



## William T. Kemper Center for Home Gardening

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### Growing Vegetables at Home

Vegetable gardening is a rewarding hobby that has many benefits not the least of which is getting exercise and growing fresh food. Most vegetables purchased at the grocery store can be grown seasonally in the St. Louis area. With new compact varieties, vegetables can be grown in almost any space as long as certain requirements are met including a location in full sun, well-drained, fertile soil and access to ample water.

#### Site Selection

Many factors must be considered when choosing the right site to establish a vegetable garden. Ideally, it should be located in full sun; most vegetables can be grown successfully with a minimum of six to eight hours of direct sunlight per day. The amount of sunlight received is directly proportional to yield. Gardens established in part shade do poorly, therefore avoid locations close to large trees where tree roots will compete with vegetable plants for moisture and nutrients. Shade cast by buildings, fences and other structures may or may not affect the yield, depending upon the circumstances. While it is ideal to site a vegetable garden on a flat plain, it need not be perfectly flat; however, sites with steep slopes may require terracing to prevent erosion during heavy rains. Vegetables grow well in locations with shelter from strong winds. Strong winds can knock plants down and cause the foliage to dry out as soil moisture is depleted. Windbreaks on the northern side of the garden will help protect plants from cold in the spring and fall. Vegetables require approximately one inch of water per week from either rain or irrigation. Therefore, the garden must have a convenient water source. Overall, the choice of where to locate the vegetable garden may be a compromise of some of these considerations.

#### Preparing the Site

Site preparation is the most critical step since the initial establishment of a garden is only as good as the health of the soil. The various steps to preparing the soil include removal of existing vegetation, soil testing, amending and tilling the soil, and fertilization.

**Vegetation Removal:** Once the site is selected, existing vegetation must be removed. The procedures involved are dependent on the type of vegetation present. Some weeds can be pulled by hand or simply turned under with a shovel. To remove sod, use a sharp spade and cut away the upper layer of soil including grass and roots. These can then be added to the compost pile. A good way to eliminate perennial weeds such as nutgrass, bindweed, and bermudagrass is by smothering the entire area. Methods of smothering include solarization and sheet composting. Solarization involves covering the area with a double layer of 2 to 4 mil UV-resistant clear plastic, polyethylene or polyvinyl chloride sheeting. The soil beneath should be moist and worked to a depth of at least 6 inches. White or black plastic will not transmit enough light (which is converted into heat) to elevate the soil temperature significantly. Plastic should be in place for a period of 4 to 8 weeks.

With sheet composting, the area is covered with a layer of organic matter such as leaves, grass clipping and manure to a depth of twenty-four inches or more; basically creating a large compost pile over the future garden. Once the compost has matured, it can be turned into the soil and the garden will be ready to plant. Sheet composting may take up to a year. If perennial weeds are not completely eliminated, they will be difficult to control during the growing season.

**Soil Testing:** Plants require 16 elements from the soil for proper growth. Carbon, hydrogen and oxygen come from air and water. Nitrogen (N), phosphorus (P), and potassium (K), magnesium (Mg) and calcium (Ca) are considered macronutrients because they are used in relatively large amounts. The supply of these nutrients is primarily from soil and must be supplemented by fertilizer additions when deficient to promote vegetable development. The remaining elements are considered secondary and micronutrients because they are utilized in smaller quantities. Although these may be present in sufficient amounts for plant growth, a routine soil test will give the soil pH, percentage of organic matter and available levels of phosphorus, potassium, calcium and magnesium as well as recommendations for correcting deficiencies. Nitrogen levels are typically not assessed in a soil test because this element is very soluble in water and leaches away from the root system, requiring some replacement each year. A typical application of fertilizer for a vegetable garden is two to three pounds of nitrogen per one hundred square feet of garden area. Fertilizers should be fully incorporated into the soil prior to planting in spring.

**Amending and Tilling or Turning:** Amending the soil with fertilizers and organic matter to correct nutrient deficiencies or imbalances and improve its texture will create an optimal environment for root development. The best time to work the soil is during the fall in preparation for spring planting. Soil with a high level of humus is desirable for growing vegetables. Humus is the final, most stable form of decomposed organic matter. Humus increases drainage in heavy clay soils and helps retain moisture in sandy soils while improving texture. In the fall, incorporate generous amounts of organic matter such as compost, leaves, grass clippings or aged manure to a depth of ten inches using a shovel or tiller. Do not work the soil if it is too wet. The soil can be worked if you are able to make a ball in your palm and it easily crumbles. When amending the soil immediately before planting in the spring, use only well composted materials.

**Fertilization:** Fertilizers come in organic or inorganic forms. Organic fertilizers are derived from plant and animal remains. These materials release nutrients slowly, which reduces the potential for fertilizer burn and application frequency. Before organic nutrients can be used by plants, they must be broken down to an inorganic form by soil microorganisms. This is a good reason why organic fertilizers should be applied in the fall; providing time for decomposition and liberation of nutrients so they will be available to plants early in the growing season. Inorganic fertilizers are derived from non-living materials. Some sources are contained in mineral deposits. However, most are produced through chemical synthesis reactions. The nutrients in most inorganic fertilizers are water soluble and therefore readily available after application. These can be applied during the growing season for immediate uptake by plants, presenting an advantage to plants that require a quick feed for fruit formation.

If existing soil is unsuitable for improvement or only a very shallow layer of soil is present, the vegetable garden can be created by forming raised beds. Raised beds can be made to any size using wood, plastic lumber, brick, stone or other suitable construction materials. Alternatively, a raised bed can also be formed by just heaping the soil without structural sides. Avoid the use of treated lumber. Raised beds should be at least twelve inches deep to hold enough soil for root development. Raised beds present certain advantages and disadvantages. They warm up quicker in the spring allowing for earlier planting and provide improved drainage. Conversely, because of increased drainage, raised beds require more frequent watering, especially during the summer months. Also, when creating raised beds the soil must be imported. Raised beds are often employed when subsoils are poor and inhibit plant growth even after considerable amendment.

## Planning the Garden

Vegetable selections need to take into account seasonal temperature changes including frost dates. For east-central Missouri, the average last frost date is April 15th. In the fall, the average first killing frost date is October 15th. That gives an average frost-free period of one hundred eighty five days; long enough to grow most vegetables.

Vegetables can be classified as cool season, warm season, or perennial.

Cool season vegetables can tolerate a light frost and grow best in the mild temperatures of spring and fall in East Central Missouri. Growing cool season vegetables is a great way to extend the gardening season beyond the average frost-free period. Most cool season vegetables can be planted in early to mid-March and again in July and August for a fall harvest. Cool season vegetables include: broccoli, cauliflower, cabbage, Brussel sprouts, kohlrabi, kale, collard greens, lettuce, onions, spinach, beets, Swiss chard, carrots, radish, potatoes and peas.

Warm season vegetables are those that are easily damaged by cold temperatures. For this reason they are planted outdoors only after the last chance of frost in the spring; this would be sometime in late April to early May. Warm season vegetables include: tomato, pepper, eggplant, corn, cucumber, green beans, sweet potato, squash and melons.

Asparagus and rhubarb are perennial vegetables. Because they will remain in the same space for many years, perennial vegetables should be planted along the edge of the garden in an out-of-the-way location so as not to interfere with soil preparation for annual vegetables.

One of the biggest reasons for failure is planting vegetables in the garden too early or too late. Planting time for some vegetables can be very important, not only relative to temperature, but also because some require a longer growing season (eighty to one hundred days) to produce fruit. These need to be planted as soon as possible to avoid effects of extreme heat in summer that can affect fruit set and development. This is especially true of tomatoes, peppers and eggplant.

### Cool Season Vegetables

Cool season vegetables are grown in the spring and fall because they do not perform well in the heat of summer. Although they tolerate frosts, cool season vegetables can be damaged by freezing temperatures. Temperatures below 25°F are likely to injure cool season vegetables beyond recovery. Minimal protection during freezing weather is beneficial and helps extend the growing season even further. Covering plants in the garden with a row cover or old sheets will protect leaves from desiccating winds and frost burn. Growing crops in cold frames is another excellent way to prevent cold injury. Protection from cold is more important when establishing plants in the spring.

Many cool season vegetables planted in the spring will mature during the warmer temperatures of early summer. When air temperatures rise above 80°F it is useful to apply a light-colored organic mulch. A layer of mulch approximately two inches thick will moderate soil temperatures, retain moisture, and suppress weed growth. Avoid application of mulches too early in the growing season. This prevents warming and keeps soil temperatures too cold for optimal growth. Light colored mulches are also useful in reducing soil temperatures when transplanting seedlings in late summer. Crops planted in late summer will appreciate artificial shade to protect them from the heat of the sun until established.

Broccoli, cabbage, cauliflower, Brussels sprouts, kohlrabi, kale, and collard greens are variations of the species *Brassica oleraceae*. These garden vegetables were all derived from a common ancestor. Broccoli, cabbage, cauliflower, and Brussels sprouts are generally grown indoors as seedlings and planted outdoors

in the garden at the appropriate time. If grown at home, transplants should be started in a sunny window or under fluorescent lights six weeks before planting outside. For most gardeners, purchasing transplants from a nursery is preferable to growing them at home. Using transplants reduces the amount of time from planting to harvest and makes efficient use of garden space. Kohlrabi, kale, and collards can also be grown as transplants but may also be directly seeded in the garden. The flavor of Brussels sprouts, kale, and collards, is enhanced by a frost during maturation in the fall.

Potatoes are planted from “seed” potatoes—part of the tuber that we consume. While a true seed is the product of fertilization, “seed” potatoes are genetically identical to their parent plant. Planting whole “seed” potatoes instead of cutting them into pieces increases the yield of each plant. When potatoes grow, new potatoes are formed above the original “seed” potato that was planted. Due to this trait, it is effective to plant the “seed” potato about six inches deep and then mound soil around the stem as the plant grows up. Mounding potato plants increases yield and prevents new potatoes from being exposed to the sun and turning green. The foliage of potato plants can be killed by even a light frost if left unprotected. However, plants damaged by frost will rejuvenate from underground portions.

Onions form bulbs in response to day length. When choosing varieties of onion to grow, select only long-day varieties. Short-day varieties are grown in the South in areas with mild winters and will not form bulbs if grown in St. Louis. Onions grown from sets or transplants usually produce better results than direct seeding in the garden. Reduce watering when onion bulbs reach full size for proper maturation and curing. Mulching onions is not recommended because of increased moisture retention during maturation and curing. Allow onion tops to fall over and dry up before harvesting.

A loose, rock-free soil is necessary to grow quality carrots. To prepare the soil, incorporate generous amounts of compost to a depth of 8-10 inches. Creating raised beds is another way to provide the ideal conditions to grow long, straight carrots. If your garden soil contains clay or rocks, experiment with growing some of the shorter carrot varieties. Successive plantings of carrots can be made at weekly intervals to increase the harvest period.

Peas are members of the legume family and benefit from inoculation with nitrogen fixing bacteria. Since peas grow as a vine, support should be provided with a trellis of some sort. In our area, successful production is often interrupted by warming temperatures in early summer. Peas must be planted early to ensure some harvest. Choose early maturing varieties.

Radishes come in many shapes and sizes. Small round varieties are some of the fastest maturing vegetables grown, reaching harvest size in less than a month. Some Japanese radishes grow to 100 pounds and are used as livestock feed. Radishes that form long roots such as daikon varieties require soil conditions similar to carrots and take longer to mature. Because of fast maturation times radishes should be sown in small succession plantings so that too many are not mature at one time. Radishes become tough and develop a hotter taste as they become older.

## **Warm Season Vegetables**

Hot conditions are generally favored for warm season vegetables. However, extremes in heat during the period when most plants are in flower and ready to set fruit (pollination) are not good. Transplanting of tomatoes, eggplant and peppers should be planned so that flowering and fruit set occur before air temperatures rise into the eighties. For most gardeners it is more convenient to purchase transplants than growing them at home. When growing your own transplants, sow seeds indoors eight weeks before planting outside. The seed of other warm season vegetables should be planted directly in the garden.

Tomato, eggplant and pepper transplants should be set in the garden when soil temperatures rise above 60 degrees F. Transplants should be 6-8 inches tall, stocky and dark green in color. They need support by

either tying to stakes or growing them inside of cages. Tomatoes are either determinate or indeterminate in growth habit. Determinate varieties cease growth at a predetermined size and ripen most of their fruit at one time. Indeterminate varieties continue to grow throughout the season and ripen their fruit over a longer period of time. When planting tomatoes, remove the lowest set of leaves and bury the stem up to that point. New roots will form along the buried portion of the stem. Netting may be necessary to protect tomato plants from birds. Wire enclosures may be necessary to protect tomato fruits from marauding squirrels. Peppers have somewhat brittle stems and should also be supported with stakes. When harvesting peppers and eggplants, cut the fruit from the stem with a knife or scissors to avoid damage.

Cucumber vines benefit from being grown on a trellis. Trellising cucumbers makes efficient use of garden space and reduces the risk of fungal diseases. Trellised cucumbers also produce straighter fruit, which is convenient when making pickles. Cucumbers are best when harvested immature, before the rind becomes tough and seeds mature.

Sweet corn should be located on the north side of the garden to prevent shading of other crops. Planting corn in blocks instead of single rows insures adequate pollination. It is wind pollinated so be sure to space varieties out in order to prevent cross pollination. Super sweet varieties will become less sweet if common sweet corn varieties are allowed to pollinate them. Because of their height, corn plantings are easily blown over by strong winds. Corn plants form prop roots at the base of the stem for support. Mounding additional soil around the base of mature plants helps reduce wind damage. Make successive plantings of corn for a continuous harvest throughout the growing season. The key to good corn is water. Water during drought periods.

Okra is a member of the mallow family and has attractive flowers. After flowering, okra fruits mature very rapidly. Okra should be picked almost daily during peak production. Harvest the pods before they reach four inches long at which point they will become tough and woody.

Green beans are members of the legume family and benefit from inoculation with nitrogen fixing bacteria at planting time. Beans grow in either bush or vine forms. If vine forms are grown, they will need to be trellised. The advantage of bush beans is that they occupy less space and produce a crop in a shorter amount of time.

Squash types can be divided into winter squash and summer squash. The fruit of winter squash is eaten at maturity when the outer rind is hard. Some bush types of winter squash have been developed but others grow as vines up to twenty feet long. Winter squash can be stored for a long time without refrigeration. Pumpkins are a type of winter squash. Summer squash is eaten when the fruit is in the immature stage and generally grows on short bushes. Successive plantings of summer squash like zucchini will provide a continuous harvest throughout the growing season.

Sweet potatoes are grown from slips instead of seed. To produce slips at home, plant a sweet potato on its side about half buried by soil and keep in a sunny window. Shoots will emerge and be ready for planting in 4-6 weeks. When the slips are about six inches long and rooted detach them at the base from their parent sweet potato and plant them in the garden, covering the stem about halfway. The sweet potato grows as a sprawling vine and requires excellent drainage.

Melons grow on large vines and take up a considerable amount of space. For this reason many gardeners grow them in locations separate from their other vegetables. Many varieties of smaller melons have been developed which are recommended for the home garden. These smaller melons grow on short vines and have quicker maturation times. Cease watering when melons begin to ripen. Over-watering during maturation time will produce less flavorful fruits. When growing watermelons, the most difficult aspect can be judging ripeness. Watermelons will not ripen if picked prematurely. When ripe the tendril opposite of the fruit will have shriveled up and the spot where the fruit rests on the ground will turn yellow. After



checking for these indicators, test the sound of the watermelon. A ripe melon will make a deep sound when thumped. Cantaloupe needs the same cultural requirements as watermelon. When cantaloupes are ripe the fruit detaches easily from the vine.

## **Perennial Vegetables**

If properly maintained, asparagus beds can remain productive for twenty-five to thirty years. Asparagus needs a fertile, well-drained soil, with a high level of organic matter. Incorporate generous amounts of well-rotted manure or compost to a depth of twelve inches prior to planting. Add about four pounds of 5-10-10 fertilizer for each one hundred square feet of bed. Most gardeners buy one to two year old asparagus crowns to start with. Asparagus should be planted in early spring. Dig a trench six inches deep to plant the crowns in. Cover them lightly with soil and continue to add soil as the shoots emerge until you have created a bed six inches high and two feet wide over the planting area. Maintain this raised bed for the lifetime of the planting. Do not harvest asparagus until the second year after planting. To harvest, break spears off at ground level. Once plants have become established, the harvest period can last from six to eight weeks. Fertilize annually with about two pounds of 5-10-10 fertilizer per one hundred square feet of bed or apply well-rotted manure to maintain high production levels. The best way to control weeds is to maintain a layer of organic mulch over the asparagus bed.

Rhubarb can be grown in more shade than most other vegetables. Rhubarb plantings usually last for five to six years. After this time, rhubarb plants can be divided to make new plantings and reestablish vigorous growth. Rhubarb plants are purchased as dormant roots. Plant rhubarb roots in early spring with the crown bud two inches deep. Rhubarb stalks can be harvested during the second year of growth. The leaves of rhubarb contain toxic levels of oxalic acid and should not be eaten. Rhubarb thrives where winters are reliably cold. Productivity declines in warmer regions of the country so strategically locate plantings where summer temperatures remain cool.

## **Maintenance Techniques**

A general rule-of-thumb is that the garden should receive about one inch of water from rainfall or irrigation per week during the summer. Watering requirements are less in the spring and fall when temperatures are moderate. When starting vegetables from seed, keep the surface of the soil moist until germination occurs. Once established, frequent light watering will encourage shallow root development and make plants less resistant to drought conditions. To encourage deep root growth and drought resistance, soak the soil thoroughly when needed and allow it to dry slightly between water applications. The best time to water is in the early morning which reduces evaporative losses and allows foliage to dry thoroughly and quickly. Wet foliage encourages fungal disease and provides an optimal habitat for insect pests to thrive. When possible, avoid wetting the foliage at all, applying water only to the root zone. A handy way to water vegetables is with drip pipe or weeping hose. That way, water is delivered directly to the root zone and not to the foliage.

When preparing a garden bed, it is important to remove all existing weeds, however, many seeds will remain in the ground and germinate during the growing season. The best method to control weeds is to prevent them from becoming established. Weekly cultivation with a garden hoe will generally prevent weeds from gaining a foothold in the garden. Use caution when cultivating around vegetable plants to avoid damaging their root system. Never allow weeds to go to seed in the garden and do not add weeds that have formed seeds to the compost pile. Using mulches in pathways and between rows is a great way to prevent weed growth. Generally a two to three-inch layer of organic mulch is sufficient to suppress weed growth.

In addition to weed suppression, mulches increase moisture retention, moderate soil temperatures, add organic matter back to the soil and reduce compaction. Commonly used organic mulches include wood chips, nut shells, straw, hay, lawn clippings, leaves, pine needles and compost. Avoid application of mulches

until after the ground has warmed up in the spring. If applied too early, the soil will remain cold and this will slow plant growth. In the St. Louis area a good time to apply mulch is after mid-May. Mulch after a good rain or a thorough watering. Never mulch dry soil.

After a killing frost in the fall, the garden should be prepared for the following spring. Soil pH adjustments, nutrient deficiency corrections and the addition of organic matter should occur at this time. Use a shovel or tiller to mix nutrients and organic matter to a depth of eight to ten inches. Do not fertilize generally at this time. Wait until spring to apply nitrogen fertilizers, working them in just prior to seeding or transplanting. During winter the cycle of freezing and thawing will help to break up large soil particles. By preparing the garden in the fall, it will be ready for planting in early spring. Avoid working the garden if it is saturated from heavy rains. Tilling wet soils will damage soil texture. A good rule-of-thumb is to work the soil only when it crumbles easily after being pressed into a ball in the palm of your hand.

### Preventing Insect and Disease Problems

Integrated pest management (I.P.M.) is a multi-step approach to preventing excess damage from pests and diseases. First, learn about the potential problems that each crop might have; learn to identify pests and to distinguish insect predators (the “good” bugs). Second, establish your level of tolerance for damage. Does the damage significantly reduce the quality of your vegetables? Third, hand pick insects or diseased leaves if you can, or use a physical barrier such as a spun fabric row cover to exclude insects from your plants. Spray pesticides only as a last resort.

### Planting Guide

\* crops with split dates can be planted in the spring and fall

\*\* number of days until harvest begins when either the seed or transplant is planted into the soil

Vegetable	Minimum Row Space (in.)	Space Between Plants in Row (in.)	Dates to Plant *	Number of Days to Harvest **
Asparagus (roots)	48	18	4/1-4/20	3 years
Beets	18	3	3/15-4/15, 8/1-8/10	55-65
Broccoli (plants)	30	24	3/20-4/10, 7/25-8/5	70-80
Brussels sprouts (plants)	24	18	3/20-4/10, 7/25-7/30	70-80
Cabbage (plants)	24	12	3/20-4/20, 7/20-8/5	70-80
Cantaloupe	48	60	5/1-5/20	80-90
Carrots	18	3	3/15-4/5, 7/25-7/30	70-85
Cauliflower (plants)	24	24	3/20-4/20, 7/20-8/5	65-75
Collard greens	24	12	3/15-4/10, 7/20-8/5	85-95

Corn	36	10	4/25-8/1	70-85
Cucumber	36	48	5/5-5/30	65-70
Eggplant (plants)	24	24	5/10-5/25	80-90
Green beans, bush	24	3	4/15-5/20, 7/25-8/10	50-60
Green beans, pole	30	36	5/1-5/20	60-70
Kale	24	8	3/20-4/5, 7/20-8/5	50-65
Kohlrabi	24	4	3/25-4/15, 7/25-8/5	55-65
Lettuce, head and romaine	18	6	3/15-4/25	55-80
Lettuce, leaf	18	3	3/15-5/10, 8/1-8/20	35-50
Okra	30	12	5/1-5/25	55-60
Onions	18	3	3/15-4/15	100-120
Peas	24	2	3/15-4/10	65-75
Pepper (plants)	30	18	5/10-5/30	70-80
Potato	30	12	3/20-4/10	100-120
Radish	18	1	3/15-5/1, 8/1-8/25	25-35
Rhubarb (roots)	48	36	4/1-4/20	2 years
Spinach	18	3	3/20-4/20, 8/1-8/20	40-50
Summer squash	48	48	5/10-5/30	80-90
Sweet potato	30	12	5/10-6/10	150
Swiss chard	18	3	4/1-5/20	55-65
Tomato (plants)	48	36	5/10-5/20	75-90
Watermelon	96	96	5/1-5/20	85-95
Winter squash	48	60	5/10-5/30	100