



Environmental Horticulture Notes

EHN 96

VEGETABLE GARDENING 101

Few experiences can match the pleasure of savoring homegrown vegetables, especially if you grow them from seeds or seedlings. The flavor and number of varieties that you can grow far exceeds what you can buy at a grocery store. If you follow the advice in this document, growing vegetables does not have to be time consuming or difficult. Experience really is the best teacher, and as your knowledge increases, so will the rewards of gardening.

SELECTING A SITE

You do not need a large space for your vegetable garden. If you choose to grow in containers, you do not even need a yard. However, the following elements are critical to grow good vegetables.

- **Sunshine** – Choose a site for your garden that gets at least 6 to 8 hours of full sunlight per day. Avoid shaded areas such as under trees or large shrubs or on the north side of tall buildings or fences.
- **Water** – The closer your garden is to a source of water, the better. Vegetables need a steady supply of water during growth, so be sure there is a handy and adequate water source near the site.
- **Good soil** – Something between clay (fine-textured, heavy soil) and sand (coarse-textured, light soil). Most vegetables need loose, crumbly soil that drains water well but still holds moisture, and loam (medium-textured soil) is ideal.

No soil is perfect, but fixing bad soil is not hard; very light or very heavy soils can be modified with organic amendments to increase their water-holding capacity or to improve drainage. Examples of organic amendments are hay, straw, peat moss, leaves, well-rotted manures, compost, sawdust, and pesticide-free lawn clippings. Additional nitrogen fertilizer may be needed when organic matter is used. Nitrogen is a vital ingredient of the decomposition process and a critical plant nutrient, but it cannot be both at the same time. As organic amendments decompose, they can tie up nitrogen that would otherwise be feeding your plants. If your amendment is not completely composted, you may need to add nitrogen fertilizer.

If your soil is less than ideal and does not drain well, you may want to consider planting in raised beds. If you plan to grow vegetables in containers, do not use garden soil; instead, fill the container with a high-quality potting mix.

PREPARING THE SOIL

Soil should be spaded or tilled when it is moist but not wet; it should be dry enough to crumble when pressed in your hand. If you turn the soil when it is too wet, it can destroy its structure, causing it to form large clods that later harden. Large dirt clods cause poor germination because seeds planted in or under them have little contact with the soil or may be buried too deeply. When your soil is sufficiently dry, loosen it to a depth of 6 to 10 inches and immediately break up large clods with a spading fork or rake to ensure that the soil is pulverized into pea-sized granules. Spread any fertilizer, manure, leaves, or compost and work that into the soil and then rake it smooth.

It is a good idea to test the soil every few years. This will provide needed information on soil pH and nutrients. The pH scale is a numerical chart used to indicate the relative acidity or alkalinity of a given substance. The scale is from 0 (extremely acid) to 14 (extremely alkaline); pH of 7 is the neutral point. Garden vegetables do the best in slightly to very slightly acid soil (pH of around 6).

Soil pH affects the availability of plant nutrients in the soil which are essential for plant growth and development. If the pH is too high or too low, plants will not be able to use the nutrients around them, no matter how naturally rich the soil is or how much fertilizer you add. Soils may be made less acidic (more alkaline) by raising the pH with additions of lime (calcium carbonate) or wood ashes. They may be made more acidic (less alkaline) by lowering the pH with additions of elemental sulfur or aluminum sulfate. Unless you test your soil, you will not know how much lime, sulfur, or fertilizer is needed.

Inexpensive do-it-yourself soil test kits, available at most garden centers or through mail-order catalogs, are quick and easy to use but provide only a rough estimate of your soil's condition (soil pH and nitrogen, phosphorus and potassium composition of the soil). A complete soil analysis at a laboratory is important, especially if you are breaking new ground for a garden plot. Contact the Sacramento County Master Gardener Office for a list of companies that provide soil testing services.

WHAT TO PLANT

It is tempting to try growing a large variety of vegetables. A better approach might be to consider what you and your family like to eat. Then consider the space that you have available. Plant only as large a garden as you can easily maintain, as there is a time commitment (thinning, weed and pest control, irrigation, fertilization). A smaller, properly tended garden will be more productive and satisfying than a larger garden receiving minimal attention.

Be sure to plant varieties adapted to your growing area. Try some new plants on a trial basis, but always include varieties that have proven their success in your climate. You may want to grow more than one variety to determine which is best suited for your locality, microclimate, and individual taste. Consider such factors as disease resistance, maturity date, compactness of plants, and the size, shape, and color of the vegetable desired. If you have little space, it might be advisable to plant varieties that do not become too large, or to select varieties that can be grown vertically on trellises or wires.

SEEDS AND PLANTS

You can grow many vegetables from seed, but you can also buy young plants from a nursery or garden center. If you sow seeds into the garden soil, you must wait for the ground to warm up enough to germinate the seed. Carrots and beans are two vegetables that require "direct seeding". With direct seeding, you place the seeds at the recommended depth (generally seeds should be covered to a depth equal to 2 to 4 times the diameter of the seed, but check out the seed packet for this information), water thoroughly, then wait for the plants to emerge.

Buy fresh seeds. Some seeds, such as onion, parsley, and parsnip, lose viability after about a year. Seeds of other vegetables are good for three years or more. Write the date of purchase on the seed packets and store any leftover seeds in a cool, dry place.

Vegetables produced by young plants are ready to harvest earlier than those grown from seed. The vegetables most commonly bought as young plants for transplanting are tomatoes, peppers, lettuce, broccoli, celery, cabbage, cauliflower, and eggplant. When purchasing seedlings, select short, stout, healthy plants that are not yet producing flowers, buds, or fruit. Roots should not be sticking out through the drainage holes.

Growing transplants from seed gives you a much wider universe of varieties to try. Starting vegetables indoors is not difficult, but it does require some time and attention. Seed packages provide information for planting the particular seed, but here are some guidelines to help you be successful.

- In general, sow seeds 6 to 8 weeks before the date you wish to set the plants in the garden. However, the sowing period may range from 4 to 18 weeks before transplanting, depending on the speed of germination, the rate of growth, and the cultural conditions provided. It is important to time seed sowing so that the seedlings are at the correct stage when it is time to transplant them into the garden.
- You can use a variety of containers, such as wooden or plastic flats or trays, small individual pots, and cell packs. If you are reusing old containers, be sure to wash them thoroughly and soak them in a solution of 1 part household bleach to 9 parts water. This procedure prevents most seedling diseases from occurring.

- Fill the pots with a light, porous seed-starting or potting mix. Do not use garden soil by itself to start seedlings as it is too heavy, not sterile, does not drain well, and shrinks from the sides of containers if allowed to dry out.
- Follow printed recommendations on the package for the suitable planting depth, and avoid planting seeds too deeply. Label each container with the plant's name and the date.
- After seeds are sown, moisten the planting mix thoroughly using a fine mist or spray; then set the container aside to drain. The soil should be moist but not wet. Ideally, seed flats should remain sufficiently moist during the germination period so that adding water is unnecessary. One way to maintain moisture is to slip the whole flat or pot into a clear plastic bag or cover it with clear plastic wrap after the initial watering. Be sure to remove the cover as soon as the first seedlings appear. Drain off water collected at the bottom of the planting tray so that seedlings are not sitting in water.
- After germination, move the flats to a bright, airy location that is kept at 55 to 60° at night and 65 to 70° during the day. Place them in a window facing south, if possible. If a large, bright window is not available, place the seedlings under fluorescent lights. Use two 40-watt, cool-white fluorescent tubes or special plant-growth lamps. Position the plants about 2 inches from the tubes and keep the lights on about 16 hours each day. As the seedlings grow, the lights should be raised accordingly. This will result in a more compact, healthier transplant to set out into the garden. Keep the soil evenly moist and do not allow seedlings to wilt. Regular fertilization with half-strength soluble plant fertilizer solution is recommended.
- If the plants have not been seeded in individual containers, they must be transplanted to give them proper growing space. The ideal time to transplant young seedlings is when the first true leaves develop above or between the cotyledon leaves (the cotyledons or seed leaves are the first leaves the seedling produces).
- In order to reduce transplanting shock, seedlings should be gradually conditioned to the outdoors for at least two weeks before being set into the garden. This "hardening off" process starts by gradually exposing the seedlings to the more harsh outside conditions. Set the plants out in a shady place on a warm day for 1 to 2 hours at first. Then gradually move the seedlings into sunlight, increasing the length of exposure each day until you are leaving them outdoors day and night. Bring them indoors whenever cold temperatures are predicted. Reduce the frequency of watering to slow growth, but do not allow plants to wilt. After several nights outdoors, plants should be ready to transplant into the garden.

GROWING IN CONTAINERS

If you choose to grow vegetables in containers, use a half wine barrel or other large container that is large enough to accommodate the root system. Shallow-rooted crops are those whose main root system is in the top 1 to 2 feet of soil. Examples are cabbage, cauliflower, lettuce, celery, corn, onion, potato, and radish. Moderately deep-rooted crops are those that have the main root system in the top 1 to 4 feet of soil. Examples are snap bean, carrot, cucumber, eggplant, peas, pepper, and squash. Deep-rooted crops are those whose main root system is in the top 1 to 6 feet of soil. Examples are asparagus, globe artichoke, cantaloupe, pumpkin, tomato, and watermelon. (The maximum rooting depths given here are the potential rooting depths under ideal soil conditions.)

Ideally the container should be at least 18 to 24 inches wide and 12 to 16 inches deep with multiple drain holes. Fill the container with a good-quality potting mix (do not use garden soil), and install any necessary wire cages or other supports at planting time. Gardening in containers requires more frequent irrigation and fertilization.

TRELLISING AND STAKING

Do not grow horizontally what you can grow vertically. Twining and vining crops such as tomato, squash, cucumber, melon, and pole beans use a great deal of space when allowed to grow along the ground. Trellises, stakes, and other supports minimize the ground space used and increase garden productivity. Support materials can be wooden structures, wooden or metal stakes, twine, wire cages, or a nearby wire fence.

WHEN TO PLANT

Timing is everything. Some crops like to mature in cool weather in the spring and fall (cool-season vegetables), but others prefer the warmth of summer (warm-season vegetables). The *Sacramento Vegetable Planting Schedule* (Environmental Horticulture Note #11) provides appropriate planting dates for commonly-grown vegetables.

Cool-season vegetables grow best and produce the best quality crops when average daytime temperatures are 55 to 75°, and they usually tolerate slight frost when mature. Examples include: artichoke, asparagus, beet, broccoli, cabbage, carrot, cauliflower, chard, lettuce, onion, parsnip, potato, radish, spinach, and turnip.

Warm-season vegetables require long, hot days and warm soil to mature. They grow best and produce the best quality crops when average daytime temperatures are 65 to 95°, and they are intolerant of freezing temperatures. Examples include beans (lima and snap), corn, eggplant, melon, peppers, pumpkin, squash (summer and winter), and tomato. It is recommended that you not plant in the ground until the soil has had a chance to warm up. Seeds planted too early, when the soil is too cold for germination, may rot, and transplants may become stunted or die unless you provide cold protection to the plants. The average date of last frost in the Sacramento area is February 8 (record is April 7). The average date is based on extremes, so you should be prepared for the unusually late frost.

IRRIGATION

For optimal plant growth, the soil should remain evenly moist as plants mature. Try to avoid alternating wet and dry soil conditions. Although deep irrigation is preferable because it promotes deeper root growth, you may need to provide frequent, light irrigations for shallow-rooted crops such as lettuce or corn. As a general rule, water should be applied when the top 1 to 2 inches of the soil have dried out. Your watering schedule will vary according to your soil and weather conditions.

Overhead watering with a hose, watering can, or sprinkler is usually considered the least efficient irrigation method. Much of the water is lost through evaporation, and some will fall on soil away from the roots and provide moisture to weeds. Additionally, water that falls on the foliage may contribute to leaf diseases. The best results are usually obtained by using drip tape or soaker hoses, which slowly supply water directly to the plant roots with minimal loss through evaporation and little water contact with the foliage.

MULCH

Using a layer of organic mulch around plants helps conserve soil moisture and reduces the frequency of irrigation, and it also discourages the growth of weeds, which compete with your vegetables for water and nutrients. Examples of organic mulches that you can use are leaves, pesticide-free lawn clippings, fresh sawdust, fine wood shavings, pine needles, compost, hay, and chopped straw. However, be sure that adequate water is able to move through the mulch layer into the root zone of the plants. Matted leaves, for instance, can form an all but impervious layer. The ideal mulch is light and open enough to permit the passage of water and air.

Do not be too anxious to mulch in the spring. Give the soil an opportunity to warm up in direct sun, then give the plants a chance to get growing before mulching.

FERTILIZATION

A good water and fertilizer schedule promotes healthy plants which yield better home grown vegetables. Healthy plants are less susceptible to, and tolerant of, insect damage and fungal diseases. Many gardens are over-fertilized or given the wrong ratios of the well-known trio: N-P-K (nitrogen-phosphorus-potassium). Example: fertilizing a tomato plant with high nitrogen lawn fertilizer produces vines galore but no tomatoes.

Vegetables grown in most California soils often require some fertilizer for best growth. In general, the plants will need nitrogen; however, some soils are low in available phosphorus and some are deficient in potassium. If you have tested your soil, you will know what nutrients are needed. You can either use organic forms (such as composted manures, cottonseed meal, bone meal, dried blood, and compost) or inorganic forms (chemical fertilizers) to supply needed nutrients.

Organic fertilizers are less caustic than inorganic fertilizers and, except for poultry manure, may be used with little possibility of damage to plants. The nutrients from organic fertilizers are rather slowly made available to plants. This may be an advantage where delayed release is desired to promote plant growth over an extended period.

Inorganic chemical fertilizers work quickly, and because of their concentration and solubility, they are somewhat caustic and must be used with care to avoid damage to roots or foliage. Often a combination of the two forms gives better results with vegetables than either used alone, particularly if phosphorus and potassium are required in addition to nitrogen.

Regardless of the type of fertilizer used, apply it by broadcasting it before preparing the seedbeds, or in bands at seeding time. Follow the directions on the fertilizer package—more than recommended is never better.

COMPOSTING

Making a compost pile is an ideal way to recycle organic waste from your home and community. Composting turns kitchen garbage, garden residues, leaves, lawn clippings, weeds, wood products, and many other normally unused materials into a dark, sweet-smelling garden soil amendment. UC Publication #8037, *Compost in a Hurry*, has simple, straight-forward tips to help you generate useable compost in 2 to 3 weeks (<http://anrcatalog.ucanr.edu/pdf/8037.pdf>).

PESTS AND DISEASES

Pests and diseases are ongoing problems for many vegetable gardeners. Although specific problems may require special solutions, there are some general principles you can follow.

- Protect young plants against some insects with row covers (lightweight sheets of permeable material similar to fabric). Row covers are also helpful to prevent damage from light frosts.
- To reduce fungal diseases, water the soil, not the leaves of plants. If you must use a sprinkler, do it early in the day so the leaves will dry by nightfall. If a plant does fall prey to a disease, remove it promptly and throw it in the trash; do not add diseased plants to your compost pile.
- Grow varieties that are listed as disease resistant. For example, diseases such as Fusarium wilt or Verticillium wilt cannot be controlled once they infect tomato plants, so selecting varieties resistant to these diseases is highly recommended. The seed packet or plant label will indicate any disease resistance.
- Keep your garden clean. A number of insects and diseases overwinter or spend part of their life cycle on plant debris. Discarding infected plant parts and spent plants and tilling or turning over the soil, especially in fall, can slow the spread of many pests.
- Pick larger insects and caterpillars by hand. Once you get over the “yuck” factor, this is a safe and effective way to deal with limited infestations. While you are watering, weeding, and harvesting your crops, inspect plants for the first signs of damage. Try hosing off small pests, such as spider mites and aphids, with a jet of water from the hose. Use stronger measures only if your first efforts fail.
- Use insecticidal soap, which is available at most garden centers, to provide safe control of listed pests. Whatever pest control chemicals you use, read the label carefully and follow the directions to the letter. Never use any chemical that is not specifically labeled as safe for application to the crop you are growing. Be exact in following directions about the length of time you must wait between spraying and harvesting.
- Encourage natural controls. Chemical sprays often kill helpful insects along with pests, leaving the garden wide open for a new attack.
- By planting a diversity of flowering plants in your vegetable garden and protecting pollinators by avoiding the use of pesticides, your garden can support all kinds of pollinators, including honeybees, native bees, hummingbirds, and butterflies.
- Finally, make it a habit to change the location of crops each year. Rotating crops in the garden not only enhances soil fertility, but it can be effective against insect and disease pests that develop on a narrow range of vegetable plants. Moving crops to different sites isolates such pests from their food sources. This practice reduces the chances that soil borne insect and disease pests will gain a permanent foothold in

your garden. Backyard gardeners with limited space should at least avoid planting exactly the same crop or crops from the same family (see the chart below) year after year in the same part of the garden. For example, do not follow melons with cucumbers or squash, and do not plant peppers, eggplant, or potatoes where tomatoes grew the year before.

Families of Vegetable Crops Grown in Home Gardens			
Scientific and Common Family Names and Vegetables in Those Families			
<p>Amaryllidaceae (Onion Family) chives garlic leek onion shallot</p> <p>Brassicaceae (Mustard Family) arugula broccoli Brussels sprouts cabbage cauliflower Chinese cabbage collards horseradish kale kohlrabi mustard greens radish rutabaga turnip</p>	<p>Chenopodiaceae (Goosefoot Family) beet chard spinach</p> <p>Compositae (Composite Family) endive globe artichoke Jerusalem artichoke lettuce</p> <p>Convolvulaceae (Morning Glory Family) sweet potato</p>	<p>Cucurbitaceae (Cucurbit Family) chayote cucumber muskmelon pumpkin squash (summer and winter) watermelon</p> <p>Gramineae (Grass Family) corn</p> <p>Leguminosae (Legume Family) dry bean fava bean jicama lima bean pea snap bean soybean</p> <p>Liliaceae (Lily Family) asparagus</p>	<p>Malvaceae (Mallow Family) okra</p> <p>Polygonaceae (Knotweed Family) rhubarb</p> <p>Solanaceae (Nightshade Family) eggplant pepper potato tomatillo tomato</p> <p>Umbelliferae (Parsley Family) carrot celeriac celery Florence fennel parsley parsnip</p>
Adapted from Family Relationships Table, Vegetable Research & Information Center, University of California Cooperative Extension			

HARVESTING

This is what it is all about! To get the most out of your vegetables, harvest them when they are at the best stage for eating. Vegetables will be crisper and cooler if harvested in the early morning.

KEEP A JOURNAL

Record what vegetable varieties you grew and indicate which vegetable crops and varieties did well or poorly. Record specific garden pest problems and when they occurred.

WHAT YOU SHOULD KNOW ABOUT SELECTED VEGETABLES: A GUIDE FOR CULTIVATION IN THE SACRAMENTO AREA

The following chart provides general planting requirements for selected vegetables. This information is not intended to be a comprehensive reference source, and you will need to consult other vegetable gardening materials to obtain detailed information. The key to any successful garden is planning. Close attention should be paid to timing of planting and harvesting, variety selection, trellising, and other space-saving practices. In the Sacramento area, there are 3 to 4 seasons in which vegetables can be grown, yet many gardeners grow only summer crops. By planting a spring (cool-season) crop, followed by a summer (warm-season) crop, and finishing with a fall (cool-season) crop, you can get three crops from the same space. Careful attention to days to harvest for each crop will establish the ideal rotation.

Vegetable Crop (See footnotes for additional information)	Crop Type ⁴	Planting Distance (In Inches)		Days to Harvest (approx.)
		Between Plants*	Between Rows*	
Asparagus ³	C	12-18	36-48	2 years
Bean ^{1, 2} (bush)	W	3	18-30	45-65
(pole)		24	36-48	60-70
Beet ^{1, 2}	C	2	18	55-70
Broccoli, Broccoli Raab ^{2, 3}	C	12-24	24-36	60-110
Cabbage ^{1, 3}	C	24	36	65-120
Carrot ^{1, 2}	C	2	24	120-150
Cauliflower ³	C	24	36	90-110
Celeriac, Celery ^{1, 3}	C	5	24	90-120
Corn ²	W	12	36	65-95
Cucumber	W	24	48	50-75
Eggplant ^{1, 3}	W	18	36	60-80
Garlic ^{1, 3}	C	2-4	12-18	150-180
Jicama	W	10-12	40-42	150-210
Kohlrabi ¹	C	3	24	50-60
Leek ¹	C	2-4	12-18	80-150
Lettuce, head ^{1, 2}	C	12	24	70-90

Vegetable Crop (See footnotes for additional information)	Crop Type ⁴	Planting Distance (In Inches)		Days to Harvest (approx.)
		Between Plants*	Between Rows*	
Lettuce, leaf ^{1, 2}	C	6	24	40-50
Melon	W	12	72	85-95
Okra	W	18	36	50-60
Onion, dry ¹	C	3	18	90-150
Onion, green ^{1, 2, 3}	C	1-2	12-18	50-60
Pepper ^{1, 3}	W	24	36	65-80
Potato ³	C	12	30	90-120
Pumpkin	W	48	72	100-120
Radish ^{1, 2}	C	1	6	21-30
Soybean/Edamame ¹	W	3-4	24-36	85-100
Spinach ¹	C	3	18	40-50
Squash, summer ¹	W	24	48	50-60
Squash, winter ¹	W	24-48	72	85-110
Tomato ^{1, 3}	W	18-36	36-60	60-80
Turnip ¹	C	2	18	45-75
Watermelon	W	60	72	85-95

¹ This crop is suitable for a small garden if compact varieties are grown.

² This crop can be planted more than once per year for a continuous harvest.

³ Transplants, shoots, or roots are used for field planting.

⁴ C=Cool season; W=Warm season

* Planting distances listed here are standards. Many crops can be spaced more closely for intense production.

Source: Vegetable Research & Information Center, University of California Cooperative Extension; *Vegetable Gardening* (Sunset Publishing Corp., 1998)