

Frosts and Freezes

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Gardening has plenty of challenges. Insects, diseases, drought, wind, excessive rainfall, soil problems, lack of pollination, too much sun, not enough sun, blazing heat, bitter cold...and the list goes on. But then if it was simple and easy, with guaranteed results, how much fun would that be? I don't mean to say that gardening is difficult and only the professionals can do it. In fact the basics of gardening are quite simple and easy. But there are plenty of challenges that keep things interesting.

Part of the enjoyment of gardening comes from the challenge. Like any great hobby it takes learning, time, skill, practice and just a little bit of good fortune to achieve the best results. One of my favorite things about gardening is that it is always new and at least partially unpredictable.

One of the great challenges we gardeners face each year, in fact twice a year, is the threat of frosts and freezes showing up to spoil the show. I say twice a year because we deal with the early frosts of fall that would cause our warm season gardens to face an untimely demise, and the late frosts of spring that make gamblers of anyone who ever set a tomato in the ground, and worriers of everyone with a peach tree in full bloom.

We could also add a third challenge, the cold of winter that would be the arbiter of what can and cannot be grown in your particular zone. And we all must try to cheat the zone map at least a little, right? Now the best way to beat winter is to have a greenhouse. But not everyone has one and then there are all those plants in the garden and landscape that can't be dug up and moved into a greenhouse. The purpose of this article is to provide some suggestions on ways to protect your plants from the threat of cold. However we should begin with a little technical information on frosts and freezes.

The Science of Frosts and Freezes

We all know that freezes can kill plant tissues but do you know how? When the water inside a plant freezes it causes ice crystals to form that pierce the cell walls of the plant. 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 black to brown and dry up.



Freeze Damage

Frosts on the other hand appear on the surface of plant tissues as well as on most any other exposed surface. During the night these surfaces radiate heat to the sky. When their temperature drops to the freezing point the water vapor next to it freezes on the surface. It is somewhat similar to the process on a warm day when water condenses on your iced tea glass because the glass is colder than the air around it.

Someone may ask, "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. Solid surfaces lose heat faster than air on a cold night. The metal and glass on your car are good examples of this. They radiate their heat away dropping in temperature faster than the air around them. As a result we see frost on a windshield when few other things around the landscape show frost.

Plants also lose heat faster than the air. The surface of a leaf can drop a little below the temperature of the air around it on a cold night causing it to drop below freezing and frost to form on the 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. So when you see frost there has been a freeze at the point of the plant surface.

Anything that reflects the radiating heat back down will prevent or at least greatly reduce frost formation. In winter walk out on a frosty morning and notice that while there is frost on the lawn around your landscape, underneath the live oak tree or underneath a picnic table there is little if any frost. Clouds perform the same radiant heat-reflecting function. On a clear night temperatures drop fast. On a cloudy night much heat is reflected back to the ground slowing the drop and in many cases preventing a frost or freeze.

We use the terms frost and freeze to refer to different types of temperature-related events. Typically frost forms on a still night when the temperature drops to near or just below freezing. A freeze on the other hand refers to a more extended period below freezing and may or may not include wind.

Most of the time in the fall or spring season we gardeners are dealing with a marginal freeze where the temperature drops briefly to just below freezing at the end of the night and then moves back up above freezing soon after the sun rises. This is enough to destroy a fall or spring garden or fruit blooms and the hope of a spring crop.

We can do a lot to protect plants from such a freeze because the temperatures are usually not too low and the duration is brief. Hopefully there is also not much wind, thus making protective measures easier and more effective.

On the other hand when a hard freeze hits with a strong wind and lasts for a day or more there is usually little we can do to protect our gardens. The wind displaces any heat that might have helped protect the plants and speeds cooling of plant tissues. The extended time below freezing makes our simplest protective measures inadequate to the task.

Sometimes all we need to do is keep a plant alive through the cold. The first parts of most plants to freeze are tender new growth areas and the areas between leaf veins where the leaf is thinnest. A little injury to new growth is tolerable especially if the plant itself is saved. This would be true of a citrus tree or bougainvillea for example.

Keep in mind also that plants vary in their cold hardiness as they develop from seedlings to mature producing plants. 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

In much of the state our winters are brief with lots of moderate to cool temperatures interrupted by a few killing freezes. If we can take steps to help our plants through those cold snaps we can cheat the hardiness zone a bit in the landscape and keep a vegetable garden going all winter long.

There are a number of techniques we can use to help avoid freeze damage to our plants. Here are a few of the more common ones.

Watering

There are two ways that water can help protect plants. First of all plants under drought stress can be more susceptible to cold damage. By watering plants several days or more before cold weather threatens you can relieve stress if they are suffering from drought. Water is also a great "heat sink." That is, it holds warmth and releases it slowly, more slowly than plant surfaces or air.

Watering your plants right before a freeze creates a source of warmth that will slowly lose its heat over the course of a long cold evening. This alone is not going to provide protection from a hard freeze but can be used with covers to make a small difference on a marginal night, and every little bit helps!

The second way water is used is by sprinkling plants on a cold night. The basic concept involves the physics of water. If you were to chart the drop in temperature of water you would see that it drops steadily to about 32 degrees and then levels

off before dropping again after the water freezes. It takes a lot of energy to push water to change from liquid to solid. That is the key to using water to protect plants.

Water is sprinkled on the plants and then freezes causing a small amount of heat to be released as it changes from liquid to solid form. Then another 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 will not drop below about 32 degrees.

So why don't we all just sprinkle plants and be done with all this worrying over freezes? Well the devil is in the details. 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 may be a feasible strategy.

Most folks end up using lawn sprinklers which put out too much water, so after a while the plants end up drowning in soggy soil while we create a major swampy mess in the landscape. Additionally if the freeze lasts very long we end up with an ice load that shatters our fruit trees like toothpicks and flattens the garden.

Most importantly when using water you must not stop sprinkling after the temperature rises above 32 degrees. You have to continue to sprinkle until almost all the ice is melted. Otherwise the process works in reverse. As the ice goes from solid to liquid water it absorbs heat causing supercooling. So you theoretically could have made it through the freeze but then lost plants in the morning after temperatures started rising.

All this said, protecting plants with sprinklers, while possible in some situations, is seldom a viable option.

Covering Plants

Covering plants is the simplest, most practical way to protect against a frost or freeze. Gardeners head out with sheets, blankets, plastic, rowcovers and anything else that they can get their hands on to wrap up plants for a cold night.

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. These "landscape lollipops" as I call them are not effective. In fact they may keep some of the heat available to the plant away from it.

Here's what I mean. The main source of heat for a plant is the soil. On a cold night heat from the soil rises up around the plants. If you use a blanket to trap this heat within the plant's canopy you can make a very significant difference on a cold night.

When I talk about trapping heat I don't necessarily mean warm air, just air that is warmer than freezing. If you keep the temperature around plants from dropping below freezing you have accomplished your goal. Even cold soil is actually significantly warmer than freezing and thus a source of "heat" 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. This is especially helpful in preventing a breeze from cooling things down faster. The next day, remove the covers to allow the sun to warm the soil surface a little and then replace the covers as the sun goes down.

I have used cardboard boxes and large round garbage cans to cover plants. Plastic sheeting or any material that radiates its heat out quickly will "burn" (actually freeze) plant tissues where it touches them. It also tends to not reflect the radiant heat back down as well. Plastic is good, however, in holding in the air on a windy night so if you cover the plastic with a blanket or sheet you can increase the amount of heat reflected back to the plant and soil.

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", but all types are helpful.

Some gardeners will sprinkle the fabrics with water to create a shell around the plants. Research in Florida has shown that sprinkler irrigation used in combination with row covers can extend frost protection to around 21° F. Keep in mind that this is not a one time squirt of water but a continuous light sprinkling as mentioned above. Since most gardeners aren't set up to do this correctly I don't recommend sprinkling the rowcover.

I have set up hoop tunnels with PVC pipe stuck into the ground to form a series of arched hoops down the row. You can also drive short sections of 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 from the top of the hoops for added support. The hoop tunnel is useful for preventing a tarp or other heavy material from crushing plants.



Rowcover over hoops

Adding Heat

If it is going to get too cold for a simple cover to protect your plants, adding a source of heat beneath the cover can make a big difference. Anything that provides some heat is going to be helpful, especially if you have a good cover that is secured to prevent wind from moving the warmer air out from beneath it.

Two common ways to add heat are by adding a mechanic's light or a string of Christmas lights beneath the cover. When I say Christmas lights I mean the big ones, not the little twinkling things as they don't put out much if any heat. Take caution to check for shorts in the wiring and prevent rain or other moisture from getting into the fixtures. Also don't allow a hot light bulb to come close to plant tissues or they can suffer damage.

Another way to add heat is to place containers of water beneath a cover. This is most helpful when the plant is very small such as a new tomato transplant. Milk jugs work well for this purpose. Make sure and 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. Five gallon buckets are especially helpful if you can make sure the cover over the plant prevents air movement from outside wind and is effective in reflecting radiant heat back down.



Milk jug for latent heat

Soil and Mulch

Some of our tender perennials may make it through a mild winter just fine but be lost in a colder than average winter season. Mulch is a great way to insulate around them and use the warmth of the soil to protect them. Placing a thick mulch of hay, composted bark or similar material over them provides a measure of protection to the crown of the plant. Take care to not totally smother them with a deep mulch.

Soil, too, is a good insulator. Citrus growers often will mound up a cone of soil around the base of the tree's trunk to protect this area of the lower trunk. If a killer freeze destroys the tree they will still have a strong root system and graft union from which a new tree can be regrown in less time and without the expense of replanting new trees.

If you have some 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 encouraging rot of the lower trunk.

Protecting Container Plants

Plants growing in containers are especially susceptible to cold weather. Not only are the tops exposed like any other plant, but being above ground the roots lack the insulation of the earth and will get much colder than roots of an in-ground plant. Roots

are often less hardy than the top portions of the plant. Some species which are normally quite hardy can suffer root death when temperatures in the container drop to just 28 degrees.

The most obvious solution is to move container plants into a garage or other protected location. When this is not possible 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.

We have plenty of challenges in gardening. With our mild climate we can take on the challenge of cold and turn what might be a dormant season into more of a gardening season.

This fall and winter take advantage of some of the ways you can protect plants and keep that garden going all winter long.