Frost Protection in the Garden

Our normal date of first frost is around Thanksgiving. Light frost has been reported some years in outlying areas as early as Nov. 13 - 14, and heavy frost was recorded on Nov. 15, 2000.
But don't get too worried. While a normal frost will kill off summer annuals or nip the new growth on some subtropical plants, most can sustain 31 - 32F with little damage.
Likeliest dates of severe frosts or regional freeze events are around the winter solstice. See the chart at the end for what we experienced in 1990 and 1998.

How does frost occur?
Frosts occur on still, clear nights. Heat from the ground radiates to the sky, and the surface becomes colder and colder. When the surface reaches the freezing point, the layer of water vapor just in contact with the surface freezes into ice, and then the next layer above that, and so on. Frost develops earlier in the evening on your car, because metal and glass lose heat more rapidly than soil. Fog or cloud cover usually will prevent a frost by trapping the heat that otherwise would radiate out to the open sky.

Why doesn't the temperature always keep dropping?
Since a small amount of heat is released as the water vapor converts to ice, the temperature usually stops dropping at about 30-31 degrees F for awhile; most plants can sustain 30 degrees without damage. With less water vapor, the temperature continues to drop to levels that can damage many plants. With very little water vapor, plants can be killed by low temperatures without visible frost on the ground; this is sometimes called "black frost."

How does freeze damage occur on plants?
Damage is a combination of *how cold* and *how long*. Another factor is what the preceding weather has been: plants “harden” to cold as temperatures decrease in the season.
Freeze damage is cumulative, continuing to kill tissue deeper into the plant as freezing weather continues or recurs.
The damage affects three vital parts of the plant: the growing points, the vascular tissue and the growth buds that are dormant farther down on the stem.
First to go is the tender outer new growth, then exposed leaves, then smaller new twigs and then eventually older wood. Dormant growth buds, found at the base of older leaves, can survive if there is a “blanket” of leaves and twigs above them — even if those leaves and twigs are dead.

How can I protect plants from frost?
Protecting plants from frost damage usually is accomplished

- by trapping the heat that is radiating from the ground with frost blankets, clear plastic, or similar materials;
- by moving the plant to a sheltered location, or
- by directly providing heat via light bulbs.

Damage can be increased if the soil is dry, so watering is helpful on the afternoon when frost is expected that night. Container plants are especially vulnerable to the desiccating effects of freezing.

How much effort should you put into frost protection? Sometimes it's a pretty simple cost-benefit analysis. One customer's landscaper planted eight five-gallon tropical Hibiscus rosa-sinensis in her new landscape. While lights may not be an option for her, frost blankets may get them through until spring, and the $20 investment might save $300 worth of plants.

- **Which plants are likely to be damaged?**
  Plants always killed by frost include your summer annual flowers and vegetables: Impatiens, coleus, marigolds, tomatoes and peppers. There's no point in trying to protect these; simply replace them next spring.
- Any house plants that have been growing outdoors need to be brought inside--by Hallowe'en as a good rule of thumb. Check them first for aphids, ants, or other pests; to make sure you don't include any uninvited guests. A quick spray with a soap solution can prevent unpleasant surprises!
- Subtropical plants will be damaged if they aren't protected, and may be killed.
  These include Bougainvillea, Hibiscus, and some of the tender jasmines. Most of these are best grown in containers so they can be moved to a protected microclimate, such as an east or south-facing wall, preferably with an overhang; this traps heat, and both exposures warm up earliest in the morning. If such plants are to be planted in the ground, east/south exposures provide the best chance of survival from year to year.

Covering these plants with plastic or "floating row cover" (a light fabric, sometimes sold as frost blanket or "seedling blanket") can make a big difference. If plastic touches the leaves, each point of contact will freeze, so it's better to make a light frame and staple the plastic to that ... but don't worry too much about it. (You're trying to keep the plant alive, not looking perfect!). Frost blanket is lightweight enough that you can simply drape it over the plant, but it will need to be secured against even light winds.

While most cactus are cold-hardy outdoors in this area, some succulents will be damaged or killed, including Crassulas (Jade plants), kalanchoes, some aloes, and many euphorbias.
The water in the succulent stems and leaves can crystallize, expanding dramatically, and the plant bursts ... and then turns to mush. This is interesting to watch, but very bad for the plant; they are safest indoors for the winter. Sedums, echeverias, sempervivums, and many others are hardy outdoors.
Many subtropical plants will sustain severe damage to the leaves and stems, but will resprout in the spring and thus need no protection. Lantana, Tecomaria, Passiflora vines, and Lycianthes rantonnei (Purple potato vine) are good examples. They look bad, but will recover. Wait until all danger of frost is past in the spring, before you cut them back.

Davis	1990-1	1998-9
15-Dec	38	38
16-Dec	36	35
17-Dec	33	34
18-Dec	30	35
19-Dec	32	31
20-Dec	24	31
21-Dec	21	22
22-Dec	18	22
23-Dec	17	21
24-Dec	20	21
25-Dec	21	23
26-Dec	23	28
27-Dec	24	29
28-Dec	24	34
29-Dec	31	27
30-Dec	23	31
31-Dec	25	37
1-Jan	23	33
2-Jan	25	32
3-Jan	31	32
4-Jan	28	34
5-Jan	33	32
6-Jan	39	33

Citrus trees are a special case!
Age and variety are important considerations. Young citrus trees that have been in the ground less than one season are vulnerable, and should be protected if low temperatures are expected to drop into the upper 20s.
Older trees of most varieties will only have cosmetic damage -- burnt-looking leaves -- from temperatures into the upper 20s.
Limes and lemons are the most tender, and the fruit may be damaged at about 26 degrees F. But avoid harvesting it all if you can, because Citrus fruit doesn't store well, and doesn't get any sweeter once it's picked. Fruit on outer branches is more exposed and is worth picking; fruit inside the tree is more protected, and usually can be left. Fruit of oranges and mandarins can take colder temperatures without damage, even into the mid- to low 20's.

Draping the plants with "floating row cover" can provide enough protection to save the fruit, and stringing Christmas lights on the trees -- the big ones, not the little twinkle lights -- can save foliage and twigs from severe damage.

Frost vs. freeze?

Frost is a local condition which occurs in your area on a still night: temperatures usually go no lower than 29-30 degrees F, and it warms up again the next day.

A freeze involves an entire region, has significantly lower temperatures, and may last from several days to a couple of weeks.

In the event of a major regional freeze such as we experienced in 1990 and 1998, our efforts turn away from saving fruit/foliage/flowers and we focus on simply trying to keep the plants alive. Draping with blankets, wrapping the trunks with burlap, flooding with water ... all of these are extreme measures we rarely need to take here.

How does a plant protect itself? Why do some get harmed more than others?

The science of it is that plants reduce their freezing point, or cloak their tender tissue, and the microflora on the leaf surface changes as the temperatures get lower.

Hardening is a process where the plant increases the sugars and salts and alcohols in the leaves and stems over time to form natural antifreeze; i.e., they lower the freezing point of the plant tissue. Mineral content of the plant and internal synthesis pathways change. Plants that didn't evolve with cold weather won't do this. Take an impatiens to Minnesota, and it isn't suddenly going to create internal antifreeze. It's going to turn to mush at 32 degrees.

Another factor is the presence of ice-nucleation active (INA) bacteria. Ice forms around these bacteria, which are more abundant in the warm season, and their population diminishes as the nights get colder. So the earlier frost occurs in the season, the worse the damage.

Finally, bark insulates the living tissue that is farther down on the plant, and buds are protected down in the bark. Bud sheaths and dense twiggy growth also protect buds. So the older and woodier the plant, the better it can recover. A bougainvillea that would be killed in its first winter can survive after a year or two in the ground, re-growing from the stem farther down because the buds were protected.

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