

CMG GardenNotes #722

Frost Protection and Extending the Growing Season

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Types of Frost

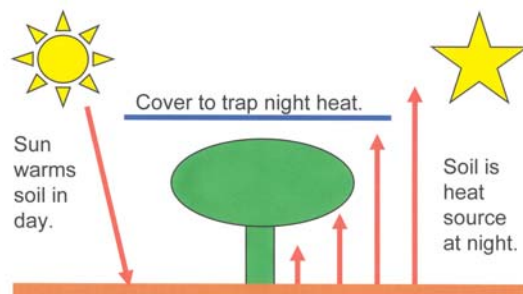
Advection frosts occur when a cold front moves into the area. Temperatures may drop significantly below critical levels making crop protection questionable.

Radiation frosts occur on calm clear nights that lack cloud cover to hold in heat. Radiation frosts at the beginning and end of the growing season are typically only a few degrees below critical levels making crop protection worthwhile.

Heat Source at Night

Soil warmed by the sun in the daytime, is the source of heat for frost protection at night. Moist, smooth soil absorbs more heat. To trap heat from the soil around young vegetables at night, place a covering that is low to the ground and spreading. To recharge the heat source for the next night, any covering must allow sunlight to shine through to the soil or must be removed in the daytime. [Figure 1]

Figure 1. The sun warms the soil in the daytime. Heat from the soil keeps crops warm at night. A covering traps heat from the soil around the crops.



Coverings

Blankets and Sheets

Grandma's old method of covering the garden with blankets and sheets works well as long as the fabric remains dry. If the fabric absorbs water, evaporative cooling can lead to colder temperatures adjacent to the blanket. To recharge the heat stored in the soil, fabric must be removed in the daytime.

Floating Row Covers

Floating row covers are lightweight fabrics that lay directly over crops. Since they transmit light, they provide crop protection over an extended period of time without being removed. They provide 2° to 4° F of frost protection, cut wind on tender plants, and screen out some insects. On insect pollinated crops, covers must be removed for pollination to occur. [Figure 2]

Floating row covers are popular in commercial vegetable production where crops planted in large blocks are easily covered with row covers. Many brands and fabric types are commercially available.



Figure 2. Floating row cover on broccoli and cabbage, protecting crops from cabbageworms.

Clear Plastic Covering on Frame

When plastic is used as a covering over a growing bed, it must be held up off the plants. Plants will freeze where the plastic touches them.

Tunnel Gardening – Gardening catalogs carry wire hoops for use in “tunnel” or cloche gardening. Hoops are placed at three to five foot intervals depending on the wind exposure of the site. The wire hoops hold up a strip of plastic forming a tunnel-shape covering down the growing bed. Bury the edges of the plastic a few inches into the soil on all sides. On a raised-bed box made with lumber, staple the plastic to the sides of the box. Two-inch holes cut in the sides of the plastic tunnel at two to three foot intervals prevent over heating.

This type of covering is popular with commercial tomato, pepper, and melon growers for an early start to the growing season. It provides 2° to 4° F of frost protection, protects tender plants from cold spring wind, and provides warmer growing temperatures inside the tunnel. Tunnels are removed when warm weather arrives and the danger of frost is past.

Plastic Covered Cold Frame Made with Concrete Reinforcing Mesh

An easy cold frame structure for a growing bed is made with 4-mil clear plastic (polyethylene film) draped over concrete reinforcing mesh. The structure is easily opened during warm days and closed for cold nights. It works well with a 4-foot wide, raised-bed garden system. [Figure 3]



Figure 3. Cold frame for a raised-bed garden made from concrete reinforcing mesh covered with 4-mil plastic. Notice the belt-like plastic straps, which hold the covering in place. The covering is slid between the straps and mesh to open and close. Pictured open for ventilation on a warm day.

The frame is concrete reinforcing mesh, available at hardware and lumber stores. This stiff wire mesh typically comes five feet wide in 50 and 100-foot rolls. A six-foot length is required to make a Quonset-type frame over a four-foot wide growing bed. In trials, the low and spreading shape was ideal for trapping heat from the soil during a frosty night.

Cover the frame with clear, 4-mil polyethylene plastic. It typically is sold in 10' by 25' rolls. For a 4-foot wide raised bed box, place a 3½-foot wide section on each side, overlapping at the top. On a raised bed box, staple the plastic to the sides of the wood box. In soil bed applications, bury the plastic a few inches along the sides.

Hold the plastic onto the frame with small clips available at local hardware stores. Clothes-pins do not hold in the wind. Another method is to use a series of 6-inch wide, belt-like plastic straps arching over the frame (above the plastic cover) and stapled onto the box. Open and close the cover by sliding it between the frame and the belt-like straps. Hold the plastic closed at the ends with a rock or brick. [Figure 4]



Figure 4. Clip holds plastic on frame.

During the day, the covering **MUST** be opened, at least a slit, to prevent overheating. With just an hour of sun, temperatures under a closed cover can quickly rise to over 130°! [Figure 5]



Figure 5. Left: Cover must be opened at least a slit to prevent over-heating. Right: Cold frame pictured closed for a cold night.

On cool days, open the top a crack to prevent excessive heat build-up. On a warm day, the plastic can be slid down the side, ventilating and providing crops exposure to the outdoors. On freezing nights, close the cover completely. On warm nights, the covers may be left open a crack. On stormy days with full cloud cover and no direct sun, the cover may remain closed. [Figure 5]

Not only will the covers provide frost protection, they also increase growing temperatures for early crop growth and provide protection from cold winds.

In trials in Fort Collins, Colorado, a plastic cover on a frame typically provides 3° F to over 6° F of frost protection. It works well for cool season crops that are somewhat tolerant of frosty nights, and adds two to six weeks or more on both ends of the growing season. For warm season tomatoes and summer squash crops that are totally intolerant of a frosty nip, adding a small light inside the cold frame provides even better frost protection.

Adding Space Blankets

On extra cold nights, placing an aluminum space blanket over the plastic on the frame significantly adds to the frost protection. With the aluminized side placed down (towards the plants), a space blanket reflects 99% of the heat. They are readily available where camping gear is sold. [Figure 6]

In trials in Fort Collins, topping a plastic-covered, concrete mesh cold frame with a space blanket prevented freezing when outside temperatures dipped to 0° F following a sunny spring day. The space blanket must be removed each day to recharge the soil's stored heat



Figure 6. Aluminum space blanket covering a cold frame for extra protection on cold nights.

Lights for Additional Heat

Christmas tree lights – For additional protection, add Christmas tree lights inside the cold frame. In Fort Collins trials, one 25 light string of C-7 (mid-size) Christmas lights per frame unit (four feet wide by five feet long) gave 6° F to over 18° F frost protection. Lights were hung on the frame under the plastic and turned on at dusk and off at dawn. Christmas lights work better than a single, large light bulb in the center by eliminating cold corners and edges. [Figure 7]



Figure 7. Cold frame with Christmas tree light for additional warmth.

Space blanket with Christmas tree lights – For the gardener really wanting to extend the growing season, try Christmas lights plus a space blanket. One 25 light string of C-7 (mid-size) Christmas lights per frame unit (4 feet wide by 5 feet long) with a space blanket on top gave 18° to over 30° frost protection in Fort Collins trials.

Wall of Water®

The Wall-of-Water® is a cone-shaped ring of connected plastic tubes filled with water that surrounds a single plant, like a tomato, pepper, or summer squash. [Figure 8]

This device works on the chemistry principle of heat release in a phase change; there is a significant amount of heat released as water freezes (changes from the liquid phase to the solid or ice phase). A Wall-of-Water provides frost protection typically down to mid-teen F temperatures. It also provides wind protection for tender plants and growing temperatures may be slightly warmer inside a Wall-of-Water.



Figure 8. Tomato in Wall-of-Water. Notice use of black plastic mulch to warm the soil, another limiting factor of early production. Also, note the plant has grown beyond the device and is now less protected from frost.

They are helpful to get a few extra weeks head start on vine ripe tomatoes. However, an extra early tomato may out-grow the protection and the tops may be nipped back by frost.

Both cold air temperatures and cold soil temperatures are limiting factors in early crop production. When using a Wall-of-Water to start early crops, warm the soil with black plastic mulch. For details on using plastic mulch, refer to CMG GardenNotes #715, *Mulches for the Vegetable Garden*. In filling the Wall-of-Water, be careful not to splash excessive water onto the soil. A wet soil will be both slow to warm and dry in the spring. Moderately moist soils are best.

Additional Information – *CMG GardenNotes* on vegetable gardening:

#711	Vegetable Garden: Soil Management and Fertilization	#718	Early Blight of Tomatoes
#712	Sample Vegetable Garden Seed Catalogs	#719	Vegetable Garden Hints
#713	Block Style Layout in Raised Bed Vegetable Gardens	#720	Vegetable Planting Guide
#714	Irrigating the Vegetable Garden	#721	Sample Planting for Raised-Bed Garden
#715	Mulches for the Vegetable Garden	#722	Frost Protection and Extending the Growing Season
#716	Water Conservation in the Vegetable Garden	#723	Growing Vegetables in a Hobby Greenhouse
#717	Growing Tomatoes	#724	Vegetable Gardening in Containers

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- o Colorado Master Gardener training is made possible, in part, by a grant from the *Colorado Garden Show, Inc.*
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Revised June 2007