, pepper, and potato. Anthracnose caused by *C. acutatum* is relatively new to the pepper industry in the U.S. It is fairly widespread in the south and has occurred for consecutive years in Massachusetts. Unlike *C. coccodes*, this species attacks fruit of all ages and is very aggressive. Symptoms are first noticeable on ripe fruit, although green fruit is also infected and these latent infections can become a serious post-harvest problem. Tiny lesions may also occur on leaves and stems. These are usually overlooked, but

can serve as an initial source of inoculum for fruit. Small, circular, sunken spots appear on ripe fruit and are characterized by numerous submerged, black microsclerotia often in concentric rings. Early symptoms in warm, moist areas may appear as salmon colored rings.
Management. Start with certified disease-free seed. Use fungicide-treated seed or treat seed with hot water (122°F for 25 min). Rotate with non-solanaceous crops for 2 years and keep field clean of solanaceous weeds. Overhead irrigation can spread disease. Fungicide sprays provide acceptable control of Anthracnose if applied on a regular schedule from first fruit set to harvest. See New England Vegetable Guide for recommendations.

Phytophthora Blight of peppers is caused by the oomycete *Phytophthora capsici*, a soil-borne pathogen that can survive in fields for several years, and is dependent on ample soil moisture to cause disease. Prevention is the key to managing *P. capsici* because the disease is difficult to suppress with fungicides once it develops. Initial symptoms of Phytophthora fruit rot are water soaked or depressed spots typically on the underside of the fruit where it is in contact with the soil. Symptoms can develop on the upper side of the fruit if infected soil and spores are splashed up. Eventually the fruit will become covered with white sporangia and will rapidly collapse either in the field or shortly after harvest. *P. capsici* also causes a root and crown rot of pepper which produces distinctive black lesions on stems. Root infection leads to wilt and eventual death of plants. Leaf infections produce water-soaked, circular, brown lesions. Leaf and stem lesions often result from splash dispersal of the pathogen onto the lower portions of the plants.

P. capsici on pepper.

Management. Use at least a 4 year crop rotation in infested fields and plant peppers on raised beds. Tolerant cultivars (i.e. Paladin and Intruder) are available. Increase soil drainage by subsoiling. Practice good sanitation and do not discard cull fruit in the field or allow equipment to carry infected soil into new fields.

- S. Scheufele, K. Campbell-Nelson & R. Hazzard, UMass Vegetable Program

LATE SUMMER COVER CROPS

A well-established late season cover crop increases organic matter, improves soil structure, scavenges remaining nutrients, chokes out weeds, and prevents soil erosion. Grains and grasses can provide all of these functions and legumes can add additional nitrogen. Each has strengths and weaknesses. Below is a list of several good choices, depending on your specific goals and field conditions.

Grasses can return a significant portion of organic matter and other nutrients to the soil if planted after removal of a seasonal crop and given enough time to mature. Kill grasses before maturity in the spring or mix with a legume to reduce the C:N ratio and supply more nitrogen for the following year's crop.

Winter or Cereal Rye (*Secale cereale*) is the most common cover crop used by growers in Massachusetts. It is inexpensive, easy to get and to establish, and can be seeded until 2 weeks before a killing frost. However, it is best planted before September 15th in order to recover the available N from soil and to produce enough canopy to protect soil from erosion and outcompete weeds. It consistently overwinters here and will continue to grow in the spring, producing up to 7,000 lbs/A of biomass contributing to soil organic matter. It should be seeded with a legume to keep the C:N ratio low making more N available in the spring. Some growers are hesitant to use this cover crop because of the longer decomposition rate and allelopathy against spring seeded crops. *Seeding rate: 90-120 lbs/A broadcast; 60-120 lbs/A drilled; 50-60 lbs/A mixed with a legume.

Annual or Italian Ryegrass (*Lolium multiflorum*) and Perennial Ryegrass (*Lolium perenne*) are used by some growers because of the dense root system that outcompetes weeds and protects against erosion. Annual ryegrass can tolerate some flooding while perennial ryegrass is more cold hardy. Both are shade tolerant. These cover crops should be planted at least 40 days before the fall frost date. The seed is small and light, so specialized equipment will be needed

if seeding a large area. Seeding rate: 20-30 lbs/A broadcast; 10-20 lbs/A drilled; 8-15 lbs/A mixed with a legume.

Oats (*Avena sativa*) can be seeded in the late summer, will come up quickly, and ares best planted before September 15th similar to winter rye. Unlike winter rye, oats will winterkill in Massachusetts, making for simpler field preparation in the spring, however, with less organic matter contribution. To maximize nitrogen carry-over to the following crop, mix with a legume that will overwinter such as hairy vetch. Seeding rate: 110 – 140 lbs/A broadcast; 80-110 lbs/A drilled; 60-90 lbs/A mixed with a legume.

Winter Wheat (*Triticum aestivum*) is increasingly being used as a cereal grain and as a cover crop. It is winter hardy, but does not grow as tall or mature as quickly as rye so there is no rush to kill it in early spring and risk compacting wet soils. Wheat is excellent for erosion control, scavenging N, P and K, building soil organic matter and improving tilth. Plant it in late summer to early fall; before September 15th. Best growth will be in well-drained soils with moderate fertility. Rye is a better choice on wet soils. Wheat works well as a nurse crop for legumes such as hairy vetch or clover. Seeding rate: 90-160 lbs/A broadcast; 60-120 lbs/A drilled; 60-90 lbs/A mixed with a legume.

Legumes are a good choice if you are interested in adding nitrogen to the soil, however, it is important to inoculate seed before planting with the appropriate root nodulating bacteria that will fix nitrogen from the air. Some growers use coca cola or sugar water to help the inoculum stick to the seed and plant while still wet to keep the bacteria alive. Bacterial inoculants are specific to certain legumes and therefore must be used with the correct plant groups in order to establish. Inoculum groups are: 1) red and white clovers, 2) crimson and berseem clovers, 3) alfalfa and sweet clover, 4) pea, vetch and lentils, 5) annual medics, 6) cowpea and lespedeza. If well managed, legume cover crops can provide as much as 100 to 150 lbs nitrogen per acre to the following crop.

Hairy Vetch (*Vicia villosa*) usually benefits from being grown with a nurse crop such as rye, oats or wheat to help reduce matting during spring and to keep weeds down. Both the vetch and the grain can be mixed together in the seed drill. In the spring, vetch is incorporated at early bloom, typically in late May. With a good flail mower, vetch can be used in a deep zone tillage system without matting and tangling in the equipment. Seeding Rate: 25-40 lbs/A broadcast; 15-40 lbs/A drilled, 15-20 lbs/A mixed with a grass.

Red Clover (*Trifolium pratense*) is a short-lived perennial that is somewhat tolerant of soil acidity or poor drainage. Mammoth red clover produces more biomass for plow-down than medium red clover, but does not regrow as well after mowing. Mammoth will often establish better than medium in dry or acid soils. Sow in early spring or late summer. Red Clover can be undersown in mid-summer into corn or winter squash before it vines and other crops if soil moisture is plentiful. Seeding rate: 10-15 lbs/A broadcast; 6-15 lbs/A drilled; 6-10 lbs/A mixed with a grass.

White Clover (*Trifolium repens*) is a low-growing perennial, tolerant of shade, moisture and slightly acid soil. Ladino types are taller and live longer than the Dutch or New Zealand types. The clovers do not compete well with weeds unless mowed to improve lateral growth and establishment. Thus, they are suitable for use in mowed walkways or alleys. Seed tends to be expensive, although stands can last for many years, especially if mowed or grazed, since the laterally-growing stolons continue to root. Seeding rate: 7-14 lbs/A broadcast; 10-12 lbs/acre drilled; 2-6 lbs/A in a mix.

Sweet clover (*Melilotus officinalis*) is a biennial crop, except for the annual types called Hubam. It is deep-rooted and adapted to a wide range of soils and thus is a good soil-improving crop, as a provider of free N and "biological subsoiling". Yellow Sweet clover is earlier maturing and somewhat less productive than white Sweet clover. Sow before August 30th for best results. Heavy growth is produced in spring after overwintering. The tall, lush growth may be difficult to incorporate without proper equipment. This should be done in latespring, or by mid-summer at flowering since growth will cease after that. Seeding rate: 20-30 lbs/A broadcast; 10-20 lbs/A drilled; 6-10 lbs/A in a mix.

Other species may be used as cover crops in disease management or in the case of the forage radish, for improving water drainage and soil structure.

Radish (*Raphanus sativus*), known as Daikon, tillage, forage or oilseed are also appropriate biological subsoilers, often producing 8-14 inch tap roots. With its deep roots, this crop can recover N, P, S, Ca and B for the following season, but must be planted into a crop early in the spring or else these nutrients are lost through fast decomposition and the deep root holes. This cover crop can be planted 4-10 weeks before a killing frost and typically winterkills in December or January. It can be used as animal forage. Seeding rate: 10-13 lbs/A broadcast; 7-10lbs/A drilled.

Brown Mustard (*Brassica juncea*) found in many of the 'Caliente' seed mixes is a biofumigant planted to combat root knot nematode and a variety of soil-borne fungal pathogens. It is also allelopathic against weeds. Do not plant this

cover crop in rotation with any brassica crops. If allowed to flower, this crop is highly attractive to honey bees. Plant this in late August through September. Other brassica cover crops include Rapeseed or Canola and Turnips, which are often used as livestock forage. Mustards should not be planted following any brassica crops since they are in the same family. Seeding rate: 10-15lbs/A broadcast; 5-12 lbs/A drilled.

Keep in mind it is always best to plant a cover crop as leaving a field bare over winter is very damaging to soil structure, increasing erosion and reducing long term fertility. Though it may take several growing seasons or a lifetime to perfect the art of cover cropping, your soil will thank you.

Cover Crop Resources:

1) A Comprehensive Guide to Cover Crop Species used in the Northeast United States. prepared by: Shawna Clark.
2) Managing Cover Crops Profitably: 3rd ed. Published by the Sustainable Agriculture Network, Beltsville, MD.
3) Cover Crop Plant Guides prepared for the USDA by: NRCS, RMA and FSA.

* Note: seeding rate recommendations may vary with regional differences.

- Katie Campbell-Nelson adapted from work by R. Hazzard & F. Mangan, UMass; Vern Grubinger , UVM and Thomas Bjorkman, CU. Resources: Managing Cover Crops Profitably, 3rd edition, published by Sustainable Agriculture Network; New England Vegetable Management Guide (www.nevegetable.org).

UPCOMING EVENTS:

UMass Extension IPM Field Walk

Where: Powisett Farm 39 Powisset St., Dover, MA 02030
When: Wednesday, August 14, 2013 - 3:00pm to 5:00pm

We will get out and scout insects and diseases in fall Brassicas, raspberries and tomatoes, and discuss organic IPM management of these crops. We'll see Powissett's new sprayer in action with a demonstration of easy ways to test for sprayer coverage. Two contact hours for the Vegetable Pesticide License will be available.
For more information call Katie Campbell-Nelson at (413)-545-1051 or email kcampbel@umass.edu

Vegetable Notes. Ruth Hazzard, Katie Campbell Nelson, Lisa McKeag, Susan Scheufele, co-editors. Vegetable Notes is published weekly from May to September and at intervals 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.