

Frost and freeze protection for nursery crop

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These techniques can help nurseries reduce late frost damage when Michigan temperatures return to normal.

The current record warm temperatures this early in the season means that plants are going to be susceptible to cold damage as winter temperatures return. Plants can be provided some protection as temperatures return to normal by covering with blanket-type materials or using wind machines. Heaters are effective, but cost prohibitive for use in open fields. Finally, irrigation can be used to provide protection from frosts depending on the irrigation system. The effectiveness of any of these techniques depends on the severity, duration, and type of event for which protection is being attempted.

Frost versus freeze

When listening to weather reports, you will hear the terms frost and freeze. Distinguishing between the two types of events is important when implementing cold protection. Freezes occur when a windborne (wind speeds usually above 5 mph) cold air mass moves into an area bringing temperatures below 32°F. The thickness of the cold air mass is usually between 500 to 5,000 feet. Frosts occur when the sky is clear and winds are calm, creating a temperature inversion (temperatures near the ground surface drop below freezing while higher air is warmer).

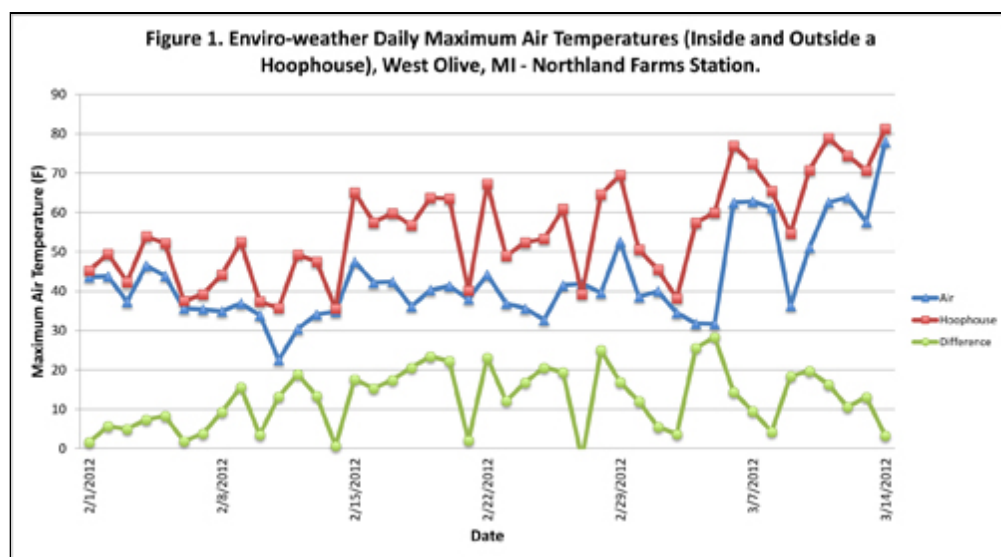
Winter blankets

Cold protection is difficult for freezes because of higher wind speeds and the thickness of the cold air mass. Covering plants with lightweight fabric helps to trap radiant heat from the ground around the plant canopy and help prevent air temperatures from dropping below freezing. Some key considerations for using frost fabrics: use light-colored, woven or non-woven materials that can breathe; avoid dark-colors and impermeable materials;

and remove frost blankets as soon as temperatures rise above freezing – heat can build quickly under covers once the sun comes out. Snow is also still a possibility and snow on top of blankets can cause breakage to plants. Make sure the fabric is held securely in place in case the wind should pick up. Plant size and spacing limit the practicality of blankets; smaller, shorter, tightly-spaced plants can more effectively be covered than large plants on wide spacings.

Hoophouses

Hoophouses are very effective for freezes since they eliminate the effect of wind speed and allow use of more techniques than unprotected plantings. Properly ventilated houses will help reduce plant susceptibility to cold temperatures, although the unusually warm weather and high light conditions resulted in temperatures up to 28°F higher in hoophouses than outside (Figure 1) at the Enviro-weather station in West Olive, Mich., at Northland Farms. As temperatures drop, closing vents and covering plants inside hoophouses with an additional layer of a blanket material will provide additional cold protection. However, in the daytime as temperatures increase, especially on sunny days, removing blankets and opening doors and vents will be necessary. Heaters can be used to maintain hoophouses above freezing if available, although costs will be a factor. Heating houses with higher value crops might make sense. Irrigation (see below) can also be used inside hoophouses to provide cold protection and can be very effective since wind speed is practically zero in hoophouses. However, diseases and other pests can become a problem due to poor drainage and high humidity. If plants are elevated from the ground, drainage will be less of an issue.



[Click here](#) to view larger image.

Irrigation for frost protection

Irrigation can be used for frost (not freeze!) protection in many horticultural settings. The irrigation application rate and wind speed are critical in the effectiveness of irrigation for frost protection. Irrigation can protect plants from frost damage since a small amount of heat is released as water changes from liquid to solid; however, if the application rate is not fast enough or wind speeds are too high, more damage can be done to the plants than if protection was not attempted. Water removes much more heat from the air as it evaporates (think evaporative cooling) than it provides when it freezes. If evaporation occurs as you are applying water, you will be dropping temperatures around the plants rather than protecting them. Also for this reason, it is essential that irrigation be run consistently throughout the frost event to provide protection so that new ice is constantly formed.

Irrigation should be discontinued once temperatures rise back above freezing. Generally, irrigation is not effective for wind speeds higher than 5 mph for taller plants and 10 mph for plants growing close to the ground. When using irrigation in hoopouses, once temperatures outside rise above freezing, ventilate houses to reduce humidity, increase air flow, and help minimize disease problems. Ice buildup and damage must be considered as well as saturating the soil (flooding damage and disease problems). For an excellent discussion of irrigation for frost protection, see Chapter 12 of "[Irrigation of Forest Tree Nurseries](#)" in the [Forest Nursery Manual](#). Also, see "[Guide to Deciding When to Start and Stop Irrigation for Frost Protection of Fruit Crops](#)," especially Table 2 for irrigation rates needed for various temperatures and wind speeds.

Wind machines in frost situations

Wind machines are also practical for certain frost situations. Under frost conditions, air further from the ground surface is warmer so wind machines redistribute the warmer air to crop level. The temperature differential between the surface, the effective mixing height of the wind machine, and the effective radius of mixing (motor horsepower/air flow rate) determines the amount of protection that can be provided. Wind machines are not effective for freeze situations.

Unfortunately, most of these techniques require pre-existing installation. Winter blankets are the main exception. These techniques also require appropriate management and implementation under proper conditions. Using techniques that only work for frosts will not be effective, and possibly counterproductive, under freezes. Make sure that protection is provided until temperatures rise above freezing. Also, remember that these techniques may have consequences for production decisions as we move into spring. Biotic and

abiotic stresses can result from blankets and irrigation. Irrigation, especially if soils become saturated, should be considered when implementing fertilizer programs. Saturated soils can also affect timing of cultural practices by delaying access to fields.

It is very likely that winter damage will occur this year. For information on handling winter-damaged plants, see MSU Extension News articles “Winter injury, a sure sign of spring,” and “Pruning frost-damaged plants.”

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