

Vegetable Gardening

Basics, Tips, Tricks, and How-To Steps



PanAmerican Seed offers a novel, high-quality collection of vegetables and herbs especially for those who supply fresh market farmers and hobby gardeners.”

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Background

Born and raised in Wallingford, Vermont

Grew up working at her father's small local flower wholesale business

Worked at Garland's Garden Center in Rutland, Vermont, throughout high school

Earned Bachelor's Degree in Plant Science from the University of Minnesota - Twin Cities

Interned for W. Atlee Burpee & Company at Fordhook Farm Trial Facility in Pennsylvania

Currently working for PanAmerican Seed as a Trials Manager in Elburn, Illinois

Basics and Must Haves

The basics to growing vegetables requires research, planning, good seed, sunshine, water, food, and attention. In your research, ask yourself these questions: What hardiness zone am I in? What do we want to grow? Are those crops acclimated to this hardiness zone? Do we have all the resources and space available and prepared?

Vegetable production must include sunshine, water, warm temperatures, space, nutrients, and maintenance. Some of the nitty-gritty yet still important factors include soil testing for texture and pH, crop rotation, and planting media . We will be diving into each of these factors throughout the presentation to give you the tools you need to have a successful vegetable garden.

Sunlight

When planning your garden location, the first factor to consider is light exposure. Carefully monitor how many hours of sunlight hits that spot throughout the day. Most vegetables need full sun which means approximately 6-8 hours of sunlight.

If your garden area is covered by partial shade, here are some vegetables to consider.
Cole Crops, Beets, Celery, Potatoes, Parsley, Garlic, Chard, Spinach

Irrigation

All plants need water. And lots of it! But not too much... Monitoring the soil moisture each day will help you determine if your garden is in need of more water or not. When watering your plants, be sure to water at the base of the plants rather than overhead (discussed later). To save on water costs and usage, install a drip irrigation system.

Temperature

Ideal temperatures for growing vegetables is between ~70-85°F. When starting seedlings indoors, be sure to keep the soil warm and moist. Most garden centers supply heated germination mats that will make your indoor starters much happier! Once the danger of frost has passed, it is safe to put direct sow seeds, plugs, or starters into your outdoor garden.

Space

As much as we want to use up every square inch of our gardens, we have to remember each plant needs plenty of space. Threats from less space include increased disease pressure, resource competition, and crowding (poor fruit development = difficult harvest). At our Elburn facility, we give our tomatoes 2 feet spacing between each plant to allow for continuous growth and trellising. For our peppers, they only need about 1 foot (unless they are hot peppers which tend to have larger canopy cover).

Nutrients

Macronutrients are elements that most vegetables absolutely need in large quantities. which can be broken down into two sections. Primary elements, aka the magic trio, NPK, as well as Hydrogen, Oxygen, and Carbon. Plants have direct access to oxygen, hydrogen, and carbon through air and water but NPK is not so easy. You may have seen this on fertilizer bags or soil adjustment recommendations. NPK stands for Nitrogen, Potassium, and Phosphorus. In general nitrogen helps keep the plant green and growing vegetatively, such as sending off new shoots and leaves, too much of it can result in abnormal vegetative growth or lots of new leaf growth with minimal flower setting. Phosphorus helps with root growth and overall production of flowers and fruits. When you see your tomatoes turning an odd shade of purple with little to no fruit set, you may want to consider adding some phosphorus to your soils. Potassium helps regulate many of the plant's functions such as photosynthesis, transpiration, and overall development. Secondary elements within the macronutrients include calcium, magnesium, and sulfur.

Micronutrients, which are needed in lesser amounts include boron, copper, iron, manganese, molybdenum, and zinc.

Maintenance

Garden maintenance will make or break your garden's yield. This is the tedious work some gardeners absolutely enjoy, and others dread. Either way, it is required for a successful harvest. Maintenance includes everything from weeding, pruning, dead-heading, trellising, etc. Specific requirements for maintenance depends on which crops you are growing. Different tasks for maintaining tomatoes and peppers will be mentioned later.

Crop Rotation

As you continue to garden annually, be sure to switch it up! Crop rotation helps minimize soil disease pressure, replenishes nutrient availability, and pest control especially for in ground gardens. Two or three years between similar crops will yield the best results. This means if you grow tomatoes on one end of your garden this year, consider planting your other solanaceous crops (peppers and eggplants) on the other side of the garden with your tomatoes the following year. If you have raised beds or containers, I recommend replenishing or ideally replacing your soil each year to minimize soil pathogens from carrying over into the next season.

Plant Selection

The easiest and most efficient way to prevent diseases from causing trouble in your garden is to select resistant varieties. These varieties can be found in your suppliers catalog in the product descriptions.

Only certain plants can grow in certain climates. This is where the hardiness zone map comes in handy (see this year's farmers' almanac). Most of the vegetables we love can tolerate our zone 5B. However some crops may be more sensitive to the cold or to high temperatures and you will want to schedule your sowings and plantings accordingly.

Garden Preparations

Planting Options - Pick a site

There are many different ways to plant your tomatoes. Here are examples for in ground, raised bed, and container. All are great options. If you are planning on growing tomatoes, each option will require trellising, staking, or caging in some way.

Pick whichever system works best for your available space and resources. Have fun with it!



Planting in raised beds or in containers allows you to supply the best possible soil or media for your plants. Planting in the ground, however, is not so easy. Determining whether or not your soil is ideal for your tomatoes or not can be done by soil testing (mentioned below). Most garden centers have tools that will help you identify the key nutrients your

soil provides or is lacking. With this information, you can find out what type of fertilizer (either synthetic or organic) you can use to support your garden.



Planting Media

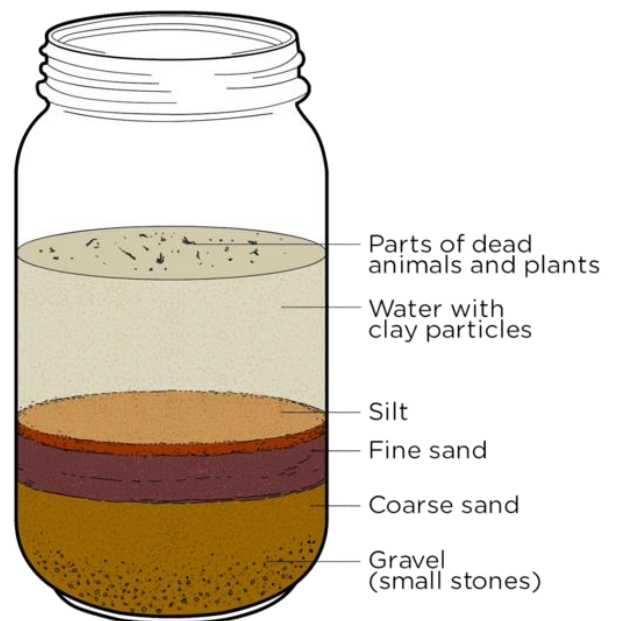
How do you know what to fill your gardens with? Should different soils be used for different planting sites? There are many options when it comes to which soil to use for your vegetable gardens. The most popular media we are familiar with is regular garden or top soil. These can be found at your local garden center and can be used for either in-ground use, containers, or raised beds.

Another option for media or soil additive is peat moss. This media has become a popular item for home gardeners because it's fairly cheap, soilless (which means it won't have any soil borne pests, or weed seeds), great drainage and moisture retention, lots of available organic material, and is a great source of acidic material.



Soil Texture

40% sand, 40% silt, and 20% clay is ideal for ideal loamy soils. One way to estimate soil texture is the jar method. Fill a jar about $\frac{1}{3}$ full of soil from your garden and fill the rest with water. Shake vigorously. Let the jar sit overnight. The first layer that will settle is the heavier particles like gravel and then sand. Next will be silt followed by clay particles that will be settling last. Other organic matter may float to the surface. Here you will clearly see the percentage of your garden's texture. If one is largely more than the other, you may consider adding more material to balance and create a loamy soil.



Another method to determine soil texture is called the ribbon test. To do this take a small handful of soil and roll it between your fingers, if a ribbon forms and the soil is smooth to the touch, then the soil consists of mostly clay particles. If you roll it between your fingers and notice the texture to be grainy and rough and no ribbon forms, it consists mostly of sand.



Soil Moisture

These three pictures indicate the three major soil moisture types. We have saturated, moist, and dry. Clearly, we want our soils to be moist with enough available water but not an excess



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amount where the plant can't uptake any oxygen or where the roots may rot away.

One of the reasons why we test the soil texture is to determine how well the soil can hold moisture. Sandy soils tend to drain fairly quickly while clay soils hold tight aggregates and drain slowly. The middle ground where the soil drains well while retaining moisture is usually found in loamy soils.

One method I used to find the correct soil moisture when transplanting or sowing was attempting to form a ball with the soil. If it fell apart and couldn't hold the shape then it was too dry. If it held the shape but water was dripping down my hands when I pressed it together then it was too wet. If it held its shape and I could throw it like a baseball then it was just right.



Irrigation

There are two main types of irrigation systems. Drip line and good old fashioned hand watering. I would recommend drip irrigation especially for vegetable production for a few reasons. First, it ensures consistent and efficient irrigation. The released amount is adjustable for dry spells or exceptionally rainy



seasons. Second, the water is only in contact with the soil not the foliage or other plant parts that are more susceptible to disease when wet. Third, you can save on water usage

and costs by only irrigating the areas of the bed with plants.

There's no need to water the entire bed if the roots do not have access to the moisture.

Drip irrigation can be installed in any type of garden whether its inground, raised, or container.

Supplies may be found at your local garden store or large retailer.



When hand watering, it is crucial that you are concentrating the water at the base of the plant, not over the top of it. When watering, observe how quickly the water is being absorbed by the soil. A general rule of thumb is if the water takes 15 seconds or more to be taken in then the soil has reached field capacity.

Tensiometers, or moisture meters, are very handy tools that read the soil moisture to ensure your plants have enough available moisture. You can place these in each raised bed or throughout your garden. They can also be found in most garden centers or large retail stores.



pH Testing and Adjusting

Another helpful tool to keep in the gardening shed is a soil pH meter. The pH scale reveals how acidic or alkaline your soil is. This is important because pH is the key to nutrient availability in the soil. If your soil is too acidic, you may experience any form of NPK or magnesium deficiency, which your plants will respond with yellowing of the leaves and poor growth. This may trick you into adding more fertilizer when really all you need to do is

add some lime to balance the soils for nutrient release. Therefore, I recommend testing your soils before applying any fertilizer. Who knows what your soil may already have available! For most of the vegetables we grow in this area, neutral soil pH levels (5-8) are preferred.

The best time to test and adjust your soils is in the fall. This will allow your soils to acclimate before the growing season in spring. If this time has already passed, you may also test in the spring, but be aware the soil may not adjust in time by the time you are planting so you may see some signs of deficiency.

Now that you know how acidic or alkaline or soils are, how do you fix it? If your soil tests reveal 0-4 on the scale, your soil is too acidic and could use some alkaline (limestone). If it shows 9-14 on the scale, your soil is too basic and could use some form of acid (aluminum sulfate, sulfate). To help determine what the appropriate amount and which product is best for your specific garden, consult your local garden center.

Garden Mulch

Another recommendation I have is to apply some type of mulch or ground cover. Having ground cover helps maintain soil moisture and soil temperature, keeps weeds down, and

reduces soil/splash erosion. Forms of ground cover include plastic mulch, landscape fabric, wood chips, or straw.

For our size at Elburn it is more cost effective for us to have plastic mulch for the vegetable trials. Many small growers have utilized landscape fabric in their raised or garden beds. The down side of plastic mulch is that it is for one use and must be thrown away at the end of the season. Landscape fabric can be reused, however, it must be sanitized to ensure no carry over of soil diseases or pests. Plastic mulch comes in black, white, and red. Each color has variable benefits depending on location. White reflects the sun and will keep the soils cooler compared to the black plastic which will absorb the sunlight. Red is comparable with black plastic with not many differences. Straw is also used commonly with smaller gardeners. Straw is fairly cheap, biodegradable, and effective. Straw also holds moisture very well and also works as insulation for soil temperature but may have a few weeds pop up. For small scale vegetable growing, I would recommend straw.



Growing Tomatoes

Sowing

Tomatoes can either be directly sown into the garden after the danger of frost or sown indoors about 6-7 weeks before the last frost. You may either bump up the young plants into small pots and then plant the transplant into the garden directly. Before transplanting into a larger container, wait until the seedling has produced their true leaves. True leaves are the first set of leaves to develop after the cotyledon leaves have opened.

Starter Plants

I would recommend purchasing starter plants from your local garden center so you can plant them in the ground right away. Starter plants are usually grown in greenhouses before the last frost so when the ground is ready you can get a head start on growing your tomatoes. This is also a great opportunity to support your local growers like Woldhuis Farms!



Transplanting

When you plant tomatoes, do not be afraid to plant them deep. It is recommended to plant about $\frac{2}{3}$ of the entire tomato plant. Adventitious roots are roots that emerge from any other part of the plant apart from the root axis or radical.

I would recommend spacing tomato plants about two feet apart to give them space to be trellised or caged.

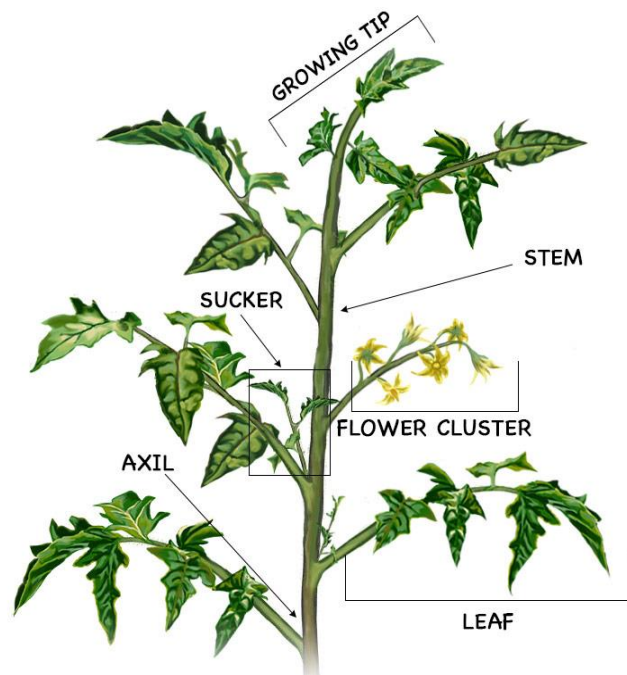


Staking and Trellising Tomatoes

Trellising is a technique many gardeners use to hold up their tomatoes. This is more commonly seen when there are several tomato plants. It may be more cost and time efficient than caging numerous plants. The first technique displayed here is the vertical string trellis (in high tunnels and greenhouses you may see this done with roller hooks). You can attach the plant to the string with either plastic clips or garden tape. The second technique here is called the florida weave where twine is literally weaved between each plant and then wrapped tightly around the post for tension. As the plant continues to grow, the twine acts as a support to prevent lodging or breaking. Depending on the variety, most tomatoes will have less than a foot spacing between each level of twine. The third technique may be one of the most common amongst home gardeners which is regular staking. Gardeners can easily insert a wooden or plastic post, transplant their tomatoes, and tie the main leader stem to the post with garden tape or twine. This may become difficult throughout as the plant matures because it will send off more shoots that won't be easily tied to the post but pruning and training of early shoots will help by repositioning their direction of growth. Tomato cages too.

Pruning/Suckering

Pruning or suckering is one of my favorite parts of growing tomatoes because of how satisfying it is. Suckering is the removal of young shoots that emerge from axils of tomatoes. These shoots can be a nuisance because the plant is pouring more energy into producing vegetation instead of fruit. This is a great way to maintain each plant to have a main leader and to prevent unmanageable overgrowth. Be sure to leave the flower clusters or trusses! Also be very careful when you



are suckering towards the top, you do NOT want to remove the shoot tip or the apical bud or growing tip. This is called “topping off”. The plant will no longer grow vertically. It may send out more side shoots which will continue to bare fruit but not as efficiently. As the tomato continues to grow, feel free to remove the bottom most leaves to help air circulation throughout the plant and focusing the plant on fruit production not vegetative growth.

Harvesting

Now time to harvest! Tomato fruit can be picked immaturely and will ripen if left on a windowsill or on the counter. Green tomatoes are used culinarily fairly often (my favorite is fried green tomatoes with corn sauce). At the farm in Elburn, we harvest fruit just as they are showing color because we only harvest once a week and tomatoes can over ripen fairly quickly if left on the truss. Daily harvests are enjoyable and healthy for the plant as well.

Feel free to prune away the old trusses that have been harvested so the plant has more air circulation and less vegetative growth to pour energy into.

What's wrong with my tomatoes?

Guttation

You may recognize this phenomenon on a hot and humid morning or right before night fall in July. Perhaps you may have assumed it was a lovely arrangement of morning dew. At least that's what I thought it was! As a matter of fact this occurrence is called guttation; when water and sap from the xylem



(transpiration/water plumbing system of plants) is pulled to the edges of the plant and forms droplets. This usually occurs when root pressure is higher than the transpirational pull so instead of moisture leaving through the plant's stomata to be evaporated, it is pushed out through hydathodes (water glands) that are located on the edges of the plant's leaves. This is no cause for alarm...yet...However, when there is excess moisture on the plant's surface for long periods of time, it may increase the likelihood of disease introduction. This can be remedied by proper plant spacing to allow air flow.

Adventitious Roots

This is one of the more disturbing occurrences you may see later in the growing season. Here is an example of adventitious roots emerging from the main stem. Adventitious roots are roots that form from any non-root tissue. This will usually happen when there is high moisture levels and warmth around the base or thicker foliage areas of the plant. When the

tomato notices these conditions, it sends signals to tell the root system of the plant that this must be an area where water is accessible and it will then send out roots to absorb it. Even though it is not a fatal situation for the plant, it is not ideal because high humidity could mean fungal disease threats and occasional stem splitting if too aggressive. To help reduce high humidity around the plant, you may want to thin some of the foliage cover to allow more air flow.



Growing Peppers

Sowing

Pepper seeds take about 2-3 weeks longer to germinate than tomatoes. Peppers are notorious for slow and low germination. Because of this, it is not recommended to direct sow outdoors. If you decide to start your own seedlings, you may want to consider starting them indoors with optimal light and temperature. Then you may transplant into a larger pot or transplant outdoors.

Starter Plants

Just like tomatoes, I would recommend purchasing pre-grown pepper starters to get a head start on your vegetable garden. These young plants are ready to be plugged in right away after the danger of frost has passed.



Transplanting

Unlike their cousin, the tomato, peppers should NOT be planted deeper than their plug soil line. Covering the stem with soil will result in stem rot as they do not send out adventitious roots. Since peppers are not as vegetatively vigorous as tomatoes, they can be planted closer together which also helps with cross pollination to develop fruit. At our facility, we plant with 1 foot spacing for sweet peppers and 2 foot spacing for hot peppers.

Staking and Maintenance

You may decide to cage your pepper plants to prevent lodging and to keep them contained, however it is not completely necessary compared to tomatoes that absolutely need some

type of cage or trellis. Pruning peppers is also not completely necessary unless you would prefer your plants to be thinner.

Harvesting

When I first started working at panamerican seed I remember one of the technicians telling me “There is no such thing as green or purple peppers”. I stared and tried to understand what she meant because clearly....there is. Then she explained “No pepper matures to green or purple. Those are all unripe fruits.” For data purposes we



could not harvest unripened fruit even though my consumer brain thought the big green bells were perfect. Buying green peppers isn't bad and won't hurt you, however, unlike their cousin, the tomato, they will not continue to ripen if you leave them on the windowsill to develop color. Even though most gardeners get away with harvesting pepper fruit by hand, by twisting and pulling, I would recommend taking a pair of garden clippers and carefully cutting each fruit off the plant to eliminate fruit and plant damage.

Common Tomato and Pepper Diseases

Common diseases and deformities you may find while growing vegetables like tomatoes, peppers, eggplant, etc., include fusarium and verticillium wilt, phytophthora blight, septoria leaf spot, verticillium wilt, blossom end rot, septoria leaf spot, septoria leaf spec, cracking, damping off, downy mildew, bacterial rot, anthracnose, and many more. Remedies, cures, and preventative actions can be found easily online or by asking your local garden center attendants. Remember, the best preventative action is to plant resistant varieties!

Growing Cole Crops

Cole Crops

Broccoli, Cauliflower, Kale, Cabbage, Collards, Brussel Sprouts, Kohlrabi

When to Plant

Cole crops can be grown in both spring and fall but amongst growers, fall is the preferred season. Cole crops are better suited for cooler temperatures than warmer temperatures. In the fall, as the temperature gradually decreases, their growing season is extended compared to the spring season when the temperature gradually increases. Most cole crops are fairly frost tolerant and can handle below freezing temperatures. Hence their name "Cole or Cool Crops".

Planting

For cole crops, transplants, or starter plants, are recommended over direct sow for a higher success rate. Cole crops can be sown indoors 4-5 weeks before your target planting date. For a fall harvest, direct sow outdoors mid-June. Be sure to leave ~2 foot spacing between plants.

Blanching Cauliflower

For cauliflower, sunlight can cause yellowing of the head. Blanching is a technique used to help eliminate yellowing of the cauliflower by tying the innermost leaves over a young head thus blocking any sun exposure. Some varieties do this naturally without the need of tying.



Harvesting Broccoli

After harvesting the main head, broccoli will send out side shoots that will continue to develop floret bunches.

Recommended Sources

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