UMASS EXTENSION

Vegetable Notes

For Vegetable Farmers in Massachusetts

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Crop conditions

Soils dried out and warmed up over the past two weeks since the end of ten days of cold, wet weather that brought planting to a standstill. The month of May ended with 90-degree days, as growers worked hard to get warm-weather crops into the ground. Transplanting squash, melons, tomatoes, peppers, and eggplant continue, along with planting winter squash, pumpkins, and the next successions of sweet corn, carrots, cabbage, etc. Corn that suffered through the cold and wet period is greener now and growing well. Fields and crops that were lost to flooding are being replanted, and in some cases plastic had to be picked up and laid a second time. Potatoes are emerging -- and Colorado potato beetles are ready to find them. Other June pests are also arriving: striped cucumber beetle, eggplant flea beetle, European corn borer. Harvests included asparagus, rhubarb, and lettuce, greens or herbs grown under some kind of protective cover.

Sweet corn

Corn is recovering from cold conditions of mid May. There may be gaps from the long wet period when planting was impossible, but growers have been planting again for the past two weeks, and warm soils will help crops catch up. Plants will start to show tassels next week for the earliest plantings. Hopefully, very little early corn is still under plastic after the >90 degree heat of the past week. However, corn under row cover did not overheat and is protected from the first corn borer flight.

The first European corn borer (ECB) moths were captured this week in warm areas of the state (eg Southwick), and we expect flight to begin in cooler areas next week. Earliest corn is the most attractive, for moths laying eggs. If you want to know what's happening with ECB flight on your farm, the best way is to set up pheromone traps. Use two Scentry net traps, placed in weeds at the edge of the field, with a lure for the two races of ECB (known as Iowa-Z-I and NY-E-II). Traps and lures can be obtained from Great Lakes IPM (517-268-5693)

Some growers around the state have used Trichogramma wasps with success in early corn. *Trichogramma ostriniae* lays its eggs in ECB egg masses; larvae hatch and feed, killing the egg. These tiny wasps can reduce the need for sprays, and will reproduce and attack egg masses all season. These wasps are available from IPM Laboratories, Inc. in New York State, (315) 497-2063 FAX: (315) 497-3129. Order soon to be ready for release the week of June 15. If you would like more details, contact Pam Westgate at 413-545-3696.

Dealing with phytophthora blight: checklist for field preparation and planting

Phytophthora blight is the most destructive disease of cucurbits and peppers in the Northeast, and is getting worse each year. Growers' selection of fields for cucurbit and pepper crops is increasingly determined by which fields have a history of or a potential for this disease. Sub-soiling has become a standard practice for field preparation. Growers are looking for more rotation crops which are not susceptible.

This article will focus on prevention: what you can do while preparing the field and planting the crop. No single method is sufficient to provide adequate control; a combination of cultural and chemical practices is required to reduce damage caused by Phytophthora blight. Future articles will address other cultural and chemical options.

The pathogen, *Phytophthora capsici,* is soil-borne and will remain in the soil for years, perhaps indefinitely. It is important to keep track of sites that are contaminated with Phytophthora. Do not rent land for susceptible crops without investigating the history of disease problems (there are other important soil-borne pathogens as well). Phytophthora blight is particularly important during wet weather or after long irrigations. Phytophthora can move through the air during windy storms and hurricanes but it would be difficult to estimate how far it can move. It is better suited to moving in water than air. It can also move on clods of soil on tractors.

Phytophthora capsici does not appear spontaneously, but it can sometimes be difficult to identify the source of contamination on particular fields. Since it is not efficiently wind disseminated it tends to be "locally important" on specific fields or farms. Once a site becomes contaminated it will remain so, but the fields across the way may remain free of the pathogen as long as farm machinery does not bring it in. If contaminated fields drain into an irrigation pond, then irrigation can easily disperse it throughout the crop or onto another field.

The pathogen is very dependent on water to initiate disease and to move it from plant to plant. Phytophthora produces spores that can swim to susceptible hosts (very short distances). Splashing rain and irrigation water can easily move spores from plant to plant. Its dependence on soil moisture is obvious in fields that have low spots or areas that do not drain readily. The disease will always begin in these areas first. Anything that can be done to improve drainage in the field will help prevent the disease from getting started.

Crop Rotation. Wherever possible, avoid planting susceptible crops in contaminated soil. Practice long rotations: do not grow cucurbits, peppers, eggplant or tomato for at least five years after infections occur. Before planting, use a chisel plow to break up any hard pans and to improve drainage.

Growing in Infected Fields. The fact is, however, that many vegetable growers have little choice; given their crop mix and the fields they have available, they have to use fields that have a history of Phytophthora blight. Some growers have found that it is possible, though not easy, to grow susceptible crops in fields infected with Phytophthora without a disease outbreak. The critical point is to MANAGE WATER so that there is NEVER STANDING WATER FOR LONGER THAN 24 HOURS ANYWHERE IN THE FIELD. If you must grow crops in a field with a past history of Phytophthora blight, here are some management practices that will help reduce disease. Be aware that extended periods of rain are very likely to result in significant disease development if the pathogen is present.

1. Use a V-ripper or other sub-soiling tool between rows to break up hardpan and encourage drainage. Use this preplant and as needed during the season, especially after a hard rain to speed drainage of water out of the field.

2.Plant non-vining cucurbit crops (i.e. summer squash) and peppers in dome-shaped raised beds of at least 9 inches height. Use atransplanter that does not leave a depression around the base of the plant.

3. Breaks in raised beds—where beds run across the slope, cut breaks to allow water to drain. Don't allow raised beds to become dams that hold water.

4. 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.

5. Make sure the flow of water from within the field leaves the field – dig ditches if necessary!

6. Don't plant low areas – where there is a low section that puddles, don't plant a crop – plant a cover crop or leave it bare. (Better a small loss in yield than a total loss of the crop.)

7.. Check your irrigation system for leaks and fix them – don't allow puddles of water to sit near your irrigation pumps or lines.

8. Avoid moving soil from contaminated land to and area of land that does not have the problem. Use a power washer to remove soil from tillage and planting equipment and tractor tires.

9. Use farm machinery as little as possible to avoid soil compaction.

10. Separate different susceptible crops (if possible) such that there is no opportunity for water to move from one planting to another.

Using Resistant Pumpkin Varieties

Margaret McGrath of Cornell University and others are evaluating commercial and experimental varieties of pumpkins for resistance to Phytophthora. Pumpkins with hard, gourd-like rinds or shells were shown to be less susceptible to Phytophthora fruit rot when mature than pumpkins with conventional, softer rinds through research conducted with Lil'Ironsides and Apprentice (HMX 5682) at LIHREC. Iron Man (HMX 2690) is another new variety with the gene for hard rind from Harris Moran. Degree of control obtainable with hard-rinded pumpkins is high: proportion of fruit developing Phytophthora fruit rot when evaluated in 1997 and 1998 was 2 and 29% for Lil'Ironsides, respectively, 2 and 12% for Apprentice compared to 25-42% and 56-71% for horticulturally similar pumpkins with conventional rind. Rockafellow is also described as having a hard rind. Cannon ball has a tougher skin than conventional pumpkins and thus may also be less susceptible to Phytophthora fruit rot. Cannon ball, Iron Man, and Rockafellow also have resistance to powdery mildew.

Descriptions of pumpkin varieties with hard shell or tough skin:

- Apprentice: 1 lb fruit, 4-5 in diameter, round, dark orange, bush type
- Lil' Ironsides: 2 lb fruit, 6 in diameter, round flat, dark orange, vine type
- Iron Man: 3-4 lb fruit, 6-7 in diameter, round, dark orange, vine type, PMR
- Rockafellow: 2.5-3 lb fruit, elongated oval shape, very

smooth, semi-bush type, PMR

•Cannon Ball: 5 lb fruit, 7-8 in diameter, round, dark orange, semi-bush type, PMR

These varieties will be evaluated in 2006 at LIHREC, along with several experimental lines producing small, medium or large fruit with a hard shell.

Among bell peppers, the cultivars Conquest, Paladin, and Emerald Isle have resistance to Phytophthora (however, none of these have resistance to Bacterial leaf spot).

Transplant or furrow drench

New phosphorous acid fungicides (ProPhyt, Phostrol and Fosphite) (Resistance Group 33) are more effective than Aliette as foliar applications. They have a 4 hr REI and can be applied to all cucurbits at 2-6 pt/A on a 7-14 day interval up to 6-7 times/crop. PHI is 0 days. Cost is about $4.65-14.00/A/application for Fosphite. Phosphite ion, the active ingredient for these fungicides, affects fungal pathogens directly and promotes the plant's defense system. These fungicides are also labeled for use on asparagus, crucifers, leafy vegetables, onion, potato, and tomato.

In addition to foliar applications, ProPhyt is now labeled for use as a drench treatment to transplants before transplanting or as an in-furrow drench at planting. Research is being conducted on applying ProPhyt through drip irrigation during the season. This is an option that may provide early-season protection for crops grown in infected fields.

--Sources: Margaret McGrath, Long Island Horticultural Research and Extension Center (LIHREC) of Cornell University; Rob Wick., Bess Dicklow and Ruth Hazzard, Dept. of Plant Soil and Insect Science, UMass

SEEDCORN MAGGOT AND WIREWORM DAMAGE ON EARLY CUCURBIT TRANSPLANTS

Seedcorn maggot and wireworm are occasional pests on cucurbits. This year, it is possible that unusually warm temperatures in April followed by unusually cold and wet conditions in May has favored these pests. Pest alerts from Maine to Indiana have noted this pest as a problem. We have seen damage in Massachusetts in one early melon field. Symptoms are wilted plants and collapsed, rotting stems.

These pests feed on the roots and bore into stems at the ground surface. They feed on the internal tissues and kill the plants. In the field if you find wilting plants and no clues of insect feeding or diseases on the aerial parts, then dig up the plant and check for seedcorn maggots and wireworms. The seedcorn maggot is yellowish-white, legless, with a pointed head and is about ¼ inch long when fully grown. The wireworm is slender, jointed, usually hard-shelled, with three pairs of legs, and tan brown in color.

This week at a farm in the Connecticut River Valley, we found maggot pupae which are ¼ inch long, oblong and tan or brown. Symptoms were noticed by the farmer last week, when maggots were actively feeding. Once maggots pupate, the damage is done. A new crop of adults will emerge in 7-14 days. Wireworms were also found, but maggots were most numerous.

Stem damage on melon with seedcorn maggot fly adult and pupae

Cold conditions which inhibit crop growth but favor the maggots encourage this pest. Once a field is infested with seedcorn maggot or wireworm, not much can be done to cure the problem. Replanting decisions should be made based on estimates of the size of the maggots infesting the field. If the maggots are smaller than ¼ inch long we recommend waiting 10 days to replant, if they are larger or equal to ¼ inch long, plants can be replanted after 5 days. If wireworms are found, wait to replant until soil temperatures are above 70 degreesF. Soil insecticide application for control of seedcorn maggot and wireworm needs to be made prior to laying plastic, unless a drench application is made to each individual plant at planting.

The field in which we found damage in Massachusetts was planted with melon transplants in early May, after tilling in a healthy cover crop, applying plastic with straw mulch between the rows, and putting row cover on hoops over the entire crop. It appears that the seedcorn maggot flies emerged, mated and laid eggs under the row cover or laid eggs after tillage but before transplanting. Maggot flies are attracted to the odors given off by the microorganism associated with decaying organic matter or diseased plants. For growers who want to improve their soil by incorporating large amounts of biomass in the spring, or use reduced tillage systems, it may be important to figure out how to avoid this risk. Waiting until soil is warm enough to en-

courage rapid germination and crop growth may help. Disking cover crops at least four weeks before planting may make them less attractive. Seedcorn maggot attacks seeds and seedlings of many vegetable crops. After May and June this pest is rarely a problem.

-- adapted by Ruth Hazzard from May 26, 2006 article by Dan Egel, Chris Gunter, and Frankie Lam, Vegetable Crops Hotline, Purdue University Cooperative Extension Service

MANAGING STRIPED CUCUMBER BEETLE IN VINE CROPS: UPDATES FOR 2006

All over the Northeast, striped cucumber beetle is our most serious early-season pest in vine crops. These beetles spend the winter in plant debris in field edges, and with the onset of warm days and emergence of cucurbit crops, move rapidly into the field. Densities can be very high, especially in non-rotated fields or close to last year's cucurbit crops. Adult feeding on cotyledons and young leaves can cause stand reduction and delayed plant growth. More importantly, the striped cucumber beetle vectors *Erwinia tracheiphila,* the causal agent of bacterial wilt. This disease overwinters within the beetle and is transmitted by contact of beetle feces with the open wounds in leaf tissue caused by beetle feeding. Bacteria multiply and block the vascular system of the plant, causing vines to wilt. This disease can be effectively managed only by preventing feeding by the beetle. Vine crops vary greatly in their susceptibility to wilt.

Avoid early season infection with wilt. Cucurbit plants at the cotyledon and first 1-2 leaf stage are more susceptible to infection with bacterial wilt than older plants, and disease transmission is low after about the 4-leaf stage. Wilt development is strongly influenced by the dose of the pathogen that the plants receive. It may be a relatively small proportion (1-10%) of overwintering beetles that carry the Erwinia pathogen and are able to infect plants. The higher beetle density during early plant growth, the more severe the incidence of wilt. Male beetles that discover a host plant will release an aggregation pheromone that calls others to their spot. Groups of beetles feeding, wounding and defecating on a single plant are more likely to transmit disease, and to acquire the pathogen and transmit it to other plants.

Cultural Controls: Crop rotation. Because beetles spend the winter in field borders close to last year's crop, planting into the same field encourages rapid invasion by high numbers of beetles. Rotating to a field at a distance from last year's cucurbits reduces beetle numbers significantly. Of course, crop rotation has many other benefits as well – in vine crops, it is critical for disease management. Any barriers between the fields – woods, buildings, fallow fields or other crops, roadways and waterways – help delay the arrival of beetles.

Cultural Controls: Using Transplants. Several studies in the Northeast have shown that three-week-old transplants, set out in the field at the same time as a direct-seeded crop, will produce not only earlier but higher yields. These studies were done with both summer and winter squashes. Transplants have multiple benefits. Germination of untreated seeds in cool soils can be spotty, while transplanting ensures a good stand. Transplants provide a jump on the weeds. Plants are bigger when cucumber beetles arrive so that they are less vulnerable to both feeding damage and to wilt. An insecticide or repellent can be applied to flats before plants are set out, making it less costly. Planting dates are more flexible – for some crops, it may be possible to delay planting until late June and avoid the worst of the beetles. Plants can be held inside to avoid late frost or wait until fields are dry (or wet) enough to plant. Of course, it is not advisable to hold transplants too long. If they are already flowering or have been stressed when they are set out, they tend to develop into small plants with early but small fruit. Standard seedling production methods work well for vine crops, but large cell sizes (72, 36 or 24) or peat pots are recommended as roots should not be disturbed when transplanting.

Cultural Controls: Floating, or spun-bonded, row covers are very effective barriers that keep beetles off the crop during the critical early growth stage. They have the added benefit of enhancing growth and reducing wind damage in the early season, for an earlier yield. Studies have also shown an increase in yield with row covers. Covers must be removed at flowering to allow for pollination. Wire hoops are very helpful, to prevent damage from abrasion; these are usually used on single rows, but can also be used under wide sheets of 15 or 25 or 50 feet. Black plastic adds warmth and solves the problem of weed management under the covers.

Thresholds and foliar controls. Beetle numbers should be kept low, especially before the 5-leaf stage. Conventional IPM systems have relied on scouting frequently (at least twice per week) and treating after beetles colonize the field. To prevent bacterial wilt, we recommend that beetles should not be allowed to exceed one beetle for every 2 plants in susceptible crops. This is a lower threshold than is needed to prevent significant foliar damage. Less wilt-susceptible crops (butternut, most pumpkins) will tolerate 1 or two beetles per plant without yield losses.

Proper timing is key. There are a number of broad spectrum insecticides which can be used for foliar control (including Capture 2EC, Decis 1.5EC, Thoinex 50W, Asana, and Sevin). See *2006-2007New England Vegetable Management Guide* for more details.

Organic insecticides. Insecticides available for organic growers include kaolin clay (Surround WP), pyrethrin (Pyganic Crop Spray 5.0 EC)), and spinosad (Entrust). Pyrethrin is primarily a contact toxin, while spinosad acts both as a contact and a stomach poison. None of these provides a highly effective 'knockdown" of beetle populations. No rotenone products are approved under the National Organic Program.

Surround WP should be applied before beetles arrive because it acts as a repellent and protectant -- beetles do not "recognize" the plant and so do not feed -- not a contact poison. It can be tricky to mix and use. One approach is to mix a slurry in a bucket and then add the slurry to the tank, as the dry powder can cake if added directly to the tank mix. Another approach is to add the powder to water and allow it to settle slowly. Once the powder is fully wet, agitate gently. Regular agitation is needed during spraying. With direct-seeded crops, apply as soon as seedlings emerge if beetles are active. Transplants can be sprayed before setting out in the field. Surround can also be used on the main crop of a PTC system, creating a "push-pull" dynamic. Ensure good coverage of the foliage (it will look like it was sprayed with white latex paint), including, if possible, the undersides of leaves (not easy when cotyledons are close to the ground). Reapply after a heavy rain and on new growth. And, wear a respirator or mask when mixing and spraying. Although kaolin is very safe in terms of skin exposure or ingestion, handlers should take precautions to avoid breathing the powder.

Perimeter trap cropping. This strategy saves time and money – and it works! See the accompanying article on this topic.

Systemic controls. Two systemic neo-nicotinoid products, *Imidacloprid* (Admire) and *thiamethoxam* (Platinum), are registered for use in cucurbits; in New England, Platinum is labeled for use on striped cucumber beetle only in MA and CT. **Note that Admire is being sold in two different formulations now**: Admire 2F (21.4% active ingredient) and Admire Pro (42.8% active ingredient). Rates for Admire Pro are approximately half that of Admire 2F, because it is twice as concentrated.

Because of the systemic activity when applied to soil or seed, these products are taken up through the roots and transported into new leaf tissue where they persist through the critical early plant stages. They can be applied in the furrow or as a surface band at planting, which simplifies control efforts especially in fields where a sizable invasion of cucumber beetles is likely. Some may also be applied through drip irrigation, which allows application to be timed shortly in advance of the expected arrival of the pest, and is suited to crops grown on plastic. They can be applied as a transplant drench prior to setting out in the field. Also, they are very well suited to a perimeter trap crop system – which dramatically reduces the cost per acre for pest control.

Using systemics in direct seeded crops. It is important to get the insecticide into the soil to avoid photochemical breakdown; placing it in the furrow or irrigating it in can accomplish this. One of the most efficient systems for an in-furrow treatment is to attach an injector to the planter for placement at the seed level after the furrow is opened and before the seed drops. This has the advantage of one trip through the field and very precise targeting of material. Where it is applied to the soil surface, it should be watered in with irrigation (or rainfall) to move it to root depth for seedlings. For growers who plant by hand on a two-way grid for cross-cultivation, apply in a twelve-inch band at the time that fertilizer is incorporated.

Platinum rates are recommended at 5 to 8 oz per acre. The label provides a chart of recommended rates per 1000 feet of row at various row spacings. For example, at 3 foot spacing, the recommended range is 0.34 to 0.55 oz/1000 liner feet, while at 7 foot spacing, the rates range from 0.8 to 1.29 oz/1000 feet. It may be possible to use a similar approach as for Admire (see table below) in calculating rates per row feet. In a trial conducted at the UMass research farm this summer, both high and low rates gave comparable levels of control compared to imidacloprid.

The Admire label gives a range of 16 - 24 oz per acre or 0.9 to 1.3 oz per 1000 feet of row. Studies have found a rate of 1.0 or 1.1 oz per 1,000 feet to be sufficient for controlling cucumber beetle in the critical early weeks. Given the wide range in row spacing with these crops and the fact that this is a banded application, we have suggested that growers calculate rates based on the number of row feet to be treated per acre.

Using systemics on transplants: This method of application is, obviously, less expensive than a furrow drench. The best time to treat is about 1 day prior to planting in the field. We have seen effective results with a rate of 0.02 ml/Admire 2F per plant, although this is lower than the rates for some plant populations listed on the label. Be careful of phytoxicity at higher rates. In Pennsylvania, burning of leaf tissue in cucurbits was observed at 0.04 ml/plant. Use half the rate for Admire Pro. Note: You can convert ml to oz by dividing by 29.6 (there are 29.6 ml in one fluid oz).

Another way to apply imidacloprid to transplants is through a water wheel planter. Use the same rate of Admire 2F per plant (0.02 ml) and the rate of water per plant that fits your planter (e.g. 8 oz). Multiply by the number of plants and mix the total Admire needed with the total water needed in the tank. Make sure your workers wear protective gloves and allow time for uptake (1+ days) into leaves.

Note that the highest rate of uptake will be into new growth.

Drip application: A drip system can be used for Admire or Platinum applications to either direct seeded or transplanted crops. Know your system well enough to know how long it will take to inject a given amount of concentrated solution (eg one bucketful) and to soak the area between emitters. Apply early enough to allow the plant roots and leaves to take up the material before beetles arrive. The system should be primed with water first, and imidacloprid injected slowly for even distribution. Make sure to use enough water to soak the area between emitters. More emitters provide more even distribution of product.

Calculate the rate needed per 100 or 1000 ft of row. Place the total amount in the bucket with enough water for 20-30 minutes of injection. Charge the system with water first to get the soil wet. Turn on the Venturi or other injector, to inject slowly for even distribution (20 or 30 minutes). Then flush lines with clear water and to move product out and down.

Non-target effects: Bees are very susceptible to imidacloprid and thiamethoxam and could be affected by its presence in pollen if it is still at high levels in the plants at the time of flowering. Bees intoxicated by Admire or Platinum, like beetles, show unusual behaviors such as tremors, staggering, and falling over before dying. This could happen with bees at excessively high rates of these insecticides. We have not observed it at the rates suggested in this article. The foliar formulation of imidacloprid (Provado)is not labeled for cucurbits, and the foliar formulation of thiamethoxam (Actara) has a label for cucurbits but may not be sprayed during bloom. Carbamates such as Sevin and synthetic pyrethroids should not be used during bloom to avoid killing bees.

Resistance from overuse. The down side of systemic products might be that they are 'too easy'. That's not necessarily a bad thing for growers who are always too busy! However if these are overused on a routine basis, these products may well be lost to resistance in a fairly short time. Furthermore, they are not cheap. For a truly IPM approach, combine or alternate these materials with crop rotation, perimeter trap cropping, and field scouting followed by foliar sprays with other classes of insecticides to reduce the likelihood of resistance and keep use rates low. Perimeter trap cropping provides a large, untreated refuge which can delay resistance.

--Ruth Hazzard, University of Massachusetts

PERIMETER TRAP CROPPING IN BUTTERNUT: MORE FARMERS TRY PTC.

Seventeen farmers are part of a PTC experiment this summer that will compare two different traps crops to be used around butternut squash for controlling striped cucumber beetle. With funds from the Northeast IPM Program of USDA/CSREES and from the New England Vegetable and Berry Growers Association, the UMass Vegetable Program has made agreements with farmers to work in 22 butternut fields. Fifteen different fields of butternut squash, grown by twelve different farmers, will be surrounded by perimeter trap crops of buttercup or blue hubbard squash. Seven other fields, without a trap crop border, will serve as the 'controls.' We will be scouting for cucumber beetle in June, and after flowering we will visit each field at least twice to count which pollinators are active –honeybees, bumblebees, squash bees, or others. To meet the pollinators, we have to arrive at each field between 5 and 9 am. As a result, the participating farms are all within an hour's drive of UMass Amherst. However, we encourage growers throughout the state to try this system. Blue Hubbard and buttercup squash are very attractive to striped cucumber beetle – while butternut squash (as well as pumpkin, cucumber and summer squash) are less attractive. Kabocha squash is a type of buttercup that is also very attractive and has a growing market demand, especially in Latino markets. When one of these is planted in a one or two-row perimeter entirely surrounding the butternut main crop, beetles stop on the border as they arrive. Beetles winter in field borders, so they arrive from outside the field. Borders are treated with Admire or Platinum at planting or sprayed when beetles are first spotted. Beetles are stopped at the border, and those that get into the main crop are generally too few to warrant a spray. Thus, often only 5% of the field is treated – for a major savings in time and money.

Two rows of 'Blue Hubbard' squash as a perimeter trap crop for Butternut

We appreciate the interest and help of so many growers in this project. We will have seven replicates of each type of border, and seven control fields. At the time of this writ-

ing, beetles have started showing up, and the earliest fields have germinated. It will be a busy June! We look forward to reporting the results next winter.

If you would like to try a PTC system and have any questions, please contact Andy Cavanagh at 413-577-3976 or Ruth Hazzard at 413-545-3696. See also articles posted on the UMass Vegetable Program website, http://www.umassvegetable.org/soil_crop_pest_mgt/insect_mgt/cucumber_beetle_striped.html

--Ruth Hazzard, Andy Cavanagh, and Lynn Adler

MANAGING COLORADO POTATO BEETLE

Colorado potato beetles (CPB) are moving into potato and eggplant crops, and will soon be laying eggs. Some adult beetles spent the winter in last year's potato fields, but most moved into the woods and brushy borders next to these fields, where they burrowed into the soil up to a depth of 12 inches. In spring the beetles have to regrow their flight muscles before they are able to fly. At first they search for food plants by walking from the field edges. This is why the edge of non-rotated crops are attacked first. If beetles do not find host plants via walking they will fly some distance in search of food.

Once host plants are found adults begin to feed and lay eggs. The beetles will have mated the previous fall or late summer; hence they have no need to mate in the spring to produce viable eggs. However, they do continue to mate in spring. The bright yellow eggs are laid in clumps that average 30-35 eggs, generally on the undersides of leaves.

Crop Rotation. The single most important tactic for CPB management is to rotate potatoes or eggplant to a field that is at least 200 yards from the previous year's fields. Barriers such as roads, rivers, woodlands, and fields with other crops are helpful. Rotated fields tend to be colonized 1-4 weeks later in the season. Also, the total population of adult beetles is lower, producing fewer larvae to control.

Now is the time to scout for adults, eggs and egg hatch. Walk your fields and look for CPB adults and eggs. The economic threshold for adult beetles in potato is 1 beetle per 2 plants (or per 2 stalks, in midseason). Eggplant seedlings have a low tolerance to damage.

Look on the undersides of leaves for the orange-yellow egg masses. The fresher the eggs, the brighter orange the eggs will appear. Eggs hatch in 7-10 days, depending on temperature. If you want to know when the earliest eggs are hatching, you can flag the earliest egg masses you find with bright tape or flags, and then keep an eye on the hatch. Larvae go through four stages before they drop to the soil and pupate. In the first stage, the larvae are about the same size as the eggs and in the second stage they are about an eighth of an inch long. As the larvae get bigger, they do more feeding. The fourth, or largest, stage does 85% of the feeding damage. It's a good idea to prevent beetles from ever reaching the fourth instar!

Colorado Potato Beetle egg mass on underside of potato leaf

After larvae complete their growth, they drop to the ground and burrow into the ground to pupate. Ten days later the next generation of adults emerge and feed. If they emerge before August 1, they will lay more eggs. After August 1, they feed and head to overwintering sites.

Systemic treatments. Neo-nicotinoid insecticides (Resistance Group 4) that are labeled for CPB include Assail 70 WP, Platinum, and Admire (2F or Pro). These are systemic insecticides that are applied as an in-furrow, banded drench or, in eggplant, as a drip irrigation application to the root zone. Admire may also be used as a transplant drench prior to placing in the field. Foliar products with the same active ingredients (eg Provado) are also labeled.

Colorado potato beetles have a phenomenal ability to develop resistance to insecticides. In the Connecticut Valley, there are fields where CPB resistance to imidacloprid (Admire) is 300 times that of susceptible populations. Control requires higher rates, does not last as long, or does not happen at all. There is cross-resistance among products in the neo-nicotinoid group. For resistance management, do not use a product in this group on more than one generation per year.

Spray timing and thresholds. If you are using Bt (Novodor), you want to make the first application when 20-30% of the eggs have hatched. If you are using spinosad (Spintor 2SC or Entrust, the organic formulation) or a broad-spectrum insecticide, you can wait until more larvae have hatched, when the oldest larvae reach the third instar, when they are about 1/3 inch long. Applications made at this time with Spintor, Provado, AgriMek, or synthetic

pyrethroids will kill all the larvae that have hatched up to this point. The threshold for small larvae is 4 per plant; for large larvae, 1.5 per plant (or per stalk in midseason), based on a count of 50 plants or stalks.

Thresholds established in the Northeast for eggplants from seedling to fruiting stage include: 15 CPB per 10 plants (Rutgers) or 2 small/1 large larvae per plant (<6 inches) or 4 small larvae /2 large per plant (>6 inches) (Cornell). In eggplant, in addition to defoliation, beetles sometimes clip the stems of flowers or flower buds. This directly reduces fruit formation and marketable yield. On the other hand, potatoes can tolerate 20% defoliation without reduction in yield (or even more, depending on time of the season and cultivar).

To prevent resistance, alternate among classes of insecticides in each generation, and throughout the season. If you used Admire at planting, do not use foliar applications of Provado. Classes (different modes of action) include synthetic pyrethroid (Asana, Pounce, Baythroid or Ambush) but many populations are already resistant to these; carbamates (Thionex, Vydate); neonicotinoids (Admire, Platinum, Actara, Provado); spinosad, (Spintor, Entrust); Bacillus thuringiensis (Novodor); and abamectin (Agri-Mek). Use the resistance group numbers (listed in the *2006-2007 New England Management Vegetable Management Guide* and on each pesticide label) to help know which pesticide is in which group.

One low-risk strategy would be to use a material such as spinosad, which control adults and larvae for the first spray, followed by a Bt to kill emerging young larvae or Agrimek to control all stages of larvae. The following three insecticides each have a different mode of action. They have not shown field resistance in this area (yet) and provide good options for alternate insecticides that provide effective control:

Spinosad (SpinTor 2SC, a liquid formulation or Entrust, an organic formulation, dry powder) gives excellent control of all stages of CPB at a 3.5 to 4.5 fl oz rate. For a heavy population, two applications about 10 days apart, with the initial application when third instars occur, will control the first generation. Spintor has the advantage that it will control adult CPB and also European corn borer if a grower has that pest on early potatoes. It is currently the only effective CPB insecticide approved for organic growers.

Abamectin (AgriMek 0.15EC) is mainly a contact material, which controls larvae. It may be best used early in the season, when good coverage is easier to obtain. Rates of 5-6 fl oz per acre gave effective control in commercial fields in trials on Long Island. The lowest labeled rate is 8 fl oz.

Bacillus thuringiensis subspecies *tenbrionis* (Novodor FC) controls small larvae, through the third instar. Time applications to begin when 30 percent of the eggs have hatched. Where fields are densely populated and eggs are hatching continuously, reapply every 5 to 7 days. Currently there are no formulations of *Bt tenebrionis* products that are approved for organic use under the National Organic Program. You can check with the MASS organic certification program (MICI, 978-297-3644) for more details.

Perimeter treatments or perimeter trap cropping can be applied to potato. One approach is to plant a barrier crop between overwintering sites and this year's crop and get it in earlier than the main crop; then control early-arriving beetles with a systemic or foliar insecticide. Another approach is to plant three to five rows of potatoes treated with a systemic insecticide (for example, Admire or Platinum–assuming resistance is not a problem) in a perimeter around the field to be planted to potato, tomato, or eggplant; this treated crop will kill up to 80% of the colonizing beetles. In eggplant or tomato, the perimeter border can be an Italian eggplant type, which is more attractive to both CPB and flea beetles. Treat only the border, as soon as beetles arrive.

Late planting

Another strategy for beating the beetle is to plant late. CPB adults that do not find food leave the field in search of greener pastures. Planting after mid- June, using a short season variety, often avoids CPB damage and eliminates the need for controls.

- R Hazzard; thanks to sources including: D Ferro (UMass Amherst), J. Mishanec (CornellUniversity), J Boucher (Univ. of Connecticut).

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