

Vegetable Gardening in the Mountains

Fact Sheet No. 7.248

Gardening Series | Fruits and Vegetables

by Irene Shonle*

Growing vegetables in Colorado presents challenges, but growing vegetables in the mountains is harder still. This is due to the much shorter growing season, cool nights, wind, critters, and possible watering restrictions. For the purposes of this fact sheet, 'high elevation' or 'mountains' means anything over 7,500 feet in elevation in Colorado.

The first factor to consider is the short growing season. For every 1000 feet gain in elevation, the temperature drops by an average of 3.5° F. This means that the temperatures will be below freezing later in the spring and earlier in the fall. As an example, the Extension office in Gilpin County (9,300') has a last average frost date of June 10 and the average first frost is September 15, but in many other places there can be less than 90 frost-free days in the mountains. Gardeners at the lower end of the elevation range will have a longer growing season and be able to grow a wider variety of vegetables. An exception to this general rule is that valleys are often cooler than surrounding hillsides, due to the sinking of cool air at night. Even though the elevation may be lower, valleys may actually have cooler growing conditions than surrounding hillsides.

Growing Degree Units (GDUs)

The short growing season, combined with cool nights, means that high elevation areas don't accumulate enough 'growing degree units' (GDUs, also called growing degree days and heat units) to support some of the most coveted 'warm-season' vegetables including tomatoes, corn, winter squash, beans, cucumbers, melons, peppers, eggplant, okra,

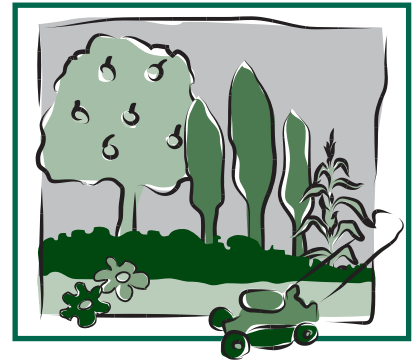
and more. Of the warm season vegetables, bush beans and summer squash are the most likely to succeed. If your garden is in a particularly warm microclimate, or you just want to experiment, try some of the warm season vegetables and see what works in your garden (the advice on selecting varieties below still applies).

Plant development occurs only when the temperature exceeds a specific base temperature for a certain number of days. Each type of plant is adapted to grow best over its own specific base temperature, called T_{base} . Be aware that even cultivars of the same plant species sometimes can have a different T_{base} . 50° F is often the T_{base} used for warm season vegetables, but cool season vegetables usually have a lower T_{base} .

GDUs are calculated by taking the average temperature for the day (maximum and minimum temperatures added together and divided by two) and subtracting a minimum base temperature.

$$\frac{\text{Max. Temp.} + \text{Min. Temp.}}{2} - T_{base} = \text{Daily GDU}$$

For a typical mountain summer day in Gilpin County the calculation might look like this: $(79 + 45 / 2) - 50 = 12$ GDU. In this example location, around 1,000 GDUs may accumulate over the course of the summer (but remember that each garden will have specific microclimates, and may acquire more or less GDUs). Even ultra-early 'Siberian' or 'Arctic' tomatoes require 1,100 GDUs for the first ripe fruit, and extra-early corn can require 1,870 GDUs, which explains why it is so difficult to grow warm season crops in the mountains. Unfortunately, comprehensive lists of GDUs needed for various vegetables are difficult to find, so this concept may be more illustrative than a practical tool.



Quick Facts

- If using a well, check your permit for possible outdoor water restrictions.
- Cool-season vegetables are the most successful.
- Protect your vegetables from animal intrusion with hardware cloth under beds and use floating row covers.

©Colorado State University Extension. 3/14.

www.ext.colostate.edu



Cool Season Vegetables are Easiest and Most Productive

Mountain gardens excel (and perhaps do even better than lower elevation gardens) with cool season vegetables. Below are vegetables recommended for the mountains:

- Leafy greens: lettuces, arugula, kale, spinach, Swiss chard, mâche, collards, cabbage, endive, radicchio, turnip greens, beet greens, garden cress;
- Root vegetables: carrots, beets, radishes, turnips, kohlrabi, rutabaga, potatoes, leeks;
- Other vegetables: peas, broccoli, cauliflower, Brussels sprouts;
- Herbs: reliably hardy perennial herbs include French tarragon, horseradish, some mints, and chives. Perennial herbs that are not reliably hardy (such as sage, thyme, oregano, rosemary, bay laurel) can be grown in pots and brought in for the winter. Annual herbs that can be direct-seeded in beds include parsley, dill, calendula, and borage. Basil and cilantro are annual herbs that are heat lovers and need a lot of GDUs to develop. Consider growing them in a pot in a warm, sunny location and putting them inside at night or covering them.

Selecting Varieties

Within each vegetable/herb species are many different cultivars or varieties. Some will work better for the mountains than others. In general, look on the back of the seed packet or in the catalogues for the 'days to harvest' and choose the ones with the least number of days because these require fewer GDUs. Be aware that the actual days a plant needs to mature may be considerably longer in the mountains, because the 'days to maturity' number was usually established in a warmer climate. Other desirable mountain characteristics to look for on a seed packet include "cold-tolerant," "reliable in cool weather," 'easy to grow', 'vigorous', 'productive', and 'great flavor'.

Site Selection

In general, try to find a site that gets 6-8 hours of full sun per day (for leafy greens, only 4-6 hours are necessary). A

south-facing, slightly sloped area is ideal for warming soils in spring and staying frost-free later in the fall. The site should be near your house for easy tending and watering. In windy areas, find a spot on the lee side of the house, or put up windbreaks. If you are attempting some of the warm-season vegetables, find the warmest microclimate available near your house (often on the south side). Try to plant close to the house or a rock wall so the plants can benefit from the thermal mass.

Soils

Most mountain soils need significant amendments in order to provide good growing conditions for vegetables. Many mountain soils have less than 1% organic matter, whereas 5% is ideal. Compost and aged manure are the best amendments to add, incorporating 1 inch per every 4 inches of soil depth. Potting soil and 'top soil' are poorer choices since the former is formulated for growing in containers and the latter may have low organic matter and may contain many weed seeds.

It is highly recommended to get a soil test to determine pH, organic matter, and major nutrients, and then to amend and fertilize the soil accordingly. Methods for amending soil and fertilizing vegetables are not specific to the mountains, so please refer to the following Garden Notes from the Colorado Master Gardener program:

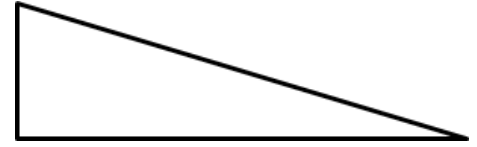
- [Choosing a Soil Amendment](http://www.ext.colostate.edu/pubs/garden/07235.html)
www.ext.colostate.edu/pubs/garden/07235.html
- [Soil Amendments](http://www.ext.colostate.edu/mg/gardennotes/241.html)
www.ext.colostate.edu/mg/gardennotes/241.html
- [Vegetable Garden: Soil Management and Fertilization](http://www.ext.colostate.edu/mg/Gardennotes/711.html)
www.ext.colostate.edu/mg/Gardennotes/711.html

Raised Beds

Raised beds will warm up more quickly in the springtime than in-ground beds and are a good option when the ground is too rocky to dig. They are also good for gardeners who may have trouble bending down.

Alternatively, pile the soil in the bed so it is south-sloping. This style of bed also warms up quickly in the spring, and helps to increase GDUs. It can also provide a windbreak if the winds come out of the

north or northwest. It is not necessary for greens and other cool season crops, and may be harder to water, since the water will tend to run off, rather than percolate down.



South facing sloped bed.

Floating Row Covers

A very useful tool for mountain gardeners is the floating row cover. These lightweight, spun polyester fabrics allow sun and rain in, don't need venting, provide frost protection down to 24° F (depending on the thickness of the fabric), and will help keep out insects and critters such as rabbits and deer. They also increase humidity, reduce water needs, and prevent some sun scorch while providing some protection from light hail and drying winds. Most of the vegetables recommended for the mountains do not need pollination, so keeping them continually covered is not an issue. An exception to this is summer squash; the cover would need to be removed at flowering. Beans and peas, although they do flower, are both self-fertile, and the shorter varieties will happily grow under floating row covers.

Floating row covers can be placed directly over plants. If desired, hoops or wires can be used to keep the cover from touching the plants (this will help protect plants from scorch and abrasion and will provide more frost protection). The downside to hoops is that rain or irrigation water may run off instead of penetrating the fabric and it can be harder to secure in the wind. Make sure to use garden staples, rebar, logs, or heavy rocks to keep the covers from blowing off in strong spring winds. These covers can be found in many garden centers and online.

Critter Protection

Place hardware cloth (1/4" metal mesh) beneath beds to keep voles and pocket gophers out. On a raised bed, the hardware cloth can be stapled to the bottom before adding soil. For in-ground beds, dig a pit 1-2' deep (1' for greens and 2' for root vegetables) and line the entire bottom

with the hardware cloth before adding soil back in.

The combination of hardware cloth and floating row covers will protect most gardens from all critters, whether burrowing (voles, pocket gophers) or above-ground (rabbits, chipmunks, deer). If row covers are not used, a two foot tall fence of 1" mesh squares with the bottom buried 6" in the ground will keep cottontail rabbits out, and snap traps can be used on mice and voles. If you find you require a fence for deer, it should be a minimum of 8' high, or a double fence—two 4' high fences placed 4' apart. Electric fencing may be necessary where there is a lot of deer pressure.

When to Plant

You can direct-seed frost tolerant plants into the garden four weeks before the last frost date (kale kohlrabi, lettuce, spinach, turnips, chard, mustard, beets, carrots, cabbage, endive, peas, and radish). It is more accurate to use a soil thermometer and plant when the soil 6" deep is 40 ° F at 8:00 a.m., but often the frost date is a good rule of thumb. If the ground is still frozen, or there is still a lot of snow, wait for warmer weather.

Plants that take longer to mature—such as broccoli, cauliflower, leeks, and Brussels sprouts—can be sown indoors 6-8 weeks before the last frost and planted out two weeks before the last frost date for earlier yields. Transplants can also be bought at garden centers, but be sure to harden them off to mountain conditions by exposing them gradually to outdoor conditions.

Potatoes can be planted 2-3 weeks before the last frost date, and can be pre-sprouted (place potato in a warm area with indirect light for 2-3 weeks before planting) to increase yields. Cut potatoes into 2-4 oz. pieces (each piece should have a sprout) and let dry for a few days before planting.

Frost-tender plants such as summer squash and beans can be sown inside four weeks before the last frost date and transplanted outside after all danger of frost has passed (be very careful transplanting summer squash, as the roots are fragile—biodegradable pots can be planted pot and all and will reduce transplant shock). Harden the transplants by exposing them gradually to outdoor conditions over a few

days, and then planting them in the evening or on a cloudy day. If frost threatens, these plants can be protected by placing an inexpensive cloche made from a gallon milk jug (with the bottom cut off and the cap removed).

Succession Planting

Many mountain gardens do not have a long enough, or warm enough, growing season to have the three distinct growing seasons found in other climates (two cool seasons in spring/fall and a warm summer season). Often, there is just one cool season. However, this does not mean that the entire garden needs to be planted as soon as the ground thaws. Many of the cool season vegetables will mature in 25-60 days such as lettuce, spinach, and radishes. In order to prevent a glut of any vegetable (which may then bolt and turn bitter or tough), plant smaller amounts every two weeks or so in a method called 'succession planting'.

Another space-and-water-saving recommendation is to plant in blocks, rather than rows: www.ext.colostate.edu/mg/gardennotes/713.html. Plant crops with an equal-distance spacing between neighboring plants in both directions. Due to higher plant density, block plantings require a weed-free, fertile, well-drained soil that is rich in organic matter. Give extra attention to watering and frequent, light fertilization to nourish the dense plant population. Make the blocks no wider than 3-4 feet so they can be easily tended. Plant only a few square feet of leafy greens at a time (depending on your consumption rate).

Watering

In vegetable production, an adequate supply of water during the growing season is directly related to produce quality and yields. Many vegetables become strong-flavored, or tough, with water stress. Check soil moisture regularly. Irrigate when the top 2-4" of soil is dry to the touch rather than on a strict schedule. Vegetables will often need to be watered daily during the summer unless it rains, and seed beds may need to be watered twice a day. Again, the use of floating row covers is helpful in maintaining moisture in seed beds and reduces overall water use.

Water Rights

A challenge with some mountain gardens is water rights. If you have a well (not municipal water) which was drilled after May 2, 1972, and your property is less than 35 acres, you may not have any outdoor water rights. Check your well permit to see what type of well permit you have. ('Household Use Only' means there are no outdoor water rights while 'Domestic Use' means you can water up to an acre). If you have no outdoor water rights, you can check whether there are community garden options available in your area, or you could buy a cistern and have water delivered to you. Another option is the 'no-water' vegetable garden described below.

No-Water Garden

If you don't have outdoor watering rights but still want to have a garden at your house, it is possible to plant a no-water garden. Locate the garden bed under the drip line of the house or near a downspout and dig a pit 20- 24" deep. Line the pit with ¼" hardware cloth (to keep animals out), then line again with 6 ml plastic. Poke numerous large holes in the bottom of the plastic for drainage. Amend the soil heavily with compost, alfalfa pellets, aged manure, or other organic matter to help the soil hold water. The bed will "charge" with precipitation over the winter, and the drip line or downspout will funnel even small amounts of rain to the garden—150 gallons of water will come off a 1000 sf roof with just ¼" of rain. If you are using a downspout, you may need a diffuser head to reduce flow and to prevent washing out your garden. To place the garden further away from the house, attach a flexible tube to the downspout to transport the water. The key to keeping within the water law is that you don't hold the water for later use such as with rain barrels.

Leafy greens are the most reliable plants to grow with this technique. It is recommended that you germinate seeds indoors and transplant when the seedlings are still small since germinating seeds need even moisture and may dry out too much between rainfall events. First harden seedlings off and then transplant them during a rain event so they get watered in. Use a floating row cover to help

hold moisture and protect from drying spring winds. This method has been used successfully under a drip line of the roof at the Gilpin Extension office since 2008.

Season Extension

Floating row covers are a good way to gain a couple weeks of growing on either side of the season. If you buy those billed as 'frost blankets', they provide more frost protection and can extend the season a week or two longer at each end.

Plastic-covered low tunnels can increase the growing season by a month at either end (although wind and snow might cause damage if used too early or too late in the growing season). These tunnels are made by bending hoops from ½" PVC pipe, electrical conduit, or 6 or 9 gauge wire and putting sturdy plastic over the hoops. UV-stabilized greenhouse film will last more seasons than untreated plastic, but it costs more. The plastic needs to be pulled tight to form a tunnel, weighed down along the sides with sand bags or large rocks, and staked out at either end. (<http://extension.psu.edu/plants/plasticulture/technologies/low-tunnels> or <http://county.wsu.edu/benton-franklin/gardening/general/Fact%20Sheets/Making%20a%20Covered%20Bed.pdf>)

Cold frames are another good method for getting a jump on the growing season. Information on how to build them (including how to use completely recycled/repurposed materials) is easy to find on the internet. Here are some examples: <http://extension.nmsu.edu/greenhouse.html>, <https://store.extension.iastate.edu/Product/How-to-Construct-a-Cold-Frame-or-Hotbed>.

Gardeners with a lot of space can try an unheated hoop house, or high tunnel: http://clark.wsu.edu/volunteer/mg/gm_tips/hoophouses.html.

Cold frames and both low and high tunnels covered in plastic will need to be ventilated on sunny days or temperatures may rise enough to kill plants.

Tomatoes for the Really Determined Mountain Gardener

If you must try growing tomatoes, look for 'cold-set' varieties with a Siberian or Arctic heritage, and ultra-early tomatoes. Cherry and smaller tomatoes are easier to ripen. Determinate tomatoes will usually do better than indeterminate ones because they set all their fruit at once and have a better chance of ripening. Also, the growing season is not long enough to take advantage of the longer period of production from the indeterminate varieties.

Start seeds indoors under grow lights at least six weeks before the last frost date. Make sure they are fertilized regularly and are getting good light so the plants are stocky and healthy, and harden them off before placing outside.

The easiest option is to plant a compact tomato in a pot, putting it outside each morning in a sunny, protected location and bringing it in at night. Be aware that chipmunks may eat the tomatoes as they ripen.

If you want to leave tomatoes outside all the time, find the warmest microclimate available (this will increase the GDUs), use water-insulated growing chambers (such as Wall o'Water™), or place jugs of water around the plant. For best yields, grow tomatoes in a tall cold frame, hoop house, or even a greenhouse. Saving seeds of any tomatoes (or other warm season vegetables) that work well at your house will help to create lines of hardier, better adapted plants for your specific garden. Do not be surprised if tomatoes succeed some years and not others.