

PLANT & PEST ADVISORY

VEGETABLE CROPS EDITION \$1.50

OCTOBER 3, 2001



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Preventing Damage from an Early Frost

Stephen Reiners, Associate Professor in Horticultural Sciences, Cornell University

Reprinted from Long Island Fruit & Vegetable Update, No. 27, Sept. 7, 2001.

An early frost can have disastrous results. There are two types of frost, advective or radiation. Advective frosts occur when a cold front sweeps into an area. Winds are typically gusty, clouds may occur and the thickness of the cold air layer may reach more than a mile high. One seldom sees the first frost of the season under these conditions. The first frost is typically a radiation frost. These occur under a clear sky and calm winds. Typically an inversion layer develops. The term inversion means that atmospheric conditions are inverse or opposite to normal daytime conditions when air temperature decreases with height. In an inversion, cold air collects near the ground while warmer air lies above this trapped cold layer.

Typically, we may have 3 – 5 weeks of good weather following a frost but the crops have already been damaged or killed. Rather than just talking about the weather, there are several things that growers can do to minimize the effects of the first radiation frost. These include:

Watch the Calendar and the Forecast

Know when the average first frost will be in your area. This is the date by which a frost will occur 50% of the time. In looking over weather records in upstate New York over the past 50 years, it seems that this date is coming later each decade (although the date of the last spring frost has not changed much). Keep a careful eye on the weather forecast too. Air with a low humidity will not hold as much heat as more humid air and will cool quickly at night.

Beware the Full Moon?

People have always associated the full moon with an increased chance of frost, the belief being that the moon reflects heat from the sun to the earth's upper atmosphere. This heat effect, though small, is at a maximum near the time of full moon. The heat evaporates as a light haze or thin cloud formations. Clearing the sky in that way, heat radiates from the surface of the earth and frost is more likely. However, in reviewing weather records of four locations in the Northeast for the last 100 years, a full moon did not increase the

SEE EARLY FROST ON PAGE 2

chance of a frost. It was just as likely to occur when no moon was present as when the moon was full!

Harvest Early

A crop like tomatoes is very sensitive to frost. If you have no way to protect plants, you may want to harvest all fruit that are in the mature green state of ripening. Fruit harvested at this stage will still ripen, albeit not with the same flavor as fruit harvested with some color. Since you will need to store the fruit, wash in a chlorine bath. Dry and place in boxes in a warm, dark location with some air movement. Tomatoes do not need light to ripen, in fact, light will slow ripening. Store where the temperature does not go below 55°F. Lower temperatures will cause the fruit to be poorly flavored.

Use the Soil

Your soil serves as a heat reservoir. As it may take a while in the spring for a soil to warm, it also takes time in the fall for it to cool. A loose, cultivated field insulates the soil and prevents heat movement from the soil to the air (and around the plants). This results in frost. A more compacted soil, typical of a field near the end of the season, will lose heat more quickly to the air, protecting the plants from frost. The bottom line - do not cultivate when a frost threatens.

Irrigate Before the Frost

A moist soil can hold 4 times more heat than a dry soil. It will also conduct heat to the soil surface faster than a dry soil, aiding in frost prevention. In a study performed years ago, the air temperature above a wet soil was 5°F higher than that above a dry soil and the difference was maintained until 6 am the next morning.

Row Covers

The use of a floating row cover can give you 2°F to 5°F protection. The covers can be laid right over the crop and no support other than the plants is needed. They come in varying lengths and widths, depending on your need. The cost can be high as the material will cost \$500 - \$700 per acre. You will also need additional labor to help you get the covers on the crop. The best time to apply would be in the late afternoon after the wind has died down. Remove the next morning. If you are careful and avoid ripping the covers you should be able to use the covers over several nights and even next year.

Irrigate During the Potential Frost

Strawberry growers often irrigate their crop on a potentially frosty spring night to protect the crop. Typically, sprinklers are mounted above the crop canopy. As the water freezes, heat is released, 80 calories for each gram of water that freezes. As long as ice is being formed, heat will be released. Often the crop is coated with ice by morning. In fact, this is

a major disadvantage as the weight of the ice will cause branches to break and plants to lodge. Also, if the irrigation rate is not high enough, you may actually cause more frost damage than if you did not irrigate. That's because if the one gram of water evaporates rather than freezes, it takes 600 calories of heat with it, cooling the environment around the plant. Compared to the 80 calories released on freezing, 7.5 times more water must be applied to provide a net heating effect. Since wind will speed evaporation, wind speeds greater than 5 MPH will make irrigation for frost protection ineffective. And once started, you cannot stop irrigating until the next morning when the sun is on the crop and the ice loosens.

Chemical Sprays

Buyer beware! Many materials will claim to provide frost protection using a variety of techniques. No commercially available product seems to be able to stand up to a replicated, scientific test. There will be some people claiming to have miracle products this fall but use them with caution. Do not put your trust in these materials.

Heaters

This has traditionally been used in some areas but the high cost of fuel makes it somewhat prohibitive. They are also more effective in orchards with tree fruit than for vegetables. They can burn propane, natural gas or oil. They are most useful when there is an inversion. The heaters break down the inversion and mix the warmer air with the cooler. Most of the protection from heaters is due to this with only a slight effect from radiated heat from the heaters.

Wind Machines

These are more often seen in orchards, similar to heaters but they could provide protection for vegetables. Like heaters, they work best when there is an inversion and warm air from above is mixed with the cold air at the surface. Typically, the fans have a diameter of about 16 feet and are mounted on a 30-foot steel tower. The engine to power the fan is usually 85 to 100 hp. The cost of installation is similar to heaters but they use only about 10% of the energy that heaters do. A single wind machine can protect 5 to 10 relatively flat acres.

Be prepared for an early frost. Use more costly methods of frost protection on your most profitable crops. By protecting your crop from that first frost, you may add weeks to your growing season.

Submitted by Wes Kline, Cumberland County Agricultural Agent. □

Vegetable Crops Diseases

Stephen A. Johnston, Specialist in Plant Pathology

✓ General:

- Take soil samples from fields in the fall, and have them assayed for plant parasitic nematodes at the Rutgers Plant Diagnostic Lab in New Brunswick. Fields with high levels of plant parasitic nematodes should be fumigated to reduce the population level low enough to avoid damage to next season's crops. Soils can be fumigated up until Thanksgiving in most areas of the state. Soil temperature at the time of treatment should be 50°F or above.

- Also, have a soil test done on the soil sample to determine the pH. Fields with low pH (below 6.5) should be limed this fall or winter in order for enough time to allow the pH to raise to the proper level for next season.

- Thoroughly incorporate crops into the soil following the last harvest in order to promote microbial breakdown of the plant debris. Once the crop is completely decomposed, pathogens present on the debris will be destroyed also. Without incorporation in the soil, pathogens can survive on the previous crop debris, and be present next season to start disease epidemics.

- Plan next season's crop rotation pattern to avoid planting the same crop in the same field. Also, avoid planting susceptible crops in the same field next year (i.e. do not plant peppers in a field that had cucurbits the previous year to reduce incidence of **Phytophthora blight**).

- Review seed catalogs this winter to determine the latest disease resistant varieties. Use these varieties whenever possible to reduce disease epidemics next season.

- Attend winter crop production meetings to hear the latest disease management information. Valuable information is generally obtained from interactions with speakers and other growers that cannot be obtained from written documents.

- ✓ **Asparagus:** After the brush has turned brown this winter, mow it off and incorporate into the soil as much as possible to destroy the fungus that causes **purple spot**. Waiting until next spring to destroy the brush will result in a high level of inoculum survival for next season's crop. Fungicide application is not effective on newly emerging spears; therefore, the only means of control of **purple spot** is through the destruction of the brush, and subsequent microbial breakdown of the plant debris in the soil.

- ✓ **Bean:** Scout lima bean fields for the presence of **downy mildew**. The disease will occur when fields receive 1.2 inches or more of rain within 7 days, and

when the daily temperature during this period is 78°F or less. Apply a copper fungicide at 2 lb/A for control.

- ✓ **Broccoli raab:** **Bacterial leaf spot** is present in some fields at this time. Infected plants have numerous small, tan, circular lesions scattered over the leaf surface. Infected leaves rapidly decompose. Avoid working in fields while the foliage is wet to reduce spread.

- ✓ **Carrot:** Fungicide applications for control of **leaf blights** are warranted until frost.

- ✓ **Cole crops:** **Downy mildew** is present in several cole crops at this time. Lower leaves on infected plants contain several circular yellow lesions, and on the underside of the lesion there is short white sporulation of the fungus present that can best be seen early in the morning. Maintain applications of maneb or chlorothalonil (Bravo or Equus) every 7-10 days for control of **downy mildew** and **Alternaria leaf spot**. Following the production season, take soil samples from fields where cole crops will be produced next year. If the pH is less than 7.0, add lime this fall or winter in order to allow enough time for the pH to raise before next year's crop to reduce the incidence of **clubroot**. In order to have a low incidence of **clubroot**, the soil pH should be 7.0 or above.

- ✓ **Corn, sweet:** Thoroughly incorporate stalks into the soil following the harvest period in order to reduce the overwintering inoculum of **leaf blights** and **rust**.

- ✓ **Cucumber:** Excellent control of **root-knot nematodes** was obtained this fall in a field experiment in Salem County where Vapam was injected into the drip irrigation system 2 weeks prior to seeding and followed with an application of Vydate L through the drip at mid-season.

- ✓ **Greens:** **Downy mildew** is present on turnip greens at this time. Infected leaves have large, circular, chlorotic lesions present, and beneath the lesions on the underside of the leaf is short, white sporulation of the fungus. Apply Aliette as a foliar spray for control.

- ✓ **Leeks:** Maintain fungicide applications at 10-day intervals for control of **purple blotch**. In addition to chlorothalonil (Bravo, Echo, Equus), Quadris 2.1F is also labeled for control. Apply Quadris at 6.2-12.3 fl oz/A for control.

- ✓ **Lettuce, endive and escarole:** Avoid excess soil moisture by producing the crop on raised beds, and improving the drainage in fields to reduce incidence of **corky root**. Apply Ronilan or Rovral as a directed spray to the base of the plants shortly after thinning or transplanting, and repeat 10 and 20 days later for control of **drop (Sclerotinia)**. For control of **bottom rot (Rhizoctonia)** only use Rovral.

- ✓ **Parsley:** Apply Quadris 2F as a foliar spray every 7-14 days for control of **Septoria leaf spot**. In order to prevent the development of resistant strains

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of the pathogen to Quadris, do not make more than 2 applications/crop. If a third fungicide application is needed prior to harvest, apply a copper fungicide. Apply mefenoxam (Ridomil Gold 4E, Ultra Flourish 2E) as a soil surface application prior to emergence to control **damping-off**.

✓ **Pepper: Anthracnose** is present on red fruit at this time. Infected fruit have sunken circular lesions with black centers. Applications of maneb once the fruit are formed, and continued every 7-10 days would have assisted in control. Be sure to thoroughly incorporate crop debris in the soil to destroy overwintering inoculum of **bacterial spot**. Remove stakes from fields and clean as much plant debris and soil as possible to reduce inoculum for next year's crop.

✓ **Potato, sweet:** Care must be taken when harvesting potatoes to avoid injury, and potatoes need to be cured as soon as possible after harvest to prevent **surface rot & soft rot**. Potatoes should be cured at 80-85°F and 90% relative humidity for 6-8 days. After curing, temperature should be lowered to 55°F and 90% relative humidity.

✓ **Pumpkins & winter squash:** Harvest fruit as soon as possible, and remove from field to avoid **Phytophthora fruit rot**. **Fusarium fruit rot** is present in some fields at this time. Infected fruit have small dry, pitted or larger sunken, circular areas covered with gray or white mold. Long rotations away from pumpkins will assist in reducing the incidence of the disease in future years.

✓ **Spinach:** Observe fields for the presence of **white rust**. Once observed, apply a copper fungicide if the planting is young. If the planting is closer to harvest, apply Quadris at 6.2 fl oz/A. Do not make more than 2 consecutive applications of Quadris to avoid the development of resistant strains of the pathogen.

✓ **Tomato:** Be sure to thoroughly incorporate crop debris in the soil to destroy overwintering inoculum of **bacterial diseases**. Remove stakes from fields and clean off as much plant debris and soil as possible to reduce inoculum for next year's crop. □

Pest Notes

Gerald M. Ghidui, Ph.D., Specialist in Vegetable Entomology

The fall "worm" pests that are usually a pest at this time of the year have not been reported in high numbers throughout the state. **Cabbage loopers** are the primary pest at this time, with anywhere from 1 to 5 **loopers** per 10 cabbage heads. **Imported cabbageworms** and **diamondback moth** larvae remain at low numbers throughout most of the southern areas of the state.

Closely monitor both the feeding damage and the numbers of these pests on cabbage and other cole crops. If 5% or more of the heads are infested, treatments are justified. It is important to identify the species of worm pests because different species are controlled with different insecticides, and some materials do not work against certain worm pests.

Cabbage loopers are best controlled with a biological insecticide (*B.t.*), a pyrethroid (Ammo, Asana, Ambush, Pounce, Warrior), or Lannate, Larvin, SpinTor, or Thiodan. Two new materials, Confirm and Proclaim, are new classes of insecticides that are also effective, and have a completely different mode-of-action than the others.

For **imported cabbageworms**, all of the above are effective, as well as Lorsban (note: Lorsban is not effective against cabbage looper and diamondback moth larvae).

For **diamondback moth** larvae, it is recommended to use any of the new biological insecticides (*B.t.*'s) that have this pest on the label (including Agree, Biobit, Condor, Crymax, Cutlass, DiPel 2X, Javelin, Ketch, Lepinox, Mattch, Prolong, XenTari, Proclaim, or SpinTor). **Diamondback moth** larvae are reported to be resistant to most other pest control materials, including pyrethroids. Overuse of any one class of insecticide may result in development of resistance to that class of insecticides (diamondback moth resistance to nearly everything, including SpinTor, is reported from several southern locations because of heavy use of those insecticides). It is important to obtain good coverage, apply when larvae appear, and rotate classes of insecticides.

Refer to pages 88-90 of the *2001 Commercial Vegetable Production Recommendations for New Jersey* for more information on rates, restrictions, and management of these pests on cole crops. □

IPM Update

Kristian Holmstrom and Sarah Walker, Program Associates in Vegetable IPM

Lettuce

The adult **corn earworm** (CEW) population has significantly declined as a result of the cooler weather (see the sweet corn section below for local counts). Continue to monitor fields weekly for the presence of larvae, especially prior to the heading stage.

Spinach

The **beet armyworm** (BAW) moth counts from pheromone traps located in Cumberland, Salem, and Burlington Counties have dropped significantly with the cool weather this past week. From the traps we have been operating it does not appear to be a year where BAW will be a huge problem. The main activity has been sporadic and located primarily in Cumberland County. Small BAW larvae were observed in a spinach field there last week. Some fields have been treated, and no new infestations of either **webworms** or **BAW** were seen this week. While the cooler weather should significantly slow insect activity, continue to check fields at least once a week to make sure new infestations are not occurring.

Cole Crops

Plantings of broccoli, cabbage, etc. that have been treated within the past two weeks for **imported cabbage worm**, **cabbage looper** and **diamondback moth** larvae remain relatively clean through this week. Reinfestation does not appear to be occurring quickly, probably due to lower temperatures. As temperatures rise, be sure to check fields weekly for the presence of these pests.

Alternaria is increasing in some scouted plantings in the northern counties. It is important to apply fungicides on a preventive basis for this disease as well as **downy mildew**. See the *2001 Commercial Vegetable Production Recommendations* for products and treatment intervals.

Pumpkin

The pumpkin crop is largely mature now in New Jersey. Consider removing fruit from the field whenever possible to prevent injury from insects, rodents, and deer. **Phytophthora** infections on fruit have appeared sporadically in some scouted fields. Prompt removal of fruit will reduce losses from this disease.

Sweet Corn

Most, if not all remaining plantings are now silking. The late **European corn borer** flight is now over. The remaining pest to consider is **corn earworm** (CEW). Cooler weather has depressed CEW moth numbers over the past week, but they should rebound somewhat with warmer evening tempera-

tures. All silking sweet corn should be on a regular spray schedule to prevent injury from CEW.

The highest average nightly **CEW** blacklight trap catches are:

East Vineland	8	Shirley	3	Medford	2
Hammonton	6	Centerton	2	Seely Lake	2
Jones Island	6	Cohansey	2	Springdale	1
Elm	5	Elmer	2	Tabernacle	1

General Sweet Corn Spray Schedule*

Silking corn:	South	3-day
	Central	3-day
	North	3-4-day

Field Cleanup

Don't forget to clean up your fields as soon as possible when harvests are completed. The practice of field sanitation, whereby crop residues are promptly and thoroughly destroyed and incorporated into the soil, is an important and basic pest management strategy. The prompt destruction of the crop will help eliminate overwintering insect populations as well as reduce the disease inoculum that can survive on infected plant tissue. For example, **European corn borers** overwinter as larvae in the stalks and stubble of corn left in the field, so make sure to thoroughly chop up and incorporate the plant material into the soil. For **black rot** infections of cole crops, and **bacterial diseases** of tomatoes, peppers, and cucurbit crops, make sure to completely incorporate the plant debris into the soil to facilitate decomposition of the plant material. Over the winter asparagus brush should be burned, or mowed and disked, to help destroy fungi like **rust** and **purple spot** that overwinter on the infected plant material. Consult the *2001 Commercial Vegetable Production Recommendations* book for the crops you grow to make sure you are doing all you can in the area of field sanitation since what you do now can have a major impact on next year's crops. □

Rutgers Plant Diagnostic Laboratory

The Plant Diagnostic Laboratory and Nematode Detection Service is a diagnostic service available to the residents of the State of New Jersey. The mission of the Plant Diagnostic Laboratory is to cooperate with Rutgers Cooperative Extension personnel to provide the residents of New Jersey with accurate and timely diagnoses of plant problems. There is a fee for this service.

The laboratory was established in 1991 on the Cook College campus of Rutgers, The State University of New Jersey.

- ❖ Diagnostic Services
- ❖ Disease and Insect Pest Diagnosis
- ❖ Plant and Weed Identification
- ❖ Insect Identification
- ❖ Nematode Assays
- ❖ Screening for Acremonium Endophytes
- ❖ Benzimidazole Fungicide Resistance Screening
- ❖ Other Services Available by Contract

Fees

All In-State Samples (except fine turf) . \$20
In-State Fine Turf \$50
All Out-of-State Samples \$75
Other Services Negotiable

For sample submission instructions and forms, visit our web site at: <http://www.rce.rutgers.edu/plantdiagnosticlab/submissions.html>

Forms may also be obtained from your local county Rutgers Cooperative Extension office or via fax request (732/932-1270). □

Plastic Mulch Increases Soil Erosion, Runoff

Reprinted from Journal of Environmental Quality, Vol. 30, Sept. - Oct. 2001.

Fresh-market tomatoes are often grown in raised beds covered with plastic (polyethylene) mulch. Because 50 to 75% of the field is covered with an impervious plastic surface, there will be an increase in the quantity of runoff produced during rain events. A study by Rice et al. reports a significant increase in surface runoff volume, soil erosion with runoff, and the quantity of pesticides measured in runoff from vegetable plots with plastic mulch compared with plots with hairy vetch. Results suggest that fresh-market vegetable production with plastic mulch may have a more harmful impact on the environment than production with the vegetative mulch.

P.J. Rice, Runoff Loss of Pesticides and Soil: A Comparison between Vegetative Mulch and Plastic Mulch in Vegetable Production Systems. J. Environ. Qual. 30: 1808-1821.

Submitted by Joseph Heckman, Specialist in Soil Fertility. □

Will Soil Survive Copper Pesticides?

Reprinted from Journal of Environmental Quality, Vol. 30, Sept. - Oct. 2001.

Copper (Cu) sprays are widely used agriculturally to control plant diseases and are acceptable in organic agriculture, partly because Cu is a natural product with relatively low mammalian toxicity. A study by Epstein and Bassein estimated the amount of Cu that loaded into soil in fields where multiple pesticide applications are made each year. Because Cu tends to accumulate in the topsoil, and many soil microorganisms that are essential for long-term soil function are harmed by Cu, the authors question whether current use of Cu is a sustainable practice in some fruit and nut orchards that are heavily treated.

L. Epstein, Pesticide Applications of Copper on Perennial Crops in California, 1993 to 1998. J. Environ. Qual. 30: 1844-1847.

Submitted by Joseph Heckman, Specialist in Soil Fertility. □

Editor's Note: This is the last issue of the Vegetable Crops edition of the Plant & Pest Advisory for the 2001 season. Thank you for subscribing.

Weekly Weather Summary

Keith Arnesen, Ph.D., Agricultural Meteorologist

Temperatures averaged below normal. Extremes were 82 degrees at Seabrook and Pemberton on the 25th and 38 degrees at Charlotteburg on the 26th. Weekly rainfall averaged 0.97 inches north, 1.13 inches central, and 0.92 inches south. The heaviest 24 hour total reported was 1.75 inches at Long Branch on the 30th to 1st. Estimated soil moisture, in percent of field capacity, this past week averaged 97 percent north, 86 percent central and 63 percent south. Four inch soil temperatures averaged 56 degrees north, 63 degrees central and 63 degrees south.

Weather Summary for the Week Ending 8 am Monday 10/ 1/01

WEATHER STATIONS	RAINFALL			TEMPERATURE				GDD BASE50		MON %FC
	WEEK	TOTAL	DEP	MX	MN	AVG	DEP	TOT	DEP	
BELVIDERE BRIDGE	1.32	26.72	-1.85	79	41	56.	-2	2883	269	93
CANOE BROOK	.92	28.15	-1.89	79	42	56.	-2	3063	434	100
CHARLOTTEBURG	.79	24.77	-5.57	76	38	55.	-1	2522	443	93
FLEMINGTON	.95	35.69	7.04	78	41	55.	-4	2792	97	96
LONG VALLEY	DATA MISSING									
NEWTON	.87	22.14	-5.76	77	39	54.	-2	2620	285	92
FREEHOLD	.93	25.00	-2.80	80	44	59.	-1	3260	385	93
LONG BRANCH	2.04	28.82	.68	74	46	59.	-2	2990	171	100
NEW BRUNSWICK	.90	29.16	.86	80	43	58.	-3	3087	83	97
PEMBERTON	1.20	23.73	-4.75	82	43	58.	-3	3330	383	100
TOMS RIVER	.93	27.67	-1.12	78	44	59.	-1	3101	281	100
TRENTON	.76	27.31	.55	81	43	58.	-4	3202	73	81
CAPE MAY COURT HOUSE	1.02	22.62	-2.36	80	46	60.	-4	3318	438	71
DOWNSTOWN	.79	20.28	-5.87	80	42	58.	-4	3173	24	83
GLASSBORO	1.06	22.93	-4.63	81	46	59.	-3	3500	389	96
HAMMONTON	.98	18.90	-8.62	80	44	59.	-2	3305	188	86
POMONA	1.01	17.45	-7.32	78	43	59.	-2	3197	302	80
SEABROOK	.98	25.82	.57	82	45	58.	-4	3452	282	85
ATLANTIC CITY MARINA	.59	16.70	-7.17	79	48	60.	-3	3312	414	57
SOUTH HARRISON	.66	24.46	-2.50	79	44	59	NA	3346	NA	NA

*Some values for Flemington were estimated for the period April-May

WES KLINE — GDD BASE 40 PINEY HOLLOW

Last Week 193 (Ending 9/24/01)

This Week 125 (Ending 10/01/01)

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