Growing tomatoes in cool, short-season locations

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YOU ARE A SHORT-SEASON, HIGH-ALTITUDE GARDENER IF:

You live in Idaho at an elevation above 4,500 feet, **OR**

Your USDA hardiness zone is 4 or lower, **OR**

You have a frost-free growing season of 110 days or less

University of Idaho Extension

INTRODUCTION

The state of Idaho contains many climatic areas that are challenging for tender plants. The tomato, *Solanum lycopersicum*, is a tender plant that is damaged by frost and by cool, above-freezing temperatures. Short-season areas such as those found in Idaho pose a challenge to the plant's growth and survival. Even if plants survive, they may not produce many tomatoes, or the tomatoes may fail to ripen.

This publication presents techniques to increase the chances for success when growing tomatoes in short-season areas.

The tomato is in the nightshade family of plants, which includes tobacco, potato, chili peppers and eggplant. This is important because diseases are shared within this family of plants. Technically, the tomato is a perennial plant grown as an annual in cooler temperate climates such as those found in Idaho.

Since the anther of the tomato flower is produced within a hollow tube, very little pollen is shed without movement of the flower or plant. In the outdoors, wind helps promote pollination. In windless environments such as greenhouses, artificial wind, flower agitators and cultured bumblebees are used to improve pollination.

WHY IS IT DIFFICULT TO GROW TOMATOES IN SHORT-SEASON AREAS?

The two biggest limitations to tomato growing in short season areas are frost, which damages the plant and flowers, and cool nighttime temperatures that can interfere with pollen formation and fruit ripening. The determined tomato grower will find these limitations relatively easy to overcome in all but the harshest areas of Idaho. Short season areas may also have very hot days during midsummer followed by cool nights. This situation further stresses tomatoes. Refer to "Introduction to Short-Season Gardening in Idaho" (http://info.ag.uidaho.edu/pdf/BUL/BUL0857.pdf) for a detailed description of specific short season areas in Idaho. On sloped areas or areas with different exposures, a few hundred feet may mean a noticeable change in growing conditions.

CHOOSING ADAPTED VARIETIES

It is important to use the quickest maturing tomato varieties in short season areas. Look for tomatoes that ripen in 68 to 75 days. The "days to maturity" refers to the time it takes to get your first ripe tomato. Remember, ripening time is often measured in warmer areas, so in cool temperatures tomatoes will take perhaps 10-15 days longer than stated. Many of the tomatoes with larger fruit take 80 to 100 days to mature. Fortunately, some "determinate" types of tomatoes, which tend to mature early, do have larger fruit. Experiment with different varieties to find out which ones do best in your garden.

There are hundreds of varieties of tomatoes. *Heirloom* varieties are older, and prized because they have good flavor and interesting characteristics (such as color or shape). One disadvantage to heirloom tomatoes is that they are often susceptible to diseases.

Hybrid varieties have been bred for higher yields and enhanced disease resistance. When selecting varieties for disease resistance, take note of the following letters, located after the name of the variety on seed packets, that indicate resistance to these diseases.

V – Verticillium wilt—Verticillium albo-atrum is a fungus sometimes found in saturated soils. This fungus develops at an optimal soil temperature of 75°F.

F – Fusarium wilt—Fusarium is caused by several fungi that are sometimes found in cool season areas, especially in northern Idaho. If Fusarium develops, it is usually later in the season.

N – root knot nematodes—Nematodes are generally found in warm soils. These microscopic worms cause root stunting and damage from their feeding, which promotes infection by other soil-borne diseases.

T – tobacco mosaic virus (TMV)—TMV persists in soil for a long time and affects a wide range of plants. This virus can be transferred to tomato plants from the hands of someone who smokes tobacco. If you are a smoker, be sure to wash your hands thoroughly before handling your tomato plants.

DETERMINATE VERSUS INDETERMINATE TOMATOES

Determinate tomatoes are more compact plants that do most of their growing before fruit set. They tend to mature early and to yield their complete harvest within a relatively short time frame. It is easier to set up frost protection devices around these compact plants. For these reasons, determinate plants are a good choice in short season areas.

Indeterminate tomatoes are larger plants that grow, flower and set fruit during the entire growing season. These plants can be very large (10 to 12 feet tall and wide) because they produce numerous suckers (shoots found between two other shoots). They yield over a longer period of time and generally set fruit later in the growing season. To produce fruit satisfactorily in short seasons, indeterminate plants will need pruning and training.

Semi-determinate varieties will produce suckers like indeterminates, but will only grow three to five feet tall.

Parthenocarpic tomato varieties are those bred to produce fruit at lower temperatures with or without pollination. They are a good choice in cool, short season areas. They set fruit earlier than many varieties, but the fruit may be deformed due to few or no viable seeds. These tomatoes tend to have lower acidity, so you may not like the taste.

For a list of tomato varieties recommended for short-season, high-altitude areas, consult "Choosing and Growing Adapted Vegetable Varieties" in the Short-Season, High-Altitude Gardening Series:
http://info.ag.uidaho.edu/pdf/BUL/BUL0863.pdf

SELECTING A LOCATION

Tomatoes need plenty of sun, water and warmth, especially in short season areas. In order to generate enough energy to produce fruit, the tomato plant needs at least seven hours of sunlight per day. If possible, select a location that has a southern or western exposure. In colder areas, locate your plants next to masonry, boulders or other heat-absorbing objects to help increase temperatures during cold nights. This can improve fruit set and ripening. Avoid locations where structures exist that could block the drainage of cold air, creating frost pockets.

BUYING OR GROWING TOMATO TRANSPLANTS

In short-season, high-altitude areas, the length of the growing season and cool soil temperatures do not allow for direct-seeding tomatoes in the garden. One of the best ways to increase your chances of success growing tomatoes in these areas is to buy plants, or grow transplants indoors.

Buying transplants at local garden centers is an option, but the selection of cultivars may be limited. Select plants that are dark green, that do not have purplish colors on the stems and undersides of leaves, and that have no flowers. Choose short and stocky plants. Check the roots, making sure they

High Tunnel at University of Minnesota

High Tunnel at Iowa State University

are a light creamy color and not overly crowded in the container. Choose short season varieties and remember that "days to maturity" in this case will refer to the time from transplanting until harvest.

By purchasing seed and growing your own transplants, you have a wide selection of varieties. Purchase seed, a "soilless" planting mix, and containers well in advance of the season. The containers should be sterile and free from pathogens. Old containers and flats can be sterilized using nine parts water and one part household bleach. New fiber "peat-pot" type containers can also be used.

Sow your seeds six to ten weeks before your average last spring frost date. For quick seedling emergence, the flats should be kept between 75 and 85°F. After the seedlings emerge, keep the temperatures at 75 to 85°F during the day and 65°F at night. Growing tomato seedlings in cool temperatures results in stunted, wiry plants that perform poorly in the garden. For light, set the plants on a bright windowsill, or in a greenhouse. You can also use cool-white fluorescent shop lights or plant "gro" lights suspended about three inches above the seedlings. Keep the lights on about 16 hours per day and keep the soil moist, but not saturated. You may cover the flats with clear plastic film, at first, to hold in heat and moisture. Remove the film when the seedlings are four to six inches tall. Seedlings grow rapidly. When they become crowded in their containers, transplant them into deeper, roomier ones. Sometimes this needs to be done more than once before transplanting into the garden.

Before plants can be set out in the garden, the seedlings need to be "hardened off," meaning they need to gradually get used to the outdoor environment. This can be accomplished with a few days in a cold frame or other protected outdoor area. Bring plants inside or protect them inside a cold frame if temperatures below about 50°F are predicted.

Low tunnel

EXTENDING SHORT GROWING SEASONS

In short season areas cold temperatures in the spring and fall limit the growth of heat-loving plants like tomatoes. The following are some techniques to extend the growing season in spring and fall.

Raised beds allow soils to warm earlier in the season for earlier planting. For tomato production, make raised beds three to four feet wide. Weed control, irrigation, fertilization and other tasks are easy and efficient in raised beds.

Mulching with clear plastic in spring warms the soil. Using organic mulches after the soil has warmed will moderate soil temperatures. Mulching also suppresses weeds, conserves soil moisture and helps prevent blossom end rot.

A floating row cover is a fabric made of spun polyolefin of various thicknesses that can be laid over plants or attached to support structures. Water, wind and sunlight penetrate these fabrics, which provide frost protection from temperatures between 26°F and 32°F. Another benefit to the fabrics is that they provide a physical barrier to keep out damaging insects. While these fabrics can be useful for short frosts, they provide little or no protection during prolonged freezes.

Water tubes (Wall O' Water) consist of vertical connected tubes approximately two inches in diameter filled with water. The tubes are used when plants are small, and can be open or closed at the top. When closed, the water tubes provide protection from outside temperatures as low as 20°F. Remove the water tubes before the plant becomes crowded inside.

Low tunnels consist of plastic covers (1.0 to 1.5 mil thick) that are supported above the crop with wire hoops, PVC pipe or other supports cut to lengths of 65 to 72 inches. The covers are left in place for three to four weeks and removed as the weather warms up. Some form of ventilation must be provided in low tunnels to keep temperatures inside the tunnel from exceeding about 80°F. A simple way of ventilating the low tunnels is to roll one or both of the sides up during the day and unroll them at night or during cool weather.

High tunnels, also called "hoop houses," are unheated plastic-covered structures that provide less protection than greenhouses and more protection than open field conditions. They are left in place through the entire growing season. They are tall enough to walk through and can grow trellised tomatoes. Most high tunnels are ventilated by rolling up the sidewalls. Row covers can be used inside high tunnels, providing additional protection from cool temperatures.

See PNW #497, "Short Season Vegetable Gardening," for additional discussion of season-extending techniques: http://info.ag.uidaho.edu/Resources/PDFs/PNW0497.pdf.

PLANTING

Since tomatoes are very susceptible to frosts, they generally must be planted in the spring after all danger of frost is past. However, in short season areas with a limited number of frost-free days, it is important to plant tomatoes before the last frost date, using season extending techniques (above). This will allow your tomatoes time to mature and produce fruit.

Transplant tomatoes into the garden on a cloudy day or late in the afternoon to reduce stress from the sun and high temperatures. Tomatoes are unique since they benefit from being transplanted deeper than their original soil line. Dig a long, shallow trench, remove the lower leaves, lay the stem down in the trench and cover with soil. Gently bend the top of the plant so the tip leaves are above the soil level. Roots will grow along the stem, providing a better root system early in the year. A quart of water applied to the transplanting hole will reduce transplant shock. Place plants between 24 and 36 inches apart in the row.

To prevent damage from cutworms, protect the stem of the plant with a can with either ends removed, or a length of cardboard tube from a roll of paper towels. Be careful when pushing the can or tube into the ground around the plant that you don't cut the sideways-planted stem. This also provides early protection from drying winds and cool temperatures. Remove the can or tube when the plant becomes tough and "woody" and can resist cutworm damage.

PRUNING AND TRAINING

Suckers are the growth in the leaf axils between two young shoots. Removing them generally results in earlier fruit maturation but lower yields. *Determinate* varieties will need little pruning of the suckers and *indeterminate* varieties will need and tolerate extensive pruning. Do not prune once tomatoes have started to form. Pruning a plant with mature fruits may result in sunscald, because fruit will be more exposed to the sun.

Staking tomatoes speeds crop production, improves fruit quality, reduces the incidence of disease, and makes plants easier to cover. It needs to be done at time of transplanting to reduce root damage. A simple 6-foot stake set 10 inches into the soil and next to the main stalk will provide enough support. In windy areas put the stakes on the side of the plants opposite the prevailing winds. As the plant grows, tie it loosely to the stake with strips of cloth about every 12 inches up the stem. A staked plant will need to be pruned to maintain a single stem. Pinch off the shoots as they grow from the bases of leaves. Staked plants may produce fewer fruit due to a reduced canopy. In addition, the exposed fruit on staked plants are more susceptible to sun burn.

Trellising shares the same advantages and disadvantages of staking. However, trellises use little space and plants can be placed closer together, providing a larger yield. Trellising is best used for indeterminate varieties. Set plants one to three feet apart in the row, depending on how severely you will prune. Set support posts several feet apart so the tops are five to six feet above the soil surface. Stretch heavy wire or twine between the posts at one-foot intervals. Train the tomatoes so the branches interweave on the horizontal support system. Remove many of the suckers or side shoots. When the plants reach the top support on the trellis, cut them to stop any higher growth.

An alternative trellis has a single wire at the top of the posts to which a length of heavy twine is attached above each plant. The plant is then trained up the twine. With this trellis, plants will be planted closer together. Prune the plants to the main stem and remove all suckers as they develop.

Caging will eliminate the need to severely prune tomato plants. Store-bought cages can be used, but usually need additional support to keep them from falling over. Cages can be made at home from concrete reinforcement wire or hog wire made into a ring, and will be secure if they are pushed into the soil.

Plants can be allowed to sprawl on the ground, saving work, requiring no training and providing a bigger tomato crop. This will require more room for each plant and possibly a mulch on the ground to keep the fruit clean. However, this method extends the time needed to mature a crop since plants are not pruned.

TOMATO FERTILIZATION

Tomatoes grow in any well-drained, fertile soil with a pH of between 5.5 to 8.0. A light, well-drained soil warms faster in the spring. Heavy soil will need to be amended with organic matter to improve the texture. Forming soil into raised beds also helps to increase soil temperatures earlier in the spring. Phosphorous deficiency can be an issue, especially in northern Idaho where volcanic soils tie up available phosphorous. In these areas, a handful of steamed bone meal per plant will correct this problem. If soil is low in organic matter, incorporate two to three inches of compost, aged manure or peat moss into the area to be planted and work it into the top 6 to 12 inches of soil.

Ideally, have a soil test done and follow the recommendations based on the results. In the absence of a soil test, apply a balanced fertilizer at a rate of 0.1 pound of nitrogen per 100 square feet before planting. Most Idaho soils will have enough phosphorous and potassium to support tomato production. Additional fertilizer can be side-dressed to each plant as needed when 12 inches tall and again when the fruit is 1 inch in diameter. Use 0.2 lb of nitrogen per 100 square feet each time. Care must be taken not to add too much nitrogen to tomato plants, as this will cause plants to produce more leaves and less fruit. Table 1 shows recommended amounts of commercial fertilizer to add per plant, at the time of planting.

There are many choices of fertilizers for use on tomatoes. *Soluble* fertilizers contain nutrients that are available immediately and are ideal for use at time of transplanting. *Granular* fertilizers release nutrients to the plant slowly throughout the season. *Balanced* fertilizers contain all three major nutrients in their analysis, which are expressed as three numbers referring to the percentage of nitrogen (N), phosphorus (P), and potassium (K). *Conventional* fertilizers are derived from a non-organic source with analysis clearly labeled. *Organic* fertilizers are derived from plant or animal materials and the N-P-K contents may not be clearly stated. Table 2 describes the typical contents of some organic materials.

Table 1: Recommended amounts of commercial fertilizer

ANALYSIS	AMOUNT PER PLANT AT TIME OF PLANTING
10-10-10	2.5 oz.
12-12-12	2 oz.
15-15-15	1.6 oz.
6-24-24	4 oz.

Table 2: Recommended amounts of organic fertilizer

FERTILIZER	ANALYSIS	AMOUNT PER PLANT AT TIME OF PLANTING
Fish emulsion	5-2-2	8 oz.
Alfalfa meal	2-1-2	1.5 lb.
Horse manure	0.5-1-2	4.5 lb.
Poultry manure	2-2-2	1.5 lb.
Steer manure	0.5-1-4	4.5 lb.

WEED CONTROL

You can easily control weeds in your tomato patch by applying mulch to the base of each plant and between the rows of plants. *Black plastic mulch* is easy to apply. It can be removed and used for more than one season. *Organic mulches* such as grass clippings, clean straw, leaves or compost can be applied in thin layers to a total depth of three inches. Organic mulch must not be added to the soil until it has warmed thoroughly. This is especially important in short season areas, since cool soil temperatures will slow plant growth. Be sure no herbicide residues or weed seeds are present in organic mulches, and avoid using organic mulches on naturally cool, wet soils.

In areas not covered by mulch, mechanical or hand cultivation can be used to control weeds. It is imperative that weeds not be allowed to go to seed.

IRRIGATION

Tomatoes require even watering throughout the season. Widely fluctuating soil moisture will cause tomatoes to develop problems.

Early in the growing season, tomatoes need light and frequent irrigation. As the season progresses, tomatoes need more water applied at less frequent intervals. Irrigate deeply to encourage a deeper root system. The flowering and fruiting period is the most crucial time to maintain soil moisture. The goal is to keep the soil moist, but not waterlogged. If you allow the soil to dry, and then flood it with water, this can result in poor plant growth and fruit cracking.

Irrigate tomatoes by applying water to the base of plants. Avoid wetting foliage to reduce disease problems. Drip or trickle irrigation systems help keep the soil evenly moist. Applying water to the base of the plant with a hose or hose-end wand also works well.

COMMON TOMATO PROBLEMS IN COOL AREAS

Blossom drop caused by poor pollination is very common in short season areas. Blossoms may drop without fruit production, or misshapen fruit may result from incomplete pollination. Cool or cloudy weather retards pollen shedding. The bulk of pollen is shed on dry, sunny days between the hours of 10 am and 4 pm. Tomatoes require a very narrow temperature window between 60°F and 70°F in order to set fruit. If night temperatures drop below 55°F, pollen may fail to devel-

op and flowers that open the following morning may not set fruit. Nighttime air temperatures need to be increased in order for pollination to take place. Normally, a relatively warm location will provide suitable conditions as nights get warmer. In cooler areas, you may need to use plant protection devices or "heat sinks," such as rocks or other heat absorbing materials, to provide adequate nighttime heat.

Blossom end rot in Idaho is usually the result of widely fluctuating soil moisture during pollination and early fruit set. It is characterized by a water-soaked light tan spot on the blossom end of the fruit. The spot enlarges and becomes dark brown or black and leathery. In some cases, calcium deficiency may cause blossom end rot. Calcium deficiency in tomatoes is relatively common on acidic soils found throughout central and northern Idaho. Mulching, avoiding soil moisture fluctuations, and the addition of soil calcium will prevent the problem. On acidic soils (pH below 7.0), applying lime to the soil surface can help prevent calcium deficiency. When soil pH is neutral or alkaline (7.0 or above), gypsum adds calcium to the soil without raising the pH.

Early blight is caused by a fungus which overwinters in garden refuse. Infection appears as small, irregular blackish-brown spots on older leaves. To avoid early blight, rotate tomatoes with other crops and practice good sanitation. Consult the Pacific Northwest Plant Disease Control Handbook for current control information. This guide is available online at http://plant-disease.ippc.orst.edu/.

Late blight is caused by a fungus-like organism that overwinters in potato tubers or can be introduced with seed potatoes or tomato transplants. Lesions start as irregular, greenish, water-soaked spots on leaves, petioles or stems. Destroy volunteer potatoes and tomatoes and purchase planting stock from reliable sources. Avoid wetting foliage when irrigating. Consult the Pacific Northwest Plant Disease Control Handbook (http://plant-disease.ippc.orst.edu/) for current control information.

Cold soils are a common problem in short season areas. Tomatoes grow best at soil temperatures above 65°F. Lower temperatures will result in slow growth, stunting or root rot. Invest in a soil thermometer if necessary to be sure soil has warmed sufficiently for tomato growth. Raised beds can help raise soil temperatures, and hoop houses and tunnels usually provide good tomato-growing conditions in colder areas.

Curly top virus is very common in areas where sugar beets are grown. This virus is spread by beet leafhoppers. Peppers, melon, squash and cucumber may also be infected. Once the virus is in the plant, there is no control. The older leaves become thick and leathery and show an upward rolling. Fruit ripen prematurely and are small and leathery. Remove infected plants as soon as they are identified. Covering the plants with a row cover can help keep the leafhopper from transferring this disease.

HARVESTING

During warm weather, tomato fruit will ripen normally. A ripe tomato has seeds that are well developed, and that are not cut when the tomato is sliced. As the end of summer approaches and air and soil temperatures become cooler, the ripening process slows. This occurs as early as late August in some short season areas. As night temperatures drop, tomatoes can be harvested when green and brought indoors to ripen. Green tomatoes that are exposed to temperatures below about 40 °F may fail to ripen, even when brought indoors. This failure to ripen is caused by chilling injury to the fruits. The cavities inside mature green fruit have a thick jelly-like material and seeds that have turned from white to tan.

RIPENING AND STORAGE

Mature green tomatoes can be stored for 1 to 6 weeks by placing them in warm (55-60°F), moist (80-85% relative humidity) conditions. A paper or plastic bag in a semi-heated outbuilding or a cool room of the house can satisfy these conditions. To ripen, move mature green tomatoes to 68 to 72°F as needed. Ripe fruit will keep for 4 to 10 days in storage. The ideal storage conditions are cool (45 to 55°F) and moist (80-90% relative humidity). Tomatoes are susceptible to chilling injury at temperatures below 45°F.

FOR FURTHER READING

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