

Extending the Growing Season Protecting Plants from Frosts and Freezes

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Fall, winter and spring bring the danger of frosts and freezes to our gardens and landscapes. An early fall frost can bring an end to our warm season gardens, while the threat of spring frosts make gamblers of tomato growers, and worriers of anyone with a peach tree in full bloom. Winter cold threatens plants that are marginal in our zone.

The Science of Frosts and Freezes



Freeze Damage

When the water inside a plant freezes it forms ice crystals that pierce the plant’s cell walls. When the temperature warms up, the cells leak out their fluids as they die and turn to mush. Freeze damage first shows up as dark, water-soaked tissues which then turn brown or black and dry up.

Frost appears on the surface of plant tissues and other exposed surfaces. During the night, these surfaces radiate heat to the sky. When the temperature of an object drops to the dew point, the water vapor contacting the object freezes on the surface. This is similar to water condensing on your iced tea glass because the glass is colder than the air around it.

Can you have a frost without a freeze? The answer is yes...and no. It is possible for frost to form when the air temperature is above freezing. For example, solid surfaces lose heat faster than air on a cold night. The windshield on your car radiates its heat, dropping in temperature faster than the air around it. As a result, we see frost on a windshield when the surrounding landscape may not show frost. Those surfaces with exposure to clear sky cool more rapidly at night than understory plants or surfaces that have a shelter above them to slow their radiation loss.

Plants similarly may lose radiation on clear sky nights and be colder than the measured air temperature. On a cold night, the surface of a leaf can drop as much as 5 degrees Fahrenheit below the temperature of the air around it causing frost to form on its surface. So you can have a frost without the temperature of the air dropping below freezing, but frost is a sign that the plant tissues have dropped below freezing.

Anything that reflects the radiating heat back down will deter frost formation. For example, you may have noticed frost on your lawn where it is exposed to the sky but not beneath a tree canopy or picnic table. Clouds perform the same radiant heat-reflecting function. On a clear night, temperatures drop fast. On a cloudy night, some heat is reflected back to the ground slowing the temperature drop and in many cases preventing a frost.

Early fall or late spring radiative frosts are usually brief as the temperature drops just below freezing

at the end of the night and then rise above freezing soon after the sun comes up. We can do a lot to protect plants on a still night when the temperature doesn't drop too low and the duration is brief.

On the other hand, when a hard freeze hits with windy conditions and lasts for a day or more it is more difficult to protect our gardens. The wind displaces any heat that might have helped protect the plants and speeds cooling of plant tissues.

The first parts of plants to freeze are tender new growth and the areas between leaf veins where the leaf is thinnest. Some plants vary in cold hardiness as they grow and mature, and not all plant parts are equally cold hardy. Broccoli, for example, is quite hardy as a strong, growing plant but the flower buds, the part we eat, are much more sensitive to cold.

Plant Protection Techniques

Our Houston area winters are usually brief with moderate to cool temperatures typified by several mild frost events but only occasional severe freezes. Here are a few techniques to help avoid frost or freeze damage to landscape and garden plants.



Broccoli with Ice

Watering

Plants under drought stress are more susceptible to cold damage. Water plants several days before cold weather threatens to alleviate drought stress. Water is also a great "heat sink." That is, it holds warmth and releases it slowly over the course of a long cold evening. This alone won't provide protection from a hard freeze but can be used with covers to make a difference on mild frost night, and every little bit helps!

You may have also seen commercial fruit producers sprinkle plants with water on a cold night. This works because water gives off energy (heat) as it changes its state from liquid to solid (ice). A gallon of water weighs 8.3 pounds and yields 1,200 Btu's of heating power as it freezes. That is the key to using water to protect plants.

Water is sprinkled on the plants and then freezes releasing a small amount of heat as it changes from liquid to solid form. Then another water drop lands and freezes releasing more heat. As long as there is a thin layer of liquid water on the surface, the interior of the ice coating on a branch will not drop below about 32 degrees Fahrenheit. A common misconception is that the ice is insulating the plant tissues against the cold, but ice is a poor insulator, so once new droplets of water stop being applied, the leaves or branches also continue to cool below 32 degrees Fahrenheit and may be damaged.

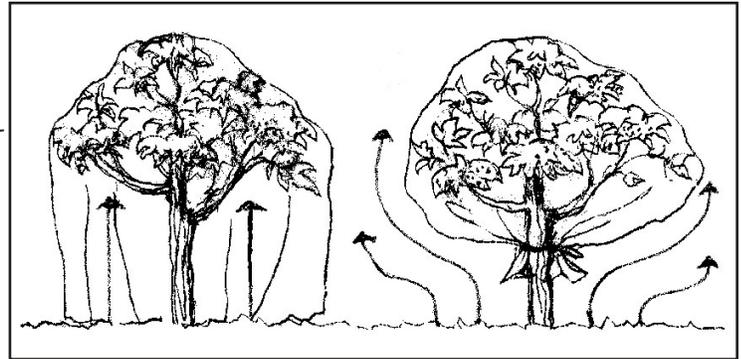
So why not just sprinkle plants and be done with all this worrying over freezes? If the freeze is not too severe or too long AND if you can install sprinklers that put out a small amount of water constantly over time, it could be a feasible strategy. However, lawn sprinklers put out too much water and when left on overnight can create very soggy soil conditions that exclude oxygen from a plant's roots. If the freeze lasts very long the accumulating ice load can break trees and shrubs, and flatten garden plants.

If you use sprinklers, you must start watering before the air temperature reaches 32 (so that sprinklers are not stopped up with ice) and continue to water through the night and next morning until the temperature rises far enough above 32 degrees Fahrenheit that the ice is rapidly melting. Otherwise the process works in reverse. As the ice goes from solid to liquid water it absorbs heat causing super cooling in the branch or leaf tissues inside the ice. A familiar example of this is homemade ice cream. When the salt causes the ice to change to liquid it pulls heat out of the ice cream mixture causing it to freeze! Therefore protecting plants with sprinklers, while possible in some situations requires a large volume of water and is seldom a

viable landscape or garden option.

Covering Plants

Covering plants with sheets, blankets, or rowcovers is the simplest, most practical way to protect against a frost or freeze. Keep in mind, however, that a blanket doesn't keep a plant warm, at least not to any significant degree. Blankets keep us warm because our bodies produce heat that the blanket helps hold in. If you wrap up the branches of a small tree or shrub with a blanket you aren't doing it much good other than some minor slowing of the cooling process. The practice of covering a plant and tying the cover to the trunk creates "landscape lollipops" which are still quite susceptible to the cold temperatures.



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On a cold night, warmth from the soil rises up around the plants. A blanket can help trap this warmer air within the plant's canopy and make a significant difference on a cold night. The air need not be warm, just warmer than freezing. If you keep the air temperature around plants from dropping below freezing you have accomplished your goal. Even cool soil is significantly warmer than freezing air and thus a source of "warmth" on a cold night.

To cover plants effectively, lay the cover over the plant and allow it to drape down to the soil on all sides. Then secure it with boards, bricks, rocks, or soil to hold in the air. Sealing the air inside the cover prevents a breeze from cooling the plant down faster. The next day, remove the covers to allow the sun to warm the soil surface a little and then replace the covers just before sundown, if another freeze is forecasted.

Spunbound polyester rowcover fabric works quite well in holding heat. The lighter weight types are not as effective as the heavier types, which are generally sold as "frost blankets".

When you run out of sheets, blankets, or frost cover material, you can use cardboard boxes and large garbage cans to cover plants. Plastic sheeting or any material that radiates its heat out quickly will freeze damage plant tissues where it touches them. Clear plastic also tends to not reflect the radiant heat back down as well. Plastic is good, however, for holding in the air on a windy night so it is sometimes helpful to cover the blanket or sheet with plastic when it is going to be breezy and cold.



Clear plastic hoop cover

Another technique is to set up hoop tunnels with 1/2" PVC pipe stuck into the ground to form a series of arched hoops down the row. You can also drive short sections of 3/8" rebar into the soil and then slide the PVC onto them. Space the hoops about 4 feet apart and attach another piece of PVC down the row along the top of the hoops for added support. The hoop tunnel is useful for preventing a tarp or other heavy material from crushing plants. Longer PVC arches can also be used to create a structure to hold a tarp over a citrus or other valuable small tree or shrub.

Adding Heat

Adding a source of heat beneath a cover can make a big difference, especially if you have a good cover that is secured to prevent wind from moving the warmer air out from beneath it. Common heat sources include



Milk jug for latent heat

a mechanic's light, a clamp on flood light, or a string of Christmas lights (the ones with large bulbs, not the very small ones that don't put out any heat). Check for shorts in the wiring and make sure rain or other moisture can't get into the fixtures. Don't allow a hot light bulb to come close to plant tissues or it can cause damage. When protecting small plants such as tomato transplants, a container of water such as a milk jug can provide a little warmth. Place one or two jugs right up against a new transplant to provide maximum protection. The larger the container of water, the more latent heat it can hold.

Soil and Mulch

Mulch is a great way to protect tender perennials that are marginally hardy in our climate. Prune back the plants to near the soil and cover it with a thick mulch of hay or leaves to hold in the soil's warmth.

Soil is also a good plant protector during freezes, because it transfers the heat of the earth to the plant parts that it contacts. Citrus growers often mound soil up around the base of the tree's trunk when a hard freeze is forecast. If the top portion of the tree is lost they will still have a strong root system and graft union above which a new tree can sprout and regrow, saving the expense of replanting new trees.

If you have citrus trees in the landscape, consider adding this measure of protection when a hard freeze is forecast. Use a loose, lightweight soil such as a sand or sandy loam and pull it back away after the danger of frost is past to avoid promoting rot diseases of the lower trunk. The soil mound should be in contact with the soil below the lower limbs and above the graft, but not heaped on top of mulch or leaves which breaks the contact of the soil mound with the soil in the surrounding earth.

Protecting Container Plants

The roots of plants growing in containers lack the insulation of the earth and will get much colder than roots of in-ground plants. Roots are often less hardy than the top portions of the plant, sustaining root death when temperatures in the container drops much below 32 degrees Fahrenheit.

A garage or other protected location is a good way to protect container plants during a killing freeze. The next best option is to mass the containers close together on a protected side of the home or other structure. For added protection pile leaves over the containers and/or place a tarp or blanket over them.

Assessing Damage After A Freeze

After a freeze is over, damaged plant tissues may show up immediately as water soaked or withering foliage. Cold damage to branches or trunks often doesn't show up right away. Wait a few days and then use a knife or thumbnail to scrape back the outer bark on young branches. Cold damaged areas will be brown beneath the bark, while healthy tissues will be green or a healthy creamy color. If in doubt, wait to prune out any cold damage until new growth begins in the spring. It will then be evident how far back to prune the plant to remove any freeze damaged areas.



Checking for cold damage on a branch