VEGETABLE CROPS HOTLINE

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

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IN THIS ISSUE

USING PLASTIC MULCH AND ROW COVERS FOR EARLY CROPS - *(Liz Maynard)* - Getting a jump on the harvest season is a goal of many vegetable producers. Some Indiana growers have years of experience using a variety of techniques including: 1) transplants; 2) black, wave-length selective and clear plastic mulches; and 3) row covers or low tunnels of non-woven fabrics or plastic. Others may be working with these techniques for the first or second season. This article highlights some things to watch out for when using plastic mulch and/or row covers.

Warming Soil with Plastic Mulch - A black plastic mulch provides the most warming if it is applied to a bed with a smooth surface and if the mulch is in close contact with the soil surface. Clear mulches raise soil temperatures more than black plastic, and mulch-soil contact is not as critical. Wavelength selective mulches raise soil temperatures more than black plastic and less than clear. Plastic mulches should be applied over moist soil. Application in advance of planting will allow soil warming before the crop is in the ground. Plastic mulches warm the soil, not the air, for the most part. Any effect a mulch has on the air temperature is limited to areas very close to the plastic. Also the presence of the mulch can lead to cooler air overnight because it traps heat in the soil. If the air temperature is still below that required for crop growth, consider using a row cover in addition to the mulch.

Plan to Control Weeds Under Clear Mulch - If clear mulch is used, weeds will grow under the mulch. This will also happen with colored mulches that let enough light through. A plan for controlling weeds under the mulch is important in these cases. Some herbicides can be used under mulches, while others are not recommended because of the potential for crop injury. Refer to the *Midwest Vegetable Production Guide 2003* (ID-56) <www.entm.purdue.edu/entomology/ext/targets/ID/index.htm> and the herbicide label for more information on particular materials.

Direct-seeding Under Clear Mulch - Plastic mulch is most commonly used for transplanted crops, but it can also be used with direct-seeded crops. Sweet corn, snap beans, and cucurbits can be direct-seeded through holes in the mulch. Often two rows of the crop will be seeded on one strip of mulch to make the most of the mulched area. Crops can also be direct-seeded into paired trenches before applying clear mulch, and clear mulch can be laid over the planted furrows. With this method, the mulch warms the air as well as the soil and crop growth is even faster. The trench provides room for the crop to grow for a few weeks. The mulch is slit when air temperatures under the mulch get too high, and is eventually pulled back entirely to allow for crop growth. Sweet corn looks funny bent over under the mulch, but once the mulch is removed it will right itself and continue to grow normally.

Watch for Excessively High Temperatures Under Row Covers - Clear plastic and spun-bonded fabrics can also be used with support of wire or plastic hoops to make low tunnels, 1 to 2 feet high. Air and soil temperature in the tunnels will be warmer than outside and plants will grow more quickly. It is very important to be aware of the air temperature in the tunnel. Consider putting a max./min. thermometer in the tunnel where you can see it. It can get hot enough inside the low tunnel to interfere with flower development, leading to delayed yield instead of the earlier yield that was the goal. The plants may look great - vigorous, green, healthy, and yet it may be too hot for flower development. The type of material used to make the tunnel has a big influence on how hot it will get. Clear plastic with no

ventilation produces the warmest environment, and is likely to reach damaging temperatures on warm sunny days. Clear plastic with holes is cooler, but can still get over 100˚F; non-woven fabrics are the coolest during the day. If plastic mulch is used in combination with the low tunnel, the type used will also influence the air temperature in the tunnel: a black or dark-colored mulch will lead to a higher air temperature in the tunnel than a clear mulch. I recommend that you be prepared to vent or remove the cover if the temperature exceeds 100˚F or if highs consistently exceed 90˚F for melons, 86˚F for sweet corn, and 80˚F for tomatoes or peppers. This is especially important if plants are beginning to produce flower buds.

Frost Protection Depends on Material - The degree of frost protection provided by row covers will depend on the cover material and on the type of mulch used, if any. The heaviest fabric materials will provide the most frost protection. Don't expect much protection from a clear plastic cover.

Floating Row Covers - The fabric row covers are also used without supporting hoops, sometimes in sections wide enough to cover a number of rows. This works better on crops that don't have a tender exposed growing point near the top of the plant, because the growing point can be injured as the cover ripples across the crop in the wind.

For more information, see "Season Extension Techniques for Market Gardeners", by Janet Bachmann and Richard Earles, available on-line at <http://attra.ncat.org/attra-pub/seasonext.html>, or request by phone at 800-346-9140.

Winter Temperatures (2002-2003) and Survival of Insects in Indiana - *(Frankie Lam and Ken Scheeringa)* - Winter temperature has a strong impact on the survival of overwintering insect populations. The number of insects on crops during the early season is determined mainly by the size of the colonizing population, which is closely related to the survival of the overwintering of insect stages. For most insects, their numbers in spring depend greatly on the weather of the past winter.

Winter temperatures affect the survival of overwintering insect populations in two ways; one is how cold the temperature was and the other is how long the insects had to stay at that particular cold temperature. A study at Iowa State University, on the winter survival of bean leaf beetle, developed a model to predict the percentage of winter mortality of the beetle by accumulating the daily mean subfreezing temperatures (< 32˚F) through the winter. The model demonstrated that the colder the winter temperature, the lower the percentage of overwintering beetles that survived through the winter. In addition, the model was used to predict the population fluctuations of the beetle in the following season. The model was relatively accurate in predicting beetle populations during the past four years in Iowa.

Not much research has been conducted studying the role of the winter severity on insect population fluctuations. Except for a few insects, we do not have models to predict the percentage of winter survival for most species. However, following the logic of the study in Iowa we can understand relatively how cold the past winter was and imply the impact it might have had on the overwintering insect populations. In Table 1, **Accumulated Subfreezing Temperatures** were

Table 1. Accumulated subfreezing temperatures and total number of days below freezing in winter 2002-2003.

District	Winter 2002-2003						
	Accumulated Subfreezing Temperatures (°F)						Days Below Freezing
	Nov	Dec	Jan	Feb	Mar	Total	
NW	-22	-132	-427	-253	-79	-913	89
NC	-21	-142	-422	-262	-86	-933	91
NE	-20	-154	-411	-273	-98	-956	93
WC	-14	-98	-391	-226	-49	-777	84
C	-13	-93	-375	-229	-51	-760	80
EC	-17	-112	-398	-258	-60	9844	84
SW	-1	-60	-217	-116	-13	-406	56
SC	-4	-58	-233	-117	-14	-425	62
SE	-6	-59	-267	-139	-23	-494	68

obtained by calculating the daily average temperature (˚F) minus 32 and accumulating only those days, which were negative through winter. The **Days Below Freezing** is the total number of days with daily average temperature below 32˚F through winter. In this article the **Climate Normals** are used as "standards" to compare

Table 2. Climate normals (1971-2000) of the nine Indiana agricultural statistics districts.

District	Climate Normals (1971-2000)						
	Accumulated Subfreezing Temperatures (°F)						Days Below Freezing
	Nov	Dec	Jan	Feb	Mar	Total	
NW	0	-112	-270	-118	0	-500	82
NC	0	-97	-255	-114	0	-466	80
NE	0	-99	-259	-129	0	-487	83
WC	0	-57	-191	-51	0	-299	66
C	0	-49	-177	-52	0	-278	66
EC	0	-62	-202	-74	0	-338	71
SW	0	-2	-52	0	0	-54	33
SC	0	-5	-57	-2	0	-64	38
SE	0	-3	-54	-2	0	-59	36

with those values from the last winter (Table 2). A climate normal is simply the arithmetic average of the values over a 30-year period (three consecutive decades). If we compare the total accumulated subfreezing temperatures and the days below freezing of the past winter (2002-2003) with the climate normals (1971-2000), we can draw a simple conclusion that the past winter was much colder than that of a normal year in Indiana.

Based on these weather data, we might summarize that if the insect pests have a certain stage that overwinters in Indiana, the overwintered population in the early season would be relatively smaller than that of a normal year or would not be as high as that of last spring. On the other hand, if the insect pest has more than one generation per year in Indiana, other than the overwintered population it is difficult to predict the relative numbers of the subsequent generations with this model. This is because the numbers of subsequent populations will also be greatly affected by the weather in the coming spring and early summer. Moreover, if the weather in the coming season is favorable for their growth, the insect populations still have the probability of reaching the economic thresholds.

Proper Use of Trifluralin Herbicides on Melons - *(Chris Gunter)* - In the past few weeks I have received a few calls about the proper use of herbicides which contain trifluralin (e.g., Treflan, Trilin, Trifluralin) on watermelon, cantaloupe and other cucurbits. Their label on cucurbits is for use only after planting.

There are two common formulations for Treflan, for example that are labeled for use on cucurbits. Trefalan TR-10 is applied as a granular and Treflan HFP is a liquid spray directed between the rows. Both formulations are to be applied when the plants have reached the 3-4 true leaf stage. It must then be incorporated. For plants grown without plastic mulch, incorporation equipment should be set to move treated soil around the base of the plants. Care should be taken to avoid foliar contact with the liquid spray as slight damage may occur.

When cucurbits are grown on plastic mulch, an application of Treflan below the plastic is not labeled. In addition, incorporation of Treflan following application between the plastic mulched rows may be difficult. In this case you may want to consider a herbicide, which has the same mode of action, but does not need to be incorporated (e.g., Curbit). As always, follow the labeled use on any herbicide.

New Fungicide Labels for Root Crops - *(Dan Egel)* - Root crops include garden beet, carrot, parsnip, radish and turnip. The fungicide Quadris has an expanded label that includes root crops. Cabrio is a new fungicide with uses on root crops. Both fungicides are strobilurins, which means that both compounds have the same mode of action and should not be used in back to back sequence. Details of these fungicides are listed below.

- Quadris is labeled for Alternaria leaf spot, Ascochyta leaf spot, powdery mildew, rust, white rust as well as several soil borne diseases. The rates vary depending on whether one is growing the crop for its foliage or roots. For foliage crops, use 6.2 to 15.4 fl. oz. per acre. For crops grown for roots, use 6.2 to 12 .3 fl. oz. per acre for Alternaria leaf spot, Ascochyta leaf spot, rust and White rust. For Cercospera leaf spot and powdery mildew as well as for soil borne diseases, use 9.2 to 15.4 fl. oz. per acre. Do not apply more than 2 sequential applications of Quadris before alternating with a fungicide with a different mode of action. For powdery mildew, do not apply more than 1 sequential application of Quadris before alternating with a fungicide with a different mode of action. Observe a 4 hour restricted entry interval (REI) and a 0 day pre-harvest interval (PHI).
- Cabrio is a new fungicide with a label including uses on root crops. Diseases on the Cabrio label include Alternaria leaf spot, Cercospera leaf spot, powdery mildew and white rust. The labeled rate is for 8 to 12 oz. per acre except that the white rust rate is 8 to 16 oz. per acre. Do not apply more than 2 sequential applications of Cabrio before alternating with a fungicide with a different mode of action. Observe a 12 hour REI and a 0 day PHI.

Many other details are on the labels of these fungicides. Please read the label carefully.

New Seed Treatment - *(Dan Egel)* -Although most vegetable growers do not treat their seed with fungicides, growers this year might notice that a new fungicide treatment has been registered on vegetable seeds.

Protege is a newly registered fungicide from Syngenta for use on the seed of a number of vegetables including sweet corn, cucumber, snap beans and peas. The active ingredient in Protege, azoxystrobin, is the same as that in Quadris. Applicators and handlers should wear long sleeves and pants, chemical resistant gloves and shoes plus socks. If the treated seed is incorporated into the soil (greenhouse mix) workers can enter the area treated with no restricted entry interval, if there will be no contact with seeds.

The objective of seed treatments is to protect the seed from soil fungi such as *Rhizoctonia solani* and *Pythium* spp., which cause damping off, and to guard against fungi that may be seed borne. An example of the later would be gummy stem blight in cucurbits. However, use of treated seed does not guarantee freedom from seedling diseases.

To avoid damping-off diseases, growers should avoid contaminating greenhouse soilless mixes with surfaces that have not been thoroughly cleaned and sanitized. Over watering also encourages damping-off diseases. Once seedlings have emerged, growers should carefully scout greenhouses and remove diseased seedlings.

Additional details are available on the label. Please read and follow the label carefully.

Preventive Management for Cabbage and Seedcorn Maggots in Early-Season - (*Frankie Lam*) - Cabbage maggot and seedcorn maggot are two species of flies belonging to the same family. The damaging stage of both species is the larval or maggot stage. The maggots feed on the root surface and tunnel into the roots and crown. Plants attacked by the maggots may wilt and show stunted growth, and eventually die. The feeding sites of the maggots may cause secondary infection of plant pathogens. Both species have more than one generation a year in the Midwest, but the first-generation is the most damaging population.

The maggots of the two species look relatively alike and it is not easy to identify them based on the external features. Cabbage maggots usually attack cole crops, however, the seedcorn maggot prefers corn, beans, and cucurbits. To a lesser extent, germinating seeds and seedlings of cole crops may also be attacked by the seedcorn maggot. Furthermore, light and sandy soil is more susceptible to infestation by the cabbage maggot, whereas heavy soil with plenty decaying organic matter is more attractive to the seedcorn maggot.

One of the tactics to prevent heavy infestation of maggots during early-season is to avoid planting the crop in the wet, cool spring and within the peak of adult emergence and the egg-laying period. Wet and cool weather usually favors the development of both cabbage and seedcorn maggots. A study indicated that once the soil temperature reaches 70˚F at 4-inch depth there is seldom an outbreak of the seedcorn maggot. The peak of adult fly emergence and the egg-laying period can be predicted by the equation, [(Maximum Temp. + Minimum Temp.)/2] - Developmental Threshold. The calculated degree-days, which are positive, are accumulated from April 1. In addition, the developmental threshold for cabbage maggot is 43˚F, whereas for seedcorn maggot is 39˚F. The total degree-days for the first-generation of the cabbage maggot to emerge as an adult is 300, while for the seedcorn maggot it is 200. To avoid a heavy infestation, the crop should be transplanted at least 1 week before or after the predicted peak emergence.

Table 1 shows the temperatures measured at Southwest Purdue Agricultural Center near Vincennes and the accumulated degree-days for the maggots in April 2002. The degree-days for the cabbage maggot

Table 1. Calculated degree-day of cabbage maggot and seedcorn maggot at the Southwest Purdue Agricultural Center near Vincennes in April 2002.

Temperature (° F)			Accumulated degree-day	
Date	Maximum	Minimum	Cabbage maggot	Seedcorn maggot
1	61	34	4.5	8.5
2	67	38	14.0	22.0
3	40	33	14.0	22.0
4	46	23	14.0	22.0
5	52	26	14.0	22.0
6	49	32	14.0	23.5
7	64	36	21.0	34.5
8	67	56	39.5	57.0
9	60	52	52.5	74.0
10	65	39	61.5	87.0
11	78	48	81.5	111.0
12	75	62	101.5	135.0
13	67	59	127.0	164.5
14	75	65	147.0	188.5
15	83	67	202.0	216.5
16	83	69	234.0	
17	83	62	267.0	
18	85	72	297.0	
19	82	60	297.5	
20	69	60	331.5	

was calculated by [(Maximum temp. + Minimum temp.)/2] - 43; whereas the degree-days for the seedcorn maggot was calculated by [(Maximum temp. + Minimum temp.)/2] - 39. The predicted day for the peak of adult emergence for seedcorn maggot and cabbage maggot is April 15 (> 200) and April 20 (> 300), respectively. Thus, the planting dates which should be avoided for the seedcorn maggot are from April 8 to 22 and for the cabbage maggot the dates to avoid planting are from April 13 to 27.

As a whole, the preventive tactics to avoid heavy infestation of maggots during early-season are:

- Plowing down cover crops at least 3 to 4 weeks before planting.
- Avoid planting in the cool and wet spring.
- Plant the crop when soil temperatures at the 4-inch depth exceed 70˚F.
- Check with the weather forecast and predict the peak of adult fly emergence. If the weather is warm, transplant the crop at least 1 week before or after the predicted peak of adult emergence.

New Labels for Cucurbit Vegetables - *(Dan Egel)* - Several new fungicides are available this season. Below I have outlined some of the important points for each compound. Details are available in the *Midwest Vegetable Production Guide for Commercial Growers 2003* (ID-56).

- **Cabrio -** The label for this new fungicide includes use on cucurbit vegetables including cucumber, pumpkin, squash and watermelon. The labeled rate is 12 to 16 oz. per acre for Alternaria leaf blight, Cercospera leaf spot, gummy stem blight, Microdochium blight, powdery mildew and target spot. For downy mildew, the rate is 8 to 12 oz. per week. Observe a 12 hour restricted entry interval (REI) and a 0 day pre-harvest interval (PHI). Do not apply more than 1 sequential application of Cabrio before alternating to a fungicide with a different mode of action. Do not use Cabrio tank mixes with additives or adjuvants on muskmelon or injury may result. Growers should refer to the section on tank mixes for more precautions.
- **Procure 50 WS -** This fungicide is labeled for powdery mildew on cucurbits. The REI is 12 hours and the PHI is 0 days. The use rate is 4 to 8 oz. per acre.
- **Gavel 75 DF -** This fungicide has the same active ingredient as other mancozeb fungicides (e.g., Dithane, Manzate, Penncozeb, etc.) plus zoximide, primarily for downy mildew control. On cucurbits, the fungicide is labeled for Alternaria leaf blight, Cercospera spot, downy mildew and fruit and stem rot caused by *Phytophthora* spp. The rate is 1.5 to 2 lb. per acre. Observe a 48 hour REI and a 5 day PHI. Some muskmelon varieties are sensitive to Gavel. Several precautions are listed on the label for downy mildew control.

Downy mildew on pumpkin

Microdochium blight on the stem and the fruit of pumpkin

Always consult the label before any pesticide application. Many important details are listed on the label.

Winter Survival and Insect Management in Early Season - (*Frankie Lam and Rick Foster*) – Winter survival of insects depends on both physical and biological factors. Physical factors include temperature, precipitation, and relative humidity of the overwintering habitats, whereas the biological factors include diseases and predation on the overwintering populations. Although winter temperature is usually regarded as one of the most important factors affecting the overwintering populations, insect pathogens also have a critical effect on the fitness of an individual insect through winter. Moreover, spring temperature, precipitation and date of planting are equally important in affecting insect infestation during the season.

The following table lists the overwintering stages and habitats of insects and related species in vegetables and melons in Indiana. Most of the overwintering habitats are protected areas, such as under leaf litter, crop residue, trash, or in the soil. These environments have buffering microhabitats that maintain a relatively stable condition for the overwintering insects and enhance their survival.

The temperature of the past winter was much colder than that of a normal year in Indiana (Please read the article, *Winter Temperatures (2002-2003) and Survival of Insects in Indiana*, in this issue). It is possible that the insect numbers in the early season would be slightly smaller than that of last spring. However, if you had a relatively high number of a given insect pest in your field during the past season, do not expect that there would be a dramatic decrease of that insect population in this year. Although cold winter temperatures have a detrimental effect on the survival of overwintering populations, ecologically it requires consecutive years of cold winters to knock down a relatively high population to "normal density." In addition, if the weather of the coming season is favorable for the development of that particular species, population outbreaks still might occur in the mid or late season.

With the past cold winter, late planting may not have to be considered for insect management, however we have to consider the weather for planting during spring. Furthermore, predicting the number of insects in the early season is like forecasting the weather, not very precise. No matter how accurate the prediction might be, it should only be considered a guideline and not a "fact." That means, for management strategies we still have to scout the field frequently after the crop is planted or transplanted. Consult your county educators and extension entomologists as soon as insect infestation is found in the field and make a management decision before the pest population builds up.

Table 1. Insects and related species overwintering stages and habitats.

Insects and Related Species	Overwintering Stage	Overwintering Habitat
Aphids	Egg	On stems and nodes of perennial plants
Asparagus beetles	Adult	Under protected Shelters[1]
Black cutworm	--	Note in the Midwest
Colorado potato beetle	Adult	In soil
Cucumber beetles	Adult	Under leaf litter of woody area
European Corn Borer	Larva	Inside corn or weed stalks
Flea beetles	Adult	Under protected shelters
Hornworms	Pupa	In soil
Japanese beetle	Larva (grub)	In soil
Lacewings	Adult	Under protected shelters
Lady beetles	Adult	Under leaf litter of woody areas
Onion thrips	Nymph and adult	On plants or under leaf litter
Potato leafhopper	--	Not in the Midwest
Seedcorn maggot	Larva	In soil
Squash bub	Adult	Under protected shelters
Squash Vine Borer	Larva	In soil
Tranished plant bug	Nymph and adult	Under protected shelters
Tomato fruitworm	Pupa	In soil (sout of I-80)
Twospotted spider mite	Female adult	Under protected shelters
Wireworms	Larva and adult	In soil

[1]Under leaves, grass, residue or trash in the field and wood areas, along ditch banks, and similar protected places.

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