VEGETABLE CROPS HOTLINE

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

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IN THIS ISSUE

Striped Cucumber Beetles and Bacterial Wilt - *(Rick Foster and Dan Egel)* - It appears that in most areas of the state we have passed the peak of activity of the striped cucumber beetle on cucurbit crops. We are just starting to see significant amounts of bacterial wilt. Bacterial wilt of cucurbits, as most of you know, is vectored by cucumber beetles and is most injurious to muskmelons and cucumbers. Bacterial wilt causes plants to wilt and die (Figure 1, above). One way to tell plants affected by bacterial wilt from wilts of other causes is to choose a portion of the lower stem, cut it, press the stems together for a few seconds (Figure 2A) and pull the stems apart slowly. Stems affected by bacterial wilt will exhibit 'stringy sap' between the cut ends (Figure 2B). It is important to choose a plant with advanced symptoms, but is not dead. The sap behaves in this way due to the bacterial infection. Although in experienced hands the technique is fairly reliable, the only sure way to tell if a field has bacterial wilt is to get an official diagnosis.

Figure 1. Muskmelon plants with bacterial wilt in various stages of wilt and death. *(Photo Dan Egel).*

Figure 2. One way to tell if plants have bacterial wilt is cut the lower stem, press the cut ends together (A) and pull them apart slowly. If the sap forms 'strings' (B), the plants likely have bacterial wilt. It is important to get an official diagnosis to be certain. *(Photo Chris Gunter).*

If the overwintering beetles are no longer present on your melons, it is a good idea to cease spraying insecticides to control them. Continuing to apply weekly insecticide sprays when cucumber beetles are no longer present is not only a waste of money, but research has shown that melons sprayed weekly had significantly lower yields than those that received 2-3 well timed applications. In addition, excessive spraying can lead to outbreaks of aphids and mites by killing natural enemies. Once the next generation of beetles appears, it may again be necessary to spray insecticides to control them, particularly on late planted melons, young pumpkins, or if the beetles are feeding on the fruit.

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10 Useful Rules for Fungicide Application - *(Dan Egel)* - Since the season of applying fungicides to vegetable crops has arrived, below I have listed 10 rules that will help vegetable growers apply fungicides effectively and safely. Rules 1 through 7 are listed in no particular order; however, I saved the most important three for last.

1. **Apply fungicides prior to the development of disease.** Although many fungicides have systemic ("kick back") action they will not completely eradi-

cate diseases after they have started. And by the time a single disease lesion is observed in the field, many more lesions too small to observe are already working at your crop.

2. **Use shorter spray intervals during weather conducive to plant disease.** Each plant disease has its own "personality" and thus prefers different weather. However, most plant diseases require leaf wetness. Therefore, during periods of rain and heavy dews, more frequent fungicide applications are a good idea. The normal range of spray applications is every 7 to 14 days. Muskmelon and watermelon growers have the guesswork taken out of this process with a Purdue University program known as **MELCAST**. Ask the author for more details by calling (812) 886-0198.
3. **Apply fungicides *before* a rain if possible.** Water is necessary for most fungal spores to infect a leaf or stem and for the splash dispersal of many spores. Therefore apply fungicides before a rain if it appears that the fungicide will have a chance to dry before the rain. It is not necessary to apply fungicides again after every rain. Most modern fungicides have a good sticker and will persist through rains pretty well. The **MELCAST** program takes into account the affect weather has on fungicides.
4. **Avoid applying fungicides in the heat of the day.** It is possible for any foliar applied chemical to cause some plant damage if applied under conditions of heat and direct sunshine. Also remember that if fungicides and insecticides are applied together, make the applications so that bees are unharmed.
5. **Timing of fungicide applications is more important than nozzle type and spray pressure.** Studies here in southern Indiana as well as by researchers in other areas of the country have found that nozzle type and spray pressure doesn't make as much difference as we once thought. See the *Vegetable Crops Hotline* issue #430 <**www.btny.purdue.edu/pubs/vegcrop**> for details.
6. **Some diseases cannot be managed by foliar sprays.** Problems caused by soil borne fungi or nematodes cannot be controlled with foliar fungicides. Examples of these types of problems would be Fusarium wilt of watermelon or root-knot nematodes of tomatoes. Also, be certain that the problem you observe is really a disease. No amount of fungicide will improve a problem caused by soil fertility.
7. **Do not apply foliar fungicides to the soil.** Although fungicides may kill or inhibit the growth of fungi which cause plant diseases, the application of those same fungicides to the soil will be wasteful and off label. Foliar fungicides are designed to protect the surfaces of plants.
8. **Make certain the fungicide matches the crop and disease.** That is, READ THE LABEL. The label is the law. Plus, considerable time and money was spent to test each fungicide with a particular crop and disease. Off label applications also waste your time and money.
9. **Double-check the label for the current rate per acre.** Rates may vary widely based on label changes and different formulations. While you are checking the rate, also check to make sure your application method is labeled. (Can this fungicide be applied in the greenhouse?) Did you get the rate from the *Midwest Vegetable Production Guide for Commercial Growers* <**www.btny.purdue.edu/Pubs/ID/ID-56/**>? Check the label anyway.
10. **Play it safe.** Always adhere to the Post-Harvest Intervals, Re-Entry Intervals and Worker Protection Standards listed in the label. No one wants an accident or lawsuit. Besides, the label is the law.

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Corn Earworms - *(Rick Foster)* - We are just starting our corn earworm trapping network around the state and have been catching a few moths for a couple of weeks. To keep tabs on moth activity, look at our trapping data at: <**http://extension.entm.purdue.edu/cornearworm/index.php**>. Most of our early planted sweet corn this year is behind last year because of the rain and cool weather. I have one planting in Vincennes that is just starting to tassel. If you are lucky enough to have sweet corn that is approaching the silking stage, you should probably treat with an appropriate insecticide if any moths are being caught in a trap near you. Your silking sweet corn will be the most attractive place in the neighborhood to lay eggs, so the usual threshold of 10 moths/night probably is not appropriate when the surrounding corn (field or sweet) is still in the early vegetative stage.

The optimal time to make the first insecticide application against earworms is when approximately 70% of the ears have silked. Additional sprays should be made every 2-5 days until silks start to turn brown. The interval between sprays is dependent on the number of moths being caught in traps and the temperature. Sprays should go on more frequently when lots of moths are being caught and/or temperatures are high, but never more often than every 2 days. During this time of year, spraying every 5 days is usually adequate.

Over the past several years, we have seen some evidence that earworms were becoming resistant to pyrethroid insecticides (Ambush®/Pounce®, Asana®, Baythroid®, Brigade®/Capture®, Mustang Max®, Warrior®). Data collected last year from throughout the Midwest seemed to show a lessening of any resistance, with the pyrethroids again providing the best control of all products tested. A couple of alternative chemistries that growers might consider if problems develop with the pyrethroids are Belt® and Radiant®. Entomologists around the Midwest decided not to apply for a Section 18 Emergency Use Permit for Coragen® this year because these two new products are now available. DuPont™ anticipates Coragen® being fully labeled by 2010.

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Stalk Borers in Tomato - *(Rick Foster)* - Occasionally we see fields of young tomatoes that are suffering damage from stalk borers. The typical scenario is that the field was weedy, often with a high population of giant ragweeds, a burndown herbicide was applied, and the tomatoes (or other crop) was transplanted into the field. The stalk borers that had been feeding on the weeds no longer have a viable food source and so they start looking for something new to eat. Since the farmer was kind enough to provide fresh, tender transplants, the stalk borers begin feeding on the crop. The accompanying pictures show the type of damage stalk borers do to tomato (Figures 1, 2, and 3).

There are a couple of management options, some better than others. First, avoid planting into weedy fields that recently had a burndown herbicide applied. This is a lot easier said than done, especially in a rainy year like this. Second, if you know that the ragweeds or other weeds are infested with stalk borers (this is pretty easy to determine by some simple scouting), include a pyrethroid insecticide with your herbicide application. Don't do this routinely without scouting because most fields will not need it. Finally, if you discover that your tomatoes are being attacked by stalk borers, you can apply an insecticide. The pyrethroid insecticides will provide the best control and the only one I could find with stalk borer on the label was Warrior®. However, as the Warrior® label warns, this application will not control the stalk borers that are already inside your tomato stalks. It will only prevent additional stalk borer entry into the plants.

Figure 1. A stalk borer larva inside a tomato stem. *(Photo by John Obermeyer)*.

Figure 2. The entry hole for a stalk borer in a tomato stem. *(Photo by John Obermeyer)*.

Figure 3. Stalk borer larvae inside tomato stems, such as the one indicated above, are not affected by insecticides. *(Photo by John Obermeyer)*.

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Tomatoes in High Tunnels - *(Liz Maynard)* - Tomatoes in high tunnels or hoophouses are well on their way to harvest. Several inquiries have come in over the last few weeks about various leaf symptoms on these crops.

One problem reported has been an upward curling of the lower leaves, not associated with any drought stress. Sometimes the leaves are described as very dark green and leathery. The severity differs among varieties. It is quite possible that this is physiological leaf roll. We published a brief description of the problem in issue 495 of this newsletter last July. The curling resembles the way corn leaves roll up when there is not enough water, but this symptom is not due to lack of water. Nor is it an infectious disease. It is a physiological disorder. It appears to be more severe when growing conditions are good and the plant does not have many actively growing branches or a lot of developing fruit. High light levels seem to promote the problem. Plants that have been heavily pruned (had suckers removed) often have more pronounced symptoms as shown here (Figure 1). The curled leaves typically remain curled, but new growth develops normally. There is no evidence that the symptoms are associated with reduced yield or that increasing fertilizer or water applications reduce the symptoms.

Figure 1. Pruned 'Mt. Spring' tomato in foreground showing physiological leaf roll. *(Photo by E. Maynard)*

Other symptoms reported have suggested a possible nutrient deficiency or excess. Lack of potassium shows up on older leaves as marginal and interveinal chlorosis proceeding to necrosis. Excess nitrogen can lead to curling and twisting of new growth, and delayed flowering. Nutritional problems can be difficult to diagnose based on appearance alone. It is best to review soil tests, fertilizer applications, and collect a sample of leaves and submit to a lab for tissue analysis. In most cases a suitable sample would be the most recently mature leaf from about 20 representative plants. This leaf is usually the 5th or 6th leaf (complete with midrib and all attached leaflets) down from the main growing point. Leaves that have been treated with foliar fertilizers will not provide reliable results.

The tables below are designed to assist in planning fertilization in high tunnels using drip irrigation and soluble fertilizers. They focus on nitrogen and potassium because those are the two nutrients that seem most often to be over or under applied. Table 1 lists how much fertilizer is required to supply a given amount of nitrogen or potash each week. For instance, to supply 7 lb. N/A/wk, one could apply 5.84 oz. of urea per 1000 sq. ft, or 6.89 fl. oz. of 28% UAN solution. If another fertilizer is used, with X% N, the last column provides a formula to calculcate the amount of fertilizer. Table 2 shows how much total nutrient would be supplied if the weekly amount were continued for various lengths of time. Experience tells us that a reasonable crop of field grown tomatoes can be grown with 100 lb. of fertilizer N in a season. From Table 2, you can see that if 7 lb. of N is applied for 16 weeks, it would total 112 lb. N; probably more than enough for a high tunnel system with little leaching. The amount of potassium required from fertilizer depends on the level in the soil. Once a recommendation for potassium fertilizer is in hand, the tables can be used to determine weekly applications that would provide the desired amount over the season. The amount of N and/or K applied per week is often started at a lower level, increased during the major period of crop growth, and reduced towards the end of the season.

Table 1. Amount of fertilizer required for 1000 sq. ft. to supply various rates of N and K_2O per acre.

Desired Application Rate	Amount of Fertilizer per 1000 sq. ft. per Week					
	Nitrogen Source (% N)					
	Urea 44%	Calcium Nitrate 16.6%	Potassium Nitrate 13%	20-10-20 20%	UAN Solution 28%	Other X %
Lb./A/wk						
Nitrogen (N)	*ounces*				*fluid ounces*	*ounces*
3.5	2.92	7.74	9.89	6.43	3.45	128.6 / X
7	5.84	15.49	19.78	12.86	6.89	257.1 / X
	Potassium Source (% K_2O)					
	Potassium Chloride 60%	Potassium Nitrate 44%	20-10-20 20%	15-0-15 15%	Other X %	
Potash (K_2O)	*ounces*					
3.5	2.14	2.92	6.43	8.57	128.6 / X	
7	4.29	5.84	12.86	17.14	257.1 / X	
10.5	6.43	8.77	19.28	25.71	385.8 / X	
14	8.57	11.69	25.71	34.28	514.4 / X	

If irrigation is managed so that nutrients do not leach excessively, the total amount of fertilizer required in a high tunnel over the growing season may be less than what would be required in the open field. This is because without rain in the tunnel, leaching is reduced, and with fertigation, nutrients are applied closer to root zone of the crop, increasing fertilizer use efficiency. However, it can be easy to leach nutrients with drip fertigation. Nutrients that leach below the root zone represent a waste of money and potential pollution for a variety of water sources. To avoid leaching, apply only enough water to wet the soil in the root zone. Check using a soil probe or a soil moisture meter to see how far down the water has moved after irrigation. Water will move downwards farther than it moves sideways, especially in sandy soils, so do not take the moisture pattern on the surface of the soil as a guide to how far down the water has moved.

Hopefully, your plants don't show any unusual symptoms and are nearly ready to harvest for market. If symptoms do appear, take the time to investigate what they might mean. Most problems are easier to solve sooner rather than later.

Table 2. Total Amount of Nitrogen (N) or Potash (K2O) applied per acre if weekly applications are made for various numbers of weeks.

Application Rate (lb./A/wk)	Number of Weeks Fertilizer is Applied				
	6 wk	8 wk	12 wk	16 wk	20 wk
	Total Lb./A of N or K2O				
3.5	21	28	42	56	70
7	42	56	84	112	140
10.5	63	84	126	168	210
14	84	112	168	224	280

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Pumpkin Planting Time - *(Dan Egel)* – It is time to think about when to plant pumpkin seed to avoid serious yield loss from virus diseases. Purdue University recommends that seed of pumpkins be planted by 20 June to manage for pumpkin viruses. (The 20 June date has been established for southern Indiana-adjust your date accordingly.)

Almost all pumpkin fields will have symptoms of virus infection. There are several related virus diseases of pumpkin that cause similar symptoms. Those symptoms include a mosaic (Figure 1) on foliage and shoestring of leaves.

However, if pumpkins are planted sufficiently early, the virus diseases will not become widespread or severe until the fruit has set. Pumpkin plants are most susceptible to yield or quality losses after fruit have set (Figure 2).

Aphids spread most important pumpkin viruses. The aphids that spread pumpkin viruses are more abundant as the season progresses. This is the reason it is best to plant early. Although insecticides can be used to manage aphid infestations in pumpkins, insecticides will not stop the spread of these pumpkin viruses. This is because aphids will spread the virus particles before the insecticides have a chance to work.

Figure 1: Virus symptom on pumpkin foliage includes mosaic of leaves. *(Photo by Dan Egel)*

Figure 2: If pumpkin fruit are infected with virus early in development, the resulting fruit may be small and deformed. *(Photo by Dan Egel)*

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Magnesium and Manganese in Melon - (*Chris Gunter*) - This time of year cantaloupe and watermelon vines may start showing symptoms of magnesium deficiency or manganese toxicity. Both disorders are related to acid soils and usually occur in clusters in a field. Magnesium deficiency appears on sandy ridges and can be recognized by intervienal yellowing and death of tissues on older leaves (Figure 1). Manganese toxicity also first occurs on older leaves but appears in heavier or darker sands, often in swales. The diagnostic feature of manganese toxicity are the tiny pin-hole type lesions with yel-

low halos clustered between the veins (Figure 2). Leaves are best viewed when held up to the sun.

These disorders can easily be confused with an infectious disease. Symptoms may seem to "spread" from areas of the lowest pH to areas of somewhat higher pH. Individual rows seem to be worse than adjacent rows. Such rows may have likely received less lime. The remedy for these disorders is to raise the pH of the soils involved. This can be difficult to accomplish with crops growing under plastic mulch, because of the difficulty of getting the lime into the root zone.

Figure 1: Magnesium deficiency in cantaloupe. *(Photo by Rick Latin)*

Figure 2: Manganese toxicity in cantaloupe. *(Photo by Rick Latin)*

Although growers may have soil tested and spread lime before the season, there may still be pH problems in some areas of the field. Learn the symptoms of these disorders so you won't be wasting fungicides on a non-existent disease.

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