UMASS EXTENSION

# Vegetable Notes

For Vegetable Farmers in Massachusetts

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## CROP CONDITIONS

After a long period of below normal temperatures, this week brought much-needed warmth and sunshine. Planting has generally moved along on schedule this spring, with transplants of cool season crops and seeding of peas, spinach, radishes, sweet corn and potatoes. However, growers have held off on planting some crops due to the cold, and are still waiting on some varieties sweet corn and cold-sensitive crops till soils warm up. Cold air and soil temperatures have slowed growth even in cool season crops, though this week's warmth brought a surge of growth. Earlier plantings are not far ahead of later ones. We have not yet had the kind of heat wave that forces growers to remove plastic on early corn, which may help it survive the hard frost expected for tonight. There may be frost injury in store for bare ground corn, asparagus, and other crops. Harvested crops now include asparagus, over-wintered spinach (where it survived), and hoop-house greens. Farmstand sales have been hurt by cold rainy weather on the weekend before and the weekend of Mother's Day. Several farmers markets opened bravely last weekend under gray, cold conditions.

*--Ruth Hazzard*

## NEW FOR SWEET CORN: TRICHOGRAMMA OSTRINIAE IS ON THE MARKET

*Trichogramma ostriniae* kills and reproduces inside moth eggs, and is especially effective on European corn borer eggs. Starting in 1991, University researchers at Cornell, UMass and elsewhere have been releasing *T. ostriniae* into sweet corn fields and observing their effects on European corn borer eggs. They observed that this parasitoid is exceptional at dispersing and attacking ECB eggs, and repeatedly has reduced the pest population by more than half. Originally imported from China, *Trichogramma ostriniae* is a wasp that is so tiny that it can barely be seen with the naked eye. For detailed information and excellent photographs, check the New York State Agricultural Experiment Station website at ***http://www.nysaes.cornell.edu/ent/biocontrol/parasitoids/trichogramma_ostriniae.html***

**Release Recommendations:** The *T. ostriniae* come in the form of eggs glued on cards and can be placed on the plants, or on wooden stakes, at one or more sites per acre. We are recommending two or three weekly releases per field, at a rate of 30,000 wasps per acre. Timing should be linked both to crop stage (first releases at whorl stage, 12-18 inches high) and to the progress of European corn borer flight. In earliest corn, first release should be a week after male moths are captured in pheromone traps. For later plantings, release whenever crop reaches the proper stage if ECB flight is in progress. Ideally, releases will bracket the peak flight period.

This approach is a compromise between two methods for applying these parasitoids to sweet corn fields: the inoculative method and the inundative method. The inoculative technique releases relatively few adults as breeding stock to create a parasite population that will carry on throughout the crop. The inoculative technique is usually a single release of 30,000 per acre when the sweet corn is knee high or slightly before. The inundative technique is to place up to 120,000 *T. ostriniae* per acre per week for 3 - 5 introductions.

*Trichogramma release: cards in cups are attached to whorl-stage corn at one site per acre*

**Insecticide Compatibility:** Insecticides can still be used as necessary after the parasites have established. Although the tiny insects will die on contact, those that are still developing inside the corn borer egg masses can survive and emerge to continue the parasitism.

Reserve Your Supply Now:

**IPM Laboratories, Inc.**
Phone: (315) 497-2063 Fax: (315) 497-3129

E-mail: ***ipmlabs@ipmlabs.com***
or visit: ***http://www.ipmlabs.com***

The *Trichogramma* are highly perishable, and must be produced on a demand basis that also accommodates the vagaries of the weather (impossible, yet accomplished!) General production plans must be finalized in spring.

If you are interested in applying *Trichogramma* to your sweet corn this year, call IPM Laboratories when you plant and make your order. We will ask you for acreages and approximate expected planting dates. Use typical, historical ECB flight timing for your farm or your region to predict the beginning of the flight. Price will be $14.95 per 30,000 wasps plus shipping.

*--Carol Glenister, IPM Laboratories, Inc.*

## POWDERY MILDEW ON GREENHOUSE TOMATO

The pathogen *Oidium lycopersicum* – powdery mildew of tomato -- is relatively new to the Northeast and is not the same one that causes other powdery mildews that have been around quite a while. This year it has already been a serious problem in at least one greenhouse operation.

Symptoms first appear as light green to bright yellow spots on the upper surface of the leaf. The spots become more noticeable as they develop the typical white, powdery appearance. Powdery mildew of tomato is more aggressive than other mildews and once leaves are infected, they quickly turn brown and shrivel on the plant. The fungus spreads easily as abundant powdery spores are carried by air currents or production activities. Conditions that favor the disease are common in the greenhouse: high humidity and warm temperature, but unlike most other fungal diseases, water on leaf surfaces is not necessary for infection. Other hosts include rosemary, pepper, eggplant, and many bedding plant and weed hosts.

To prevent this disease do not grow bedding plants or ornamentals in the tomato house. Use adequate spacing between tomato plants to allow good air circulation. Maintain relative humidity below 90% using well-timed heating and venting. Scout regularly to identify outbreaks before they can spread. Diseased tissue should be removed as soon as it's detected by placing it in a plastic bag – do not carry infected material through the house. Production areas should be thoroughly cleaned and all plant debris removed between crop cycles. Control weeds in and around the greenhouse. If you have this problem, avoid susceptible cultivars in the near future, including Caruso, Match, or Trust.

To be effective, organic or conventional sprays should be applied as soon as symptoms are first observed since early control is critical. Be sure to get complete leaf coverage. Among the compounds registered for use in most states are chlorothalonil, paraffinic oils, bicarbonates, cupric hydroxide, sulfur, and *Ampelomyces quisqualis* (a biocontrol).

*--By Vern Grubinger for VT Vegetable and Berry News, May 2005, adapted from a fact sheet by Sharon M. Douglas, Plant Pathologist, CT Agricultural Experiment Station*

## CALLISTO (mesotrione) HERBICIDE REGISTERED FOR USE IN SWEET CORN

Callisto (mesotrione) herbicide has received a national registration for use in sweet corn. I expect that each of the 6 New England states will have this label shortly. Since Callisto has been registered for use in field corn for several years, the company would need to only update the label on file in each state to complete the registration process.

Callisto provides good to excellent postemergence and preemergence control of many broadleaf weeds including velvetleaf and triazine-resistant lambsquarters. In some cases it may replace the use of atrazine. In most cases, however, it will be used as a supplement to atraine. It can be tank mixed with a reduced-rate of atrazine applied preemergence or it can be applied postemergence to corn and weeds. In all cases, a grass herbicide is still needed.

For preemergence control, apply 6 to 7.7 ounces of Callisto per acre. If tank mixing with atrazine, apply 5 to 6 ounces of Callisto with 0.5 to 1 pint per acre of atrazine. Experience will determine whether atrazine is needed preemergence. One option is to add Callisto and a grass herbicide (Dual (metolachlor), Lasso (alachlor), Prowl (pendimethalin), or Frontier (dimethenamid)) to the tank and make one pass in the field. Then add the atrazine and finish spraying the field. Improved control after the atrazine is added will determine the value of adding the atrazine. Use whatever grass herbicide you would normally use except consider the following. In recent years, Prowl was added as an extra grass herbicide because it also improved control of velvetleaf and triazine-resistant lambsquarters. Callisto may be able to replace Prowl for this use as Prowl can injure corn when soils and growing conditions are cold or cool. Callisto does not control yellow nutsedge when applied preemergence. Bicep and Bicep Lite users who want to use Callisto preemergence should consider buying the atrazine and Dual separately so that they can reduce the rate of atrazine as the rate of atrazine in both the Bicep and Bicep Lite prepacks is too high.

For postemergence control of many broadleaf weeds including velvetleaf and triazine-resistant lambsquarters, apply 3 ounces of Callisto along with a non-ionic surfactant. Crop oil concentrate should not be used as it will increase the potential for corn injury. Corn can be any size up to 30 inches tall; however, weeds should be less than 3 inches tall.

**Overall Precautions:**

1. Do not apply more than 7.7 ounces of Callisto per acre in one season.

**2.** If there may be a need to apply both a preemergence and a postemergence spray, do not exceed 5 ounces preemergence so that there is still 2.7 ounces available postemergence.
**3.** See the label for additional precautions and more information on tank mixes, rates, and weeds controlled.
**4.** Callisto does not provide preemergence control of yellow nutsedge and provides only partial postemergence control. Preemergence control can be provided by atrazine plus either Dual or Lasso. Postemergence control can be provided by atrazine, Permit (halos ulfuron), Basagran (bentazon), or Formula 40 (2,4-D).

*--Rich Bonanno, UMass Extension*

## DEALING WITH PHYTOPHTHORA BLIGHT: CHECKLIST FOR FIELD PREPARATION AND PLANTING

Phytophthora blight is the most destructive disease of cucurbits and peppers in the Northeast. 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. It produces spores that can swim to susceptible hosts (very short distances) and 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.

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.

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.** 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.
**3.** 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.
**4.** Make sure the flow of water from within the field leaves the field – dig ditches if necessary!
**5.** 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.)
**6.** Check your irrigation system for leaks and fix them – don't allow puddles of water to sit near your irrigation pumps or lines.
**7.** 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.

**Additional considerations for peppers:** Form domed shaped raised beds at least 9 inches high and cover with black plastic. Consider the resistant cultivar Paladin. If planting on bare ground, apply Ridomil Gold 4E at 1 pt/A. in a 12" band. See label for specific instructions. If planting on plastic, apply Ridomil Gold 4E through drip lines. Repeat applications according to the label.

*--Rob Wick and Ruth. Hazzard, Dept. of Plant Soil and Insect Science, UMass*

## TEMPATURES UNDER PLASTIC

The standard rule of thumb for sweet corn is to remove the plastic if temperatures under the plastic approach 110 F. However this will depend on the stage of the corn. Recently planted corn and spike stage corn may tolerate slightly higher temperatures as long as there is sufficient moisture available in the soil. If the critical temperature is reached when the corn is at the 6 - 12 inch stage, the plastic should be removed immediately. If possible, it is best to gradually remove the plastic over a few day period by first slitting the plastic, then pulling it off.

Most of the published temperature guidelines list maximum temperatures at which either vegetative growth becomes limited or reproductive capabilities are threatened, i.e. flowers or fruit fall off. Temperatures at which vegetable plants may die vary and depend not only on the vegetable type but also on other factors such as whether irrigation is being provided or for how long the high temperature occurs. Also, a transplant will be under much greater stress than a plant that is direct seeded. The following lists temperatures at which severe stress will occur, possibly death, especially if soil moisture is low.

Sweet Corn – 120 °F; Watermelon, cucumber, pumpkin, squash – 115 °F; Eggplant and hot pepper - 110 °F; Sweet pepper and tomato - 105 °F.

These temperatures refer only to potential crop death. Temperatures 15 to 20 °F lower than those listed will result in the loss of flowers and fruit and will negate the positive effects of early warming under row covers. Temperatures over 100 degrees F will be detrimental to most crops. When there is no wind and 70 degrees F by 10:00 AM, keep an eye on tunnels and row covers. There may be a need to open or remove the cover.

*--S. Reiners, Cornell University and D. Moyer, Cornell Cooperative Extension, from Suffolk Co. Ontario, Wayne, Yates, & Steuben Counties Weekly Vegetable Update - 5/12/2004*

## TRICHOGRAMMA OSTRINIAE, PARASITE OF EUROPEAN CORN BORER:

HISTORY AND EVALUATION IN VEGETABLE CROPS IN THE NORTHEASTERN U.S.

**Background**

More than a decade of research in corn, peppers, potatoes and grapes has shown that *Trichogramma ostriniae* is a dynamic parasitoid with excellent potential for commercialization. *Trichogramma ostriniae* has demonstrated high levels of parasitism of European corn borer eggs, it disperses readily within corn, appears to prefer corn habitat, and it reproduces in the field but does not appear to readily persist from season to season. Additionally, it is easily reared on *Ephestia kuehniella*, can be stored under cool conditions, is relatively easily induced to diapause, and has not yet shown signs of fitness reduction. We remain confident that *T. ostriniae* will provide a valuable tool for growers of various crops

*Trichogramma ostriniae* Pang et Chen was collected in the summer of 1990 from Gongzhuling, Jilin Province, China and imported and reared at the USDA APHIS, PPQ Mission Biological Control Lab in Mission, TX. The collection host was *Ostrinia furnacalis*, the Asian corn borer. The collection was part of cooperative effort of USDA and university scientists and collection of *T. ostriniae* is attributed to Dr. David Ferro (University of Massachusetts) and Ma Chun Sen, ostensibly of China.

From 1991 through 1996, effort was focused on: establishing a colony at Cornell; host range studies; determining whether *T. ostriniae* would overwinter; evaluations of field efficacy. A colony of *T. ostriniae* was established at Cornell in October 1993 from parasitoids supplied by the Mission Biological Control Lab

From 1997 – 2001 studies included: efficacy of inoculative releases in commercial sweet corn and field corn; continued host range studies; dispersal studies; European corn borer (ECB) lifetable when *T. ostriniae* is released.

From 2002 until present we have: continued evaluating efficacy after large scale releases in sweet corn; efficacy in solanaceous crops and grapes; ECB lifetable studies with *T. ostriniae* compared to insecticide; ability to overwinter; behavioral aspects and their relationship to efficacy and non-target risk.

### Efficacy

**Corn**

In 1991, from June through September, approximately 8.7 million *T. ostriniae* were introduced to 14 sites in 10 counties of Delaware, Massachusetts, and New York. Permits to import the parasitoid into New York were in place in March 1991 and introduction to New York first occurred during the first week of June 1991 in Suffolk County with the intended use as 'Classical Biological Control of European Corn Borer in Field and Sweet Corn'. Approximately 2.5 million T. ostriniae were released in NY during 1991. 47% of ECB egg masses found in NY were parasitized by either *T. ostriniae* or native Trichogrammatids. In Delaware, an average of 97% parasitism of ECB egg masses was recorded after releasing 202,000 wasps per acre in sweet corn. From 1992 through 1996 in NY, efficacy studies were conducted after inundative releases of the parasitoid. In those studies, parasitism generally hovered around 80% of ECB egg masses.

Beginning in 1997, we began assessing the potential for inoculative releases of 30,000 female *T. ostriniae*/ acre. This decision was predicated on the observance of substan-

tial parasitism of ECB egg masses in fields some distance from release sites and after some time since the initial releases. We surmised that there was either substantial reproduction in the field or substantial parasitoid movement, or both.

Initial inoculative release trials indicated that on-farm persistence was up to 3 months where ECB populations were sufficient to prevent extinction. Where populations were low, persistence was documented for at least 1 month. In those trials, a total of 88 egg masses were found, of which 62% were parasitized. In 1998-2003, similar trials were conducted that corroborated our conclusions: inoculative release of 30,000 female *T. ostriniae*/acre resulted in population persistence for over a month and parasitism was slightly above 60% of all egg masses found.

In 2002 – 2003 we conducted large scale inoculative releases in processing sweet corn. Fields were from 6-40 acres and releases were conducted once when corn was knee-height and ECB flight activity had started. In that study, overall parasitism was 62% in 2003 and 38% in 2003. Again, parasitism was typically detected for over a month after releases but may have persisted for even longer; we stopped sampling at harvest time.

**Potatoes, peppers, cole crops and grapes**

Initial trials have been very promising in a variety of crops. An early greenhouse and microplot study showed the potential for controlling diamondback moth on cabbage. In that trial, 74% of DBM eggs in the greenhouse were parasitized and 92% of eggs in an outdoor microplot were parasitized.

In experimental plots in Kentucky, Virginia, Massachusetts and Pennsylvania, *T. ostriniae* substantially reduced ECB damage to peppers. In KY, ECB damage to fruit was reduced by 47%. In VA, parasitism was about 40% and damage was reduced from 32% in controls compared to 10% with releases. In PA, parasitism was 65% and damage was reduced from 15% to 4%. In MA, parasitism was 76.9% compared to 14.3% in control plots, and damage was reduced from 17.2% to 3.2%.

In potatoes in Maine and Virginia, ECB tunnels were reduced from 47 stems in control, to 27 in release plots (per 200 stems sampled). In grapes, grape berry moth damage was reduced from 36% to 16.5% when T. ostriniae was present.

**Dispersal**

As indicated, observation of relatively long-distance dispersal is what precipitated the decision to explore inoculative releases. Additional studies were conducted to determine how far and how fast the parasitoid could disperse within a field. Studies conducted in 2001 indicated that within-field dispersal was rapid and extensive- 550 feet within 6 days and 750 feet within 21 days. Parasitism was uniform within 1-2 hectares surrounding the release site, suggesting that 1 release point per 2.4 acres would be sufficient to allow uniform dispersal. We utilize one release per acre as a conservative compromise. That contrasts markedly with the currently recommended 20 release points per acre of corn for *T. brassicae*.

**Lifetable studies**

European corn borer lifetable studies were conducted in field corn and sweet corn with and without inoculative releases of *Trichogramma ostriniae*. In those studies, the corn received no insecticides. The results of the research indicated that European corn borer mortality was increased from 61% to 92% in sweet corn and from 80% to 93% in field corn. In another study, we compared European corn borer lifetables in sweet corn with *T. ostriniae* vs. insecticidal control. We found that, by far, once *T. ostriniae* was introduced, the primary cause of egg mortality was the parasitoid and that ear damage was no different between sprayed plots and Trichogramma plots. All lifetable studies were from data collected within a single season.

**Other attributes of interest**

**Pest host range-** *T. ostriniae* has been shown to attack eggs of several pest species including but not limited to: corn earworm, cabbage looper, fall armyworm, diamondback moth, imported cabbage worm, hornworms, grape berry moth, oriental fruit moth and oblique-banded leaf roller. As previously mentioned, the parasitoid appears very capable of searching several types of plant canopy.

**Storage-** Of interest to producers and users, *T. ostriniae* can be stored for a period of time at about 48°F. In addition to prolonging its useful life, this tends to extend the duration of emergence so that not all adults emerge at once. Similarly, by cold storing portions of a cohort for different lengths of time and then blending the stored eggs, the duration of adult emergence can be controlled so that there is not a single pulse of emergence.

**Fitness-** Current studies indicate that our colony is still vigorous, with no loss of fitness even after many generations of colony rearing.

**Non-target effects-** Although *Trichogramma* have a fairly broad potential host range within Lepidoptera, in reality the host range is mediated by search behavior. To date, it appears that the parasitoid is capable of moving to non-crop habitat, however, it does appear to prefer corn when given a choice.

Recent studies suggest that *T. ostriniae* are innately influenced by European corn borer pheromones, but not by corn or pepper plant volatiles. That is, habitat specificity may be governed by specific hosts within a habitat.

We have not been able to confirm that *T. ostriniae* will

overwinter in NY, but the possibility remains. On one occasion we found *T. ostrinae* in a corn field that had received the parasitoid in the previous year. It remains likely that it was evidence of overwintering, but we can not completely rule out migration from releases that occurred during the season. Manipulative studies have been conducted in NY and VA and in both states, it has been able to overwinter. However, we believe that a primary determinant of overwintering will be the availability of host eggs in non-corn habitat and the level of mortality that they experience. In NY, *T. ostriniae* does not overwinter well in ECB eggs but has shown good emergence from Ephestia and a southern Arcteid, *Utetheisa ornatrix* that has not been allowed to feed on plants possessing a chemical inhibitory to *T. ostrinae*.

In summary, *T. ostriniae* thus far appears to have several attributes desirable for augmentative biological control of European corn borer, and perhaps other pests such as corn earworm.

*--Jeffrey Gardner, Cornell University*

## CABBAGE AND ONION MAGGOT FLIES

A good indicator of the start of cabbage root maggot flight is blooming of the common roadside weed, yellow rocket. This weed started blossoming this week, with the onset of warmer weather. (see photo) Root maggot flies were captured on yellow sticky traps placed in cabbage fields in Hadley this week. Onion (*Delia antiqua*) and cabbage maggot (*Delia radicum*) flies look nearly identical but are likely to be found only near their host crop – brassicas, for cabbage maggot, and aliums, (primarily onion) for onion maggot. There is a period of time (6-10 days) after flight begins before eggs are laid, but its about time to test your eyesight, and begin to scout cabbage and onion fields for root maggot eggs.

*Blooming of yellow rocket, a common roadside weed, coincides with the emergence of cabbage root maggot flies*

Flies spend the winter as small brown pupae in the soil. Adults emerge in spring and travel considerable distance in search of host plants (1/2 to 1 mile). Cabbage root maggot flies are rather delicate, hump-backed gray-brown flies, about 5-7 mm long. You may see them moving from plant to plant in early crucifers. Female flies flies seek out plants to lay eggs at the base of the stem. When eggs hatch, cabbage maggot larvae tunnel through or eat the roots off of plants in the cabbage family such as turnips, radish, cabbage, broccoli and cauliflower. In root crops you may find the tunnels or the maggot. In crops such as broccoli or cauliflower your first sign of problems is wilting of the plant on sunny days and then later the plants die. If you pull one up you will see the reason it is wilting is the roots are gone. You may still find the little white maggots feeding.

There are 3-4 generations per year. Because of the variation in time of adult emergence in the spring, and the variation in length of developmental stages, it is possible for maggots to be present much of the growing season. However, high temperatures and disease suppress populations in July and August. The major damage from this pest is found in the early plantings of broccoli, cauliflower and cabbage. Then again in the end of the season since the cooler temperatures of late August,September and October favor development. At that time, the maggots damage fall-maturing plants such as rutabagas, turnips. Chinese cabbage, mustard, radish, rutabaga and turnip are even more attractive to cabbage maggot fly than cabbage, and may be more severely injured.

**Monitoring.** Flies are attracted to bright yellow color – the same yellow that is used for road markers, known as "Federal Safety Yellow". You might see them landing on your bright yellow tractor tire rims if you happen to own a John Deere! To a fly, this yellow is essentially the same color as a green leaf. Yellow sticky cards are inexpensive and easy to use; attach them with small wire stakes (see photo) and place near the soil.

*Yellow sticky card in emerging onion field, Ziomek Farm, Hadley*

Its best to check traps twice weekly, as they often get coated with dust when left out for a whole week. This will tell you when the flight peaks, and when it declines. In cabbage, flight typically declines after mid to late May so that some late May or June plantings do not need a soil drench. Also, higher soil temperatures that occur in June kill the eggs before they hatch.

Degree days can also be used to predict emergence.

According to a model developed by Dr. Tony Shelton's lab at Cornell University, the first emergence of cabbage maggot occurs at 160 degree days+/- 8 degree days (DD) with a base temperature of 40°F. 25% emergence occurs at 203 DD +/- 3 DD, 50% emergence occurs at 251 DD +/-8 DD, 75% emergence occurs at 304 DD +/- 37 DD and 95 % emergence occurs at 387 DD +/- 8 DD. Degree day accumulations vary greatly across New England. Degree day information for some locations in New England can be obtained from National Ag Statistic Service in the Crop Weather Report published each Monday. This report has a lot of other crop information as well. Another source for weather-based crop information is ProNewEngland (http://www.pronewengland.org/index.html).

**Monitoring cabbage for eggs.** To check your field for eggs, look for the 1/8-inch long, torpedo-shaped white eggs that are laid along the stem, or on the soil next to the stem of young transplants. Often eggs are laid in neat rows, or inserted into the soil. They may be under a small clod of dirt near the stem. A pencil point helps stir the soil to look for them. Check 20-40 plants in the field, in groups of 2-4 plants. If you find more than an average of 1 egg/stem, it is likely to be a damaging population and a banded soil drench is recommended. Eggs may be more abundant in wetter areas of the field.

**Soil Drench.** Target the base of the plants and use at least 200 gallons of water per acre to help the insecticide penetrate to the root zone. Now that Diazinon is no longer labeled for this use, chlorpyrifos (Lorsban) is the only option. This material does not move readily in soil after the application is made, so it is important to provide adequate water so that the material penetrates several inches into the soil when it is applied. Under dry soil conditions, additional water may be needed to penetrate the soil. See the 2004-2005 New England Vegetable Management Guide for more details (available online at www.nevegetable.org).

Re-scout the field five to 7 days after application to note whether eggs have hatched; if there are few maggots active, then the application was effective. Because the Lorsban is quite persistent in the soil, a second application is usually not needed.

If you make several plantings, scout each planting (it takes about 15 minutes) to achieve the best timing for a soil drench. You'll be able to apply it when it is needed, and you can save the cost of application when it is not needed. In the Connecticut Valley, fields planted after May 15 often do not need treatment; cooler areas may be at risk later in the spring.

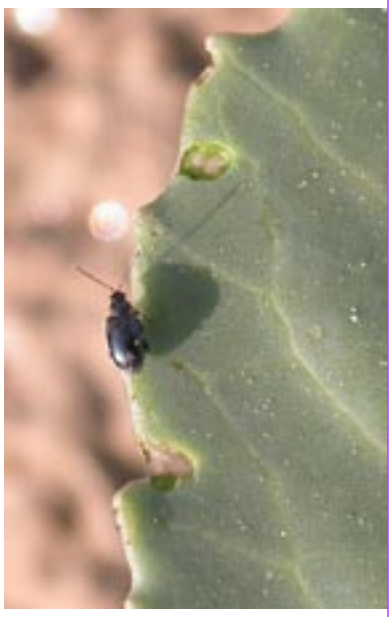
**Floating row covers** provide an effective barrier against this pest. Use in a rotated field, as flies overwinter in soil after late season crucifers and could emerge under the cover if the same field has spring brassicas. Replace cover after weeding operations.

**Other cultural practices.** Crop rotation helps keep populations low. Fall tillage to bury crop residues and expose over-wintering pupae is also important. On a small scale, there are ways to prevent maggots from getting to the root zone. A small piece of plastic, slit to the middle, can be wrapped around the plant stem and overlapped, then covered with soil. Blue plastic mulch, intercropping with non-brassica plants, cardboard or tarpaper disks that fit tightly to the stem or a 1meter high vertical barrier around the crop are other possibilities for small-scale situations. On a larger scale, given healthy growth of the crop, cultivation that brings soil up around the stem may help encourage formation of adventitious roots from the stem, which can help compensate for root loss even if maggots are present.

*–R. Hazzard, University of Massachusetts; selections drawn from Eric Sideman, Maine Organic Farming and Gardening Association*

## FLEA BEETLES IN BRASSICAS

Flea beetles are busy feeding in spring plantings of brassica crops. Numbers are likely to rise in coming weeks as beetles move out of field borders where they spent the winter. Crucifer and striped flea beetles feed on Brassica crops as well as weeds that are in the same family, such as yellow rocket or wild mustard. The crucifer flea beetle (*Phyllotreta cruciferae*) is uniformly black and shiny, about 2 mm in length, while the striped flea beetle (*Phyllotreta striolata*) has two yellow stripes on its back.



*Crucifer flea beetle and feeding injury on leaf margins of cabbage*

Flea beetle adults feed on leaves and stems, resulting in numerous small holes, or 'shot-holes'. Eggs are laid in the soil starting in late May, and beetle larvae feed on roots. The non-waxy greens (arugula, bok choi, tatsoi, mustard, Chinese cabbage, komatsuna) are preferred to the waxy cabbage, kale and collard types of brassicas. In brassica greens, beetles feed on the whole surface of the leaf, and will continue feeding from the seedling stage until harvest. Waxy crops are most susceptible at the cotyledon and seedling stage and feeding

is more limited to leaf margins.

In the past two weeks we also found tarnished plant bug adults feeding in arugula crops. In addition to the shot holes from flea beetle feeding, there were also distorted leaves that are typical of TPB feeding, which injures leaf tissue when leaves first emerge. (see photo)

*Injury to arugula leaf from combined flea beetle and tarnished plant bug feeding*

To reduce and delay flea beetle invasion of spring crops, move them as far away from the fields that were used for fall Brassica crops as possible. Beetles overwinter in field borders near last year's crop. Planting close by ensures a high population in the spring.

One of the best ways to protect Brassica crops from flea beetles is to place a floating row cover over the bed or row. It is critical to seal the edges immediately after seeding, because Brassica seeds germinate quickly and beetles rapidly find the cotyledons. Flea beetles can fit through extremely tiny cracks. Edges of the cover must be sealed on all sides using soil, black plastic bags filled with soil, or some other method.

There are a number of synthetic pyrethroids and carbamates, which are labeled for flea beetle in Brassicas and which can give effective control of flea beetles for conventional growers. Materials that are labeled for flea beetles in brassicas include Capture*, Sevin XLR Plus, Baythroid*, Ammo*, Thionex , Asana* XL, Warrior*, Larvin* 3.2, and Mustang* (* denotes restricted-use pesticide). Imidacloprid (Provado 1.6F) is also labeled for foliar application to control flea beetles in brassicas. Admire is labeled for use against whiteflies and aphids in brassicas, with a 21 dh interval. (See **2004-2005 New England Vegetable Management Guide**).

Thresholds for treatment will vary with brassica species and the quality demanded by your market. The threshold for greens is obviously much lower than for cabbage. One study in Colorado found that 5 or more flea beetles on seedling broccoli reduced subsequent head size. Cornell and Rutgers Universities recommend a threshold of one flea beetle per plant on seedlings up to the 5 leaf stage, or injury and 1 beetle/plant on 50% of the stand.

For organic growers flea beetles are especially difficult because there have been no effective insecticides and many growers depend on succession-planted greens as a key part of their crop mix. Based on trials at UMass and Ct Ag Expt Station, and a growing body of grower experience, spinosad (Entrust for organic) seems to be an effective material when sprayed on brassicas. Note label limits on the number of sprays per crop. Pyrethrin (Pyganic EC 5) showed poor to moderate efficacy in trials, but is reported by at least one grower to provide a good knockdown of flea beetles at 16 oz/acre (for a hefty price tag of $50 per acre). It is a short residual material.

The strong preference for certain crops can also be exploited in a perimeter trap cropping arrangement. by using more attractive greens (*Brassica rapa typese*) as a trap crop for cabbage or broccoli (*Brassica oleracea*). Komatsuna is a good candidate for a perimeter trap because it is highly preferred compared to cabbage, seed is inexpensive, growth is rapid, and the crop continues to produce new, attractive foliage over a long period. Growers interested in trying PTC for cabbage, kale, collard, or broccoli are welcome to contact **Ruth Hazzard** (413-545-3696) or **Andy Cavanagh** (413-577- 3976) for more information.

*Vegetable Notes, Ruth Hazzard, editor and Ben Hunsdorfer, Assistant Editor. 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; author is R. Hazzard if none is cited.*

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