

Understanding Frost

From Cornell Cooperative Extension, Chemung County

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In spring and fall, the very mention of frost sends gardeners scurrying for sheets, boxes, jars, floating row covers, the sprinkler system, or whatever they can scrounge to keep their plants safe from a possible cold snap. Just what is frost, and what does it do? How do your protective measures work?

There are two types of frost, advective and 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.

On overcast nights, cloud cover acts like a blanket on the Earth, trapping radiant heat from the ground. Any wind mixes the air thus trapped, creating a uniform temperature. However, clear skies and calm winds allow radiant heat from the Earth to rise to the upper layers of the atmosphere. Lack of wind prevents mixing of the air and an inversion layer develops. An inversion means that atmospheric conditions are inverse or opposite of 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.

The topography of the land also affects frost prevalence. Cool air settles at the bottom of slopes because it is heavier than warm air. Frost pockets will then form in valleys where cool air is trapped. Higher altitudes also have colder temperatures. Therefore you are apt to see frost damage at the bottom of slopes and

on the hilltops, while the hillsides are frost-free. On any given property, there may be temperatures on different sides of the house, under protective trees, on south or north facing slopes, or in low-lying spots.

Frost warnings signal us that our plants may be in trouble. However, the essential criterion in damaging plants is not the appearance of frost, but the internal temperature in various tissues of the plant. If this is cold enough to break cell walls or disrupt cell constituents beyond repair, damage, wilting, and death will occur in affected tissues. Frost will not always cause this degree of chilling within plant tissue, nor is it the only cause.

Typically, we may have 3 to 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 gardeners can do to minimize the effects of the first radiation frost. These include:

Watch the calendar and the forecast – Know when the average first fall 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 in fall each decade (although the date of the last spring frost has not changed much). Keep a careful eye on the weather forecast too. Cool, clear nights with low humidity, often following a cold front, are signs of an impending frost.

Beware the Full Moon? – People have always associated the full moon with an increased chance of frost. However, in reviewing weather records of four locations in the Northeast for

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the last 100 years, a full moon did not increase the 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 stage of ripening. Fruit harvested at this stage will still ripen, albeit not with the same flavor as fruit harvested with some color. Place fruit in a single layer in a warm, dark location with some air movement. Tomatoes and other fruit 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.

Irrigate before the frost – A moist soil can hold four 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 degrees F higher than that above a dry soil and the difference was maintained until 6 a.m. the next morning. Thus, plants should be well watered the evening before a frost.

Cover your plants – Covering plants can give you 2 to 5 degrees F protection. The covers can be laid right over the crop, or can be supported on stakes. The difference being that protection is less wherever the cover touches the plant. Any material can be used to cover the plants, however woven fabrics are better insulators than plastics or paper. The best time to apply covers is in the late afternoon after the wind has died down. Remove covers the next morning before the sun hits them.

Irrigate during the potential frost – Many people claim that watering the frost off plants prevents frost damage. This is partially true. As mentioned above, watering plants helps raise their temperature and the air around them to that of the water. In addition, as water freezes, heat is released; 80 calories for each

gram of water that freezes. Therefore, watering plants before they are injured from frost can help keep their internal temperature above freezing. A single application at the coldest part of the night (generally just before sunrise) may be enough on 30- to 32-degree F nights. On colder nights it may be necessary to apply overhead irrigation for an extended period of time, allowing actual ice formation on the plants. In this case, irrigation must continue until morning temperatures rise above 32 F and the ice melts. It is important to note that once frost damage occurs, watering does not help.

Chemical sprays – Buyer beware! Many materials will claim to provide frost protection using a variety of techniques. However, no commercially available product seems to be able to stand up to a replicated, scientific test.

Heaters and wind machines – These measures are generally restricted to commercial growers and work best in orchards. Both are used to break down an inversion layer. Heaters warm the cold ground air, causing it to rise. This updraft causes a corresponding downdraft, thus mixing the air. Wind machines are huge fans mounted on thirty-foot towers. The wind currents they create physically mix the warm and cold air layers.

Whatever frost protection measures we use, winter will eventually end our growing season. The time will come to say goodbye to our garden and begin chores left undone for so long under the pretext that, “there will be more time in winter!”

Compiled by Eric de Long Chemung 9/01

References

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