VEGETABLE CROPS HOTLINE

A newsletter for commercial vegetable growers prepared by the Purdue University Cooperative Extension Service

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IN THIS ISSUE

Tomato Stake Sanitation - *(Dan Egel)* - Several bacterial diseases, such as bacterial canker of tomato, cause yield losses to Indiana growers every year. Most growers know that the bacteria may arrive in a field on seeds, transplants or the bacteria may have survived on crop residue. It may be less well known that the bacteria may also survive on stakes, transplant trays and other equipment. Last fall, we were able to detect the bacterium responsible for bacterial canker on wooden stakes such as the ones shown in this photograph (Figure 1). Bacterial spot and speck also may survive from year to year in a similar fashion. Always clean stakes, transplant trays and other structures and equipment that comes into contact with plants. After cleaning, use a quaternary ammonium compound or 10% bleach for sanitization. Be sure to wear gloves and goggles and follow all directions on the label.

Figure 1: Bacterial canker of tomatoes may cause the wilt and death of tomato plants. The bacteria that cause this disease may survive on stakes such as the ones shown in this photograph. Always clean and sanitize stakes and other equipment as discussed in the accompanying article. *(Photo by Dan Egel)*

Pheromones and Pheromone Traps - *(Rick Foster)* - One way insects communicate with individuals of the same species is with pheromones. Pheromones are volatile chemicals released by an insect that usually can be detected only by individuals of the same species. There are a number of different types of pheromones, but the most common type is the sex pheromone. Usually the females will emit a tiny amount of a chemical that attracts the male to her and increases the likelihood of mating. Because the chemical is volatile, air currents carry it. The male detects the pheromone in the air with receptors on his antennae. He then flies upwind to find the source of the pheromone, a prospective mate. The chemical compositions of pheromones for a number of pest species have been identified and synthetic copies can be produced in the laboratory. Synthetic pheromones can be used in conjunction with traps to catch male insects.

There are a number of vegetable insect pests that can be monitored with pheromone traps. In my opinion, the most important pest to monitor for is corn earworm/tomato fruitworm.

Listed below are some, but certainly not all, of the suppliers of pheromones and traps.

Gempler's; P. O. Box 270; 100 Countryside Dr.; Belleville, WI 53508; (800) 382-8473; <**www.gemplers.com**>.
Great Lakes IPM; 10220 Church Rd., NE; Vestaburg, MI 48891; (517) 268-5693; <**www.greatlakesipm.com**>.
Insects Limited Inc.; 16950 Westfield Park Rd.; Westfield IN 46074; (317) 896-9300; <**www.insectslimited.com**>.
Pacific Biocontrol Corporation; 620 E. Bird Lane, Litchfield Park, AZ 85340; (623) 935-0512 or (800) 999-8805; <**www.pacificbiocontrol.com**>.
Scentry Biologicals Inc.; 610 Central Ave.: Billings MT 59102; (800) 735-5323; <**www.scentry.com**>.
Trece Incorporated; P. O. Box 129. Adair, OK 74330; (866) 785-1313; <**www.trece.com**>.

You can buy most pheromone traps from these suppliers, but for corn earworm/tomato fruitworm, I recommend that you use the wire mesh trap which is available from:

Bob Poppe's Service; 25738 N. 3200 Road; Lexington, IL 61753; (309) 723-3201. The wire traps catch more moths and last longer than the nylon traps.

To get the most from your pheromone traps, they must be used properly:

- Place the traps and the pheromones out before you would normally expect the insect pest to be active. That way you can monitor the adult activity, which will warn you that damage from the larvae may be coming soon (see Corn Earwom article, this issue).
- Be careful how you store pheromones. Ideally, they should be frozen until ready for use. At the very least, they should be refrigerated. Don't keep them on the dashboard of your truck
- When handling pheromone lures, do not touch them with your hands. Use a pair of forceps or wear latex gloves. This is especially important when you are using pheromones for more than one pest. Contamination of a lure with another pheromone will likely reduce the effectiveness.
- Lures usually should be changed every 3-4 weeks, although this will vary for individual lures.
- Check traps regularly, at least weekly. Daily would be better.

Seed and Root Maggots - *(Rick Foster)* - Three species of seed and root maggots attack vegetables in Indiana. The seedcorn maggot feeds on seeds and seedlings of sweet corn, cucurbits, lima and snap beans, peas, and other crops. Cabbage maggots can cause serious damage to transplants of cabbage, broccoli, cauliflower, and Brussels sprouts and make the fleshy roots of radishes, turnips, and rutabagas unmarketable. Onion maggots are pests of seedling onions, developing bulbs and onions intended for storage.

Seedcorn maggot flies emerge in April and May and lay eggs preferentially in areas with decaying organic matter. Fields that are heavily manured or planted to a cover crop are more likely to have seedcorn maggot injury. Maggots burrow into the seed and feed within, often destroying the germ. The seeds fail to germinate and plants do not emerge from the soil, leaving gaps in the stand. When infested seeds germinate, the seedlings are weak and may die. Maggots also will feed within the stems of transplants.

Any condition that delays germination may increase damage from this pest. Damage can be reduced by planting into a well-prepared seedbed, sufficiently late to get rapid germination. The slower the rate of growth, the greater the likelihood of seedcorn maggot injury. For any type of early season transplant, soil temperatures should reach at least 70°F or more for 4-5 days in a row to avoid maggot injury. Anything that raises soil temperature (e.g., black or clear plastic mulch) will increase soil warming and decrease the possibility of seedcorn maggot injury. Once damage is observed, the only management strategy available is the decision to replant or not. If you decide to replant, be sure to use treated seed. When resetting transplants be sure to wait 5 days from the first evidence of wilted plants before you reset.

In 2008, I had a seedcorn maggot trial on muskmelons at the Southwest Purdue Agricultural Center that had severe damage. The plot was planted the last week of April and within a week showed serious damage. The photographs below (Figures 1, 2, and 3) show the level of damage observed. Notice that the soil temperatures

Figure 1: Several muskmelon plants in this row have been severely damaged by seedcorn maggots. *(Photo by John Obermeyer)*

Figure 2: This muskmelon plant has died as a result of seedcorn maggot damage. *(Photo by John Obermeyer)*

Figure 3: Seedcorn maggots are about ¼ of an inch long and cause damage by burrowing into plant tissue. *(Photo by John Obermeyer)*

never reached 70°F during the study (Figure 4). This provided perfect conditions for seedcorn maggot injury. We tested several products that are labeled for use on muskmelons to control other pests, but none showed very good levels of control (Table 1).

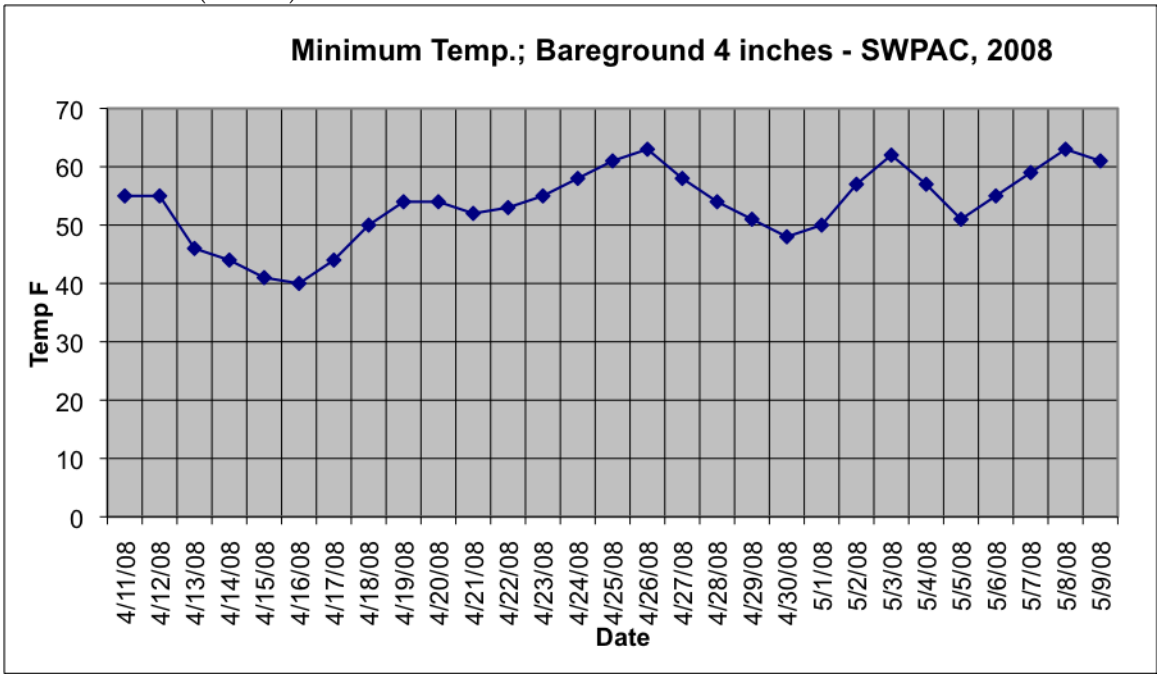

Figure 4: Soil temperature observations made during a seedcorn maggot experiment. Note that the soil temperature never reached 70°F, resulting in severe seedcorn maggot damage.

Cabbage maggot injury is also favored by cool, wet conditions. The flies, slightly smaller than a housefly, emerge in late April or early May and lay white eggs at the base of newly set plants. Larvae from this first generation tunnel in the roots of small plants, causing the plants to appear sickly, off color or stunted, and may cause them to die. Early cabbage and turnips are particularly vulnerable to damage. Control of first generation maggots can be achieved using soil insecticides such as Lorsban or diazinon at planting or transplanting. For short season crops such as radishes and turnips, long-residual insecticides cannot be used. Cabbage maggots usually do not affect later planted crucifers.

Table 1: The percent dead plants observed as a result of seedcorn maggot damage in several insecticide treatments. Percentages with the same letter are not significantly different according to a statistical test.

Treatment	Rate	% Dead Plants (5/16)
Untreated	-----	58 abc
Admire	16 fl. oz./A	77 a
Admire	24 fl. oz./A	63 abc
Platinum	5 fl. oz./A	71 ab
Platinum	8 fl. oz./A	42 bcd
Furadan	2.4 fl. oz./1000 ft	42 bcd

Onion maggot flies emerge throughout May and lay eggs at the base of onion plants. The maggots attack the underground portions of the onion plants and cause plants to wilt and die. Seeded onions are more susceptible than transplanted onions. Do not overseed to compensate for losses to onion maggots. The flies do not space their eggs evenly, so you may end up with smaller bulbs because the plant spacing is too close. The second-generation flies emerge during July and the third generation emerges during late August and early September. Each generation will damage onions.

Removing cull onions after harvest and planting as far as possible from fields planted to onion the previous year can reduce damage. Soil drenches of Lorsban or diazinon at planting will effectively control first generation maggots and provide some control of the second generation. As the onions begin to mature, they become physically resistant to attack from onion maggots, unless they have been injured in some way. Be careful during field operations not to damage the growing plants in any way. A nick in an onion bulb allows the maggots to enter and begin feeding. Also, the flies are attracted to damaged onions to lay eggs. Reducing the amount of physical damage to the onions at harvest as much as possible will also reduce the amount of injury from the third generation. Do not apply foliar sprays to kill flies before they lay eggs.

Corn Earworm - *(Rick Foster)* - Corn earworms normally overwinter in Indiana in relatively low numbers. The first generation moths come out in mid June but usually don't cause a lot of damage. We usually get our most damage from migrants coming in from southern locations, usually arriving in large numbers in late July or early August. The moths are blown up from the South when weather conditions are right. A high pressure system in the eastern US and a low pressure system in the western plains creates a insect pump that moves both warm, moist air and corn earworm moths northward. When they meet a cool front, both rainfall and moths precipitate out and fall to the ground.

My standard recommendation is that sweet corn growers place their earworm pheromone traps out on June 1. In most years this is just a precaution because we don't expect much until much later in the summer. 2008 was an exception. As the following graph shows, we had a major flight of earworm moths arrive in Indiana in early June. This created problems for growers with early maturing sweet corn for several reasons. First, the moth catches greatly exceeded our normal spray threshold of 70 moths per week, or 10 moths per night. Second, because the early sweet corn was the only corn around that had green silks present, it attracted more than its normal share of moths to lay eggs there. In this type of situation, the threshold may actually by significantly lower than 10 moths per night. Last summer, if growers were catching any moths in their trap in June and their corn was in a vulnerable stage (green silks), I recommended that they spray. Third, many growers were not prepared, meaning that they did not have their pheromone traps operating and/or were not prepared to spray.

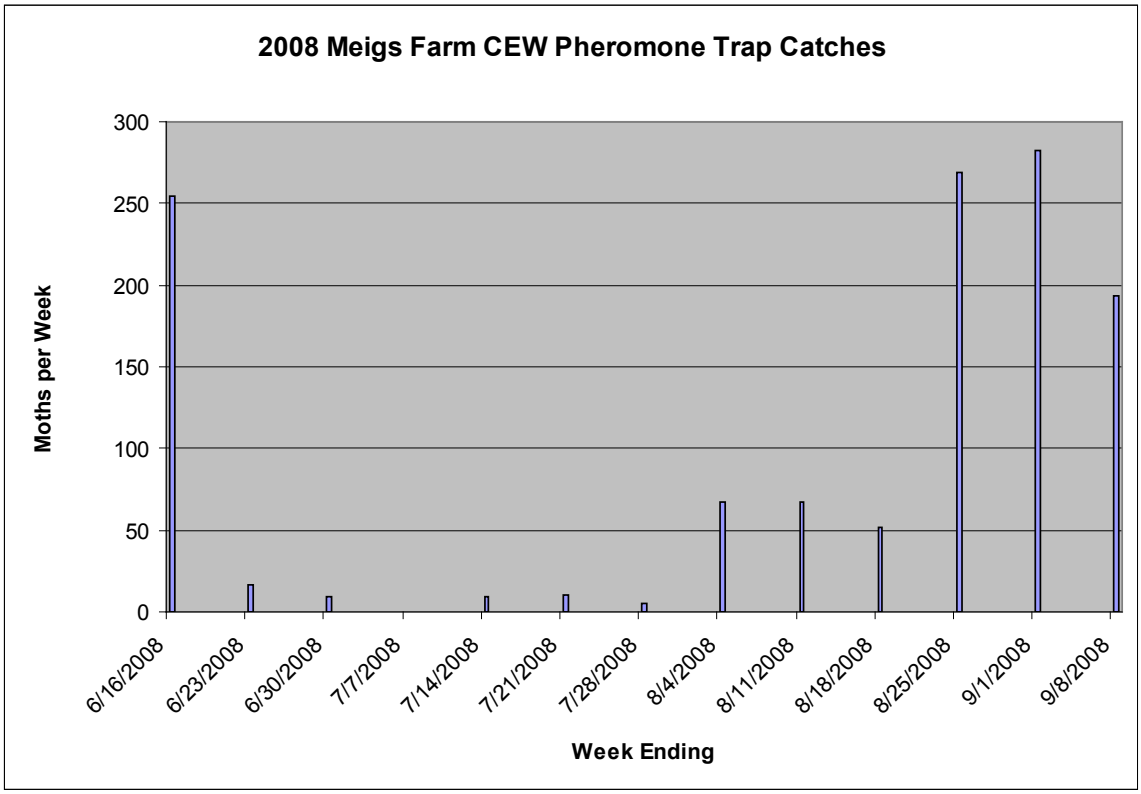

Figure 1: Corn earworm catches per week from a pheromone trap at the Meigs Farm near West Lafayette in 2008. Note the high number of catches in mid June.

I have to confess that I was also guilty of not being prepared. I didn't put my trap out until about June 9, and caught over 170 moths the first two nights. You can bet that I will have my traps up and running by May 15 this year. I advise sweet corn growers to make sure they have their traps in operation by the time tassels start to emerge on their earliest sweet corn. There is a good chance that an early flight like this will not occur again this year, but the prudent thing to do is be prepared.

Salt Injury - Too Much of a Good Thing - *(Liz Maynard)* - As with so many things, the right amount of 'salt' is beneficial to plants, but too much can cause problems. Many common fertilizers are salts (e.g. ammonium chloride, potassium chloride, ammonium sulfate, potassium sulfate, magnesium sulfate, calcium nitrate, and potassium nitrate) and some that aren't act like salts when dissolved in the soil solution.

High levels of salt injure plant cells by drawing water out of the cells. Often cells are killed. Symptoms of salt injury may occur on roots, leaves, or the entire plant. Roots injured by salt often die, turning brown and dry. Fungal pathogens like *Pythium* may invade and cause disease. Germinating seeds and seedlings may die. With larger plants, if enough roots die the plant may wilt. When absorbed salts accumulate in leaves, leaf edges may turn yellow, and eventually die and dry up. This is called 'marginal chlorosis' followed by 'marginal necrosis' or 'scorching.' If a solution too high in salts is sprayed on leaves, dry dead 'burned' spots will appear where the solution made contact.

Fertilizers differ in their potential to cause salt injury. The 'salt index' describes this potential. Sodium nitrate has a salt index of 100 and other fertilizers are compared to it based on an equal weight of fertilizer (Table 1). The salt index does not provide information about the nutrient content of the fertilizer. Guidelines for fertilizer use rates and application methods typically take into account the salt index of the fertilizer, and avoid recommendations that would lead to plant injury from salts.

Table 1. Salt Index of Common Fertilizers		
Material	Salt Index Per Unit Material	Partial Salt Index per Unit of Nutrient
Ammonium phosphate	26.9	2.442 (N)
Calcium nitrate	52.5	4.409
Diammonium phosphate	29.9	1.314 (N)
		0.637 (P2O5)
Potassium chloride	116.3	1.936
Potassium nitrate	73.6	5.336 (N)
		1.580 (K2O)
Potassium sulfate	46.1	0.853
Sodium Nitrate	100	6.060
Urea	75.4	1.618

Source: Western Fertilizer Handbook, 6th ed., Interstate Printers & Publishers, Danville, IL

Salt injury can occur when too much fertilizer with a high salt index is applied too close to roots or germinating seeds. This is why fertilizer banded at planting time is placed to the side and below the seed, unless formulations with a very low salt index are used. Even with banding, the total amount of N and K placed in the band is limited to reduce potential for injury.

Nutrient solutions used to water-in transplants can also cause salt injury if they are too concentrated. Sometimes a transplant starter solution is not thoroughly mixed to dissolve the fertilizer and salt injury is observed on just part of a planting. In other cases, dry conditions after transplanting concentrate the solution in the soil and injury occurs from a starter solution that would have been fine in wetter soil.

In soil covered by high tunnels salts can build up over the years if excess nutrients are applied and periodic leaching is not performed. Preplant soil tests allow monitoring of soil nutrient and salt levels problems can be avoided.

Bedding plants and vegetable transplants grown in flats can also succumb to salt injury if high rates of fertilizer lead to a build-up of salts in the growing media. If the media dries out, the salts become even more concentrated, and are more likely to cause injury.

Some composts contain high levels of salt. If applied too heavily or not mixed into a large enough volume of soil they can cause injury. Some guidelines suggest that compost spread in fields in the spring should have an EC less than 10.0 dS/m (see below for explanation of EC). Others suggest an EC less than 6.0 dS/m to avoid any potential problems with vegetable crops.

Suspected salt injury is usually confirmed by circumstantial evidence, including 1) ruling out infectious diseases, 2) reviewing records of fertilizer applications and soil moisture, and 3) measuring electrical conductivity of the soil or growing media solution. Electrical conductivity, or EC, is an indirect measure of the amount of salt in the soil. (Water containing dissolved salt conducts electricity better than pure water.) Sometimes it is reported as 'Soluble Salts.' The more salt in the soil, the higher the EC measurement. Soil testing laboratories can measure EC. Handheld meters for in-house testing are also available.

If soil salts are found to be high, the solution is to apply enough water to leach salts below the root zone of the crop. If root diseases have invaded, it may be possible to minimize their spread by using an approved fungicide; this is more often done when plants are grown in pots than in the soil.

Salt injury can usually be avoided by taking care to determine appropriate fertilizer rates, know fertilizer characteristics, double check calculations, measure carefully, and apply evenly.

Additional Information and References:

Laboski, C.A.M. 2008. Understanding Salt Index of Fertilizers. Proc. 2008 Wisconsin Fertilizer, Aglime & Pest Management Conference, Vol. 47: 37-41. Available online: <**www.soils.wisc.edu/extension/wfapmc/2008/pap/Laboski1.pdf**>.

Mariott, E. 2009. Making and Using Compost in Organic Agriculture. Retrieved 4/22/09 from <**www.extension.org/article/18567**>.

Ozores-Hampton, M. Beneficial Uses of Compost in Florida Vegetable Crops. Retrieved 4/22/09 from <**http://swfrec.ifas.ufl.edu/compost/pdf/Compost_Utilization.pdf**>.

Cucurbit Disease Photographs - *(Dan Egel)* - The photographs below are of some common diseases that might be found in muskmelon or watermelon transplant greenhouses. For more information, contact Dan Egel (812) 886-0198 or the Plant Pest and Diagnostic Laboratory (765) 494-7071.

Figure 1: Bacterial fruit blotch on watermelon. This disease is often associated with dark, water soaked or necrotic areas on leaves and especially along veins. Although not a serious problem on seedlings, bacterial fruit botch can cause a disfiguring lesion on fruit of muskmelon, watermelon and pumpkin.

Figure 2: A water soaked area around where the seed leaves (cotyledons) are attached to the stem is a possible symptom of the disease gummy stem blight. If the watermelon seedling shown here is transplanted in the field, the disease may spread quickly throughout the entire planting.

Figure 3: This photograph is of a muskmelon seedling with gummy stem blight. The light brown 'woody' appearance is a later stage of the disease than that shown in Figure 2. Note that the dark fungal structures characteristic of this disease are present on the stem shown here.

Figure 4: Anthracnose of watermelon. This disease is most easily recognized from the jagged, angular appearance of the lesions on true leaves. Although not nearly as common as gummy stem blight is in Indiana, anthracnose may cause lesions on fruit as well as leaves. *(Photos for this article by Dan Egel)*

Upcoming Events

Hoop Houses for Extending Your Growing Season Webinar, presented by ATTRA - National Sustainable Agriculture Information Service. Thursday, May 7, 2009, 1 - 2 p.m. Eastern/12 - 1 p.m. Central Time. Register at <**www.attra.ncat.org/webinars2009/hoophouses**>.

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