KANSAS GARDEN GUIDE

K-STATE
Research and Extension

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

GARDEN GUIDE

Charles W. Marr
Horticulturist, Vegetable Crops

Ted Carey
Horticulturist, Vegetable Crops

Raymond Cloyd
Entomologist

Megan Kennelly
Plant Pathologist

Contents

Introduction

Vegetables are an important part of our diet, and millions of Americans are home gardeners. In Kansas, home gardeners produce $15–$20 million worth of vegetables every year.

A well-planned and properly tended garden can provide food for a family throughout the year. Most home gardeners agree that home grown produce has the ultimate in vegetable flavor. Surplus vegetables can be frozen, canned, or stored, making the home garden enjoyable year-round. These vegetables not only provide food budget savings but also make a valuable contribution to nutrition.

The food from a vegetable garden is only one of the many benefits of home gardening. The relaxation and enjoyment derived from gardening is well known to all home gardeners. A garden allows even the youngest family member to help in gathering food.

Gardening is an excellent 4-H or youth project. It can provide a source of income as well as an outlet for energy.

The garden is also an excellent laboratory for experimenting with plants. Everyone can learn from simple experiments in the world of plant science.

Successful gardens are the result of careful planning, watchful care, and good management. With a few simple tools, a little land, and a desire to nurture plant growth, anyone can become a home gardener. This garden guide will assist in achieving a successful home garden.

Planning a Garden

Locate the garden in an area that will not interfere with the home landscape. A sunny, level area away from large trees is preferable because tree roots compete for soil nutrients and water. A source of water should be accessible for periods when irrigation is necessary.

In many Kansas locations, protection from wind is desirable. Take advantage of fences, small shrubs, or buildings that provide a windbreak.

Soil

Vegetables grow best in well-drained, fertile soil. Sandy loam soils are ideal for vegetables. Most home gardens, however, do not have this soil composition. Compost or manure spread over the garden and worked in with a garden tiller will improve not only fertility but also soil tilth. Adding organic material such as manure or compost is an important practice in successful gardening.

Selecting What to Grow

A wide variety of vegetables can be grown in Kansas. Space available and individual preferences play an important part in deciding what to grow. Beans, beets, summer squash, peppers, tomatoes, lettuce, onions, radishes, and turnips are well adapted for growth when space is limited.

Sweet corn, vine squash, cucumbers, pumpkins, and melons require more space for growth and should be considered only if adequate space is available. Don't be afraid to experiment with unfamiliar vegetables, but plan to be able to use most of the vegetables you produce.

Most home gardeners have too much produce maturing at the same time. This is desirable if you plan to can or freeze the vegetables. For table use, it is best to stagger plantings. Plant a few radishes every 4–5 days instead of all at once. This will provide a steady supply of radishes of ideal maturity over a longer time. Also stagger plantings of lettuce, beans, sweet corn, and peas.

Optimizing Garden Space

Use the Vegetable Garden Calendar in the back of this book to plan your garden space. Spinach, lettuce, radishes, peas, and green onions can be harvested early in the season. The same space is then available for late-season crops of beans, eggplant, tomatoes, or potatoes. Plant lettuce, radishes, or spinach between potatoes, cabbage, or other cole crops. Before the potatoes or cole crops get very large, the other vegetables will have been harvested.

Select a place along one side of the garden for crops such as rhubarb, asparagus, strawberries, or bush fruits. These perennials will continue to grow next year without replanting.

If planted in the garden, they will be in the way during tilling operations.

Make a Sketch

Draw a scale model of your garden space and plan the garden using the above information. Allow everyone involved to participate by suggesting their favorite vegetables. Make notes on the plan and save it as a reference for next year's garden. You can also use this plan when ordering seeds and plants.

Obtaining Seeds and Plants

In choosing varieties for the home garden, consider factors such as disease resistance, yield, maturity date, size, shape, color, and flavor. Seed companies and state agricultural research stations are constantly developing and testing improved vegetable varieties and procedures. The following sources of information are useful when choosing varieties:

- Ask your local K-State Research and Extension agent for the publication, *Recommended Vegetable Varieties for Kansas*, L41, or order from Production Services by sending an e-mail to *orderpub@k-state.edu*.
- Use varieties that have performed well for you or other gardeners.
- If you plan a special use for a particular vegetable, such as freezing, exhibiting, or canning, check with your local agent or study seed catalog recommendations.
- Check with your local seed store or garden center for advice on what to plant.

If you do not have a seed starting structure, you may want to buy vegetable transplants for crops that require transplanting to the garden. These can be obtained from local greenhouses or seed and garden centers. Again, make sure the varieties are what you want to produce.

Plan, then purchase the seeds and plants you want so you will have them when you need them for your garden.

Tools and Supplies

While several items are essential to raise a garden, it is not necessary to have a lot of equipment. If your friends have gardens, you might share equipment and supplies. Select supplies according to the size garden you want.

Mini-Garden (less than 100 sq ft)

- Spading fork or shovel
- Hoe
- Trowel
- Small sprayer or duster
- Pointed stakes and labels
- String and yardstick
- Fertilizer
- Fungicides and insecticides as desired
- Sprinkling can
- Compost, manure, peat moss, sawdust, or vermiculite

Family Garden (between 100 and 1,000 sq ft)

- Garden tiller
- Hoe and trowel
- Small sprayer
- Pointed stakes and labels
- String and yardstick
- Fertilizer
- Fungicides and insecticides as desired
- Hose
- Compost, manure, peat moss, sawdust, or vermiculite

Large Garden (more than 1,000 sq ft)

- Garden tractor
- Hoe
- Sprayer or duster
- Wheel cultivator
- Fertilizer spreader
- Wheelbarrow
- Pointed stakes and labels
- String and yardstick
- Fertilizer
- Fungicides and insecticides as desired
- Hose
- Compost, manure, peat moss, sawdust, or vermiculite

Composting

Compost is a mixture of soil and decayed organic matter or humus that is used to improve garden and potting soil. Properly prepared compost is free from weed seeds and offensive odors and rich in nutrients that plants need. It may be applied as a mulch or mixed into the soil in vegetable gardens. Compost is produced in piles or pits from organic waste such as leaves, grass clippings, manures, straw, hay, and garden refuse.

One of the greatest benefits of making compost is that it allows us to recycle garden and yard waste into a valuable, usable product, reducing the amount of solid waste going into landfills. Converting your garden, fruit, and vegetable wastes to compost is something you can do to improve the environment. Neighborhood composting facilities or shared family compost piles are options. Composting small prunings and twigs and encouraging municipalities to shred large prunings and downed limbs allows reuse of damaged or overgrown plants in the landscape.

Chemistry of Compost

The conversion of organic wastes to rich humus involves several types of bacteria and fungi. Bacteria begin the process of breaking down sugars, proteins and other complex molecules in the residue. Bacteria increase rapidly in a new compost pile. The temperature inside the pile may rise to 150–160°F, inactivating weed seeds and harmful disease organisms. As residue is decomposed, temperature decreases, fungi disappear, and millions of bacteria continue gradual breakdown of organic materials into rich, dark, crumbly humus. In regions with acid soils, wood ashes or limestone may hasten decay and prevent excess acidity and sourness.

Getting Started

Locate the compost heap in an area where water will not stand. Many gardeners use an out-of-the-way, accessible location near the garden or refuse disposal site for convenience.

The compost may be made using a below-ground pit or an above-ground method that does not require laborious digging. Although it is possible to simply accumulate the compost in a loose pile, an enclosure of some type is desirable. Several materials can be used for this purpose.

Woven wire or wood slat fence. Various types of woven wire are available—from reinforcing wire to fencing wire. Heavy

gauge wire that is self-supporting is preferable; however, finer wire supported by rods or posts could be used. Lining the fence with a layer of plastic will speed decomposition by retaining moisture necessary for microbial activity. In order to maintain adequate drainage and aeration, do not line the bottom.

Cement blocks or bricks. Mortar is not necessary because the weight of the blocks will hold the pile in place.

Scrap lumber. Don't use good lumber because the damp compost may ruin the boards. If a permanent enclosure is desired, use redwood or cypress. Old pallets frequently can be obtained free of charge, and strapping four or five of these together to form a cube makes an excellent compost bin.

The size of a compost pile varies, depending on the quantity of organic material available and the amount of compost needed. Rectangular or square shapes may be slightly easier to work with than round ones. Round enclosures made of wire bent into a cylinder have the least amount of surface area to dry out and work well. Either shape can be used successfully. For most households, a pile 5 feet wide by 5 feet long or a circular pile about 5 feet in diameter is sufficient. The height of the pile will fluctuate as organic material is added. If you have a lot of yard materials to compost, it is a good idea to have two or three piles or bins, one for the finished compost from last year, and the others for this year's fresh material.

Several kinds of plant materials can be used in the compost pile. These include leaves, grass clippings, weeds, garden refuse, fine hedge clippings, straw, corn cobs, cold wood ashes, sawdust, old unusable hay, and mulch raked from around flower or vegetable gardens. Avoid using severely diseased vegetable or flower plants. Kitchen scraps such as egg shells, peelings, or plant residues can be added to the pile if covered to prevent flies, but avoid using meat scraps or bones that may attract dogs or other animals.

Making the Compost Pile

Start with a layer of soil or sand 2–3 inches deep on the bottom. Then add a layer of organic materials. For fine materials such as thin grass clippings use only a 2- to 3-inch layer; for coarser materials such as straw, use 6- to 8-inch layers. To hasten decomposition, add a small quantity of commercial garden fertilizer—l–2 cups per square yard of area. You may substitute an inch or two of manure. The purpose of the fertilizer or manure is to provide a source of nutrients for microorganisms that must build up in the compost pile to ensure decomposition.

Repeat this sequence of soil or sand, organic materials, and fertilizer in layers as organic materials become available. Water each layer as it is added.

The top of the compost pile should be dish-shaped or slightly lower in the center than on the sides. This allows rainfall to soak into the pile rather than run off. Because of extremely high temperatures generated by the composting process, a dry compost pile oxidizes too rapidly and the overheated, feathery compost

A three compartment composter is easy to construct. The cover keeps things looking neat. Removable front boards allow access for turning and removing compost.

that results is of little value. In dry weather, a weekly soaking of the pile is desirable to keep it sufficiently moist.

The rate of decomposition can be hastened by turning the pile — slicing through the layers and turning them upside down. This action is similar to spading garden soil when it is turned over. This mixing should be followed by reforming the "dish" at the top of the pile and watering. Compost should be ready to use 4–6 months after starting the pile, but most gardeners prefer to keep two piles or one pile divided into two sections. Materials can be accumulated in one while last year's finished compost is available for use from the other.

As your compost pile progresses, these signs will indicate whether all is going well:

- In 2–3 weeks, the pile should shrink or sink. If it has not, loosen the pile with a shovel or fork to provide more aeration, or add moisture if the compost is dry.
- Check for a strong ammonia or offensive odor. This may be caused by overwatering, or an imbalance of materials. Aerate as above. Ammonia odors often come from composting a lot of fresh, green plant material, especially grass clippings.
- After 4–5 weeks, or less than a week for "quick composting," it should be hot deep within the pile. Push a wire or stick deep into the pile, pull it out and touch it to check temperature.
- In 3–4 months, the pile should be about half its original height. The compost will be dark, moist and crumbly. It should have the odor of moldy leaves or a rich earthy odor.

A wire container used to accumulate yard waste, which will slowly decompose over time. Not everyone builds a perfect compost pile.

Quick Composting

In recent years, the emphasis has been on quick composting. Materials are finely shredded, premixed with soil and fertilizer, moistened, and placed in an enclosed bag or bin. The resulting compost—in a month or so rather than 4–6 months—is comparable in quality to that of slow composting. It does, however, require slightly more effort.

Several commercial bins can be purchased for use in quick composting processes, and each comes with operating instructions.

You can use containers such as plastic bags or garbage cans for the same purpose. Sheet plastic and a standard enclosure work as well. Begin by lining the enclosure with sheet plastic. Next, finely shred the organic material with a soil shredder, compost grinder, or coarse hammermill. These devices are costly for most gardeners, but the serious gardener may find them useful. For those who do not wish to purchase a grinder or shredder, a rotary lawn mower can be used to pulverize or shred leaves and prunings. For mowers with bagging attachments, collect the organic materials in the bag. With discharge mowers, blow shredded materials into a central pile by turning in a circle.

Mix and add shredded organic materials, soil, and fertilizer or manure in proportions similar to those used for the slow composting method. It is not necessary to turn the pile. It should be ready for use in 2–3 weeks in warm weather or 5–6 weeks in cooler weather. The compost may be stored for longer periods if not needed immediately.

Grass Clippings

A common waste, clippings caught in grass-catcher attachments on lawn mowers comprise a large part of yard wastes and are excellent material for use in compost piles. However, recent research indicates it is beneficial to leave clippings from regularly mowed lawns spread over the lawn or mulched into it. Unless you are intent on collecting clippings to add to your compost pile, allow grass clippings to fall back onto the lawn.

Using Compost

Many gardeners follow the steps to make compost without understanding how compost can be used around the home. Compost can be beneficial in a variety of horticultural applications.

Soil improvement and fertilization. Addition of organic material improves looseness and workability of soil. Heavy, tight clay soils benefit from the loosening effects of organic materials. But sandy soils benefit as well from the improved water-holding capacity and fertility that organic materials provide.

Compost also contains nutrients that plants require. While the specific nutrient content of compost varies with the type of materials composted and the amount of water in it, a general recommendation is to apply compost at the rate of 50–100 pounds per 100 square feet. This generally is translated to 1–2 bushels of material for every 10-foot by 10-foot area of the garden. The best time for applying compost is just before tillage—either in the spring or fall. Tilling incorporates the compost throughout the plant root zone. Many Kansans till garden soils in the fall, and compost made early in the season should be ready for use by then. If you have a two-pile system, compost from last year can be used.

Compost at planting. A band of compost in the bottom of a row trench or several shovels full in the bottom of planting holes can be added and mixed with the soil. This is especially beneficial for tomato plants. The slow nutrient release of compost works through the early growth period. Compost can also be used as a top dressing over the row to prevent crusting of soil for seeded vegetables. Compost can be mixed with water to form a substitute for soluble fertilizers or starter solutions. As a rule, mix equal parts of compost and water. The leftover compost can be added to garden soil later.

Mixing compost into the soil at planting time.

Mulching. One of the most beneficial practices for summer gardening in Kansas is using mulch. Mulches hold moisture in the soil, prevent weed growth, and reduce soil crusting and splashing. Mulches also help to keep the soil cooler during hot weather. A layer of compost 2–3 inches thick along the row of garden vegetables and flowers or spread around perennial flowers, trees, and shrubs reduces moisture fluctuations and evaporation of water from the soil surface. After the garden season, simply till the mulch into the soil as a source of organic material.

Potting mix for seedlings. Compost that has been screened for large particles can be mixed with soil or sand—in about equal parts—and used as a plant growing medium. The compost must be well deteriorated and free of harmful disease organisms and insects to ensure healthy seedling plants.

Cautions in Using Compost

It is important to understand that compost is not a cure-all for garden soils or concerns. The benefits of composting certainly outweigh the limits, but it is possible to overdo applications of compost.

Some composts may provide too much of a nutrient if applications are excessive. Lush, rapid growth—often at the expense of good fruit production—can occur. Compost that is not completely decomposed may continue the process of decomposition when added to soil in large amounts, removing or tying up soil nutrients until decomposition slows. This is a particular concern with compost applied in spring and when it is incorporated into the soil.

Creating a dark, cool environment at the soil surface may provide an ideal area for certain types of insects such as sowbugs or squash bugs. Specific control measures for each of these insects might be necessary. Consult your local K-State Research and Extension agent or garden center professional for information about control measures.

Some types of compost applied to the soil surface can pack into a dense layer that may be almost impervious to water. This is frequently an indication of poorly made compost. Using more soil with the compost or mixing soil with compost prior to use can correct this situation.

Soil Improvement

All garden plants depend on the soil for nutrition. Soil condition and fertility are primary considerations in achieving a successful home garden.

Adding Organic Matter

Organic matter is an effective way of improving all kinds of soil. As mentioned earlier, adding organic matter to the planned garden area is recommended. It is also beneficial to add organic matter every few years. Organic matter serves the following purposes:

- It loosens tight clay soils.
- It increases water-holding capacity of sandy soils.
- It makes soil easier to till.
- It provides nutrients.

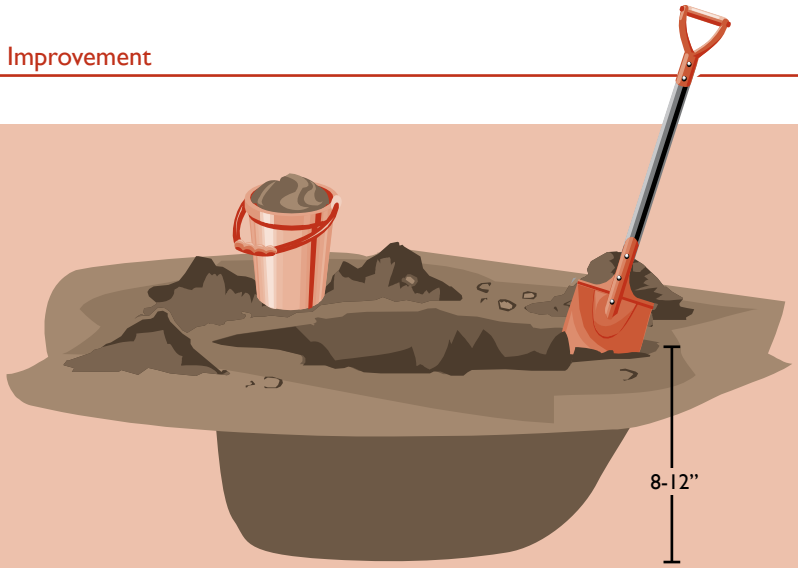
One way of adding organic matter is to seed a cover crop in fall and turn it under in the spring. This should be done only if you have equipment such as a heavy garden tiller or plow to turn the cover crop under in the spring. Some recommended cover crops include annual ryegrass (¼–⅓ pounds per 100 square feet) or rye (½–¾ pounds per 100 square feet) seeded in mid-September. This cover protects the garden from erosion during winter. It adds organic matter when the grass is 6–8 inches tall and is turned under in the spring.

However, most home gardeners prefer to add organic matter by using one of the following materials:

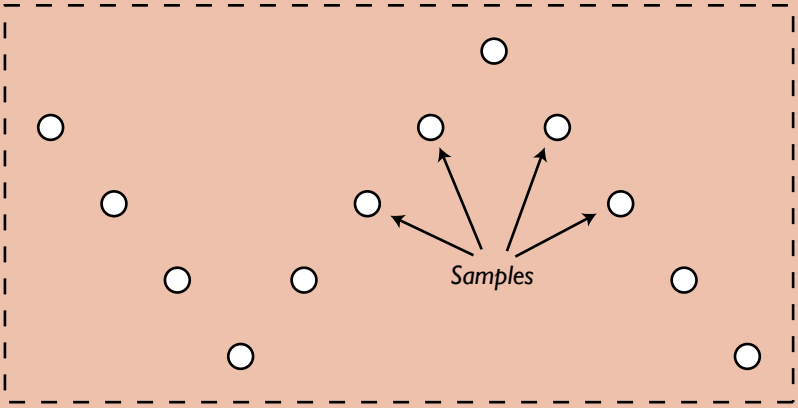
- Stable manure. Use 50–100 pounds per 100 square feet. You may want to add ¼–½ pound of superphosphate as well.
- Poultry and sheep manure. Use 10–20 pounds per 100 square feet. Again, adding ¼–½ pound of superphosphate is beneficial.
- Rotted sawdust. Use sawdust in your compost pile, then apply it to the garden. Use 3–4 bushels per 100 square feet.
- Compost. Compost is decayed plant material. Apply 50–l00 pounds per 100 square feet of garden space. (See "Using Compost" on page 11.)
- Feedlot manure. Use 10–20 pounds per 100 square feet. Adding ¼–½ pound of superphosphate may be beneficial.
- If you use uncomposted manure, bear in mind that this is a potential source of microbial contamination that could lead to food poisoning. Applying raw manure in the fall allows adequate time for decomposition before crop harvest the following summer.

Getting a Soil Test

The winter before you begin to garden you will want to get a sample of your garden soil tested to determine pH and nutrient content. (See page 14.) The soil test provides a starting place for a soil improvement program. Unless you know the deficiencies in your garden soil, you are only guessing when you apply fertilizer. The soil test will tell you how much fertilizer you must add to your garden initially. It is then much easier to maintain a high level of fertility as you garden year after year.



Slice for sample: 8-12" long by 1-1½" thick.



Taking a Soil Sample

Use a soil probe, spade, or shovel to sample the soil profile to a depth of 8-12 inches. It is important to obtain a representative sample of the soil in the root zone rather than from the surface soil.

It is advisable to take at least 10 samples around your garden area, then combine these in a clean bucket or pail. This provides a representative sample of the entire garden area.

From the bucket or pail, select about a pint of soil. Special soil sample containers are available from your local K-State Research and Extension office or a fertilizer supplier. You may use a clean milk carton, ice cream container, or similar package. Label it with your name, address, and information on the garden crops to be grown. If you send more than one sample, be sure to label each plainly.

Your local agriculture or horticulture agent will either test the sample in the county soil lab or send it to the Kansas State University soil testing laboratory. The agent will make recommendations on the amounts of fertilizer to use on your garden. Rely on your local agent for information and advice concerning your garden.

Check with your local K-State Research and Extension agent for soil testing information. Check your phone directory for County Extension Council.

Controlling Soil pH

The pH of the soil is a measure of acidity or alkalinity. Most plants grow best in a soil that is neither too acid nor too alkaline. Extremes of acidity or alkalinity are possible in Kansas soils. These extremes may make the soil nutrients unavailable to plants. Because of the parent rock materials, previous fertilizer use, cropping sequence, or other factors, the pH of the soil may differ from the desirable range.

One part of the soil test is measurement of the pH and, if needed, a recommendation of the amount of lime necessary to reduce soil acidity. Some people refer to liming as "sweetening the soil." Sulfur or other materials may be used on alkaline soils to reduce soil pH to the desired level.

Most eastern and central Kansas gardens may have soils that become too acid, while the soils of western Kansas tend to be alkaline. Your local K-State Research and Extension agent can recommend the amount of lime or other material needed to correct the soil pH. Correcting soil pH can be as important in improving plant growth as adding fertilizers.

Fertilizing the Garden

Fertilizing is an important practice, but it is not a cure-all. Fertilization cannot compensate for these problems:

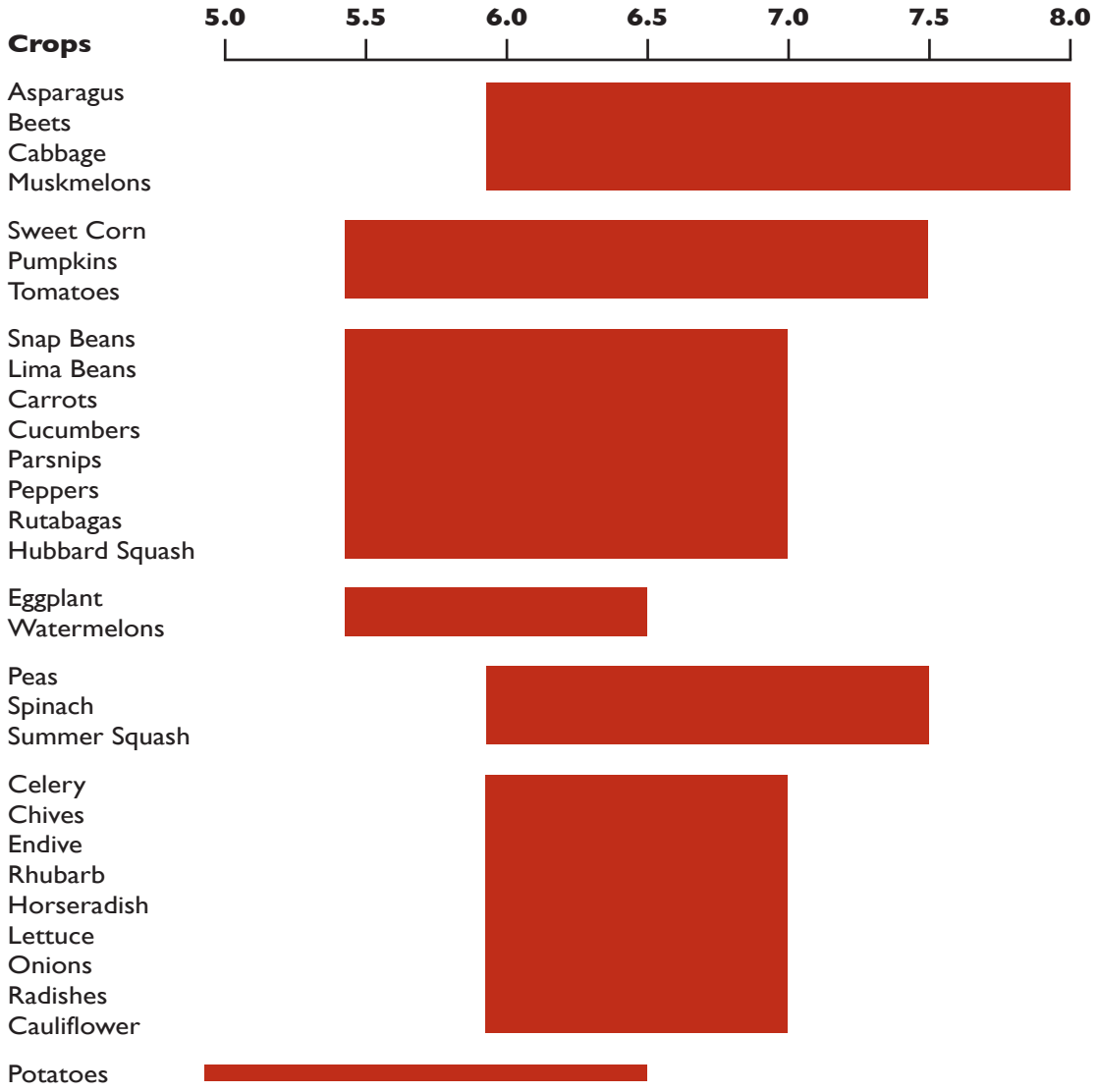
- poor soil structure that does not allow for adequate drainage or aeration
- undesirable soil pH or salt content of the soil
- poor seeds, diseased or unhealthy plants
- shade trees or tree roots in or around the garden area.

The addition of organic matter will ensure that some fertilizer nutrients are in the soil. You may need to add commercial fertilizer as well. Most chemical fertilizers are simply rock or mineral materials rich in nutrient elements.

Fertilizer Types

The nutrient elements that plants require can be supplied by either organic or commer-

Optimum pH Range for Vegetable Crops*



* Information from *Liming Vegetable Crops*, University of Illinois Cooperative Extension Service.

cial fertilizers. All plants require 16 nutrient elements for growth. Thirteen of these come from the soil. When organic fertilizers are used, they must break down to release these basic fertilizer elements in the soil before the plants can use them.

Regardless of the form of fertilizer—organic or chemical— the plant makes no distinction as long as the nutrients are there. However, large quantities of organic materials must be used compared with more concentrated commercial fertilizers.

Organic fertilizers. Organic matter is a vital part of any soil and benefits the soil in several ways. When incorporated into the soil, decaying organic residue serves several useful functions:

- loosens tight clay soils to provide better drainage
- provides for better soil aeration, which is necessary for good root growth
- increases water-holding capacity of all soils—especially helpful on sandy soils
- makes soil easier to till and easier for plant roots to penetrate
- supplies nutrients for plant growth.

Chemical fertilizers. Nutrients most frequently lacking for growth are nitrogen (N), phosphorus (P), and potassium (K).

- N (Nitrogen)—This nutrient element provides dark green color in plants. It promotes rapid vegetative growth. Plants deficient in nitrogen have thin, spindly

Materials to Add to Correct Soil pH

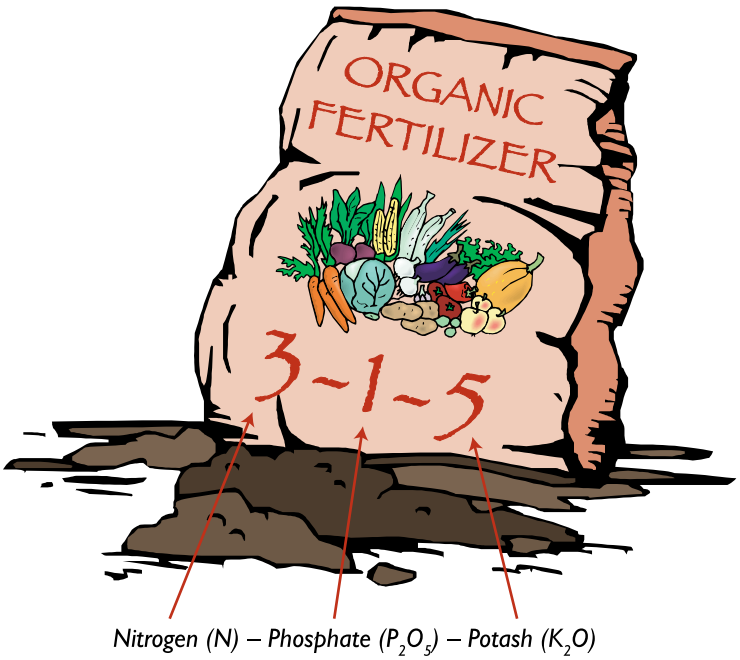
Lime (to increase pH)

pH level from soil test (increase to 6.5)	Lb Ground Limestone/100 sq ft		
	Sandy Soil	Loam Soil	Clay Soil
4.0	11	16	23
4.5	9	13	19
5	7	10	15
5.5	6	7	10
6	3	4	5

Sulfur (to lower pH)

pH level from soil test (decrease to 7.0)	Lb Sulfur (95%)/100 sq ft		
	Sandy Soil	Loam Soil	Clay Soil
7.5	1.5	2	3
8	3	4	5
8.5	5	6	7
9	8	8	8

Add all materials to soil and incorporate to a depth of 6 inches with soil tillage when no crops are growing in the garden area.
Note: Specific recommendations by your local county agent may vary from these amounts based on local conditions and knowledge of specific soil factors. Use your local recommendations in preference to this table if available.



Levels of major plant nutrients are printed on fertilizer bags.

stems, pale or yellow foliage, and smaller than normal leaves.

- P (Phosphorus)—This nutrient promotes early root formation, gives plants a rapid, vigorous start, and hastens blooming and maturity. Plants deficient in this element have thin, shortened stems, and leaves often develop a purplish color.
- K (Potassium)—Potassium or potash hastens ripening of fruit. Plant disease resistance as well as general plant health depend on this element. It is also important in developing plump, full seeds. Plants deficient in this element have graying or browning on the outer edges of older leaves.

The content of N, P, and K is specified on bags of chemical fertilizers. The analysis or grade refers to the percent by weight of nitrogen, phosphate, and potash in that order. Thus, a 10-10-10 fertilizer contains 10 percent nitrogen (N), 10 percent phosphate ($P_2 0_5$) and 10 percent potash ($K_2 0$).

Calculating the Amount of Fertilizer Needed

To calculate the amount of fertilizer needed for an area, consider the recommendation for the particular nutrient needed and the analysis.

Approximate Composition of Some Organic Fertilizers

Material	Nitrogen (N)	Phosphorus (P)	Potassium (K)
		Percent	
Bat Guano	3	10	1
Blood Meal	12	1	1
Alfalfa Meal	5	1	2
Cottonseed Meal	5	2	1
Feather Meal	12	0	0
Coffee Grounds	2	0.5	1
Cow Manure, Fresh	0.5	0.1	0.4
Cow Manure, Dried	2	1	1
Poultry Mature, Dried	3	3	1
Feedlot Manure, Dried	2	1	1
Bone Meal	2	14	0
Worm Castings	1	2	1
Wood Ashes	0	1	5

Other commercial or processed fertilizers may be available. Consult label for variation in nutrient content by brands/sources. Organic materials should be incorporated into the soil and allowed to decompose if full fertilizer value is to be available.

Recommendations for Fertilizer Additions Based on K-State Soil Test Results

	Soil test interpretation
Nitrogen* (Available nitrogen from lawn and garden soil test)	0–25 ppm – low 25–50 ppm – medium 50–80 ppm – high
Phosphorus* (P from soil test results)	0–25 ppm – low 25–100 ppm – medium 100+ ppm – high
Potassium* (K from soil test results)	0–125 ppm – low 125–250 ppm – medium 250+ ppm – high
pH	See table on previous page for materials and amounts to correct pH.

*If you do not have soil test results, follow recommendations for a medium application level.

Pounds of Actual Element to Add per 100 sq ft

	Nitrogen			Phosphorus			Potassium		
	Low	Med	High	Low	Med	High	Low	Med	High
Intensive or small gardens with successive plantings from spring, summer, and fall	.2	.1	0	.2	.1	0	.1	.05	0
Standard or large gardens with wider row spacings	.1	.05	0	.1	.05	0	.1	.05	0

Fertilizer Sources with Concentrations of Specific Elements

		Analysis
Nitrogen sources	Ammonium sulfate	20-0-0
	Nitrate of soda	15-0-0
	Nitrate of potash	13-0-44
	Monoammonium phosphate	11-48-0
	Diammonium phosphate	18-46-0
	Urea	45-0-0
Sulfur sources	Elemental sulfur	98% sulfur
	Copper sulfate	20% sulfur
	Ammonium sulfate	24% sulfur
Iron sources*	Iron chelate	6%, 10%, or 12% iron for foliar or soil application
	Iron sulfate	
Zinc sources*	Zinc sulfate	36% zinc
	Zinc chelates	Variable
Magnesium sources**	Epsom salts (Mg S04)	10.4% Mg
Boron sources*	Borax	11.3% boron

*Other commercial sources may be available. Consult the label for content.
** Some types of limestone (dolomitic) will also be sources of magnesium.

Suggestions for Nutrients as Foliar Fertilizers

Element	Material	oz/3 gal water per 100 sq ft	Remarks
Iron	Iron chelate	Follow package directions	Iron deficiency found when pH is above 6.8
Magnesium	Magnesium sulfate (Epsom salts)	4–5	Use more than one application
Nitrogen	Urea	2–3	Most crops
Calcium	Calcium chloride	2	Direct at the growing point
Manganese	Manganese sulfate	1–2	May be needed in soils with high pH

If you need to add 0.l pound of N per 100 square feet and you have 10-10-10 fertilizer, which contains 10 percent N, you will have to add 1 pound of this material per 100 square feet to achieve the needed amount of N.

The relationship of N, P, and K to each other, sometimes referred to as the ratio, indicates the proportion of each element. For example 1-1-1 means there are equal proportions of N, P_20_5, and K_20 as does 10-10-10. However, a 2-1-1 ratio means there is twice as much N as P_20_5 and K_20, as is true for 10-5-5. The ratio does not indicate the weight of the elements in the fertilizer bag, but only their relationship to each other.

In addition to N, P, and K, 10 other elements that plants require come from the soil. Generally, it is not necessary to add these elements because they are present in sufficient quantities in Kansas soils. However, on occasion addition of one or more of these micronutrients may be required. A common micronutrient element found lacking in high pH soils commonly found in western Kansas is iron. The symptom of iron deficiency is a pale yellow color that develops in plants. This can be corrected by a foliar application of iron or by reducing the soil pH.

- Measure the area of your garden: For example, suppose your garden is 10 feet wide by 20 feet long. Your garden area is 200 square feet.
- Determine the nutrient you need to add per 100 square feet from the table below: For example, suppose your test results indicate that you need .1 pound N, 0.1 pound P, and 0.05 pound K. Multiply the amount you need by the number of hundred square feet units in your garden. For example, if your garden is 200 square feet, you would need two times the amount above or 0.2 pound N, 0.2 pound P, and 0.1 pound K.
- Because you need equal portions of N and P but less of K, look for a fertilizer that may have the ratio of nutrients in this range. You might not be able to find a fertilizer that provides exactly the ratio you need, so try to get as close as you can. For example, if you find a fertilizer that has 10-10-5, this would provide the exact ratio you need. To calculate how much of this material to add, divide the amount you need by the nutrient concentration or analysis of the fertilizer and multiply by 100 because the analysis represents a percentage or fractional value of 100:
  0.2 lb needed ÷ 10 x 100 = 2 lb of fertilizer material needed to provide the N you need. This amount of fertilizer will also supply the P and K you need. Apply 2 pounds of 10-10-5 fertilizer to your 200-square-foot garden.

Most fertilizers you find are complete fertilizers with proportions of each major fertilizer element. Some sources supply specific concentrations of a single element only. Some of these are listed in the table on page 18. Standard soil tests analyze for N,P, K and pH, while additional soil tests can be made for other fertilizer elements that may be required in unusual cases. Iron, zinc, magnesium, sulfur, or other elements are seldom required to correct a particular soil fertility deficiency. Some of these deficiencies might best be corrected with a foliar application as described.

Getting the Most From Your Fertilizer

- Select sites with soil well adapted to crop growth because fertilizer will prove more profitable on good soil than on poor soil. Well-adapted soil is well drained, deep, and free from rocks or other debris. It should be fairly level, especially for vegetables.
- Get a soil test. Don't guess about soil fertility or other deficiencies. Find out exactly what your soil needs.
- Add organic matter where practical. It can provide benefits besides soil nutrients.
- Control weeds and use sound cultural practices.
- Select only the best plants and seeds.

Some Useful Measures

1 acre = 43,560 sq ft

100 lb/acre = approximately 2 lb/1,000 sq ft

3 tablespoons (level) = 1 oz

8 ounces = 1 cup

2 cups = 1 pint (equals 1 lb of most dried fertilizer materials)

Applying Fertilizers

Row applications. This provides the most efficient use of fertilizer for row garden crops. As a general rule, use about 1–2 pounds of the balanced analysis fertilizer per 100 feet of row. The best method of applying fertilizer is to dig a small trench 2–3 inches deep on either side of the row before planting. Sprinkle half the total amount of fertilizer in each trench. Cover the trenches and plant in the marked row.

An undesirable feature of row application is that it requires a lot of work. If you do not want to apply fertilizer to each row, you can **broadcast** or spread fertilizer throughout the garden area. Use 2–3 pounds of fertilizer per 100 square feet, spread uniformly over the surface, and incorporate into the soil before planting. For tomatoes, cabbage, or other transplanted crops, as well as for melons or cucumbers planted in hills, use about 2 tablespoons of fertilizer placed 2–3 inches below the roots or seeds. Again, after placing the fertilizer, cover with soil and plant as usual.

Starter solutions. For transplanted vegetables such as tomatoes, peppers, eggplant or cabbage, add a starter fertilizer to the water used in setting the plants to get them off to a faster start. Commercial starter fertilizers mix with water or are water soluble. Follow label directions, because mixing too much starter fertilizer can burn the plant roots.

You can make your own starter fertilizer solution by adding 2 tablespoons of ordinary fertilizer, such as 5-10-10, 3-12-12, 10-10-10, or similar material, to a gallon of water. Mix well with a stick or stake. While some of the larger fertilizer particles will settle out, enough soluble material will remain in the water. Use about 1 cup of this starter solution for each plant. Commercial soluble fertilizers also can be used as a plant starter. Follow label directions.

Sidedressing. Nitrogen often leaches or washes out of the reach of plant roots, particularly in years when rainfall is abundant and in sandy garden soils. A sidedressing is simply an application of a nitrogen-containing fertilizer alongside the row of growing plants. Apply when corn is 12–18 inches high, after first fruits have set on tomatoes, or when plants lack a healthy, dark-green appearance.

It is possible to apply too much nitrogen; use fertilizer sparingly. Use ¼ pound of ammonium nitrate or ⅕ pound of urea per 100 feet of row. If these materials are not available, use an ordinary balanced fertilizer such as 5-10-10, 8-16-16, or others at the rate of 1–2 pounds per 100 feet of row. Don't put the material directly on the plant foliage and, when possible, water after applying the fertilizer.

Side dressing is commonly done to ensure adequate nitrogen availability for rapidly grown vegetable crops.

Foliar feeding. In an emergency, it may be possible to add certain nutrients to a plant by applying to the foliage when nutrient deficiency symptoms develop. It is advisable to make every attempt to add the necessary nutrients to the soil before the symptoms develop because foliar application should be used only as an experimental or emergency treatment. Unless the soil conditions causing the symptoms are corrected, the symptoms will reappear soon.

Using a commercial wetting agent or a few drops of detergent in the solution provides better coverage of foliage. Apply sprays in early morning or late afternoon on a cloudy day, or soon after a rain. Mixing these elements with one another or with a pest control spray may be difficult. Do not attempt to mix foliar nutrients with pest control sprays.

Seeding and Planting

Planting date is determined by local weather conditions and the nature of the various garden vegetables. Some vegetables require warm soil and air temperatures. Others will grow in colder temperatures. Most home gardeners are eager to have some vegetables early in the season.

When to Plant

Use the Vegetable Garden Calendar in the back of this book as a guide for when to plant various vegetables in your garden. Because temperatures moderate earlier in the eastern part of Kansas, use the map on the next page to determine when to plant in your zone.

These dates are based on estimated average temperatures in various locations. There may be unusual years that are either much warmer or much colder than the average. Each year is unique. Use your judgment in evaluating the weather each year.

Many vegetables can be planted so they mature for use in the fall as well as in the spring. Use the Vegetable Garden Calendar as a guide for planting spring and fall vegetables. Some vegetables are more tolerant of frost than others. Use the last column of the Vegetable Crop Information chart, page 75, to guide you in making sure you are able to harvest before frost.

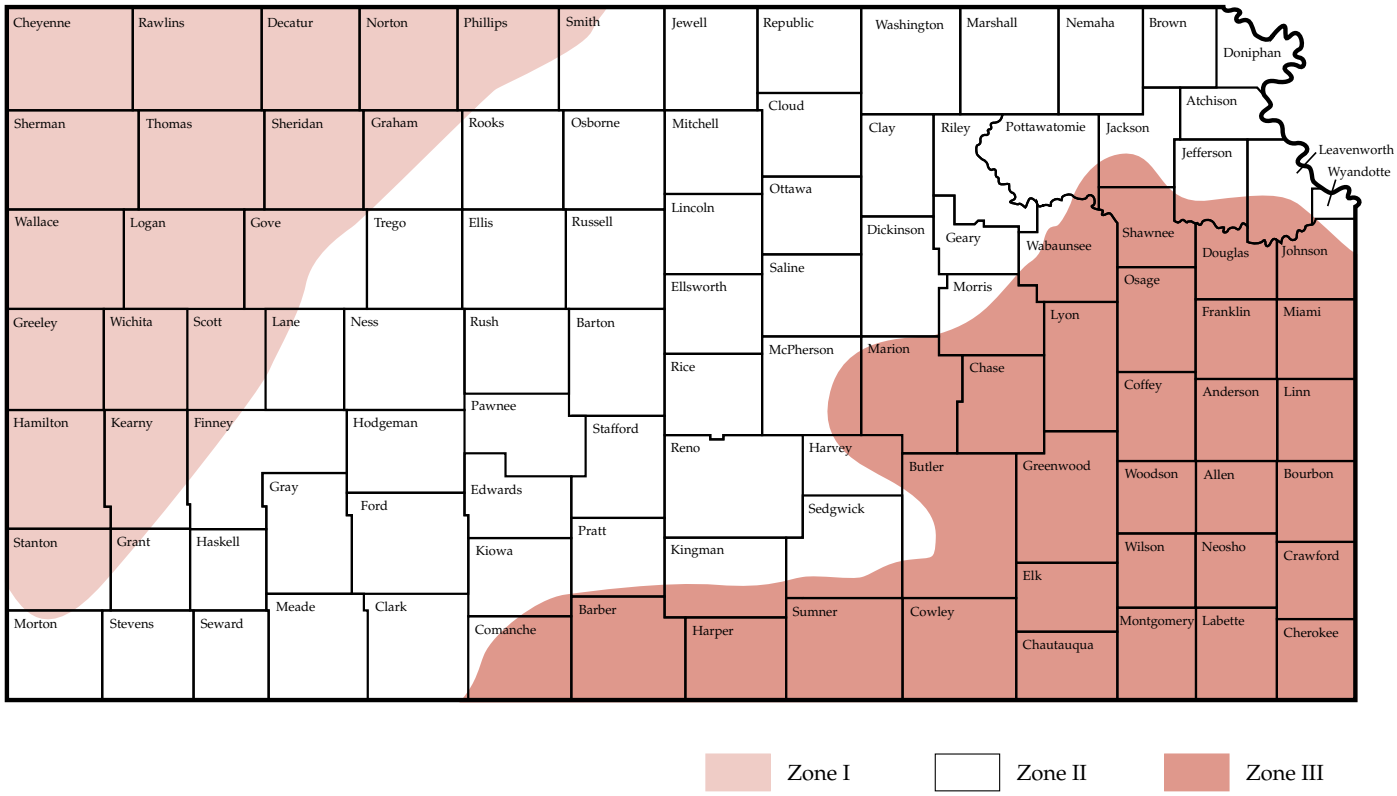
Preparing the Seedbed

The condition of the seedbed largely depends on how you prepare it. Work the seedbed as little as possible, but break up most of the larger surface clods.

Most gardeners plow or spade their soil in the spring. In some areas with heavy soils, it may be desirable to plow in the fall to allow winter freezes to mellow the clods. Make sure the soil crumbles well as it is plowed or tilled. Working the soil when it is too wet will cause a poor seedbed and poor soil conditions throughout the season. As a rule, soil is too wet to work if you can press a handful of it into a muddy ball.

For tiny vegetable seeds such as lettuce and carrots, it may be necessary to rake up a seedbed of very fine soil. For most vegetable seeds or plants, it is usually better to have some small surface clods.

Use a garden trowel to dig a hole for transplanting. It is OK to leave larger clods in prepared soil.



	Zone I	Zone II	Zone III
Average Frost-Free Days	160	175	188
Average First Frost (Fall)	October 5-9	October 11-14	October 17-21
Average Last Frost (Spring)	April 29-May 1	April 17-19	April 13-15

Seeds

Seeds should be obtained early in the year so you can get the varieties you want. The Vegetable Crop Information chart in the back of this book will guide you on how much seed to buy. Seeds can be obtained from local dealers and seed catalogs.

Avoid using seed from your previous crops unless you have a special interest such as the continued propagation of an unusual variety. Commercially available seeds are treated for disease and insect resistance and are stored under conditions that ensure health and vigor. It is possible to get atypical plants when you save your own seeds and when the plants are cross-pollinated or hybrid varieties.

Use a string to mark straight rows through the garden. Use the Vegetable Crop Information chart to indicate proper spacing. If you have a mechanical tiller or cultivator, be sure to allow adequate space between rows for cultivating. After seeding at the proper rate and depth, cover gently and water if the seedbed is very dry. If your garden soil tends to crust or the surface becomes hard after a heavy rain, apply a light layer of sand over seeds.

Producing Transplants

Most home gardeners obtain plants from local plant growers or suppliers. In areas where dealers are not available or where the desired varieties cannot be obtained, gardeners may need to produce their own plants.

Transplants are generally started by seeding vegetables in a small box or flat. In order to prevent diseases, a disease-free material such as sphagnum moss, vermiculite, or sand should be used instead of soil. Sow thickly in rows 2 inches apart. Cover lightly with a thin layer of the planting medium and water gently. Place the box or flat in a hotbed or sunny window and keep it moist until the seeds germinate.

It will be 6–8 weeks from the time seeds are sown until plants are ready for transplanting to the garden. Use the Vegetable Garden Calendar to determine the garden planting date.

After seedlings emerge and have 2–4 small leaves, they should be replanted in small pots and allowed to grow until transplanted to the garden. Pots should contain soil mixed with peat or sand to loosen it.

Various types of containers—paper cups, milk cartons, clay pots, peat pots, flats, or other packages can be used. A container must have a drain hole. Fill containers with the soil mixture and firm slightly. Lift the seedling plants from the flat and grasp the leaves, not the stem, of the small plants. Place one seedling in each pot. Water gently and place in a sunny window or hotbed until transplanting time.

Before transplanting to the garden, plants should be "hardened," or conditioned to outside temperatures. About 10 days before the transplanting date:

- gradually withhold watering so the plants are not wilting but are getting less water than normal
- gradually expose plants to the outside temperatures by removing the hotbed lids or placing the plants in a protected location outside
- avoid fertilizing, especially with nitrogen.

If this hardening procedure is followed, the plants will begin to grow soon after transplanting rather than suffer "transplant shock."

Transplanting

- Immediately before transplanting, water plants well.
- Allow as much soil to adhere to the roots as possible when transplanting.
- Water well after transplanting, using a starter solution.
- After the water has soaked in, sprinkle some dry soil over the moist soil around the plant.
- Protect the young transplants for the first few days.

When peat pots are used for transplanting, the entire pot can be planted to lessen the transplanting shock. Make sure the pot is well covered, however, because the exposed peat pot acts as a wick to draw moisture from the soil around the transplant.

Use a board with precut notches to space plants a proper distance apart. Water newly set transplants.

As the Garden Grows

A lot of effort goes into producing a successful garden. There are many things to do between planting time and harvest. Consider the following cultural practices.

Thinning

Many small seeded crops need to be thinned. For crops such as beets, carrots, radishes, turnips, and direct-seeded tomatoes or onions, it is necessary to thin some young plants from the thickly seeded row. An advantage of this process is that you can select the best of several plants and remove the poorer ones. This should be done 1–2 weeks after emergence of the seedlings. The average spacing between plants in a row is indicated in the Vegetable Crop Information chart.

Weeding and Cultivating

Weeds are a natural garden competitor. They compete with vegetable plants for water, nutrients, and space. The use of mulches and cultivation will help control weeds. Don't allow weeds to get a start. Control them when they are small. Mulching can reduce the time spent in cultivating.

Loosening the soil with a tiller or hoe accomplishes several things:

- It provides for air penetration.
- It promotes better water retention.
- It kills weeds that compete for water and nutrients.

Because most vegetables have roots near the soil surface, use care when cultivating around or near plants. A light surface scraping is sufficient around plants. Deeper tilling should be reserved for areas between rows. A tiller, garden tractor, or high wheel cultivator may be used, but most people rely on the hoe.

Pruning

Removing some of the vegetative growth on certain plants will admit more light to the plant, improve plant growth habit, and promote early fruit ripening. With tomatoes grown on stakes, it is a common practice to prune suckers or shoots that develop in the angle between the stem and branches. Remove suckers as they form and before they are 1–2 inches long.

Staking and Tying

Most home gardeners have limited garden space. Training plants on stakes or trellises makes more efficient use of space. Tomatoes are generally staked. Cucumbers and cantaloupe can be trained to a trellis or wire frame. Pole lima beans and pole snap beans also can be trained to a stake or trellis. Drive the stakes soon after plants have been set rather than waiting until they are established.

An effective trellis for home gardens can be made from hoops of concrete reinforcement wire or hog wire. Use hoops about 2 feet in diameter for tomatoes and 1–1½ feet in diameter for cucumbers and cantaloupe. You may need to put a stake or rod alongside the hoop to prevent it from turning over in strong winds.

Watering the Garden

Reducing home water use has become a major concern. Outdoor water use makes up more than half the water consumed by the average household. With careful planning, proper soil preparation, efficient watering, and use of mulches you can make the most of every drop of water for your garden.

Watering Efficiently

Two factors influence the general practice of watering: the water available in the soil environment, and the rate the plant is using water. The first depends primarily on the soil's water-holding capacity as well as the root mass. The second depends on some special characteristics of plants that allow them to retard water use and, more importantly, on weather conditions such as temperature, wind, and humidity.

The type of soil you have influences its capacity for holding water. Soil is composed of small particles, the largest particles being classified as sand; medium-sized particles as silt; and fine particles as clay. Varying amounts of each size particles in any soil determine its texture.

Some soils may have different textures at different depths. A layer of clay or hardpan beneath a loamy soil can restrict drainage. The soil texture in many garden areas has been altered by construction activity including the addition of fill soil.

Principles of Plant Water Use

Garden plants use water as part of the photosynthetic process and to move nutrients from the soil to upper parts of the plant. A continuous flow of water moves from the root system up through the plant where it evaporates into the atmosphere. In hot, dry conditions, the loss of water to the air is greater than in cool or more humid conditions. In addition, as the size and complexity of the plant increase, there is a greater need for water.

In contrast to landscape plants, garden plants need adequate water to encourage vigorous growth. Crops should never be under prolonged water stress because yield, quality, and pest resistance may be sacrificed.

New seedling plants with a shallow, poorly developed root system may require regular shallow watering, while a mature plant with its extensive root system can use water from a larger area of the soil profile.

Garden crops differ in the size and complexity of their root system. Consider the type of plant root system when determining which water practice would be most efficient.

Water-Holding Capacity and Availability in Different Soil Textures

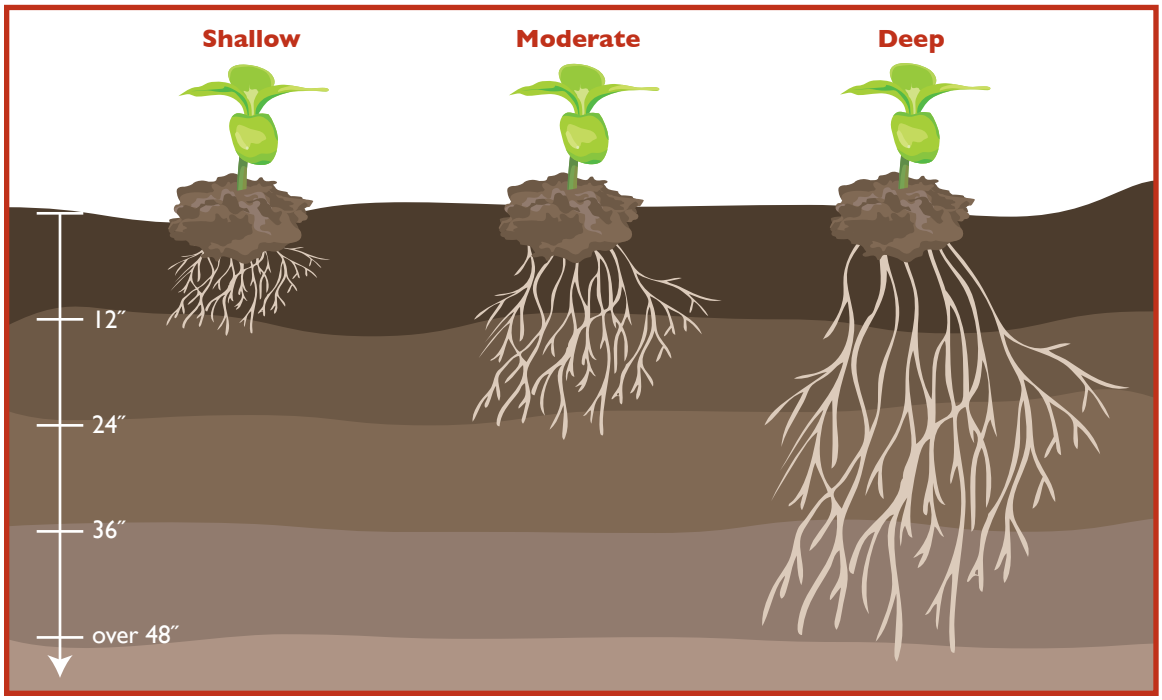
	Coarse Soils (Sand)	Mixed Coarse/ Fine Soils (Loam)	Fine Soils (Clay)
Water available (gal/cu ft)	½ gal	1 gal	1½
Depth 1″ of water penetrates	24″	16″	11″
Infiltration in 1 hour	2″	¾″	¼″

Rooting Depths of Selected Vegetable Crops

Shallow (under 24″)		Moderate (36–48″)		Deep (over 48″)	
Broccoli	Cabbage	Beans	Beet	Asparagus	Winter squash
Cauliflower	Corn	Carrot	Cucumber	Tomatoes	Sweet potato
Lettuce	Potato	Peas	Peppers	Pumpkin	Watermelon
Radishes	Spinach	Summer squash			
Turnip					

Periods of Critical Water Needs in Crops' Life Cycle

Stage	Crop
Germination	Seedlings—especially summer and fall crops
Pod enlargement	Beans, peas
Head development	Cabbage, broccoli, cauliflower
Root enlargement	Carrot, onion, potato, radish
Flowering to early fruit set	Corn, cucumbers, squash
Early fruit development	Melons
Uniform all season	Tomatoes, peppers, eggplant



The table at left shows average rooting depths of selected vegetable crops. The development of the root system of garden crops is such that most of the water is absorbed in the upper half of the root system. Thus, if the effective rooting depth of tomatoes is 48 inches, we could assume that most of the water is absorbed in the upper 24 inches and attempt to manage watering practices to keep an adequate supply in this 2-foot area.

Suggestions for Applying Water

Some vegetables, such as lettuce and corn, have especially sparse, less developed root systems. Other crops, such as pepper and tomato, have fibrous root systems that more effectively remove water from a given area of soil.

Cool-season vegetables, planted in spring or fall, generally root to a shallower depth than warm-season and perennial vegetables. These crops may need watering more frequently in stressful periods. Because fall and spring are usually characterized by cooler temperatures and more abundant rainfall, watering during these times is usually of less concern.

In many direct-seeded crops, you must be sure that adequate water is available in the root zone to encourage germination of seeds and allow for initial growth and development. It is often necessary to provide frequent shallow watering during dry seasons until the crop develops beyond the seedling stage. This is especially true of crops planted for fall production.

With transplanted garden crops, providing water at transplanting time is essential to support the plant until it is able to absorb water from surrounding soil. In general, apply ½–1 cup of water with each transplanted vegetable. Water slowly so it soaks into the area near the plant, or water at the bottom of transplanting hole.

A garden crop needs water throughout its life cycle to survive and grow. There are several periods, however, when adequate water is critical. During these periods, the plant may respond to a lack of water by changes that are irreversible during the remainder of its life. See table at left.

Methods of Applying Water

The most popular methods of applying water to the root systems of garden crops are flood, sprinkle, and drip/trickle irrigation.

Flood. Many garden crops can be watered by "flooding" or applying a flow of water to the soil surface. This can be done using a trench or basin near each plant or by running water down a furrow alongside each row.

This method works best in medium-textured soils that are fairly level. Water must flow from one end of the garden to another and must soak into the soil slowly in order to continue to flow in the trench.

Crops are usually planted in a raised bed when using this method so that water runs alongside the bed or row, not down the row itself.

Sprinkler. The sprinkler is by far the most extensively used watering method in home gardens. A sprinkler is inexpensive and can be used to water a diversity of crops in a small area. Distribution of water applied by sprinklers should be considered because more water is usually delivered to the center of the sprinkled area. Placing a few cans in the area to check for uniformity of water application will give you an idea of the pattern of your sprinkler.

One of the disadvantages of sprinklers is that they allow a considerable amount of water to evaporate into the air. Using coarse droplets and lower water pressure can reduce evaporation losses, especially on hot, windy days. Watering in cooler, less windy periods also helps.

When sprinkling garden crops, be sure to apply water in a way that allows plant foliage to dry as soon as possible after watering. Thus, early morning and early evening watering is preferable to late evening watering.

Drip/trickle irrigation. This method of watering is designed to keep a portion of the root zone well supplied by applying water on a daily or every-other-day basis. Drip or trickle tubes are usually laid to the side of the row or between two rows. To wet a continuous strip of soil, required by most vegetable crops, you should have a hole or "dripper" in the line every 10–12 inches. Many drip tapes come with the holes at prepunched intervals. Other types of drip tubing are designed to leak over the length of the tube.

Drip systems are usually operated at low pressures (5–15 PSI) and may require 1–3 hours a day to supply the water lost from crops during stress periods. Because of the danger of clogging the small pores of drip tape, water filtration is essential for this system. Most garden center dealers have drip irrigation kits with filters, pressure regulators, and water distribution lines. Most can offer assistance in design and layout of a drip system.

At the end of the garden season, the system can be flushed, dried, and stored in a protected

Drip tape can be laid under plastic mulch in the garden. Prepare soil well to ensure good contact with mulch. Bury edges of mulch so it doesn't blow away.

location for next year. It may be necessary to replace thin drip tubing each year. Thicker tubing may last several seasons. Use care in hoeing near drip tubing, and avoid walking on it. These activities may punch holes that interfere with the normal slow dripping of the tape.

Mulching

Mulching is an important practice that is often overlooked. Mulching can reduce the time spent in cultivating. A mulch can:

- conserve soil water
- control weed growth
- keep soil temperature uniform
- reduce frost damage to fruit.

One of the most effective ways of reducing the need to apply water to garden plants and conserve natural rainfall is to use garden mulches. Mulches are most appropriately used on summer crops when periods of water use are greatest.

Mulches provide a barrier that helps prevent moisture loss from the soil by evaporation. They also can be useful in maintaining cooler soil temperatures, controlling weeds, reducing soil compaction, and keeping produce cleaner.

Plastic mulches. Black polyethylene mulch is preferred because clear plastic mulch promotes weed growth underneath it. Plastics usually are available in rolls 3–4 feet wide. They are placed over the row or bed, the edges covered with soil, and various sized holes cut for the different crops. Black surfaces absorb heat, warming the soil for earlier production. Later, the foliage shades the plastic, reducing the heating of the soil. These mulches work best with warm-season crops such as tomatoes, melons, peppers, and eggplant, which are usually established by transplant.

Black plastic is most widely available but other colors such as red or green are available. Thicker 'fabric' type plastics can be re-used in other seasons. Some paper or plastic coated paper mulches are becoming available as well.

Organic mulches. Common organic materials used in gardens include compost, old hay, straw, leaves, shredded newspapers, peat moss, and grass clippings. Using coarse materials requires a 3- to 4-inch layer while fine materials can be applied in 1- to 2- inch layers. Organic mulches serve as insulation, reducing soil warming in the spring, so later season use is recommended. They can be left in place and tilled into the soil during the fall as a source of organic matter. Organic materials should be dried before use. Old or composted materials are preferable. Fresh materials may form molds or slime and repel water if used when green. Also, make sure organic materials do not contain weed seeds, insects, or disease organisms that may spread to garden crops.

Ten Ways to Improve Garden Water Use

1. Water deeply, but no deeper than the root zone of the plant.
2. Water slowly. Reduce the flow.
3. Water infrequently, but thoroughly. Adjust sprinkler equipment for a larger water droplet size to help reduce evaporation. Frequent shallow watering causes plant roots to concentrate close to the surface, making the plant more susceptible to water fluctuations.
4. Loosen the soil surface and use mulches. Most mulches help to keep soil surfaces loose and receptive to water absorption.
5. Follow directions for operating and maintaining all irrigation systems. Check regularly for leaks, malfunctions, or worn parts.
6. Keep your garden well weeded to eliminate competition for water. Consider removing surplus plants from overcrowded beds to ease water demands.
7. Use wide rows with plants closer together, which reduces soil water evaporation.
8. Avoid watering during windy weather.
9. Water early in the morning when humidity is the highest for reduced evaporation.
10. Locate your garden away from trees that might compete for water.

Fall Gardens

Fall is an excellent time for gardening in Kansas. This season is often overlooked in garden planning. A supply of fresh vegetables late in the year extends the gardening season, and the quality of many vegetables is better for fresh use and preserving.

Vegetables maturing in the cool, crisp days of fall are often better flavored than those maturing in the hot, dry days of late spring and summer. Many vegetables can be left in the garden and used as needed into the winter.

What to Plant

Space available and preference will influence the choice of crops to plant for fall production. With attention to watering and pest control, many vegetables that are already growing in the garden will continue to produce into fall. Some of these crops are tomatoes, okra, peppers, New Zealand spinach, eggplant, and sweet potatoes.

Crops that are best adapted to fall culture are mainly cool-season crops, although cucumbers, summer squash, and beans can be grown as fall crops. Peas aren't adaptable. Most spring vegetables are adaptable to fall gardening, but many Kansas gardeners report little success in growing fall peas. Peas require cool temperatures for germination and do not seem to adapt to the warmer temperatures of the summer planting period. You may want to try peas—particularly snow peas—in a mid- to late-August planting, but don't expect complete success.

Cabbage, broccoli, cauliflower, and Brussels sprouts make excellent fall crops. Plant seed rather than transplants. When young plants are ½–¾ inch tall, thin them to one plant per foot of row.

Beets and carrots require adequate moisture until they emerge. A light cover of sand or compost over the row may prevent soil crusting and improve emergence.

Freshly cut potato seed pieces will rot easily in warm summer soils. Seed should be cut 3–4 days prior to planting and held at room temperature to heal over. This will prevent seed piece decay. Seed potatoes may be difficult to find in midsummer. Potatoes just harvested should not be used because they will not sprout readily. If you are without a source of seed potatoes, old potatoes from storage or a supermarket can be used. Encourage your plant supply dealer to provide seed potatoes for next year's fall crop planting season.

Various types of lettuce may experience a marginal leaf burn with a light frost. The center leaves may escape damage, allowing lettuce—especially Bibb or head—to remain past the first frost forecasted.

Many gardeners report success in "overwintering" spinach and kale by using leaves in the fall without harvesting the entire plant. A light

mulching through the winter should keep the plants alive to begin growth in the spring without replanting a new crop.

When to Plant

Planting dates are influenced by how long it takes the crop to develop and how tolerant the crop is of first frosts or freezes. Crops such as potatoes or cabbage require a long period of development, thus a mid-July planting date, while crops such as lettuce or radishes can be planted in early September.

Although it is difficult to predict an exact date, the average first frost in the fall occurs in mid-October in most of central and eastern Kansas. It may occur several weeks earlier in northwestern Kansas and several weeks later in southeastern Kansas. The Vegetable Garden Calendar in the back of this book lists suggested planting dates for most of central and eastern Kansas, with estimated harvest periods. Northwestern Kansas gardeners may need to vary these dates about 10 days to 2 weeks earlier; southeastern Kansas gardeners 10 days to 2 weeks later.

Fertilizing and Soil Preparation

Planting in space used for spring production may require additional fertilizer to support fall crops. Large quantities of fertilizer may damage tender young plants, so use it sparingly this time of year. In general, 1–2 pounds per 100 square feet of a low-analysis, all-purpose garden fertilizer should be sufficient to produce a successful crop.

Although adding organic matter is an excellent practice, it is not a good idea to add quantities before fall planting because this may loosen and dry out soils at a critical time. Save organic matter for a late fall application.

Extensive soil preparation probably will not be needed for fall planting. Avoid deep tillage because it may dry out soil. A light surface cultivation will loosen soil to prepare the seedbed.

Additional amounts of fertilizer may be needed later in the season to ensure maximum plant growth and production. Cabbage, broccoli, cauliflower, collards, and kale, plus lettuce, mustard, spinach, and turnip greens will require about 4 tablespoons of a high-nitrogen, all-purpose garden fertilizer per 10 feet of row. It should be sprinkled along the row about 2 weeks after transplanting, or 4 weeks after sowing the seed. This will ensure lush vegetative growth before crop development during cooler fall weather. Other vegetable crops probably will not require any additional fertilization.

Establishing Vegetables in Summer Heat

Fall gardeners will find that establishing a garden during the summer when soil temperatures are extremely high is difficult. One way to avoid seeding in extremely adverse conditions is to establish plants in containers or pots for transplanting to the garden later in the season as the weather begins to cool. Crops such as cabbage, broccoli, cauliflower, Chinese cabbage, and collards can be grown in a cooler protected area, or under lights in a basement growing area for 2–4 weeks prior to setting in the garden.

It is important to acclimatize crops for several days before transplanting directly in the garden. Place the flats in the direct sun, providing adequate water for 2–4 days to allow the plants to become accustomed to the stronger winds, hot sun, and the harsh environment of the summer garden.

Crops that are seeded directly should be planted slightly deeper than they would be for a spring garden. This has two benefits—it provides a slight cooling effect, as well as more moisture available at the deeper soil depth. It is probably wise to plant more seed than necessary and to do some thinning later to ensure an adequate stand. With frequent watering and heavy, tight soils, a crust may form in planting fall gardens. This can be overcome by a light sprinkling of peat moss, vermiculite, or compost directly over the row.

Watering

As in the usual gardening season, the availability of water can influence the success of fall gardening in Kansas. Many areas of the state receive adequate rainfall for successful gardening from late August through September and October. However, trying to establish young seedlings in high temperatures during July to mid-August is difficult without a readily available source of water. Many vegetables can develop a tolerance to a hot temperature, but they cannot tolerate a lack of sufficient soil moisture and cannot germinate without it.

Seedlings. Seeds need adequate moisture to germinate. Germination can be accelerated by soaking seeds overnight before planting. Until seedlings begin to emerge, it may be necessary to supply small quantities of water frequently—perhaps as often as several times a day. In warm summer soil, you will be surprised at how fast many seeds germinate and start to grow. The period of intensive watering lasts only several days.

Before planting a fall garden, apply water until the soil is moist to a 10- to 12-inch depth. This will require about 1–1½ inches of water—equivalent to 1½ inches of rainfall—immediately prior to planting. Water can be applied by sprinkling, flooding, or drip irrigation.

As seedlings emerge, you can gradually reduce water because roots penetrate deeper into the soil. In fact, reducing water gradually will encourage deeper rooting of young seedlings, making them more drought tolerant. In certain instances, a temporary wind screen or windbreak may reduce water loss from soil and protect tender seedlings.

Regardless of the system used, it is essential to provide adequate amounts of water deep into the soil for use by vegetables during the critical period of growth.

Young plants. When plants are small, they may require watering twice a week during dry periods. Try to allow the plants to show slight stress—become slightly limp—before applying water. This will encourage deeper rooting. As plants grow, they will require watering less frequently. In late August and September, natural rain generally will replace watering in most years. A general guideline to follow is that plants will require about an inch of water a week if not supplied by rainfall.

Frosts and Freezes

The first frost in the fall will damage some frost sensitive crops. Others may be slightly damaged but will continue to grow for several weeks until a severe freeze kills them. Other crops are hardy and will stand fairly low temperatures. These can be used into the winter months as needed.

Vegetables can be harvested as they mature. From mid- to late October in most areas of Kansas, the weather forecast will indicate when a frost that will freeze tender vegetation is on the way. Many vegetables will have been producing vigorously for 2–4 weeks prior to this date; however, it may be possible to continue harvest for an even longer period of time.

Often, a few nights of low temperatures will be followed by warmer weather for several weeks. If you can protect tender vegetation during these few cold nights, you can continue harvesting vegetables. Some gardeners attempt to gain more days of growing time by covering plants with baskets, blankets, or plastic at the first frost warning.

Concentrate on saving only the tender vegetables which will be easily damaged by a slight frost. Other vegetables that may be growing in the garden and need protection are peppers, eggplant, tomatoes, and sweetpotatoes. Temporary coverings of polyethylene plastic, blankets, or tarpaulins may be stretched over the rows to provide frost protection. A small light bulb burning underneath such coverings can provide protection from freezes to around 25°F. Coverings should be anchored so that they will not damage garden crops if a sudden wind develops. As little foliage as possible should come in contact with the surface of the covering because that foliage will freeze rapidly. After the danger of frost has passed, remove the coverings; be prepared to put them on again if a sudden frost is forecast later.

Semi-hardy vegetables should be harvested if temperatures in the mid- to upper twenties are forecast and hardy vegetables harvested if temperatures in the low twenties seem imminent. Root crops such as beets, carrots, potatoes, and turnips may be mulched and used as needed until the soil begins to freeze, usually in late November to December.

Sensitivity of Fall-Planted Vegetables to Freezing Temperatures

Tender Crops	Semi-hardy Crops	Hardy Crops
Damaged by First Frost	Can Stand Light Frost	Can Stand Several Frosts, but Should Be Used Before Low 20°F Temperatures
Beans	Beets	Cabbage
Cucumbers	Chinese cabbage	Broccoli
Summer squash	Collards	Cauliflower
	Irish potatoes	Brussels sprouts
	Bibb lettuce	Carrots
	Mustard	Turnips
	Radishes	Kale
	Spinach	
	Swiss chard	
	Leaf lettuce	

Insect and Disease Control

Control of insect and mite pests and diseases is essential for successful home gardening and part of general management practices for your vegetable garden. Plant symptoms may reflect disease injury from fungi, bacteria, nematodes, or viruses; insect or mite injury; chemical or herbicide injury; or physical or environmental damage caused by growing conditions, location, or soil fertility deficiencies or excesses.

Your local K-State Research and Extension agent or garden center professional can provide assistance in identifying or recognizing specific symptoms in your garden. It is best to provide a large, representative sample along with information on the variety, when symptoms first appeared, unusual recent weather or growing conditions, and general condition of other vegetables in the neighborhood.

Checklist of Good Gardening Practices

- **Create a "healthy" soil.** In the rush to plant, this important step is often overlooked, yet it can make the difference between a productive and a so-so garden. Many insects are attracted to stressed plants. Poorly growing plants also recover more slowly from insect and/or mite injury. Conduct a soil test and follow the recommendations to supply appropriate nutrients as needed. Adding extra fertilizer won't create healthy soil, because excess nitrogen or phosphorus can promote insect and disease problems and can lead to run-off issues. Add organic matter to the soil each year in the form of soil amendments or mulch.
- **Choose pest-resistant or tolerant varieties.** Nursery and garden catalogs often identify such varieties. Additional information is available in the Extension publication *Recommended Vegetable Varieties for Kansas*, L-41.
- **Start with quality seeds and healthy plants.** Purchase stocky, dark-green transplants, and buy certified virus-free seed potatoes.
- **Eliminate competition.** Remove weeds and grass from the growing site because they compete for nutrients and water. Keep plants growing vigorously. Rapidly growing vegetables can better tolerate or outgrow insect, mite and disease damage, but they also quickly use up available nutrients. Applying fertilizer and

water at critical times during maximum plant growth is essential for producing pest- and disease-resistant plants. Refer to the Soil Improvement section on page 13.

- **Keep it clean.** Remove infected plants during the season to prevent spread within the garden, and remove plant debris after harvest to avoid harboring insects, mites and diseases. Remove weeds, which may serve as a reservoir for pests. Dispose of or burn diseased plants, fruits, and vegetables. Composting is seldom thorough enough to eliminate disease-causing fungi and bacteria.
- **Rotate crops.** Planting the same crop in the same place year after year invites losses due to soilborne diseases and overwintering insect pests. Follow a crop rotation of at least 3 years for the four major vegetable plant families—solanum (tomato, potato, pepper, and eggplant); cucurbit (melons, squash, and cucumbers); cruciferous (broccoli, cauliflower, cabbage, and Brussels sprouts); and allium (onion, garlic, and leeks).
- **Choose a sunny location away from large trees.** Eight to 10 hours of direct sunlight a day are necessary for proper growth, flowering, and fruiting of most vegetable crops. Sunlight also helps to dry foliage and reduce infection by many fungal and bacterial diseases.
- **Water properly.** Plants receiving either too much or not enough water will be less vigorous and more susceptible to insect and mite pests and diseases. Consider using a form of drip irrigation, which will keep foliage dry and prevent foliar diseases while at the same time using water more efficiently. If using a hose, direct the water towards the ground and avoid wetting the foliage.
- **Use mulch.** Mulch helps control weeds and reduces moisture evaporation from the soil surface. Much also helps prevent rot caused when fruit is in contact with bare soil. When tilled under, organic mulches become valuable soil amendments. (Refer to *Mulches and Living Organisms*, MF-2900, for more information.)
- **Provide good air circulation.** Overcrowding plants can result in weak growth and an increase in foliar diseases. Stakes, cages, trellises, and pruning all help to increase air circulation.
- **Plant at the proper time.** Seeds planted too early are more susceptible to rot. Delay planting until the soil has warmed to allow rapid germination of seeds and growth of young plants.
- **Get to know the major insect and mite pests and plant diseases in your area.** Learn their life cycle, their habits, and stages they are most easily controlled. Refrain from using any pesticide until you have correctly identified a given pest and determined the proper time for control. (You might identify a pest or disease but the window of opportunity for control has passed.) Your local K-State Research and Extension agent can help with identification. Some insect and mite pests and disease symptoms resemble improper cultural practices.
- **Grow crops that have few pest problems.** Plants that have few insect, mite and disease problems include loose-leaf lettuce, rhubarb, Swiss chard, garlic, cos lettuce, leeks, parsley, sweetpotatoes, okra, beets, snap peas, parsnips, carrots, onions, and kale.
- **Put up bird feeders and bird houses.** Birds are predators of insects. For instance, more than a dozen species of birds are known to feed on various moth larvae.
- **Inspect the entire garden at least weekly.** Check the undersides of plant leaves. Detect symptoms when they first develop so that pest problems can be more easily controlled.
- **Use chemical pesticides as a last resort, carefully and judiciously.** Several general-use insect pest and disease control measures are available that provide effective control with minimal environmental disturbance. Always read the label carefully and follow use directions.
- **If you use pesticides, apply them properly.** Thorough coverage of all plant parts is required. (Apply liquids to the point of run-off.) The use of a fine spray mist directed to all plant surfaces usually is the most effective way to ensure proper pesticide action while using or wasting as little material as possible.
- **Be realistic in your expectations.** Accept the fact that there may be some damage from pests and even an occasional crop failure.

Alternatives in Pest Control

Control	Advantages	Disadvantages
Botanical insecticides: Neem rotenone, pyrethrum	Rapid breakdown; rapid action; low toxicity to mammals and plants. Rotenone is highly toxic to fish.	Rapid breakdown, requiring more precise timing of and/or more frequent application; cost and availability; lack of test data; lack of state registration of some materials.
Microbial insecticides: *Bacillus thuringensis* (Bt), (Dipel, Thuricide, Attack, Caterpillar Killer), M-One	Selective; nontoxic to wildlife and humans; may establish and provide control in the future.	Controls only one species or group of insects; timing is critical; special storage and application procedures may be necessary.
Insecticidal soaps: Safer's Insecticidal Soap	Rapid breakdown; rapid action; low toxicity to mammals and other animals; low toxicity to most plants; selective, doesn't harm most beneficial insects.	Rapid breakdown—effective only against insects that come into direct contact with the spray before it dries; phytotoxic to some ornamental plants and houseplants.
Attractants: Pheromones, lures	Nonhazardous to humans or other animals; no residues; target specific insects while leaving beneficials unharmed.	Variable results due to weather, locations; effectiveness limited to specific adult insect populations; expensive, more useful for monitoring the presence of insects than for control in most cases.
Beneficials: ladybugs, green lacewings, syrphid flies, trichogramma wasps, praying mantis	Nontoxic to mammals and wildlife. If established, may provide control in subsequent pest generations or seasons.	Variable results; careful handling required; some beneficials are limited in the kind of insects they will eat; some pests must be allowed to remain in order to provide a food supply for the beneficials.
Fungicides: sulphur, copper, Bourdeaux mixture	Provide fungicidal action and disease control.	Toxic to mammals, wildlife, and many beneficials. Timing of application is critical. Sulphur should not be used within a month of oil sprays or when temperature is above 80–85°F. Unsafe levels may build up in soil after years of use.
Oils: dormant oils, horticultural superior oils, Volck	No residues on fruit when applied prebloom; effectively control many overwintering pests.	Must be applied while tree is dormant, though lighter weight oils are being developed for use in spring and summer. Must be applied when temperatures are above 40°F but below 80°F for several hours to avoid injury.
Traps: Tanglefoot, sticky yellow or white boards	No residues, nontoxic to mammals, wildlife, and beneficials.	Can trap both pests and beneficials; some traps are expensive; must be maintained, cleaned, and recoated periodically; effectiveness varies.
Physical barriers: Row covers, netting	Nontoxic, no residues. Allow water, air, and sunlight to pass through.	Row covers prevent pollination of fruits and vegetables by insects; durability varies from 1–3 seasons; considerable damage may result from pests that emerge under row covers.
Minerals: Diatomacious earth, kaolinite clay	Nontoxic to mammals and birds; works by presenting a physical barrier rather than poisoning; contains beneficial trace minerals.	Affects beneficials such as ladybugs; complete application required; less effective in humid weather.
Cultivation and hand picking:	The least expensive of all control practices.	Must be used long before pest damage becomes apparent and at the proper stage of development of the insect.

Integrated Pest Management

A concept of pest control or regulation emphasizes integrating preventive management, alternative pest control measures, and chemical controls to deal with the wide variety of pest concerns associated with growing vegetables. Chemicals are used only when necessary. Pest problems are often specific to one type of vegetable or vegetable types. It is difficult to generalize about specific insect, mite or disease problems because each is distinctly different. As such, integrated pest management requires knowledge of the pest, including the following:

- Life cycle and population dynamics.
- Level of plant damage that can be tolerated.
- Susceptible crops that may be damaged.
- Environmental factors such as temperature and relative humidity that may influence the pest and control measures.

With knowledge of the pest, specific control measures can be undertaken. Chemical controls should be reserved for difficult-to-manage pests that can spread to other plants.

Pesticides

A pesticide is a substance or mixture of substances intended to prevent, destroy, repel, or mitigate certain insects, mites, rodents, nematodes, fungi, weeds, or other organisms considered pests.

Chemical pesticides provide many benefits in regards to food production and nutrition, but they also pose some hazards. Some chemical pesticides may leave undesirable residues on food, in water, and contaminate the environment when not used properly. Many conventional pesticides are toxic to humans and other animals. As a result, many homeowners and growers are seeking less hazardous alternatives to conventional chemical pesticides.

Interest in using alternative pest control methods has increased due to environmental and food safety concerns. A variety of "organic" pest control methods are available for vegetables commonly grown in Kansas. These methods require regular monitoring and familiarity with life cycles (e.g. egg, larvae, pupae and adult) of different insect and mite pests in order to appropriately time applications of pest control stragegies.

Remember, pesticides are just one option available to effectively manage pests. Before using any pesticide or control measure, consult the checklist of good gardening practices. By first adopting these practices, you can greatly reduce or eliminate the need for pesticide use.

Alternative Pesticides and Control Methods for Specific Crops

Crop	Pest/Disease	Control
Various crops	Aphids, spider mites, other soft-bodied pests 	Insecticidal soaps. Effective only through direct contact with insect before soap dries. Some foliar burn may occur at high temperatures with too concentrated a soap mixture; apply to a few test plants first.
Various crops	Flea beetle 	Spray or dust with rotenone when damage is first noticed. Use row covers.
Asparagus	Asparagus beetle 	Hand pick. Use rotenone during cutting season.
	Rust	Choose resistant varieties like Jersey Giant or UC 157.
Beans	Bean leaf beetle 	Spray or dust with rotenone on underside of leaves. Use row covers.
	Mildew	Improve air circulation with proper spacing. Water early in the day so that foliage will dry quickly.
	Root rots	Rotate crops. Plant in well-drained sites when soil is warm.
	Rust	Avoid wetting foliage. Use drip or soaker hoses to irrigate.

Alternative Pesticides and Control Methods for Specific Crops

Crop	Pest/Disease	Control
Cabbage, broccoli, cauliflower, Brussels sprouts	Cabbage looper, imported cabbage worm, diamond-back moth 	Spray or dust thoroughly with *Bacillus thuringensis* (Bt). Begin when worms are small and repeat as needed throughout the season. Use row covers.
	Black rot	Use disease-free seeds and plants. Do not work with wet plants. Use 3- to 4-year rotation. Destroy plants after harvest. Some resistant varieties are available.
Corn	Corn earworm 	Apply a few drops of mineral oil to the silks just inside the tip of each ear before the silks have wilted and started to brown. Bt is not effective.
	Maize dwarf mosiac	Avoid planting near Johnsongrass, as aphids carry virus to corn. Control weeds. Choose tolerant varieties.
	Smut	Remove and destroy galls before they break open. Do not compost. Rotate crops. Plant tolerant varieties (Apache, Bellringer, Quicksilver, Seneca, Scout).
Cucumber, melons, squash	Cucumber beetle, striped or spotted 	Apply rotenone at 5-day intervals, repeating after a rain.
	Squash bugs 	Hand pick. Trap under shingles placed beneath the plant. Remove the copper-colored eggs.
	Anthracnose	Choose resistant varieties. Use 3-year rotation. Do not save seed. Avoid working with wet plants.

Alternative Pesticides and Control Methods for Specific Crops

Crop	Pest/Disease	Control
	Bacterial wilt	Remove and destroy entire infected plant along with surrounding soil and soil clinging to roots. Clean up plants in autumn. Control cucumber beetle, which transmits the disease.
	Powdery mildew	Improve air circulation with proper spacing. Clean up in autumn. Plant resistant varieties.
Onions	Onion thrip	Insecticidal soaps. Use row covers.
Peas	Powdery mildew	Water early in the day. Improve air circulation by proper spacing and weed control. Clean up in autumn. At first sign of disease, spray or dust with sulphur.
	Root rot	Practice crop rotation. Plant seed as early as possible. Avoid wet soil and improve soil drainage.
Potatoes	Colorado potato beetle  	Apply rotenone when beetle adults or larvae first appear. Repeat as needed. Hand pick. Use row covers. New formulations of *Bacillus thuringensis* for potato beetle control are relatively unavailable to home gardeners.
	Early blight	Water early in the day. Improve air circulation by proper spacing. Clean up in autumn and destroy plant residues. Practice crop rotation.
	Scab	Use certified seed. Practice crop rotation. Lower soil pH to 5.2–5.5 with sulphur. Plant resistant varieties (Chieftain, Norland, Russet Burbank, Superior). Avoid lime, manure, and wood ash.
Tomatoes	Blossom end rot	Water during drought. Mulch to keep moisture level constant. Grow on soil high in organic matter. Avoid cultivating close to plants.
	Catfacing	Grow recommended varieties. Provide adequate fertilizer and water for vigorous growth.
	Early blight	Practice crop rotation. Water early in the day. Improve air circulation by proper spacing. Clean up plant residues in autumn.
	Fusarium wilt	Practice crop rotation. Remove and destroy infected plants. Plant resistant varieties (Mt. Spring, Mt. Fresh, Scarlet Red, Celebrity, Red Defender, and others).
	Septoria leaf spot	Water early in the day so that foliage can dry quickly. Improve air circulation with cages, pruning, and proper spacing.

Container Gardening

Container gardens are an option for persons with limited space. Residents of apartments, condominiums, retirement homes, or houses on small lots can still enjoy gardening. Containers are mobile, allowing a gardener to take the plants along or move them for an instant splash of color.

You can enjoy your plants more fully by growing them on patios, balconies, and window boxes. Older gardeners can tend container gardens when standard gardening becomes too strenuous. And, what better way for children to observe the miracle of plant growth?

Container gardening involves special considerations, especially in Kansas. A container plant growing in an exposed location is under more stress, and requires more frequent watering. The effects of hot, dry winds may be more severe than in conventional gardens. Large containers can be expensive and are difficult to move when filled with potting mix. But, the advantages far outweigh these considerations.

Soil Mixes

When ordinary soil is saturated with water, the air spaces are filled, removing essential air from the roots. This is why a soil substitute, often called potting mix, is recommended for container gardening. The mix may contain some soil—called soil mix—or no soil at all, a soilless mix. Additional ingredients such as peat moss, vermic-ulite, and perlite allow rapid drainage but still hold sufficient water for plant growth.

You can purchase potting mix from nursery or garden centers under a variety of trade names: Jiffy Mix, Pro Mix, Metro Mix, Pro Soil and others. If you have only a few containers, you may want to take them to the local greenhouse and fill them with the greenhouse potting mix for a fee.

You also can make your own potting mix. Remember, to keep it simple. You don't need a different mix for each type of plant. One common formula mixes 2 parts sandy loam soil, 1 part sphagnum peat moss, and 1 part perlite or builders' sand. There are many varieties of this basic recipe. Potting mixes should be free of disease organisms, insects, or weeds. Any mix containing soil has not been pasteurized to kill weeds or disease organisms, so use these mixes for established plants.

Consult references in your local library or K-State Research and Extension office for additional information on container gardening, including recipes for making large quantities of potting mix from a variety of ingredients.

Containers

Containers come in a variety of styles and sizes. You can recycle old buckets, cans, and

similar containers. It is essential that the container have holes in the bottom for draining excess water.

Plastic. Plastic containers are available in various sizes, shapes, and styles. Many plastics are breakable and may not hold up well over several seasons.

Clay. This old favorite is preferred by many gardeners for its earth-tone color. Clay is porous and allows water loss from the sides of the container. Clay pots are breakable and may not hold up well if mobility is required.

Wood. Wood is a popular material for containers. Both redwood and cedar are relatively rot resistant and can be used without staining or painting. Exterior grade plywood and other types of wood also can be used. Avoid using wood treated with creosote, penta, or other phenolic compounds, because vapors can injure some plants. Always use copper-treated lumber if preservative-treated lumber is needed. Wooden containers are excellent for portability and can be purchased or built in various sizes and styles. Several container garden references offer plans for building attractive containers.

How big should the container be? That depends on the type of plants you plan to grow. There is a balance between the top growth and root systems of plants. Small plants can be grown in fairly small, shallow containers, while larger plants need a larger container. Plants in locations such as a hot patio exposed to west or southwest winds, or in elevated locations, may need a slightly larger container than those in more protected areas.

Most small vegetables will grow in containers ranging from 5-inch pots to gallon-size. Larger vegetables, such as dwarf tomatoes, peppers, and cucumbers will require 1- to 3-gallon containers. Full-size tomatoes require at least a 3-gallon container.

Fertilizer

Since potting mixes drain water rapidly, causing fertilizer to be washed out of the containers as you water, you will need to replace lost fertilizer. Lighter mixes will require more frequent fertilizing than heavier mixes containing soil. Remember, you are growing a plant with a small, constricted root system so regular fertilizing and watering is important.

Many gardeners prefer to apply a dilute fertilizer solution at every other watering. Several water-soluble fertilizers, including Rapid Gro, Hyponex, and Miracle Grow, are available at garden centers. If you fertilize at every other watering, use only one-fourth the recommended rate unless the instructions state otherwise for continuous feeding.

Controlled-release or time-release fertilizers also are widely available. These are pellets designed to release fertilizer gradually over a long period of time. Use these according to label directions.

Watering

Since containers are usually placed in an exposed location, water is lost from the containers quickly. Smaller containers have a smaller reservoir for holding water until needed. There is no rule of thumb on how often to water because it varies with the type of plant, potting mix, weather, and type of container.

You may find that daily watering is needed during hot, dry periods. One advantage of using a potting mix is that it is nearly impossible to over-water, as the water quickly drains from the container. Check your plants regularly and look for signs of wilting to indicate a need for water. Another method is to stick your finger into the upper inch or so of the potting mix to feel the dryness. Always apply sufficient water to allow a small amount to come out of the bottom drain hole. This indicates the container is thoroughly saturated with water.

Potting mixes can be easily washed out of a container, so never water with a direct stream of water from a hose. Always use a "breaker" nozzle to break up the stream of water or a sprinkling can to apply water. A sprinkling can is handy for applying fertilizer as you water.

Because regular watering is required, you will need to arrange for plant care when you vacation. Grouping plants will reduce water use. The most reliable method of plant watering while you are away is to arrange for someone to care for your plants. They can water plants as well as check for problems that may develop.

Culture and Care

Plants need care and attention throughout the season. Insects and disease can be concerns because plants are growing under more stress and with limited root systems. Control measures are similar to those for conventional gardening (see page 33). Contact your local K-State Research and Extension office for additional information or publications dealing with garden pest problems.

What To Grow

Vegetables require sunny locations and will vary in productivity depending on the type of crop. Check seed catalogs for new varieties developed for container gardens. There are also several types of "ornamental" vegetables adapted for growing in containers. Flowering cabbage and flowering kale are attractive relatives of standard varieties. Lettuce is available in a variety of colors and leaf textures. Red chard is another popular container plant because of its bright red stalks.

Many gardeners grow herbs near the kitchen to use in cooking. Basil, chives, marjoram, and thyme are all easy to grow in containers. Many gardeners keep mint in containers as it is an aggressive plant that spreads. Some herbs are perennial and can be moved indoors for winter use or held in the container until next year. Many gardeners dig a hole in the garden to store pots of perennial herbs until next season.

Varieties

Vegetables for Spring/Fall

Beets (3-inch spacing): Detroit Dark Red, Early Wonder, Red Ace

Carrot (3-inch spacing): Little Finger, Short 'n Sweet, Royal Chantenay, Red Cored Chantenay, Thumbelina

Leaf lettuce (6-inch spacing): Grand Rapids, Oakleaf, Salad Bowl, Ruby

Butterhead lettuce (6-inch spacing): Tom Thumb, Bibb, Buttercrunch

Onion (2- to 3-inch spacing): Use any standard variety; best grown for green onions

Radish (3-inch spacing): Cherry Belle, Champion, White Icicle

Vegetables for Summer

(Plant after danger of frost is past.)

Bean (4-inch spacing; Pole beans yield more per area — trellis them): Blue Lake, Kentucky Wonder, Fortex

Cucumber (8-inch spacing): Bush Whopper, Salad Bush, Patio Pickle, Spacemaster, Bush Champion

Eggplant (12-inch spacing): Fairy Tale, Bambino, most standard varieties

Muskmelon (12-inch spacing): Minnesota Midget, Sweet 'n Early

Pepper (12-inch spacing): Sweet, hot or banana varieties can be grown in larger containers

Squash (1 per pot): Golden Nugget, Gold Rush, various zucchini hybrids

Tomato (Dwarf; 12-inch spacing): Patio, Pixie, Orange Pixie, Tiny Tim, Small Fry, Tumbling Tom

Tomato (Small-Vined; 1 per pot): Mountain Belle (cherry), Mountain Glory, Celebrity, Sunmaster

Watermelon (1 per pot): Sugar Bush

Season Extension

Each crop in the garden has its production season when, if all goes well, gardeners enjoy abundant harvests and may have surplus to store or preserve. A number of techniques ensure continuous production of many crops beginning well before the usual production season, and extending through the normal season, into the fall, and in some cases, continuing production year-round.

This chapter provides a brief overview of techniques that can be used for season extension, ranging from using appropriate varieties and planting dates, to selecting planting locations, to modifying the environment using materials such as mulches and floating row covers, and structures such as cold frames and high tunnels.

Crop and Cultivar Selection

Peak production for cool season crops typically comes in the spring and fall. Warm season crops, which are frost sensitive, produce in the summer. The natural length of the harvest season varies by crop, with some crops, such as tomatoes, producing over many weeks, and others such as sweet corn, broccoli, and radishes, providing a relatively brief period of harvest from a planting. Cool season crops vary in their capacity to tolerate temperatures below freezing, but a number, including leafy greens, carrots and beets, can easily be grown throughout the winter in an unheated cold frame or high tunnel. The season for warm season crops can also be extended into the spring, fall and winter, but these crops must be provided with the warmth they require for growth, and be protected from freezing.

Varieties (cultivars) of crops may vary in both the number of days to maturity (earliness) and tolerance to heat or cold temperatures. One way of ensuring an extended harvest, particularly of crops that tend to produce during a brief harvest period, is to plant both earlier and later maturing cultivars at the same time.

Seed catalogs and packets almost always indicate the number of days to maturity. Seed catalogs may also identify cold or heat tolerant cultivars. For example, some lettuce and spinach cultivars are identified as slower to bolt (flower and produce seed), and these would be choices for growing into the hot summer. Cold tolerant cultivars of some warm season crops, such as beans and sweet corn would be choices for an early first planting.

Maximize Yield

Small, successive plantings. Sequential planting is another way to ensure a continuous harvest of many crops, particularly

those that produce only over a brief period. This works well with quick cool season crops, such as radish, lettuce and spinach, and also for warm season crops, such as bush beans and sweet corn. The first planting of sweet corn will often include both early and later maturing, main season varieties, which will then be planted successively approximately every two weeks through the planting season.

The planting season for warm season crops typically ends when there is no longer time for a crop to mature between the time of planting and the anticipated date of frost. If using structures such as cold frames or high tunnels, the planting season for cool season crops extends well beyond the normal season, but short days limit crop establishment and growth as winter approaches.

Well-established crops such as spinach, lettuce and carrots can continue to produce throughout the winter, but they need to be planted early enough to give them time to grow before days become very short from November through January.

Harvest promptly. A timely harvest also helps ensure a long harvest period for many crops. Harvesting crops when they are ready can stimulate continued production through thinning the stand (for example, radishes, beets, green onions, lettuce), and removal of immature fruit (summer squash). Timely harvest also improves crop health through the removal of diseased, rotting, or overly mature fruits and other plant parts, and can contribute to air flow in the crop, reducing humid conditions favorable for disease development and spread.

Use transplants. Using transplants is a further way to ensure early production of many crops by allowing the gardener to take relatively large, rapidly growing plants to the field when conditions are favorable. Transplants of warm season crops are produced in a controlled environment, such as a heated greenhouse, hot bed (see below), or under lights in the house so that they can be ready to plant out after danger of frost has passed. Care should be taken, particularly with the warm season crops, such as peppers, to ensure they are planted in soil that is warm enough. It is a common error to plant peppers in soils that are cold (below 55°F) and wet, resulting in root rots, which can kill the plant or delay production.

Garden Site Selection

Various features of the garden can influence the potential for season extension. The orientation of the slope (the aspect) of land in the garden, as well as hedgerows and fences, which can act as windbreaks or sources of shade, can have effects on the earliness and productivity of crops. Gardens in low lying areas or hollows called frost pockets are likely to be more prone to frosts than those on slopes which allow for air drainage.

A garden with a northern aspect will warm up more slowly in the spring than will a southern facing garden. Western and southern facing slopes will capture the sun's warmth and may be advantageous for production early in the spring or late in the fall, but may be too hot and dry when baking under the heat of the summer sun.

Northern facing slopes are often considered desirable for fruit production, as they warm up slowly and delay flowering till danger of frost has passed. Crops that require full sunlight need at least 6 hours of direct sunlight per day, but may benefit from a bit of shade during the heat of the summer. A crop with an eastern exposure may benefit from the morning sun, but be protected somewhat from the harsh afternoon sun. Gardeners in Kansas have reported an extended rhubarb harvest with plants receiving morning sun but afternoon shade.

Wind protection. Wind can be very damaging to vegetable crop productivity, resulting in damaged plants, both from the physical stress of the wind and from abrasion by sand particles being blown over the land. Hedgerows and fences can serve as effective windbreaks, protecting crops from prevailing winds and allowing for an extended season of production of higher quality vegetables in windy locations. Plants in a windbreak can compete with garden plants for water, so leave space between the garden and hedgerow or trees in order to avoid this.

Raised Beds

Raised beds or ridges can help not only with season extension, but with general crop health, contributing to good drainage and soil aeration for healthy root growth. These can be permanent or made annually, with hoes or with an implement on a tractor or rototiller. Because they are raised above the surface of the soil, beds can warm up more rapidly in the spring than the rest of the garden, helping to produce earlier crops. Just as raised beds can warm up rapidly in the spring, they may also cool off rapidly in the winter. Thus, if poor drainage, is not a concern, a flat surface or even a slight trench may help to conserve heat for crops grown in a protected structure such as a high

tunnel or cold frame (see below) during the depths of winter.

Mulches

Mulches are materials placed in the garden to cover the soil and can help with season extension by cooling or warming the soil and by conserving soil moisture and preventing the growth of weeds that can compete with crops. Mulches may be synthetic, including plastic films and weed barrier, or natural, including paper, straw, and wood chips.

Types. Plastic film mulches are commonly used by commercial growers, and are increasingly available to home gardeners through catalogs and garden centers. They are also almost always used in combination with drip or micro-irrigation for efficient delivery of water to the roots of plants. Black plastic mulch is the most common type, typically coming in 3- or 4-foot widths that commercial growers lay over raised beds using specialized mulch laying equipment.

Installation. In the home garden, mulch can be laid by hand. For soil warming, it is important for the plastic mulch to be in direct contact with the soil so that heat can be transferred from the plastic to the soil. Warm soil under mulches can lead to earlier and extended crop production. Plastic mulch comes in a number of other colors, including clear (which can warm soil much faster, but also grows weeds), red (which tomatoes particularly like), infrared transmitting (which acts like clear mulch but won't allow weeds to grow), white (white on one side and black on the other to prevent weed growth; white mulch keeps soil cool and is often used for mid-summer plantings); and reflective, aluminized (which also cools the soil and is repellent to whiteflies and aphids).

Disposal. One problem with plastic mulch is clean up and waste disposal. Biodegradable mulches made out of modified starch or other bio-based polymers are also available and will probably become increasingly available in the future. These biodegradable mulches can be tilled in or left to decompose naturally after use. Natural biodegradable mulches, including paper, straw, hay and wood chips, are also well-known and excellent mulches. They help to keep the soil cool in the heat of summer, conserve moisture and control weeds. Organic mulches slow soil warm-up in the early spring, so for early plantings, they should be pulled back to allow the soil to warm up.

A further option for soil covering is the use of weed barrier fabric, which can be reused from year to year. After preparing the soil, it can be placed in the garden where it will help warm soil for early planting while controlling weeds and conserving moisture. It is probably best to take up weed barrier from year to year, or it will likely become covered with soil and become a messy nuisance.

Other Forms of Protection

Row covers. Floating row cover is fabric, which as the name implies, can be placed directly over crops to protect them. It is usually made of spun-bonded polyester or polypropylene material, and comes in various thicknesses (for example, 0.55 or 1.5 oz per square yard), rated to provide varying degrees of frost protection to crops. It comes in widths ranging from 5 to 50 feet and a range of lengths, and can be secured at the edges with weights such as sandbags, or with metal sod staples.

Floating row cover can be useful in the garden, not only for short-term frost protection, but also to provide longer-term protection for overwintering crops such as spinach or strawberry, or for providing protection from insect attack and a warm and protected environment to many crops in the garden.

While it is called floating row cover, it can be abrasive to some crops such as tomato, pepper and zucchini, particularly in windy situations. Gardeners often fashion low tunnels (see below) using bent wire or plastic hoops placed over beds to keep the floating row cover from touching the crop.

Floating row covers can be particularly valuable for exclusion of serious insect pests such as cucumber beetles on cucurbits and flea beetles on eggplant or certain cole crops. It can be left to cover crops such as zucchini until they begin to flower, but then needs to removed to allow for pollination. Floating row cover is often used to provide additional protection to crops grown in high tunnels during the winter. Hoops or other supportive structures are used to avoid damaging leaves that can freeze to the floating row cover when temperatures drop.

Structures. Cold frames and hot beds are typically low wooden boxes or frames with glass (often old storm windows), polycarbonate or polyethylene film covers, which are set in the soil or over beds in the garden. Cold frames may be used for winter production of cold tolerant greens such as spinach, for late fall and early spring production of a range of cool season crops, and to harden off transplants before taking them to the open field for planting. Cold frames are often constructed

with a sloping top, and set facing the south so as to capture the most winter sun. Tops may also be peaked or arched with hoops that support a polyethylene film covering. Polyethylene film is the same thing as plastic sheeting, but for applications such as cold frames and high tunnels, special greenhouse film is used, which is typically 6 mils thick and treated with a UV blocking material so that it will last at least 4 years. Untreated polyethylene film will break down in less than a year and probably should not be used.

If the weather is at all mild and the sun is out, cold frames can heat up rapidly, and need to be vented. In the case of a cold frame with a hoop-type top, it is possible to replace the polyethylene film with floating row cover material when the season warms up, eliminating the need for manual venting, and providing a protected environment that may be used into the summer.

Fabric low tunnels can provide a warm environment while eliminating pests.

Hot beds are basically heated cold frames, which, because they stay warm, provide a favorable environment for rapid production of crops, including transplants. Traditionally, decomposing manure was used to heat beds. This is still possible, though care should be taken to avoid contact between crops and manure, which may contain human pathogens. Other methods of heating the soil include using electrical heating cable or running warm water through pipes in the soil. Hot beds are not used much any more because of their relative complexity, cost, hazard potential, and availability of more convenient alternatives such as greenhouses or lighted indoor environments.

Hot caps, cloches, and other devices are used to protect individual plants in the garden. Like cold frames, these enclosed structures can heat up rapidly and cook plants in hot weather, so they need to be vented or removed during bright days. They are typically used for protecting transplants early in the season.

Paper hot caps are commercially available. Plastic hot caps can be made by cutting the bottoms off of milk containers, and placing the hot cap over the plant, with the base pressed into the soil. Glass bell jars called cloches were used in the past. They are rarely used today because they are expensive and cumbersome to handle.

Clear plastic, double-walled protectors that provide protection from frost and a warm, protected environment for very early tomatoes are available through retail stores and garden suppliers. The space between the walls is filled with water, which provides great frost protection because it releases heat before freezing. In fact, commercial growers often use irrigation as emergency protection against unexpected freezes, particularly for fruit production.

Low Tunnels

Low tunnels (left) are hoop-supported row covers, too low to walk in. Tunnels high enough to walk in are called high tunnels (see next section). Low tunnels may be covered with polyethylene film or floating row cover and may vary in width to span a single row or one or more beds in the garden.

Hoops to form the tunnel structure may be made of bent wire (usually 9 or 10 gauge galvanized wire), PVC (½-inch schedule 40 or flexible black pipe), galvanized electrical conduit (bent to form an arch), or other inexpensive materials. The length of hoops depends on the width of the bed, and typically varies between 5 and 10 feet. The distance between hoops can vary depending on the load tunnels

A low tunnel of polyethylene plastic held on by ropes between hoops extends a fall garden into winter. Floating row covers can also protect crops.

may be expected to bear. Hoops are pressed firmly into the soil, which anchors them. If used to support floating row cover, and in a location protected from the wind, hoops may be spaced up to 10 feet apart. If polyethylene film is placed over hoops to protect crops from ice and snow in the winter, hoops should be spaced 3 feet apart.

Vegetable farmers use special thin polyethylene row cover with slits or holes for ventilation to cover early season or winter crops in some areas. The plastic, which is slitted to allow ventilation and prevent overheating on warm, sunny days, may not be practical in the average home garden in Kansas. Edges of the plastic are typically buried using specialized equipment so the cover will not blow away, and crops can easily overheat if temperatures rise too high.

Another option is floating row cover of varying weights that can be used during much of the year and can be complemented by polyethylene film during the winter. Lighter row cover can be used during the spring and summer, and heavier row cover can be used in the late and early winter for freeze protection.

For covering in the winter, greenhouse polyethylene is preferred because it can be saved, and reused from year to year, but standard 6 mil polyethylene may be easier to obtain. Because it is not treated to resist ultraviolet radiation, it may only be expected to last one season.

The edges of row cover over low tunnels can be held in place using earth staples or similar anchors, or with sand bags, bricks, boards or other weights. Polyethylene presents a greater challenge to keep in place, since it acts as a sail. A good approach is to secure the ends, bunching the plastic together and tying it off to a stake or t-post. Rope tie downs running from stakes on either side of the low tunnel can then be used to hold the plastic in place between hoops. The edges of the polyethylene may be further secured with sand bags or other weights. On hot days, if venting is required, the edges of the plastic may be pushed up and held in place by the ropes. This same principle is used to keep the polyethylene on some types of homemade high tunnels.

High Tunnels

High tunnels, also called hoop houses, are essentially unheated polyethylene-covered greenhouses. They are passively heated and ventilated, and range from homemade field tunnels large enough to walk in (which distinguishes them from low tunnels), to more permanent structures, often sold by greenhouse manufacturers as high tunnels or cold frames.

Standard sizes of commercial high tunnels are typically too large for the home garden, but greenhouse manufacturers are increasingly targeting the home garden market as the benefits of high tunnels are recognized and demand for them increases. Rather expensive mini-greenhouses are commercially available to home gardeners, but do not exactly fit the description of high tunnels because crops in high tunnels are usually grown in the soil. Plans for homemade high tunnels are available from various university extension services, including Kansas State University (*www.hightunnels.org*).

Crops, including vegetables, fruit, flowers and herbs benefit in a number of ways from the protective environment provided by high tunnels and other structures. They often grow quicker, larger and produce higher quality harvests than field grown crops. During the spring fall and winter, crops benefit from daily warming of the air and soil, leading to earlier and extended harvests.

High tunnels protect crops from severe weather, including wind, rain, hail and snow. Because rain does not leach fertilizer from the soil in high tunnels, crops can make more efficient use of fertilizer. Also, sunlight reaching plants in high tunnels is diffused and lower in ultraviolet radiation, probably contributing to lush crop growth.

Pests and diseases. With adequate ventilation, and the exclusion of rain, fungal diseases on crops, such as foliar fungal diseases of tomatoes, tend to be reduced compared to the open field. The dry high tunnel environment can be favorable for a number of pests such as aphids, mites and whiteflies, but these may be controlled by natural enemies that may already be present, or may be purchased and introduced.

Crop spacing and other cultural practices in high tunnels are similar to those used in the open field. Gardeners should avoid the temptation to plant crops such as tomatoes too densely because crops will grow more vigorously than in the open field, which can result in an impenetrable disease-prone mass of vegetation.

Ventilation. Ventilation in high tunnels is typically achieved by raising the sides to allow fresh air to enter. In structures with end walls, it is beneficial to be able to ventilate at the gable peak to let the hot air out. This can be done by installing a vent or by completely removing the end wall covering during the summer. There are numerous ways side venting can be done, including rolling up the plastic on a length of metal or pvc pipe, dropping down sides using a system developed for chicken houses, and simply tying up the sides at each hoop. For field tunnels, where the poly is held on by ropes over top of the plastic between bows, the poly can simply be propped open to vent the tunnel.

Watering. Because high tunnels exclude rain, crops grown in them have to be watered. A simple garden hose and sprinkler wand is one option, as is sprinkler irrigation, which works well for some crops. Drip or other micro irrigation is the most efficient way to irrigate crops and also provides moisture to the roots of crops without moistening foliage, which can contribute to disease development. Because high tunnels exclude rain, it is also possible for salts from fertilizer, animal manure or irrigation water to build up in soil. Gardeners can monitor possible salt build up in high tunnels by soil testing. If a salinity problem develops, salts can be leached through heavy irrigation or by removing the polyethylene cover for sufficient time to allow rainfall to leach out salts.

Provide Shade

Shade cloth is an underutilized tool for keeping things cool in the Kansas garden in the middle of summer. Shade cloth comes in a range of colors and percentages of shading. It can be used as a low tunnel covering or a high tunnel covering. It is commonly used over the polyethylene cover on high tunnels, thus providing cooling shade while maintaining the rain shelter benefit of the film covering.

By limiting the amount of sunlight entering the tunnel and striking the soil, shade cloth helps to keep both the air and soil under it cool. Fifty percent shade cloth placed over a determinate tomato crop in a high tunnel when temperatures start to rise in May, stimulates the tomato crop to produce continuously throughout the summer and into the fall.

Harvesting and Storing

Vegetables from home gardens have the benefits of being harvested just before use. Providing conditions to slow deterioration in quality after harvest is important.

Storage Conditions

Cold, moist. Many vegetables keep best if storage temperatures are low and the humidity level is high. Respiration is kept as low as possible, and crispness is maintained by preventing water loss. Early spring vegetables and leafy green vegetables are in this category.

Cool, moist. Some crops suffer internal damage if the storage temperatures are too low. They are best kept in a cool storage location—between 40-50°F—with high humidity. Many fruits such as cucumbers, melons, peppers, ripe tomatoes, and related crops are in this category. A storage temperature in the thirties may shorten the life, resulting in discoloration of the product and disagreeable flavors.

Cool, dry. Onions require a cool storage location with low humidity. Onions store best in open mesh bags so that excess humidity does not build up near the product.

Warm. Crops such as sweet potatoes, winter squash, and pumpkins store best at cool basement temperatures around 55°F. These crops are subject to internal injury when storage temperatures drop too low. The damage, called "chilling injury," is as serious as many other types of physical damage.

Select the Best

Nothing improves in storage, and defective produce should be discarded or used immediately so only the best quality, soundest products are stored. Produce must be handled carefully to avoid surface damage, skinning, or bruising. All these types of injury provide entry points for bacteria or fungi that may rot the produce and reduce storage intervals.

Check Storage Areas Regularly

Frequently check on vegetables in storage and discard any that are starting to rot or discolor by gently removing them from the basket or box. Areas that are used for storage, including boxes or baskets used to hold produce, should be disinfected prior to use. Placing the containers or storage racks in bright sunlight for several days is effective. Wiping them with a dilute bleach/water solution using about 1 part laundry bleach to 10 parts water can disinfect as well. Allow containers or racks to dry thoroughly before using. Individual harvesting and storage suggestions are provided in the text for individual crops.

Storing Vegetables

When storing vegetables for later use, follow recommendations in the Vegetable Storage Conditions table on the next page. Vegetables in the cold-moist and cool-moist groups may be stored in an old-fashioned outdoor pit or an underground cellar. Vegetables in the cold-dry and warm groups may be stored in a cool area in a heated basement. Avoid dripping water from pipes. Do not allow vegetables to freeze.

Recommended Vegetable Storage Conditions

Vegetable	Storage Temperature	Relative Humidity	Storage Period
Cold–moist group			
Asparagus	32°F	95%	2 weeks
Beet (tops removed)	32°F	95%	1–3 months
Broccoli	32°F	95%	3 weeks
Brussels sprouts	32°F	95%	1 month
Cabbage	32°F	95%	2–3 months
Carrot (tops removed)	32°F	95%	4–6 months
Cauliflower	32°F	95%	2–3 weeks
Kale	32°F	95%	2–3 weeks
Leek	32°F	95%	1–3 months
Lettuce	32°F	95%	2 weeks
Onion, green or scallion	32°F	95%	2–3 weeks
Parsnip	32°F	95%	2–6 months
Radish	32°F	95%	2–3 weeks
Sweet corn	32°F	95%	4–8 days
Turnip, greens	32°F	95%	2–3 weeks
Turnip, roots	32°F	95%	4–5 months
Cool–moist group			
Bean, snap or lima	40–45°F	90–95%	1 week
Cucumber	45–50°F	90–95%	10–14 days
Eggplant	45–50°F	90%	1 week
Pepper	45–50°F	90–95%	2–3 weeks
Potato	40°F	85–90%	4–6 months
Squash, summer	45–50°F	90%	7–10 days
Sweet potato (after curing 80–90°F for 10 days)	55–60°F	85–90%	4–6 months
Tomato (firm, colored)	60–65°F	85–90%	4–7 days
Tomato (mature, green)	60–65°F	85–90%	1–4 weeks
Watermelon	45–50°F	80–85%	2–3 weeks
Cold–dry group			
Onion, dry	32–35°F	60–70%	2–8 months
Shallot	32–35°F	60–70%	6–8 months
Warm group			
Pumpkin	50–55°F	60–70%	2 months
Squash, winter	50–55°F	60–70%	2–4 months

Vegetable Crops

Vegetables represent plants that are unique in their origin, plant type, cultural requirements, and associated concerns. This section of the guide provides additional details on the culture or growing requirements of a selected group of common vegetables.

Asparagus

Asparagus is a hardy perennial that will last for 30 years or more in the garden. Plant asparagus near the side or edge of the garden where it will not interfere with annual tillage. Asparagus is one of the first crops harvested in the spring.

Varieties. California 157 (UC157), Jersey Giant, Jersey Knight, Jersey King, Jersey Supreme, Atlas, and Purple Passion (purple spears).

When to plant. Asparagus can be planted in early spring (mid-March to mid-April) or in the fall (early October to mid-November). Purchase fresh plump crowns from a local garden center or plant seedling transplants.

Spacing. Plant crowns or transplants so buds of the crown are 7–8 inches below ground level. Cover with a few inches of soil initially, and add soil as the season progresses. After the trench is filled and the soil settles, crown buds should be about 6 inches below soil level.

Care. Asparagus produces a large, vigorous root system and is fairly resistant to stress conditions. Well-drained soil and a full sun location are necessary. Soak the area well in very dry weather. Spear production in the spring depends on vigorous growth the previous season. Spears begin to emerge in early April and may be damaged by a few spring freezes. Cut and destroy frozen spears, and the plant will rapidly send up new spears to replace them. Do not harvest the first year. In subsequent years, harvest until the spear size decreases to thinner than a pencil, usually 6–7 weeks in a mature planting. Fertilize in the early spring so that fertilizer can be carried into the root zone with spring rain. Weeds are a particular concern in this perennial plant. Control weeds with mulching, hoeing, or spot chemical treatment because weeds can invade over time. In the fall, you can remove dead ferns after they are completely brown or leave them in place through the winter to catch moisture and prevent soil loss.

Harvesting. Snap spears at the breaking point ½–¾ inch above the soil level, or cut slightly below the soil level with a sharp knife. When spears are more than 10–13 inches long, they become tough and woody. Heat will cause the tips of the spears to open and become loose—called "feathered tips"—later in the season unless harvested frequently. Asparagus deteriorates rapidly after harvest; store in a cold, moist location and use quickly.

Common concerns

- asparagus beetles

Beans

Beans are a tender, warm-season crop that is popular in Kansas gardens as either a spring crop or a fall crop. Snap or green beans are grown for their tender immature pods. Some beans can be allowed to fill, and the bean seeds can be harvested for later use. Some beans are "pole" types that require a large trellis to climb.

Varieties. Contender, Provider, Tendercrop, Strike, Blue Lake, and Dusky are common green bush type beans. Cherokee Wax, Majestic, and Goldcrop are yellow bush type beans. Kentucky Wonder and Pole Blue Lake are large vined, pole beans. Broad, flat 'Italian or Romano' beans include Roma, Greencrop, or Bush Romano.

Lima beans are difficult to grow in Kansas because they require a longer period to develop and tend to drop blossoms in hot, dry weather. Choose an early variety such as Baby Bush, Fordhook, Henderson, Thorogreen, or a similar early maturing variety.

Other types of beans grown primarily for their seeds include French horticultural types, cranberry, pinto, great northern, red kidney and similar varieties.

When to plant. Beans are sensitive to cold temperatures. Soil temperatures should be 55–60°F with danger of freezes well past before planting. Fall beans can be planted in early August. You can have a continuous supply by planting at intervals several weeks apart. However, beans planted to bloom in hot, dry weather frequently will be of poor quality.

Spacing. Plant seeds about an inch deep in rows that are 18 inches apart. A plant every 3–5 inches is desirable, so drop seed about every 2–4 inches. Plant pole beans 6–12 inches apart.

Care. Do not soak bean seed before planting. Moisten the soil to provide moisture for germination, but do not water to form a tight crust. Beans have a shallow root system and require careful cultivation, good weed control, and water in dry periods. Beans are sensitive to soil salts; avoid alkali spots or "salty" locations.

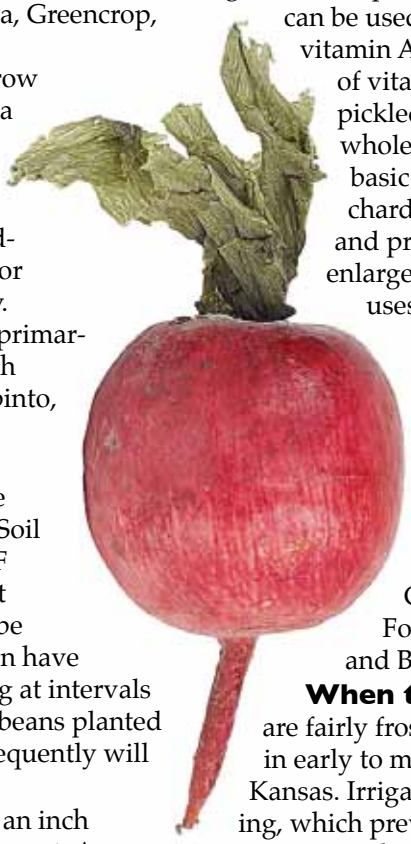
Harvesting. Harvest snap beans when the pod is crisp and before the seeds enlarge significantly. Do not harvest in early morning when dew is on the plants as this may spread bacterial blight. Most newer varieties of beans are developed to set a large number of pods at one time for a more concentrated harvest. Harvest lima beans and horticultural beans when the pods are fully formed and seeds have enlarged to the degree you desire.

Common concerns

- bacterial blight
- bean leaf beetle (black/yellow spotted beetle)
- poor stands from salt injury or soil crusting

Beet/Swiss Chard

Beets are a popular vegetable and can be grown as a spring or fall crop in Kansas. Tops can be used as a cooked green rich in vitamin A, and roots are a good source of vitamin C. Roots may be canned or pickled and are served diced, sliced, whole, and in strips. Beet juice is the basic ingredient of borscht. Swiss chard is a close relative of the beet and produces foliage rather than an enlarged root. Nutritional value and uses are similar to those for beets.



Varieties. Red round varieties include Detroit Dark red, Early Wonder, Ruby Queen, Little Ball, Red Ace, Asgrow Wonder, and Warrior. Elongated varieties include Cylindra and Long Red Blood.Varieties of Swiss Chard include Burgandy, Ruby, Fordhook, Lucullus, Perpetual and Bright Lights (multicolored).

When to plant. Beets and chard are fairly frost hardy and can be planted in early to mid-April in many areas of Kansas. Irrigate carefully to avoid soil crusting, which prevents good germination. Plant fall beets or chard in early August.

Spacing. The beet "seed" is actually a cluster of seeds in a dried fruit (one variety—Monogem—has a single seed per cluster). Plant the seeds about an inch apart and about ½ inch deep. Hand thinning is usually necessary to provide a uniform stand of beets properly spaced 2–3 inches apart. Poorly thinned stands will have an abundance of tops with few or small roots.

Care. Beets and chard compete poorly with weeds, so frequent shallow cultivations are necessary. Beet plants require a fertile well-watered location. Hand thin the plants when they are 1–2 inches tall to avoid damage to surrounding plants.

Harvest. Select beets of the diameter you prefer. Roots larger than 2–2½ inches in diameter are often tough and woody. Beets for baby beets or whole canning should be harvested smaller. Trim the tops of beets or chard to ½–1 inch above the roots and store in plastic bags in a refrigerator before use. Mulch fall-planted beets to prolong the fresh harvest season, but use them before they freeze.

Cut the outer leaves of chard when they are young and tender or about 8–10 inches long. The inner leaves will continue to grow for additional harvests until hot weather (for spring crop) or a severe freeze (for fall crop) stops the plant growth.

Common concerns

- *Cercospora* leaf spot

Broccoli

Broccoli has increased in popularity considerably in recent years. This vegetable, sometimes known as Italian sprouting broccoli, is a cluster of undeveloped flower buds. Two crops—spring and fall—can be grown in Kansas. Small secondary heads can be harvested for several weeks following the cutting of the large central head.

Varieties. Green Comet, Premium Crop, Emperor, Green Valiant, and Packman are popular green-headed varieties.

When to plant. Set plants in the garden in late March to early April, before the danger of frost has passsed. Early planting is essential so that plant heads can develop before the onset of hot weather. Plant fall broccoli plants in early August or direct seed in early July.

Care. Select broccoli plants that are small and stocky. Avoid tall, spindly plants. Weak, tall plants often "bolt" or produce a premature head, which will never enlarge. Broccoli requires a lot of fertilizer to produce a large plant and a large head. Fertilize at planting.

Sprinkle additional fertilizer—side dress—along the row every 2–3 weeks as the crop develops. Provide adequate water as the head starts to develop.

Harvesting. Harvest the head before the flowers start to open or before yellow centers of the flowers start to show. Usually 4–5 inches of the stem is also tender and can be used with the head. Continue to cut small side heads until hot weather causes them to be strongly flavored.

Common concerns

- cabbage worms
- aphids

Brussels Sprouts

Brussels sprouts gets its name from Brussels, Belgium. The plant is a close relative of cabbage, broccoli, and cauliflower, but is slower growing. Best success in Kansas is to grow the "sprouts"—small heads that grow along the stem and resemble small cabbage heads—in the fall season by planting in early July.

Varieties. Jade Cross, Oliver, and Prince Marvel as well as other early maturing varieties.

When to plant. Spring-planted crops should be set in late March. Fall crops, more reliable in Kansas, should be started in early July.

Spacing. Set plants about 2 feet apart in rows at least 3 feet apart. Plant seeds closer and thin to a strong, vigorous plant every 2 feet for a fall crop.

Care. Like cabbage, Brussels sprouts require regular watering and fertilizing. Some gardeners remove the leaves from the side of the plant after the sprouts start to develop, but this is not necessary. Topping or cutting the terminal bud from the plant when the plant is 2–2½ feet tall will speed the development of sprouts.

Harvesting. Snap or cut the sprouts from the stem when they are an inch in diameter. More sprouts will develop on the stem above.

The plant is quite freeze hardy and can be left in the garden until late November or early December many years for continued harvest. Sprouts developing in hot weather will often be loose and of poor quality.

Common concerns

- cabbage worms

Cabbage

Cabbage is a hardy, easy-to-grow vegetable that can be grown in the spring or fall in Kansas. Most varieties are green, but some produce a red head. It can be stored for long periods or made into sauerkraut. Cabbage is intolerant of our summer heat.

Varieties. These include Conquest, Headstart, Cheers, Green Boy Golden Acre, Dynasty(series), and similar early varieties. Green headed varieties with crinkled or savoyed leaves include Savoy King and Vanguard. Red headed varieties include Red Head, Red Acre, Regal Red, and Red Dynasty.

When to plant. Set cabbage plants in late March to early April or in early August for a fall planting. Direct-seeded cabbage can be planted in early July. Cabbage is easily transplanted by choosing stocky, dark green plants with strong root systems.

Spacing. Cabbage plants should be spaced 12–18 inches apart in at least 3- to 4-foot rows. Closer spacing will result in smaller, but more numerous heads.

Care. Fertilize cabbage with a starter fertilizer when setting out plants, and side dress every 2–3 weeks during the growing season. Cultivate carefully to avoid damaging shallow roots. Irrigation is critical when heads are small and enlarging.

Harvest. Cabbage is ready for harvest when the head is fully formed and dense. This can be judged by pressing or squeezing the head to indicate firmness. Waiting too long may result in heads that split, especially after rainfall or irrigation.

Common concerns

- black rot
- blackleg (choose resistant varieties)
- cabbage yellows (choose resistant varieties)
- cabbage worms
- aphids

Carrot

Carrots are a hardy, cool-season crop that grows in the spring or fall in Kansas. Carrots harvested in cooler weather will be tender and sweet. Carrots are an excellent source of vitamin A. The roots grow best in loose or sandy soils. Long slender varieties are not well adapted to growing in our heavier, tighter soils.

Varieties. Short fat varieties include Red Cored Chantenay, Royal Chantenay. Moderate length varieties include Danvers, Scarlet Nantes, Nantes. Miniature or very small carrots (baby carrots) include Little Finger, and Gold Nugget.

When to plant. Plant carrots in mid- to late April before the last freeze, because carrots can tolerate a light freeze. Make sure the soil is well tilled or loosened to an 8- to 9- inch depth before planting. Fall carrots are excellent for growing in Kansas. Plant seeds in late July to early August.

Spacing. Plant seeds ¼–½ inch deep—deeper for fall planting—in moist soil. Rows may be as close as 12 inches apart with plants every 1–2 inches in the row. Carefully sprinkle seeds so that excessive plants do not emerge. Thin carrots to the desired spacing when the plants are small.

Care. Until carrots germinate, avoid heavy watering that could form a crust on the soil surface. Germination may be slow and uneven in early spring. Young carrot plants are weak and spindly. Weeds compete with young plants, so careful weeding is necessary. Water is required as roots are enlarging. Carrots that develop in hard, compacted soils will be misshapen or forked.

Harvesting. Dig or pull the roots when they are the desired diameter. Most carrot varieties require 55–60 days from seeding to mature. Fall-planted carrots can be mulched with straw and harvested as needed until the ground freezes solid in mid- December. After harvesting, cut the tops to within ½ inch of the root top and store in plastic bags in a refrigerator until ready to use. Carrots can be stored for long periods.

Common concerns

- carrot weevil

Cauliflower

This cool-season vegetable is a close relative of cabbage. However, cauliflower takes longer to develop and is not as cold hardy as cabbage

and broccoli. Therefore, cauliflower often is considered more difficult to grow. It is also fairly intolerant of summer heat and drought.

Varieties. Choose early maturing varieties such as Snow Crown, Early Snowball, or Snowball Y. Later maturing varieties, including the self-blanch types, usually take too long for our shortened spring and fall seasons.

When to plant. Set transplants in early to mid-April for a spring crop or in early August for a fall crop. Cauliflower is difficult to direct seed most years in Kansas.

Spacing. Space plants 1½–2 feet apart in rows at least 3 feet apart. The plant is larger than cabbage or broccoli and needs more space.

Care. Use starter fertilizer when setting plants and provide additional fertilizer every 2–3 weeks during the growing season. Provide water during dry periods. When the heads are about the size of a quarter, blanch them by pulling a few leaves over the head to shade them from the hot sun. Secure the leaves with a rubber band, clothespin, or string. Check the development of the head by peeking through the leaves.

Harvesting. Cut heads when they are fully formed but before they are overmature, as indicated by a rough spiny appearance of the curds. This condition—called riciness—indicates that the head will be strong flavored and tough. In cool conditions, a slight purplish color may prevail in the heads and is normal. Some varieties also may produce a few leaves that will protrude through the head. Store cauliflower in a cold, moist location for 2–3 weeks.

Common concerns

- cabbage worms
- aphids

Chinese Cabbage

This relative of cabbage is sometimes known as celery cabbage, Wong Bok, or Bok Choi. It is an old oriental crop that is popular in oriental and stir-fry cooking.

Varieties. The heading types of Chinese cabbage form heads that may be blocky to elongated in shape, depending on the variety. Elongated types include Rocket and Michili. Medium-shaped heads include Jade Pagoda, while blocky short-headed types include China Pride, Blues, and WR60. Nonheading types include Pak Choi varieties and are harvested for their white leaf stalks with bright-green leaves.

When to plant. Chinese cabbage is difficult to plant in the spring because of a tendency for transplanted crops to bolt or go to seed. Select small, stocky plants and set them in early to mid-April, or direct seed by planting in the garden at the same time. Fall is an excellent season for growing Chinese cabbage in Kansas. Direct seed in early to mid-July, or transplant in early August.

Spacing. Space plants 10–12 inches apart in rows 2–3 feet apart. If you are direct seeding, plant seeds about ½ inch deep.

Care. Like its cabbage family relatives, Chinese cabbage needs a starter fertilizer at transplanting and regular fertilizing every 2–3 weeks during the growing season. Critical periods when water is necessary are during head formation and enlargement.

Harvesting. Heads of Chinese cabbage will be looser than cabbage. Feel through the dense leaves for the head, and cut it when the head has a distinct shape. The tender inner leaves may be used as a salad green. Once seed stalks start to appear, all head development ceases; if bolting occurs, harvest and salvage what you can of the crop.

Common concerns

- cabbage worms
- aphids

Cucumber

Cucumbers are warm-season crops that traditionally have required a lot of garden space. With a trellis and newer compact varieties, cucumbers may be grown in small spaces and even in containers.

Varieties. Slicing cucumbers are long and slender, with a dark-green skin. Improved new hybrid varieties include Dasher, Sprint, Raider, Burpee Hy, and Marketmore. Sweet Slice is a long, mild-flavored variety as is Sweet Success. Pickling varieties are short and blocky in shape, with a firm flesh that

makes a crisp pickle. Spartan Dawn, Liberty, Pioneer and SMR-8 are suggested varieties. Burpless—soft mild-flavored types—include Burpless Hy as well as Sweet Slice mentioned before. Dwarf types include Patio Pik, Patio Pickle, and Spacemaster. Another novelty variety, Lemon, produces round, yellow fruit resembling a lemon.

When to plant. Cucumbers require warm conditions with no danger of frost for best results. Soil temperatures should be approaching 60°F, which occurs in early May in most of Kansas. Using black plastic mulch to warm soil is a way of producing cucumbers earlier.

Spacing. Cucumbers are usually spaced 2 feet apart in rows 5–6 feet apart. However, new dwarf types may be grown in 3-foot rows with plants 2 feet apart. Cucumbers may be transplanted by starting seeds in large containers and moving them carefully to the garden area.

Care. Cucumbers are fairly shallow rooted and require caution at initial cultivation. One application of fertilizer along the row when the vines are 6–12 inches long will improve production into the bearing season. Cucumbers can be grown on a fence or cage, but you may have to help the vines get started up the trellis. Avoid areas where strong winds may damage vines, because cucumbers on a trellis are much more subject to injury than are tomatoes. Like other members of the vine crop family—muskmelon, watermelon, pumpkin, squash and gourds—cucumbers have separate male and female flowers on the same plant. Male flowers predominate and usually appear before female flowers start to develop. Many newer cucumber varieties are of the gynecious type or have a larger number of female flowers for higher yields. Bees are required to transfer pollen from male to female flowers for the fruit to develop.

Harvesting. Select firm, dark-colored cucumbers developed before the seeds have a hard seed coat and while the skin is tender. Small cucumbers may be harvested for pickles at any stage. Removing large, overgrown fruits will keep vines productive longer.

Common concerns

- cucumber beetles (transmit bacterial wilt)
- powdery mildew

Eggplant

Eggplant is a unique vegetable that is a close relative of pepper and tomato. It requires warm weather to grow well. Eggplant primarily is used in several international dishes, and the crop is not as popular in gardens as many other vegetables. Many newer small-fruited or elongated varieties are now available.

Varieties. Large, dark-purple, oval varieties include Black Beauty, Black Magic, Burpee Hybrid, and White Beauty. Elongated types include Dusky (very early but small), Ichiban, Long Tom, Slim Jim, and Long Purple.

When to plant. Eggplant is usually transplanted about the time peppers are set into the garden—1–2 weeks later than tomatoes or in early to mid-May in most of Kansas. Eggplant is sensitive to cold temperatures and will not grow well in cool conditions.

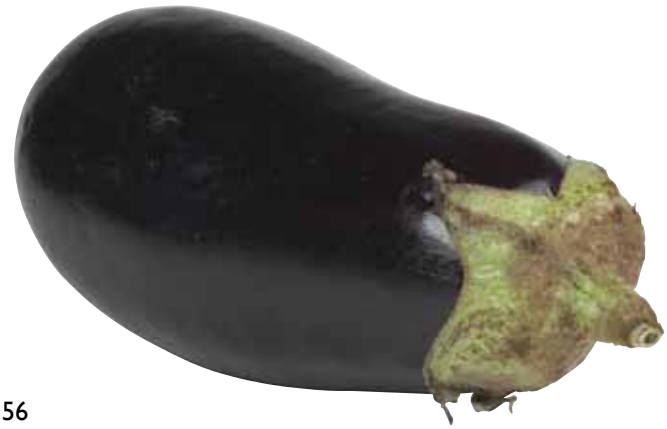
Spacing. Eggplant is usually set 2 feet apart in rows at least 3 feet apart.

Care. Eggplant will thrive in hot dry conditions better than many of its relatives. However, a good soaking in hot weather is beneficial to keep it productive. A strong plant is necessary to support fruit and to protect it from sunburning. Insects are especially damaging to eggplant foliage. Many leaf-feeding insects will nearly defoliate the plants in a short time; regular inspection and insect control measures are usually necessary.

Harvesting. Select firm, fully sized fruit that have a slightly soft touch with a bright and glossy skin. Because the stem that attaches the fruit to the plant is tough and woody, use a pruning shears to cut the fruit loose. Pick off and discard overgrown fruit to keep plants productive.

Common concerns

- flea beetles and other leaf-feeding insects



Endive/Escarole

Endive is a hardy, leafy vegetable similar to lettuce in growth habit and use. Endive has a crinkled leaf, while escarole has a broad, flat leaf. The flavor is stronger than lettuce, but both make an excellent addition to a mixed green salad.

Varieties. Endive varieties include Green Curled and Salad King. Escarole varieties include Broad Leaved Batavian, Florida Deep Heart, and Full Heart Batavian.

When to plant. These leafy green vegetables do not like hot weather and must be planted early in the spring for best results. Starting seedlings indoors and setting out transplants in early April is advisable. Direct seeding in mid-July or setting out transplants in early August is suitable for growing fall crops.

Care. These leafy crops are hardy and can withstand freezes in the fall. Like most leafy greens, they require consistent watering and are fairly shallow rooted. They also require fairly rich or well-fertilized soil.

Harvest. Cut the entire plant at ground level and discard the dark- green outer leaves. The most desirable part of the plant is the bleached light green/yellow leaves near the center. Store leaves in plastic bags in a refrigerator for several weeks.

Common concerns

- aphids

Kale

This relative of the cabbage family is used for its crinkled leaves. It can be cooked or used as garnish as a substitute for parsley. It is an excellent source of vitamins A and C. Kale is one of the most cold-hardy vegetables and can withstand very low temperatures while maintaining its characteristic dark green to purplish color.

Varieties. Common varieties include Dwarf Blue Curled Scotch, Vates, and Dwarf Siberian. Many oriental varieties are available to produce ornamental foliage known as flowering kale.

When to plant. Kale is cold tolerant and can be planted in early to mid-March for a spring crop or in early August for a fall crop.

Spacing. Plant seeds ¼–½ inch deep and thin seedlings to a plant every 8–12 inches in the row. Rows can be up to 15 inches apart.

Harvesting. Pick older, lower leaves when they are full sized and tender. Cold weather improves the flavor. Kale can be left in the garden and used until a severe freeze damages the crop, usually in early December.

Common concerns

- aphids

Kohlrabi

Kohlrabi is a close relative of cabbage and broccoli. It produces a large, swollen stem resembling a turnip, with leaves protruding like spokes.

Varieties. Grand Duke (green), Early White Vienna (white) and Purple Vienna (purple).

When to plant. Sow seeds in mid-March or late July for a fall crop. The crop will thrive only in cooler periods of the year.

Spacing. Plant seeds 2–3 inches apart and thin to a plant every 4–6 inches for best results. Rows can be 12–15 inches apart.

Harvesting. The flavor is best when the kohlrabi is small—less than 2 inches in diameter. Larger ones often become tough. You can cook the leaves like spinach, and peel and use the swollen stem as you would a turnip eaten fresh or cooked.

Common concerns

- aphids
- cabbage worms

Lettuce and Other Leafy Greens

Lettuce is a cool-weather crop that is fairly cold tolerant. However, the thin, fragile nature of the leaves makes them susceptible to freezes and drought. Lettuce is best grown as a spring or fall crop. There are four distinct types of lettuce.

- Leaf types—Leaves are loosely arranged and colors may range from green to pale red to deep red. Leaf lettuce matures rapidly and is the most reliable type of lettuce to grow in Kansas, especially from seed.
- Romaine or cos—This lettuce forms a loose or soft head with thick stronger flavored leaves. It is an excellent addition to

a mixed salad and takes longer to develop than leaf lettuce.

- Butterhead—Tender, rounded leaves that form into a loose or soft head are characteristic of this succulent and delicious lettuce. It takes longer to grow than leaf lettuce and can be started and planted as transplants as well as direct seeded.
- Head or crisphead—Head lettuce takes nearly twice as long as leaf lettuce to develop. It is most reliably grown using transplants, and the fall season is the best time to grow head lettuce in Kansas.
- Other leafy greens—A wide range of other leafy greens can be grown in addition to lettuce. Mixtures of lettuce and other greens are often sold as mesclun. General culture of most leafy greens is similar to lettuce. Some require long periods of cool weather, making them difficult to grow in many years in Kansas, but many are quick growing and will produce well both as baby salad greens or as larger greens for cooking. Greens crops include cress, red russian kale, mizuna, pak choi (chinese mustard), tatsoi, arugula, komatsuna, orach, and sorrel.

When to plant. Sow lettuce seed in mid-March or set plants in early April. Sow seeds for a fall crop in mid- to late August for leaf or Bibb types, or in late July to early August for head or romaine types. Lettuce grown in hot weather will have a strong, bitter flavor. You may improve the flavor by storing lettuce in a plastic bag in a refrigerator for several days.

Spacing. Sow seeds thinly ¼ inch deep, and water consistently until the lettuce emerges. Thin to a plant every 6–8 inches, or set transplants at this spacing. Rows may be as close as 15 inches apart.

Care. Lettuce is shallow rooted, and the root system is fairly spindly. Therefore, it will require careful cultivation so as not to damage roots. Regular watering and fertilizing are necessary. Overwatering in heavy soils can cause root or head rots.

Harvesting. Cut the heads of heading types slightly above ground level and remove damaged, dirty, or excess leaves. Select full-sized leaves of leaf lettuce individually so that the plant will continue to produce. Store lettuce in a plastic bag in a refrigerator immediately after harvest because it will become limp quickly.

Common concerns

- aphids
- tipburn (brown, dead edges of the leaves)

Muskmelons

Muskmelons, also known as cantaloupe, are a tender, warm-weather vegetable that requires culture similar to that of cucumbers. As the name implies, a strong yet slightly musky odor is characteristic of melons in this group. Muskmelons produce a sprawling vine that takes up a lot of room in a small backyard garden. Most traditional muskmelon varieties produce a pale-yellow melon covered with a netted surface and have orange-colored flesh. Some newer muskmelon varieties have a light-green flesh. Other melons such as honeydew, crenshaw, and casaba—often called winter melons—have cultural practices nearly identical to that of muskmelons.

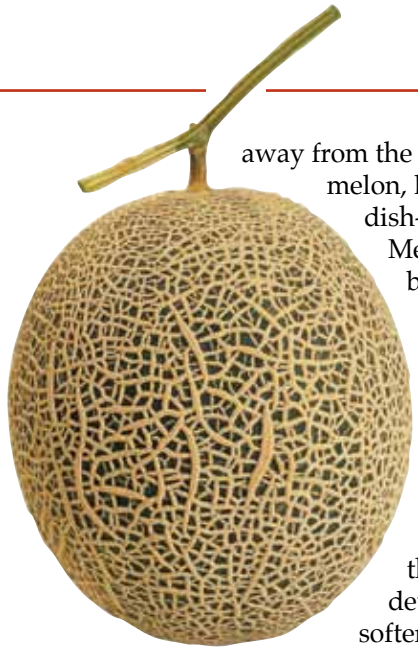
Varieties. Large sutured or ribbed varieties include Burpee, Supermarket, Pulsar, and Saticoy. Small, solid non-sutured types include Rocky Ford types such as PMR 45 or Four Fifty. Green fleshed muskmelon include Eden Gem, and Galileo. Honeydew types include Earlidew and Moonshine.

When to plant. Muskmelons are injured by light freezes; all danger of frost should be past before setting plants. Consistent soil temperatures of 58-60°F are necessary to encourage good germination. Early May is a standard planting date over most of Kansas.

Spacing. Muskmelon vines spread 6–8 feet wide, so row spacings of 6 feet are necessary with individual plants spaced every 18 inches to 2 feet in the row.

Care. Muskmelons usually do not require heavily fertilized soil. Normal maintenance fertilizers should produce an adequate crop. Mulching with black plastic warms soil, improves early season growth, and makes weed control easier. Use a starter fertilizer if setting transplants. Dry weather as the melons approach maturity is important to maintain good vine vigor and sweet flavorful fruit. Like cucumbers, muskmelons produce separate male and female flowers and require bees to pollinate them. Male flowers are more abundant and are present 1–2 weeks before female flowers begin to develop. Muskmelons and cucumbers will not cross pollinate.

Harvesting. Melons are ready for harvest when the stem slips easily and cleanly



away from the end of the melon, leaving a clean dish-shaped scar. Melons should be slightly soft and have a pleasant aroma. Honeydew, casaba, and crenshaw melons do not slip from the vine but do develop a slight softening at the flower end opposite the stem. Muskmelon fruit will not ripen off the vine. They can be stored for only 3–4 days when fully ripe.

Common concerns

- cucumber beetles (transmit bacterial wilt)
- aphids
- spider mites

Mustard

Mustard greens are a cool-season crop. They mature quickly and are easy to grow. Although cooking greens is popular in the South, many people recognize their high nutritional value, and they are becoming more popular for use in light cooking and stir frying.

Varieties. Green Wave, Tendergreen, and Southern Giant Curled are common varieties.

When to plant. Mustard is normally direct seeded in early April or can be direct seeded in early August for a fall crop. Fall is a preferred season for growing greens because of the long, cool, harvest season.

Spacing. Seeds should be planted ½ inch deep and plants thinned to a plant every 2–4 inches. Rows may be as close as 15 inches apart, or you can plant mustard in a wide row by scattering seeds in a band 5–6 inches wide.

Care. Mustard requires water during dry periods to keep the tender foliage from becoming limp. Mustard that produces a large plant too early may bolt or produce a seedstalk with bright yellow flowers instead of producing only foliage. Once seedstalk development starts, leaves should be quickly harvested and used.

Harvest. Cut the leaves when they are young and tender. You can cut the entire plant or individual leaves to allow the plant to continue to grow and produce more leaves. Leaves harvested in hot weather will be strong flavored and tough. Store leaves in a plastic bag in a refrigerator for 2–3 weeks.

Common concerns

- aphids

Okra

Okra is a tall-growing, warm-weather vegetable that is easy to grow in Kansas gardens. Okra is sometimes called gumbo, and the edible part of the plant is the young tender pods that develop following flowering. The plant will continue to bloom and produce pods up the stalk as the season progresses.

Varieties. Clemson Spineless and Dwarf Green are standard varieties. Emerald produces a smooth, non-ribbed pod. Annie Oakley is a new hybrid variety that branches more profusely. Burgundy is a red-podded variety. Cajun Delight is an early maturing variety.

When to plant. Okra requires warm weather, and early to mid-May is a desired planting time. Soil temperatures should be 60°F, and all danger of frost should be past. Okra may be transplanted or direct seeded.

Spacing. Plant seeds an inch deep and thin to one plant every 10–12 inches in the row, with rows no closer than 3 feet apart.

Okra will grow well in a wide variety of soil types and requires only minimal levels of fertilizer. It does fairly well in hot, dry seasons with periodic thorough watering. Later in the season after the plant is tall, you can cut it off about 12 inches from the ground. Use pruners or a saw because okra stalks are very tough. The plant will send up a new stem for pod production into the late summer or fall season.

Harvesting. Cut the pods from the plant when they are no longer than your finger to ensure that they will be tender, not woody. Harvesting every other day might be necessary. Okra pods can be stored in a plastic bag in a refrigerator for a week or so. Pods can easily be frozen for later use.

Common concerns

- few reported

Onions and Onion Relatives

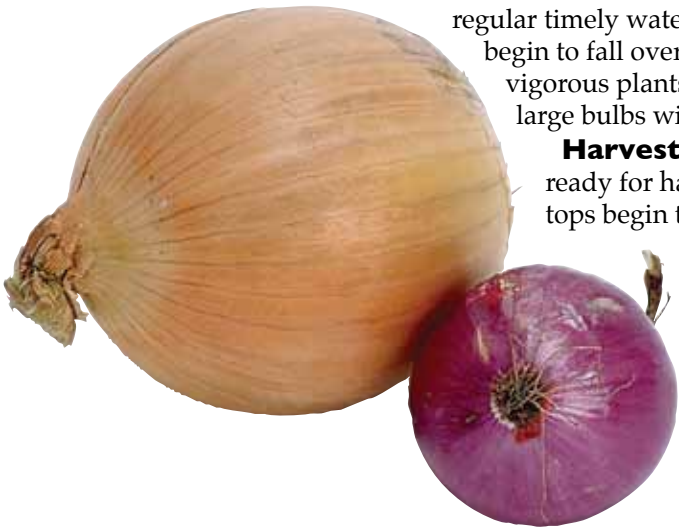
Onions are used primarily as a flavoring agent, although they are rich in vitamins and minerals and low in calories. Onions are grown from sets, plants, or seed. Sets are small onion bulbs that are planted in the spring to produce green onions—scallions—or bulbs later in the season. Most onion sets for sale in garden centers are usually poorly identified by variety. Plants or transplants are sold in bundles or growing in pots or trays and usually are identified by variety. Choose healthy, fresh plants with good green color. Onions can be grown from seed, but seed produces onions latest in the season, and the small, weak onion plant is difficult to weed or cultivate early in the season.

Varieties. Onions can be yellow, white, or red. Yellow varieties include Yellow Globe and Early Globe (pungent flavor but good keepers), or improved mild-flavored types such as Fiesta, Texas 1015 Y, Grano, and Granex. Mildest flavored onions are the Bermuda types—Yellow or White Bermuda—while the largest bulbs are produced by Spanish types—Yellow or White Spanish. Benny's Red and Red Burgundy are popular red varieties.

When to plant. Onions grow well in cool or warm weather. They should be planted early so that as much growth as possible occurs before hot, dry weather. Plant sets in mid-March or plants or seed in early April.

Spacing. Onions may be grown in rows as close as 15 inches, with individual plants spaced 2–4 inches in the row, depending on the size of the bulb. Plant sets 1–1½ inches deep, and plant transplants about the same depth.

Care. Onions have a shallow, inefficient root system and need regular watering and fertilizing for best results. Onions compete poorly with weeds and other crops. Weed control is essential to reduce competition. Watering may be reduced near the harvest period, but regular timely watering until the tops begin to fall over is needed. Large, vigorous plants are essential for large bulbs with high yields.



Harvesting. Onions are ready for harvest when the tops begin to weaken and naturally fall over. This is a signal that the bulbs are as big as they will get. Pull or dig the onions and store in a warm, dry, shaded location for 2–4 weeks until the tops and necks are completely dry. After the tops are dry, cut them, trim the roots, and store in a cool dry location. Onions need cool storage, but they should not be stored in a tight plastic bag. An open mesh bag is best for storage. Mild-flavored onions keep for only a month or so. Stronger flavored or more pungent onions keep 3–4 months.

Common concerns

- thrips
- bulb and neck rots
- smut

Onion relatives. Shallots are smaller than onions and are grown by planting a division or clove. They can be dug in midsummer for storage or used as green onions in the spring.

- Garlic is a strong-flavored onion relative that is also grown by planting a division or clove in late summer. After overwintering, the bulbs are ready for harvest in early July when the tops begin to turn yellow.
- Multiplier onions are also divided at the base. They are normally used for green onions in the spring because bulb development is poor and the flavor is strong.
- Chives are grown for the green foliage in the spring, summer, and fall. They are usually grown in clumps.
- Leeks require a long cool season for best results. They are usually planted in early spring and dug in late September to mid-October.

Parsley

Parsley is an easy-to-grow vegetable that is commonly used as a garnish. However, the nutritional value of parsley is excellent, and it can be used as a salad green in several types of recipes or added to soups, stews, and sauces. It can easily be grown in containers indoors for fresh use during the winter.

Varieties. Curled leaf types include Banquet, Deep Green, Forest Green, Moss Curled, Minicurl, Perfection, and Triple Curled. Italian parsley is not curled; it has a flat leaf. Some varieties can be grown for a large, fleshy root which has a strong parsley flavor.

When to plant. Parsley is a cool-weather crop that can be planted in mid-April, about the same time as beets or carrots, or in early August for a fall crop.

Spacing. Parsley seed is small and needs a fine seedbed because it must be planted ¼ inch deep or less. Use fresh seed each year. Plants should be 1–2 inches apart as the plant is fairly small; rows may be 6–12 inches apart. You can also grow parsley in a bed or mass planting in a small area, especially in an herb garden outside the back door where plants are handy for use.

Care. Parsley grows quickly and is best during cool periods. The plant is shallow-rooted and requires regular fertilization and watering for best results.

Harvesting. Clip or break off individual leaves when they are full sized. Wash leaves and store them in a plastic bag in a refrigerator for up to 2 weeks. Parsley can be dried for later use or leaves can be frozen easily. Freeze leaflets on a cookie sheet so they can be separated for later use.

Common concerns

- aphids

Parsnip

Parsnip is a hardy, cool-season crop that is grown for its white, carrotlike root. Roots are most flavorful when dug late in the season, as sugars accumulate in the root.

Varieties. Hollow Crown, Model, and All American are common varieties.

When to plant. Sow seed in early to mid-April as beets or carrots are planted. Using fresh seed is important.

Spacing. Plant seeds ½ inch deep with 2–4 inches between plants. Rows may be 15 inches apart. Seed may be slow to germinate, so be patient for the crop to emerge. Avoid heavy watering that would create a crust and interfere with good germination, or sprinkle some peat moss or sand over the row to prevent crusting.

Care. Parsnips need care similar to that for beets or carrots. Prevent weed competition, and water during stressful periods. Allow the crop to stand until late fall to early winter before digging.

Harvest. Dig the roots in late November to early December before the ground starts to freeze.

Common concerns

- few reported

Peas

Peas are one of the most cold tolerant plants grown in Kansas gardens. They can be planted about as early as soil can be prepared in the spring. Most varieties produce pods and the seeds need to be shelled. Several newer varieties produce thick, fleshy pods, and the pods as well as seeds can be eaten. In addition, some thin-podded oriental types produce tender pods with only the pods used. Southern peas or cowpeas are an entirely different crop and are grown in much the same way as beans.

Varieties. Standard varieties include Little Marvel, Green Arrow, Maestro, Knight, Sparkle, and Burpeeana. Edible-podded types include Sugar Ann, Sugar Bon, and Sugar Snap. Oriental thin-podded types, often called snow peas, include Dwarf Grey Sugar and Mammoth Sugar.

When to plant. Plant seed in early to mid-March when soil is dry enough to work. Peas will germinate when soil conditions are favorable. Peas are not well adapted for fall gardens because seed usually fails to germinate well in warm soil.

Spacing. Plant seed 2–4 inches apart with rows 12 inches apart. Peas usually do best where 2–3 rows can be planted 4–6 inches apart to allow the weak, spindly vines to support each other.

Care. Peas prefer cool soil and need water during stress periods. They grow best in moderate- to well-fertilized soil. A trellis may be needed to support the flimsy vines; short wire mesh or string trellis works well.

Harvesting. When the pods are swollen so that seeds within are full sized but tender, pick and shell the peas from the pods. Edible-podded types should be picked and used immediately after harvest as they tend to dry out readily. Harvest oriental types when the pods are crisp and tender but before the seeds begin to enlarge significantly. Store peas in a refrigerator in a plastic bag for up to a week. Peas are easily frozen for later use.

Common concerns

- root rots
- mildew

Peppers

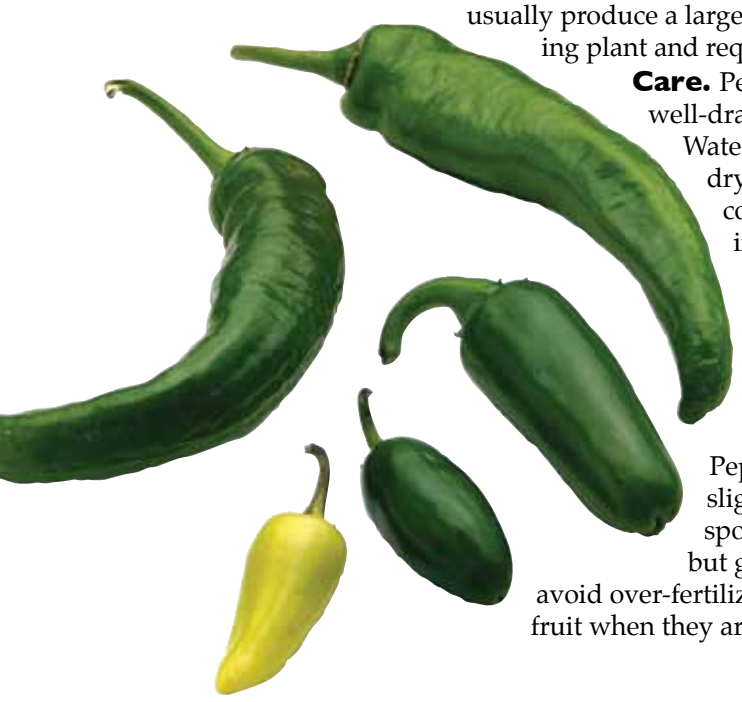
Peppers are a close relative of the tomato; but, peppers are more cold sensitive than tomatoes and usually require more fertilization. Peppers are generally classified as sweet

or hot, with the most common sweet peppers being large, blocky bell or mango varieties. Hot peppers vary in shape and size as well as degree of hotness. Peppers can be eaten either when the fruit is full sized but immature or when it changes to its mature color. A variety of colors from green to red, yellow, orange, purple, white, and brown (dull purple) are available.

Varieties. Green to red blocky bell types include Ace, Bell Boy, Jupiter, Lady Bell, Keystone Resistant Giant, and improved California Wonder varieties. Green to yellow varieties include Honeybell, Marengo, and Golden Bell. Gypsy and Canary are light yellow when immature but red when mature. Valencia and Oriole turn bright orange when mature. Purple Bell and Purple Beauty turn purple at maturity. Other sweet peppers include Sweet Cherry, Pimento, Sweet Banana, and Italian frying types. Hot peppers include Jalapeño; Anaheim, used for chiles relleños; El Paso, and Coronado. Tam Jal is a milder flavored jalapeño. Small, hot types include Serrano, Red Chili, and Super Chili. Small orange Habanero types are among the hottest peppers. Ornamental peppers vary in flavor and hotness and can be enjoyed as ornamental plants.

When to plant. Peppers are usually set as transplants in the garden and should be planted 1–2 weeks after setting tomatoes. Peppers exposed to cold temperatures early in the season will often drop their fruit, resulting in a large, unproductive plant. Mid-May is a safe time to plant peppers in most of central Kansas.

Spacing. Set plants 18 inches to 2 feet apart in rows 15 inches apart. Hot peppers usually produce a larger, more sprawling plant and require more space.



Care. Peppers thrive in well-drained fertile soil. Water is required in dry periods. Even, consistent watering is preferred as peppers can develop blossom end rot, a brown leathery patch at the base of the fruit. Peppers require a slightly more fertile spot than tomatoes, but gardeners should avoid over-fertilization. Harvest fruit when they are the desirable size, to keep the plants producing more. Poorly shaded fruit may be subject to sunburning in hot summer conditions.

Harvesting. Carefully pick or cut peppers from the plants. Avoid pulling on the fruit as you can easily break the plant. Peppers that have begun to turn color usually will continue after harvest. Hot peppers produce an oil that will penetrate the skin and cause discomfort if you get it in your eyes or other sensitive areas of the body. Use rubber gloves to harvest very hot peppers. Sweet peppers can be chopped and frozen for later use; hot peppers can be frozen or dried. Store peppers for up to a week in a refrigerator.

Common concerns

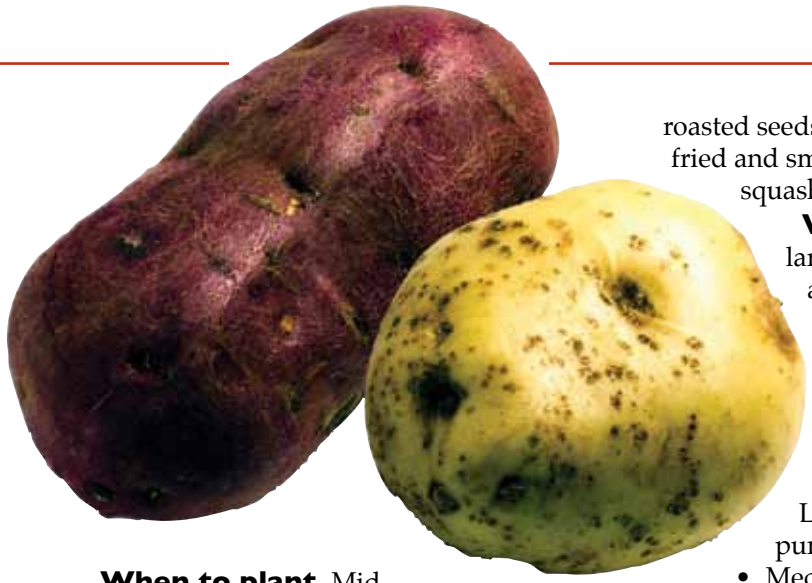
- aphids
- tobacco mosaic virus (distorted, misshapen leaves; transmitted by aphids)

Potatoes

Potatoes, often called Irish potatoes, are one of the most important world food crops and a staple for many large gardens. Potatoes are tubers, or swollen underground stems that form as a storage location for starch. Tubers form best at temperatures of 60–70°F; therefore, early spring planting or fall planting is preferable in Kansas. Potatoes are grown from cut pieces of tubers grown in northern areas the previous season, usually referred to as seed potatoes.

Varieties. Skin color can be white, red, or russet (brown). Common red-skinned varieties include Red Norland, La Rouge, Viking, and Reddale. White-skinned varieties include Superior, Norchip, Crystal, Kennebec, and Irish Cobbler. Russet-skinned varieties include Norgold and Norkotah. Varieties differ in texture as well. The russet varieties are particularly good for baking as they have a mealy, crumbly texture when baked. White or red varieties are usually preferred for boiling or mashing. Consult your local K-State Research and Extension office for additional variety information.

Cutting and preparing seed. Select firm, solid seed potatoes with a blue tag on the bag (inspected to be free of diseases). Cut the tubers into 1½- to 2-ounce pieces. An average-sized potato is cut into four pieces, while a large potato is cut into six. Store the cut seed in a warm, humid location for 2–3 days to allow the freshly cut surface to "heal." This prevents the seed piece from rotting when planted. Always purchase new potato seed. Do not use your own tubers for seed as reductions in yield and vigor will result.



When to plant. Mid-March—St. Patrick's Day—is a traditional time to plant spring potatoes in Kansas, while early to mid-July is the time to plant for a fall harvest.

Spacing. Plant seed 12 inches apart in rows 3 feet apart. Plant the seed less than 2 inches deep in the spring, or 4–5 inches deep for a fall planting.

Care. Potatoes develop along the main stem of the plant, above the seed piece. To encourage large yields and to prevent sunburning, potatoes should be hilled or ridged, pulling loose soil along the row as the crop is growing. This ridge or hill eventually should be 8–12 inches tall. Potatoes like a fertile well-drained location with loose, friable soil. Potatoes need regular, consistent watering, especially during development when the plants are 6–12 inches tall. Irregular watering lowers yields and may result in rough knobs on the tubers. Mulches can be useful in holding moisture near the plant.

Harvest. Early or new potatoes can be harvested as the plants are growing by gently removing some plants in the row. Begin digging potatoes when the vines are about half dead. Remove excess vines and carefully dig the tubers. Allow them to surface dry out of the sun for a day or more to toughen the skin and prevent sunburning. Then move potatoes into a cold, dark location for storage. Ideal storage temperature is below 40°F.

Common concerns

- scab (use certified seed)
- Colorado potato beetles
- early blight
- leafhoppers

Pumpkin

Pumpkin is a warm-season crop used primarily for Halloween decoration; it also is used for pies, breads, cookies, soup, and roasted seeds. Immature flowers can be stir fried and small pumpkins used as summer squash.

Varieties. Pumpkins produce large, sprawling vines that take up a lot of space in the garden. Some pumpkin varieties are bush or semivining types that take less space but still spread.

- Small. Small Sugar Pie and Spookie are 8–10 lb size, while Baby Pam is smaller. Jack Be Little and Munchkin are miniature pumpkins.
- Medium. Spirit (compact vine), Cinderella (compact vine), and Youngs Beauty.
- Large. Connecticut Field, Howden, Jackpot (semivining), and Ghost Rider are jack-o-lantern types. Big Autumn and Autumn Gold colors quickly and completely.
- Huge. Big Max, Atlantic Giant, and Big Moon are specimen types.

When to plant. Pumpkins can be safely planted after all danger of frost is past in early to mid-May. However, most growers prefer to plant in early to mid-June to ensure that pumpkins do not mature too early. June-planted pumpkins are ready for harvest in early October.

Spacing. Pumpkin vines need 50–60 square feet per hill—1–2 plants—and standard vining types should be planted about 4–5 feet apart in 12-foot rows. Small or semivining types can be planted 3–4 feet apart in 6-foot rows. Plant seed about an inch deep.

Care. Provide shallow cultivation to keep weeds from developing in areas where vines will spread, because weeds will be difficult to remove later. Water thoroughly as the fruit start to develop. Only female flowers develop into fruit; male flowers outnumber female flowers and appear first. Bees transfer pollen from male to female flowers, requiring care in application of pesticides that may kill bee populations.

Harvest. Pumpkins are ready for harvest when the skin is tough and hard and the stem no longer "leaks" when cut from the vine. Cut the stem with a sharp knife or pruning shears to leave a "handle" attached to each

fruit. Store pumpkins in a warm, dry location for 2–3 weeks to further dry and cure the fruit. Storage temperatures of 50–60°F in a dry location out of direct sunlight will maintain pumpkins' bright color.

Common concerns

- powdery mildew
- squash bugs

Crossing Squash and Pumpkins. Pumpkins, squash, and gourds are closely related crops that are members of the Cucurbit or vine crop family. There are four species of the genus Cucurbita used as vegetables, and crossing can occur within species only. Cross pollination, however, will only influence the crop if you save your own seed for next year's crop. The term "pumpkin" is used for anything that is round and orange, while the term "squash" is used for an edible fruit of some other shape or color. The term "gourd" is used for various shapes and sizes of fruit used for decoration.

The four species are listed below with some common varieties for each species. Only varieties within species will cross with each other.

- Cucurbita pepo, true pumpkins. Most jack-o-lantern pumpkins, zucchini, yellow summer squash, scallop or patty pan squash, acorn squash, most small, yellow-flowered gourds.
- Cucurbita maxima, true squash. Large pumpkins (Big Max, Atlantic Giant), hubbard squash, buttercup squash, delicious squash, Turk's Turban squash.
- Cucurbita moschata. Dickinson field (pie pumpkins), Kentucky field, butternut squash.
- Cucurbita mixta. Green-striped cushaw, sweetpotato squash, Japanese pie pumpkins.

Radishes

Radishes, a cool-weather vegetable, are among the first vegetables that can be used from the garden. Radishes need a sunny location and can be grown in early spring and as a fall crop. As the weather gets hot, however, the flavor of radishes becomes strong and hot.

Varieties. Round red varieties include Cherry Belle, Scarlet Globe, Red Prince, Red Boy, and Comet. White radishes include Icicle and Round White. Multicolored (white to pink to red) varieties include Easter Egg. White and multicolored varieties generally require longer to mature.

When to plant. Plant radishes in mid- to late March for a spring crop or early September for a fall crop. Make successive plantings so that you will have a continuous supply over a longer period of time. A special type of radish such as the large winter radish or oriental radish might require as long to mature as beets or carrots and requires the same culture.

Spacing. Radishes can be grown in narrow 15-inch rows, and in bed or wide-row plantings. Each radish needs 1–2 inches to enlarge its root, so thin thickly planted seedlings to this spacing. Plant seeds ¼–½ inch deep.

Care. Radishes require loose, well-drained soil and need regular frequent watering for a good crop. Excessive nitrogen fertilizer can encourage lush tops with poor-sized radishes. Control weeds while they are small, and be careful not to damage the shallow root system of this spring crop.

Harvesting. In loose soil, radishes can easily be pulled, especially if the soil is moist. For elongated radishes in heavy soil, a spading fork may be necessary. Store excess radishes by removing the tops and placing in plastic bags in a refrigerator. Radishes will remain good for a week or more.

Common concerns

- flea beetles
- root maggots

Rhubarb

Rhubarb is a perennial crop grown for its red stalk that has an acid flavor. Rhubarb often is mixed with fruits. It is among the first vegetables ready for use in spring. Because your planting may last a number of years, locate plants in full sun at the edge or end of the garden area to avoid damaging them with annual tillage.

Varieties. The most common red-stalked variety is Canada Red; others are McDonald, Ruby, Valentine, Cherry Red, and Strawberry Red.

When to plant. Rhubarb is best established in early spring—March to April—by planting a plump, healthy "crown" consisting of a portion of the woody root system with some buds in a shallow trench. Dig an old plant and divide the root into 4–8 pieces for

replanting, or purchase rhubarb roots from a garden center.

Spacing. Plant rhubarb about 2 feet apart in rows at least 3 feet apart. The crowns should be planted in a well-drained location with a slightly raised bed to encourage good drainage away from the center of the plant. The roots should be planted 1–2 inches deep.

Care. Fertilize rhubarb plantings in the spring so that spring rainfall will carry fertilizer into the root system, encouraging early summer growth. Rhubarb survives by producing vigorous leaves that produce food reserves stored in the root system, especially in the fall season. Rhubarb thrives in cool locations and is fairly hardy in severe winters. Always provide good drainage; never allow water to stand over the row.

Harvesting. Rhubarb must be established for a season before it can be harvested. Pull leaves as soon as they are large enough to use in the spring, and continue the harvest as long as the leaf stalks are large and thick—up to 7–8 weeks in the spring. After late May to early June, it is time to stop harvesting and allow the plant to produce summer growth for continued bearing the following season. In some seasons, rhubarb will produce seed stalks. These should be cut and discarded immediately as rhubarb that produces seed also produces less foliage, resulting in less vigorous crop the next year. Rhubarb dries out quickly. Trim the large leaves and place the leafstalks in plastic bags in a refrigerator to store for a week or more. Excess rhubarb can be frozen easily for later use.

Common concerns

- crown rot
- curculio

Salsify

Salsify is commonly known as oyster plant because the flavor of the cooked roots is similar to that of oysters. The thick, fleshy root of the plant, resembling a thin, white carrot, is dug in the fall or allowed to stay in the soil for digging throughout the winter.

Varieties. Mammoth Sandwich Island.

When to plant. Plant salsify about the same time as you would parsnips, beets, or carrots in the spring. Because it normally requires all season to develop, fall plantings are rare.

Spacing. Plant seeds ½–¾ inch deep and allow 2–3 inches between each plant after thinning. Rows may be as close as 15 inches.

Care. Salsify grows slowly in the early season, and careful, shallow cultivation to keep it well weeded is important. Once the plant is established, it is drought hardy and not susceptible to common garden disease or insects.

Harvesting. The flavor of salsify does not develop until several freezes have occurred in the fall. The long, thin roots usually require digging to remove them. You can dig salsify during the winter as long as the ground is not frozen, or it can be left in the ground for digging the next spring before plant regrowth. Store salsify in a plastic bag in a refrigerator after trimming off the tops.

Common concerns

- few reported

Spinach

Spinach is a hardy, cool-season crop that is increasing in popularity as a salad green. It is easy to grow and well adapted in small garden areas. It will grow in spring or fall seasons, but hot days in late spring cause spinach plants to bolt or produce a seed stalk.

Varieties. Spinach varieties vary as to the degree of "crinkle" in the leaves—called savoy. An old, standard, heavily savoyed variety is Long Standing Bloomsdale. Melody, Space, and Avon are hybrid, semi-savoyed types that produce well. Tyee is a type with smoother leaves. Smoother leaf types are easier to wash and clean if you have sandy soil that may get into the cracks and crevices of the leaves. A plant referred to as "New Zealand spinach" is not related to spinach and is often called "hot weather spinach" because it grows best during the warm days of late spring. It is not planted until later in the season and is harvested for the young, tender leaves that develop through late spring to early summer.

When to plant. Spinach can be planted very early as it is cold hardy. Mid- to late March is a common planting time. Fall spinach can be planted in mid-August to early September. Fall-planted spinach will usually overwinter if lightly mulched and vigorously re-grow in the spring. However, it will often 'bolt' (produce a seedstalk) early so spring-planted spinach should still be planted to grow longer into the spring season.

Spacing. Plant seeds about an inch apart in rows as close as 5–6 inches, or you can scatter seed uniformly about an inch apart in a wide row or bed planting. Because spinach germinates and grows early in the season, weed control is easier in this crop than in many planted this way.

Care. Spinach needs a fertile, well-drained location. Because production occurs early in the season, watering during stressful weather is not normally a concern. Additional nitrogen may be required to keep the spinach dark green and growing vigorously.

Harvest. Clip spinach leaves as soon as they are big enough to use. If you clip individual leaves, the plant will continue to develop and produce more leaves. If you want to harvest mature plants, cut the plant at the soil level. This will be necessary as hot weather approaches. Fall-planted spinach will often overwinter; clip individual leaves for fall harvest but allow the plants to remain. Cover the planting with mulch in mid- to late November and uncover early in the spring. You will usually get an additional early spring crop of spinach; however, this overwintered crop produces seed stalks early in the season. Store spinach in a plastic bag in a refrigerator for about a week.

Common concerns

- few reported

Squash

Two main types of squash are grown in Kansas gardens. Summer squash are used in their young or immature stage and grow on compact, nonsprawling vines, while winter squash are used at their mature stage and grow on trailing vines. The general culture and care are similar for both types.

Varieties. Summer Squash—Summer Crookneck, Prolific Straightneck, zucchini (several hybrid varieties vary, depending on color and shape), Eldorado (yellow zucchini), Goldrush, Sunburst (yellow scallop).

Winter Squash—Royal Acorn, Ebony Acorn, and Table Queen, Butternut (several hybrid varieties), Improved Green Hubbard, Pink Banana, Striped Cushaw, Spaghetti Squash.

When to plant. Squash are warm- season crops that are damaged by freezes. Plant after all danger of frost has passed; early May is a traditional planting time. A planting of summer squash for a fall harvest can be made in early August. Fall plantings of winter squash should be made in mid- to late May.

Spacing. Summer squash can be planted 2 feet apart in rows at least 3 feet apart. Winter squash need more room for their sprawling vines, with 3–4 feet between plants in rows at least 6 feet apart.

Care. Weeds compete with squash plants, making shallow cultivation essential, especially early in the season. Squash benefit from the soil-warming and weed-control properties of black plastic mulch. Once full vine spread is achieved, little additional care is necessary. When plants are established, squash are fairly tolerant of drier soil conditions. Squash, like other relatives such as cucumber, muskmelon, and watermelon, have separate male and female flowers on the same plant. Bees are required to transfer pollen from flower to flower. Male flowers usually appear first, and there are more male than female flowers.

Harvesting. Summer squash are harvested at an immature stage—before the skin and seeds have toughened. Usually harvesting when they are 6–10 inches long is preferable. Squash develop quickly, and regular harvesting is important. Winter squash are harvested at maturity—after the rind or skin is tough. Check the development by trying to penetrate the skin with your fingernail. Immediately af-

ter harvesting, allow winter squash to further dry by storing them at 70–80°F in a dry location for 2–3 weeks before moving them to storage areas such as a basement where temperatures are 50–60°F. This "curing" process allows squash rind to toughen. Winter squash can be stored for 4–8 months. Summer squash should be stored in a refrigerator for only a short time because they are prone to drying out.

Common concerns

- squash bugs
- powdery mildew

Sweet Corn

Ears of sweet corn are a popular addition to summer meals. The flavor and quality of freshly picked sweet corn is outstanding. Sweet corn does not adapt well to small garden areas because closely spaced plants will produce only 1–2 ears. Space is a major consideration if you want to grow sweet corn.

Varieties. New hybrid varieties of sweet corn are available. The colors range from yellow to white to bicolor, yellow and white kernels together on the same ear. Early varieties that require 65–75 days to mature produce smaller stalks and ears, while later varieties requiring 75 days or longer produce larger plants and larger ears. New varieties are available with resistance to several common diseases such as maize dwarf mosaic, smut, and bacterial wilt.

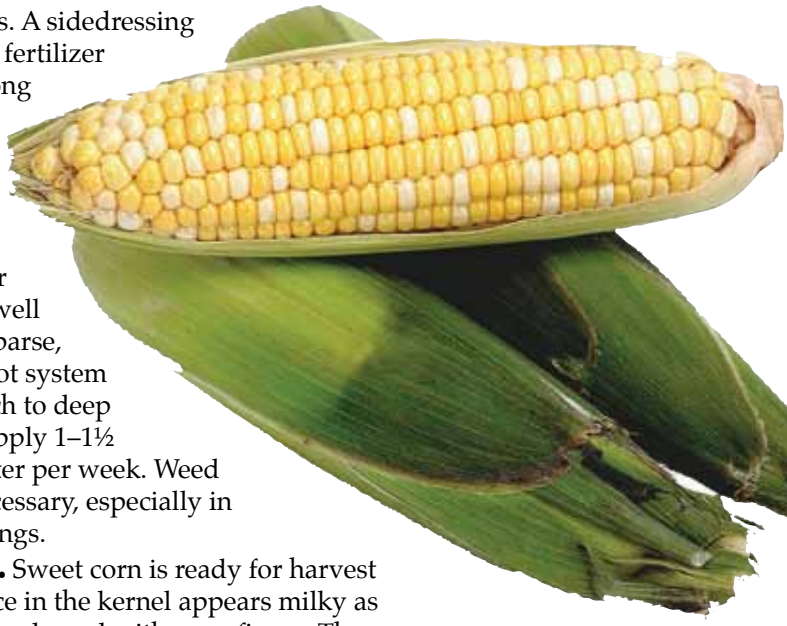
Sweet corn differs from field corn by a single genetic factor called the "sugary" or Su gene. Several new varieties that have higher levels of sugar controlled by additional genes have been developed. Varieties with the shrunken-2 or Sh-2 gene are extremely sweet and produce a more watery, crisper kernel but must be isolated from other corn varieties that may pollinate at the same time. A newer class of varieties carrying the SE or sugary extender gene are moderately sweeter, tender, and do not require isolation.

Common yellow varieties include Gold Cup, Merit, Miracle, Bodacious, Incredible, Jubilee, Sweetie, Sugar Loaf, Sweet Time, and Kandy Korn. White varieties include Quick Silver, Sugar Snow, Snow Belle, and Silver Queen. Bicolor varieties include Carnival, Calico Belle, Candy Store, Ambrosia, and Honey and Cream.

When to plant. Sweet corn is a warm-season crop and should be planted in mid- to late April. New sweeter varieties have a smaller, more shriveled seed and will rot in cold soil; do not plant these types until early May. Successive plantings of corn are important to spread the harvest over a longer period. Make additional plantings when the previous planting is ½–¾ inch tall.

Spacing. Plants should be 8–12 inches apart in rows at least 3 feet apart. Do not crowd plantings, as weak, spindly, unproductive plants will result. Plant the kernels an inch deep. If many seeds fail to germinate, do not attempt to replace missing plants; replant the entire planting.

Care. Sweet corn requires wind to transfer pollen from the tassel (male) to the ear (female). Plant corn in small blocks or several short rows rather than a single row to encourage better pollination. Sweet corn pollinates poorly in 100-degree weather, and ears with missing kernels or gaps may result. Sweet corn may be cross pollinated by other types of corn such as field corn that pollinates at the same time. If there is a danger of cross pollination, a space of 40–50 feet may be needed as cross pollination can affect flavor. Sweet corn is a member of the grass family and needs considerably more nitrogen fertilizer than other garden plants. A sidedressing of additional fertilizer sprinkled along the row every several weeks is important. Sweet corn needs regular watering as well because its sparse, inefficient root system does not reach to deep soil water. Apply 1–1½ inches of water per week. Weed control is necessary, especially in young plantings.



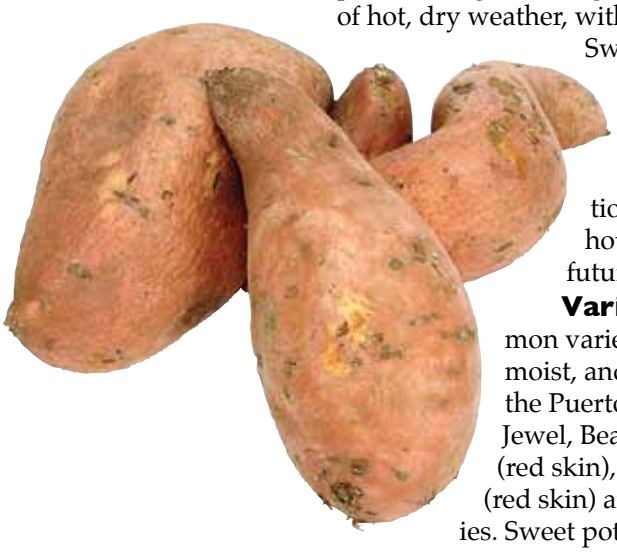
Harvest. Sweet corn is ready for harvest when the juice in the kernel appears milky as you puncture a kernel with your finger. The ear should be well filled to the tip. This ideal harvest stage lasts for only a few days in hot weather, and regular checking for maturity is important. The silks of mature ears are generally completely dry and brown. Twist and pull the ear from the plant by bending the ear down sharply. Use corn immediately or store it in a cold place immediately after harvest. Pick corn early in the morning when it is cool outside. Store corn for only a few days in a refrigerator before using. Corn is easily frozen for later use.

Common concerns

- corn earworm
- smut

Sweet potato

Sweet potatoes are a warm-season crop that is often overlooked as an easy-to-grow, productive garden vegetable. They are tolerant of hot, dry weather, with few pest concerns.



Sweet potatoes do sprawl more than Irish potatoes and need plenty of room. Sweet potatoes are nutritious and easy to store in household conditions for future use.

Varieties. Most common varieties are dark orange, moist, and sweet and fall into the Puerto Rican type varieties. Jewel, Beauregard, Georgia Jet (red skin), Centennial, and Travis (red skin) are common varieties. Sweet potatoes are grown from plants, usually called "slips," that can be purchased in bundles from your local garden center. You can also grow your own by placing a sweet potato root in a container filled with moist sand and allowing it to sprout in a warm location for about six weeks before setting plants in the garden.

When to plant. Sweet potatoes can be injured by any degree of cold weather. Wait until mid- to late May before attempting to plant. Sweet potatoes need to be planted on a ridge or mound of loose soil about 8–12 inches high to provide a bearing area for the fleshy roots to develop later in the season.

Spacing. Plant about 12 inches apart in rows at least 3 feet apart. Vines may spread to 6–8 feet wide.

Care. Avoid planting sweet potatoes in excessively rich soils or highly fertilized soils. The plants grow best in moderately fertile soil. Sweet potatoes are adapted to grow well in drier weather, but a thorough, deep watering in early August during dry periods will improve yields. Hoe as needed early in the season to prevent weeds from developing; later in the season, the dense vine growth will suppress weeds.

Harvesting. Sweet potatoes continue to develop throughout the season and do not deteriorate in quality if they get too large. It usually takes until mid-September to mid-October for the fleshy roots to enlarge to a harvest stage. Dig before freezing weather occurs. Cut or chop the vines a few days before digging to make digging easier. After digging, break the roots from the vine and allow them to air dry for a few hours before picking them up. Gently place roots in baskets or boxes to avoid injury to the tender skin. Sweet potatoes must be "cured" in a warm, humid location for 1–2 weeks to improve keeping quality and flavor. Place the baskets in an 80–90°F environment with high humidity for 7–10 days. Then lower the temperature to around 55°F for long-term storage. Never allow temperatures to drop below 50°F as poor keeping quality, flavors, and dark colors will result. If sweet potatoes are washed before storing, make sure they are handled carefully and dried before curing.

Common concerns

- few reported

Tomatoes

Tomatoes are the most popular vegetable grown in Kansas gardens. They are easy to grow, productive in small garden areas, and used in a wide variety of ways. Tomatoes require a location that is fairly fertile, well-drained, and sunny, getting at least a half day of sun or more. Smaller vine tomatoes can be grown in containers.

Varieties. Most modern tomato varieties are hybrids with disease resistance. Certain varieties produce well in our variable climate. Fl91, Jet Star, Mt. Spring, Mt. Fresh, Celebrity, Scarlet Red, Red Defender, Security28, Fabulous, and Fl 47 are adapted varieties as well as several other hybrids. Whopper and Beefmaster are large "beefsteak" types. For canning, choose the productive and firm-fruited LaRoma, Campbells, or Heinz varieties. Small fruited or cherry varieties include Mt. Belle, Red Cherry, Small Fry, Sweet 100, and Cherry Grande. Patio, Pixie, and Tiny Tim are dwarf varieties well suited to container growing.

When to plant. Plant tomatoes after all danger of frost is past. Early

May is the common spring planting time. For a later harvest, tomatoes can be planted as late as early June.

Spacing. Most garden tomatoes should be spaced at least 18 inches to 2 feet apart in rows 3–5 feet apart. Dwarf varieties can be spaced closer.

Care. Tomatoes are usually grown from transplants. Choose a strong healthy transplant that has a dark green color and balance between the size of the plant and the container. Set the plant slightly deeper than the container and firm soil well around the root system. Water with a starter solution immediately after planting. Tomatoes respond to mulching because they require stable soil moisture. Black plastic mulch encourages early growth, while organic mulches are excellent for summer when applied 2–3 weeks after planting. Weeds compete with tomatoes for nutrients, water, and light. Use shallow cultivation near the plants to scrape away small weeds. A sidedressing of fertilizer when the first fruit on the plant are about the size of a walnut usually will improve yields and lengthen the harvest period. Cold nights early in the growth period or hot, dry, windy weather may cause blossom damage or blossom drop. Irregular shaped fruit called "catfaced" fruit may develop from early cold periods. Avoid excessive fertilization as it may increase catfacing and blossom drop as well as fruit deformities.

Harvesting. Tomatoes will ripen on or off the plant when the fruit are full sized and starting to show a slight tinge of color. Harvest early to reduce the chances of cracking, fruit rots, and other damage. Early harvest encourages additional production. Store ripening fruit at 55°F for maximum storage life or place them in a warmer location for quicker ripening. Red pigments do not form in temperatures of 95°F or above; therefore, deeper red color will result from ripening off the vine in summer heat. At the end of the season, harvest all full-sized fruit and store them in a cool basement for ripening to enjoy fresh tomatoes 1–2 months after the last freeze.

Common concerns

- leaf blight diseases
- mites
- aphids
- blossom end rot
- fruit worms or hornworms

Turnip and Rutabaga

Turnip is a cool-season vegetable that can be grown as a spring or fall crop in Kansas. Turnips are easy to grow and can be used for the root, top, or both. Rutabagas are a relative of turnips that require considerably more time to develop. Rutabagas are best grown as a fall crop in Kansas.

Varieties. Purple Top White Globe, Tokyo, and Just Right (white) are common varieties grown for the root and top. Seven Top and Shogoin are varieties best grown for tops or greens. American Purple Top, Laurentian, and Red Chief are rutabaga varieties.

When to plant. Plant spring turnips in mid- to late March to allow roots to develop before intense summer heat. Plant fall turnips in late July to early August. Rutabagas should be planted in mid-July.

Spacing. Plant seed about ½ inch deep and about 2–4 inches apart in rows at least 15 inches apart. Use a slightly deeper planting for fall crops. You can also plant turnips in a bed or wide row planting by scattering seed to produce a plant every 2–4 inches in each direction. Rutabagas may need 5–6 inches between plants. It is common to scatter seed for fall turnips over a section of the garden.

Care. Turnips need regular watering during their early development to ensure emergence and rapid growth. Weeds compete with small plants and must be removed early, using care to avoid damaging young, tender, turnip plants.

Harvesting. When roots are 2–4 inches in diameter, pull and trim the tops. Store turnip roots in plastic bags in a refrigerator for 2–3 weeks. Harvest the tops when they are young and tender. Overmature tops or roots will be strong flavored, and roots may be tough. Rutabagas will be slightly larger—about 3–5 inches in diameter at harvest because the plant is larger. The roots have a yellow interior.

Common concerns

- flea beetles
- aphids

Watermelon

Watermelon is a native crop of Africa that grows well in the warm, dry days of Kansas summers. The plant grows best in deep, sandy soils; however, small icebox-type watermelons can be grown on upland shallow soils. Watermelons require a lot of room and are not well adapted to small backyard gardens. For small garden spaces, see varieties listed in the Container Gardening chapter on page 42.

Varieties. Round or elongated striped varieties include Crimson Sweet, Royal Sweet, Royal Jubilee, Mirage, Oasis, Allsweet and Calsweet. Round, dark green varieties include Blackstone and Blue Bell. Elongated light green varieties include Sweet Princess, Summer Flavor, and Prince Charles. Icebox types include Sugar Baby, Gold Baby (yellow).

When to plant. Watermelons thrive in warm soils, and planting after all danger of frost is past in early to mid-May is recommended.

Spacing. Standard watermelons require about 50 square feet per plant or hill—2–3 plants together. Plant 4–5 feet apart in rows 10–12 feet apart. Small-vined icebox varieties can be spaced closer together, using 2–3 feet between hills in rows 5–6 feet apart. Plant seeds about an inch deep.

Care. Watermelons need a warm, sunny, well-drained growing area. Weeds are difficult to control in sprawling vines, making early season weed control essential. Scrape weeds using shallow cultivation close to the plants. Watermelons can be grown as a transplant and transferred to the garden. Use a fairly large transplant or peat pot container for best results. Like cucumbers, muskmelon, squash, and pumpkin, watermelons have separate male and female flowers on the same plant. Bees are necessary to transfer pollen from the male to female flowers.

Harvest. Watermelons are ready for harvest when the underside of the fruit turns a bright buttery yellow color and when the small, curled tendril where the fruit attaches to the vine has turned brown and died. Thumping larger fruited varieties produces a dull, hollow sound when ripe; however, small icebox types are difficult to thump to determine ripeness.

Common concerns

- cucumber beetles
- aphids

Herbs

Herbs are plants that are used as flavoring agents. Herbs used in cooking are called "culinary" herbs. Mild or savory herbs impart a delicate flavor to foods, while stronger or pungent herbs add zest. A number of additional herbs are used for medicinal, aromatic, or ornamental purposes. This section focuses on the culinary herbs. These herbs are attractive and varied, giving them ornamental value as well.

Herb gardening is becoming popular throughout Kansas. Enthusiasm for natural foods has heightened this interest. Most food recipes can be accentuated and livened with proper use of culinary herbs.

The leaves of most herbs are the part of the plant that is used, although seeds or roots of some herbs also can be used. Herbs are used in small quantities, and usually only a few plants are needed to provide sufficient fresh and dried herbs for an entire season.

Location

The ornamental value of herbs makes them useful in flower beds, borders, rock gardens, and corner plantings. Some herbs are annuals, while others are perennial and come up year after year. You can plant annual herbs in your annual flower or vegetable garden. Perennial herbs should be located at the edge of the garden where they won't interfere with next year's soil preparation.

Many gardeners establish a small herb garden near the back door. Generally, a 6- to 10-foot square or rectangular area is sufficient, but you also can use circular or free-form designs. This guide provides information for proper spacing. Locate the tallest herbs at the back of the plot.

Care

Care for the herb garden will be similar to that of a vegetable or flower garden. Select a sunny well-drained location, apply a balanced fertilizer, but avoid excessive use of nitrogen fertilizers. Consult the Soil Improvement section of this guide for soil preparation, fertilization, and other garden cultural practices.

Water as necessary during dry periods. Generally, you will need about an inch of water per week, if not supplied by natural rainfall. A mulch will help conserve soil moisture and reduce weed growth as well. The mints prefer moist soil and require more frequent watering.

Getting Started

Annual and biennial herbs can be established by planting the seed directly in the garden or starting seed indoors for transplanting to the garden. You can save seed produced by the herb plants for next year's crop or obtain

seed from your local garden center or seed catalog.

To save your own seed, harvest the entire seed head after it has dried on the plant. The seeds should be allowed to dry in a protected location that is cool and dry. After the seeds are thoroughly dry, thresh the seed from the seed heads and discard the trash. Store in labeled jars in a dark, cool, dry location.

Some herb seeds such as dill, anise, caraway, and coriander can be used for flavoring.

Perennial herbs can be propagated by cuttings or division. Divide plants every 3–4 years in the early spring. The plants should be dug up and cut into several sections. You can also cut 4- to 6-inch sections of the stem and root them by placing the cuttings in moist sand in a shady area. In 4–8 weeks, roots should form. Herbs such as sage, winter savory, and thyme can be propagated by cuttings. Chives, lovage, and tarragon can be propagated by division of the roots or crowns. Apple mint forms runners or stems that run along the ground and can easily be propagated by covering a portion of the runner and allowing it to form roots.

Harvesting

Leaves of many herbs such as parsley and chives can be harvested for fresh seasonings. You can gradually remove some of the leaves as you need them, but don't remove all the foliage at one time. These plants will produce over a long period of time if they are well cared for.

Chervil and parsley leaves can be cut and dried any time. Lovage leaves should be harvested early during the first flush of growth.

On rosemary and thyme, clip the tops when the plants are in full bloom. Usually leaves and flowers are harvested together. Basil, fennel, mint, sage, summer savory, sweet marjoram, tarragon, and winter savory are harvested just before the plants start to bloom.

Drying

After harvesting, hang herbs in loosely tied bundles in a well-ventilated room. You can also spread the branches on a screen, cheesecloth, or hardware cloth. For herbs where leaves only are needed, the leaves can be spread on flat trays. Keep dust off the herbs with a cloth or similar protective cover that allows moisture to pass through.

It is generally best to dry naturally in a cool, dark room rather than to use artificial heat. This can be done commercially, but you may lose flavor and quality by attempting to use artificial heat.

Storage

When herbs are thoroughly dry, they should be put in airtight containers such as sealed fruit jars and stored in a cool dark location. Any sign of moisture accumulating in the jars indicates the herbs are not thoroughly dry. Flower stalks should be pulverized before putting them in the jars, but foliage herbs can be stored either pulverized or as whole leaves, depending on their intended use.

Herbs in Containers

Some herbs can be placed in pots and grown indoors during the winter. They should be placed in a sunny south window and given care similar to house plants. Herbs can either be dug up toward the end of the growing season and placed in pots or started from seed indoors.

Annual Herbs

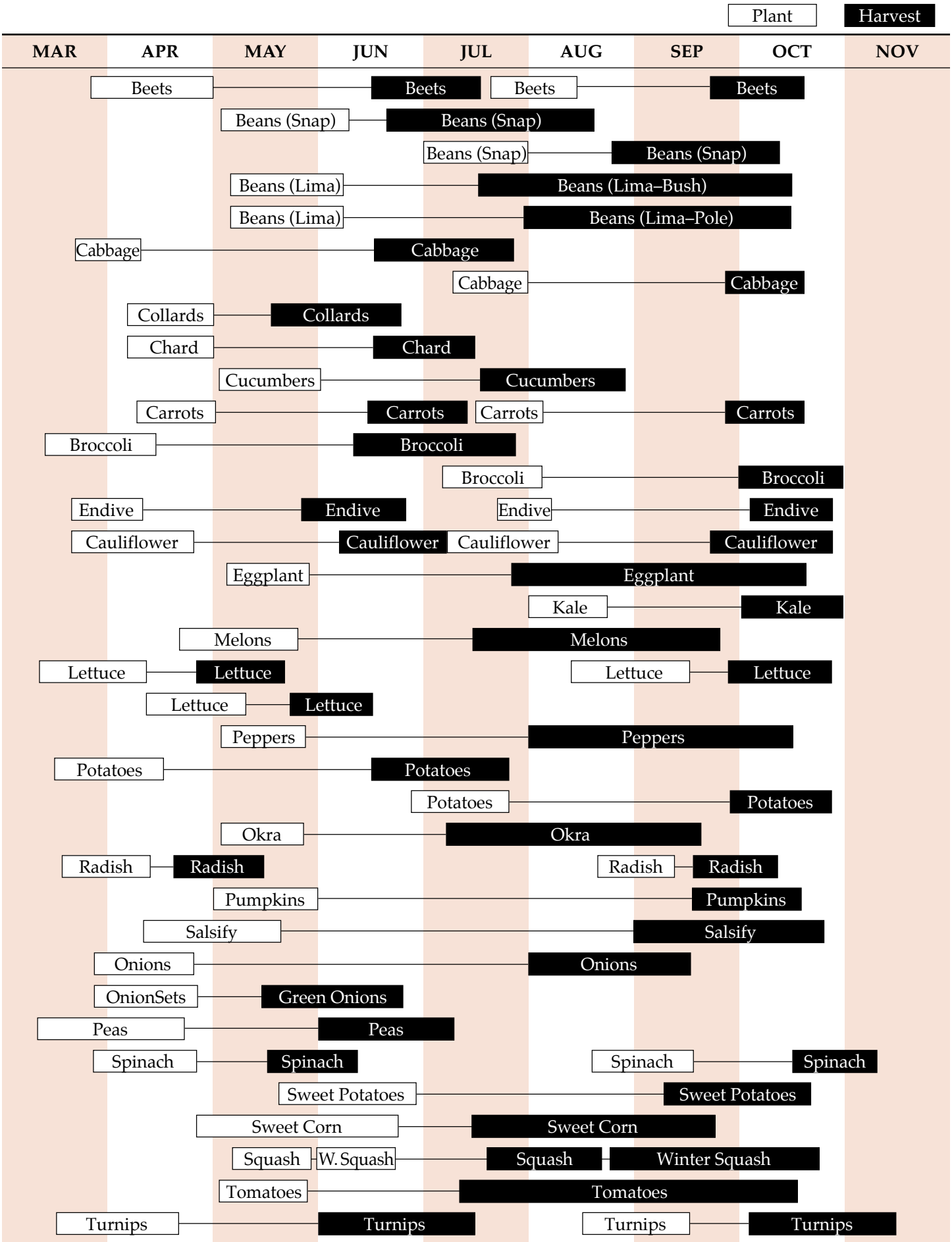
Herb	Height (In.)	Description	Culture	Harvest	Use
Anise *Pimpinella anisum*	20–24	Serrated leaves; small, white flowers. Low spreading plant is a slow-growing annual.	Moderately rich soil. Likes full sun. Space 6-8 inches in rows 12-14 inches apart.	When seeds turn brown or use leaves while green.	*Seed*—pastries, candy, cookies, beverages, meat, soups. *Leaves*—salad or garnish.
Basil *Ocimum basilicum*	20-24	Leafy, light-green foliage; white or lavendar flowers. Fast-growing annual.	Start seed indoors in early April or seed in early spring. Space 12 inches. Prefers protected sunny location.	Harvest leaves just before flowering begins. Cut plants 4-6 inches above ground.	*Leaves*—soups, stews, omelets, salads, meats, sauces.
Borage *Borgo officinalis*	20-24	Coarse, rough, hairy leaves; light-blue flowers in drooping clusters.	Seed directly in early spring. Space 12 inches apart. Seeds may be slow to germinate.	Harvest the young leaves and dry, or cook fresh like spinach.	*Leaves*—salads, greens *Flowers and leaf tips*—pickles, soups.
Caraway *Carum cervi* -biennial-	12-24	Carrotlike leaf, small, creamy-white flowers.	Seed directly in spring, locate in full sun. Space 6 inches.	Harvest leaves when mature. Seeds will form midway through second season.	*Leaves*—garnish *Seeds*—breads, cakes, soups, sauces, salads.
Chervil *Anthriscus cerefolium*	18	Similar to parsley; light-green, lacy leaves. Flowers are small, white clusters.	Sow seed in moist, partially shaded location. Space 6 inches.	Harvest mature leaves and dry or use fresh for garnishes.	*Leaves*—salads, soup, meat, poultry, garnishes.
Coriander *Coriandrum sativum*	36	Large, coarse plant; white flowers. Also known as cilantro or Mexican parsley.	Sow seeds in full sun, thin to 10 inches.	Harvest seeds when they begin to turn brown. Seeds are generally used crushed.	*Seeds*—pastries, sauces, pickles, liquors.
Dill *Anthum graveolens*	24-36	Tall plant with feathery, green leaves; open, umbrella-shaped flower heads.	Seed directly and thin to 12 inches. If seeds mature and fall, they come up again next year.	Harvest mature seed before it drops. May use small leaves as well.	*Sprigs of seed head*—pickles, sauces, meats, salads, vinegar.
Fennel *Foeniculum vulgare*	36	Fine, feathery leaves with broad, bulblike leaf base.	Sow in early spring and thin to 12 inches.	Harvest either young sprigs and leaves or seeds.	*Sprigs*—soups. *Leaves*—garnishes. *Seeds*—soups, breads.
Parsley *Petroselinum crispum*	5-6	Curled or plain dark-green leaves.	Seed in early spring. Space 6-8 inches. May be slow to germinate.	Harvest mature leaves as needed.	*Leaves*—garnishes.
Sweet Marjoram *Majorana hortensis*	12	Fine-textured plant; white flowers.	Start seedlings in shade. Mature plants prefer full sun. Space 8-10 inches.	Harvest mature leaves.	*Leaves*—salads, soups, dressings.
Summer Savory *Satureja hortensis*	18	Small gray-green leaves with purple and white flowers.	A tender annual; plant after danger of frost. Space 6-9 inches.	Harvest mature leaves.	*Leaves*—salads, soups, dressings, poultry.

Perennial Herbs

Herb	Height (In.)	Description	Culture	Harvest	Use
Chives *Allium schoenoprasum*	12	Onion-type leaves; round, purple flower head.	Can be grown in containers or outdoors in spring. Divide to increase. Space 5 inches.	Clip leaves as needed.	*Leaves*—omelets, salads, soups, sauces, dips.
Garlic Chives *Allium tuberosum*	12-16	Similar to chives.	Same as chives.	Same as chives.	Substitute for garlic flavor.
Peppermint *Mentha piperita*	18	Vigorous bush-type plant; purple flowers.	Prefers rich, moist soil. Space 8-10 inches.	Harvest young or mature leaves.	*Leaves*—soups, sauces, teas, jelly. *Sprigs*—teas, sauces, summer drinks.
Spearmint *Mentha spicta*	18	Pointed, crinkled leaves.	Same as peppermint.	Same as peppermint.	*Leaves*—summer drinks, teas, mints, sauces.
Lemon Balm *Melissa officinalis*	24	Crinkled, dull-green leaves; white blossoms. Vigorous grower.	Space 12 inches. Prefers full sun.	Harvest mature leaves.	*Leaves*—soups, meats, teas, summer drinks.
Lovage *Levisticum officinale*	24-36	Grows quite tall.	May start indoors and move to sunny location. Space 12-15 inches.	Harvest mature leaves.	Substitute for celery flavor.
Oregano *Origanum vilgare*	24	Choose English strains. Produces pink flowers.	Plant in rich soil. Space 8-10 inches. Start in protected location and move to full sun.	Harvest mature leaves.	*Leaves*—soups, roasts, stews, salads.
Rosemary *Rosmarinus officinalis*	36	Dark-green foliage; small, blue flowers.	Start cutting in early spring. Space 24 inches.	Harvest mature leaves.	*Leaves and sprigs*—meats, sauces, soups. *Dried leaves*—sachets to hang in closet with garments.
Sage *Salvia officinalis*	16	Shrublike plant with gray leaves; purple flowers.	Plant in well-drained location. Space 30 inches.	Harvest leaves before flowering.	*Leaves*—meats, teas, fish, dressings, stews.
Tarragon *Artemisa dracunulus*	24	Select French tarragon. Fine, dark-green leaves.	Prefers well-drained soil. Space 12 inches.	Harvest mature leaves or sprigs.	*Leaves*—salads, sauces, eggs, fish, vegetables, chicken, salad vinegar.
Thyme *Thymus vulgaris*	8-12	Narrow, dark-green leaves.	Start seeds indoors. Prefers full sun and well-drained soil. Space 10-12 inches.	Harvest leaves and flower clusters before first flowers open.	*Leaves*—soups, salads, dressings, omelets, gravy, breads, vegetables.

Crop	Type of Planting	Plants or Seeds Per 100' Row	Optimum Temperature (F)	Depth of Planting (In.)	Avg. Spacing Within Row (In.)	Avg. Spacing Between Rows (In.)	Frost Resistance
Asparagus	Perennial (Crowns)	75	—	8	18	48	Hardy
Asparagus	Seed (Transplant)	2 oz.	65-75	1	3	6	Hardy
Rhubarb	Perennial (Crowns)	30	—	I	36	35–48	Hardy
Beans Snap	Seeded	½ Ib.	70–85	2	3–4	36	Tender
Beans—Lima	Seeded	½ Ib.	75–85	2	4–8	36	Tender
Beets	Seeded	2 oz.	50–60	½	2–4	18	Half-Hardy
Broccoli	Seed or Transplant	½ oz. or 75	(50–60)	(½)	18–24	36	Hardy
Brussels Sprouts	Seed or Transplant	½ oz.or 100	(50–60)	(½)	12–18	36	Hardy
Cabbage	Seed or Transplant	½ oz. or 75	(50–60)	(½)	12-18	36	Hardy
Chinese Cabbage	Seeded	¼ oz.	55–70	½	10–12	36	Hardy
Carrots	Seeded	1 oz.	55–70	½	2–3	18	Half-Hardy
Cauliflower	Seed or Transplant	½ oz.or 75	(55–70)	(½)	18–24	36	Half-Hardy
Cucumbers	Seed or Plants	½ oz.	75–85	½ –1	10–48	48–72	Very Tender
Eggplant	Transplants	50 plants	(75–85)	—	18–24	36	Very Tender
Garlic	Sets	3 Ibs.	—	1	4–6	18–36	Hardy
Horseradish	Roots	75–100 roots	—	3–4	12–18	36	Hardy
Kale	Seeded	1 oz.	50–60	½	2–4	36	Hardy
Kohlrabi	Seed or Transplant	¼ oz.	(50–60)	(½)	5–6	18–24	Hardy
Lettuce (Seed)	Seeded	½ oz.	50–70	¼	2–4	18–24	Half-Hardy
Lettuce (Plants)	Transplants	100–200 plants	(50–70)	(¼)	2–4	18–24	Half-Hardy
Head Lettuce	Seed or Transplants	1½ oz. or 75	60–70	½	12–15	18–24	Half-Hardy
Muskmelon	Seed or Plants	½ oz.	75–85	1–1½	48–72	48–72	Very Tender
Mustard	Seeded	¼	50–60	½	2–4	18–24	Hardy
Onion (Sets)	Sets	2 qts.	—	1½ –2	3–4	12–24	Hardy
Onion (Plants)	Transplants	300 plants	—	1½ –2	3–4	12–24	Hardy
Okra	Seeded	2 oz.	75–85	½	18–24	36	Tender
Parsley	Seeded	½	55–70	½	2–4	18–24	Half-Hardy
Parsnip	Seeded	½ oz.	55–70	¼–½	3–4	18–24	Half-Hardy
Peas	Seeded	1 Ib.	50–65	2	1–2	12–24	Hardy
Peppers	Transplants	50 plants	(75–85)	(½)	18–24	36	Tender
Potatoes	Tuber Pieces	10 Ibs.	50–60	2–3	8–12	36	Half-Hardy
Pumpkin	Seeded	1 oz.	75–85	1	72–90	72–90	Half-Tender
Radish	Seeded	1 oz.	50–60	½	2–3	12–18	Hardy
Rutabaga	Seeded	½ oz.	50–60	½	4–6	18–24	Hardy
Salsify	Seeded	1 oz.	55–70	½	2–3	12–18	Half-Hardy
Spinach	Seeded	2 oz.	55–70	1	2–3	12–18	Half-Hardy
Squash—Summer	Seeded	1 oz.	75–85	1	36–48	48–72	Very Tender
Squash—Winter	Seeded	1 oz.	75–85	1	60–72	96	Very Tender
Sweet Corn	Seeded	½ Ib.	70–80	2	14–18	36	Tender
Sweet Potatoes	Plants	75–100 plants	—	—	12–16	36–48	Very Tender
Swiss Chard	Seeded	1 oz.	55–70	½–1	6–8	18–24	Half-Tender
Tomato	Transplants	30–60 plants	(75–85)	(½)	24–48	36–48	Tender
Tomato	Direct Seeded	¼ oz.	75–85	½	24–48	36–42	Tender
Turnips	Seeded	1 oz.	60–70	½	3–4	12–18	Hardy
Watermelon	Seeded	1 oz.	80–90	1–2	72–90	72–90	Very Tender

( ) = Seeding information for hotbed; allow 6–8 weeks in hotbed or greenhouse.


Plant
Harvest
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
Beets
Beets
Beets
Beets
Beans (Snap)
Beans (Snap)
Beans (Snap)
Beans (Snap)
Beans (Lima)
Beans (Lima–Bush)
Beans (Lima)
Beans (Lima–Pole)
Cabbage
Cabbage
Cabbage
Cabbage
Collards
Collards
Chard
Chard
Cucumbers
Cucumbers
Carrots
Carrots
Carrots
Carrots
Broccoli
Broccoli
Broccoli
Broccoli
Endive
Endive
Endive
Endive
Cauliflower
Cauliflower
Cauliflower
Cauliflower
Eggplant
Eggplant
Kale
Kale
Melons
Melons
Lettuce
Lettuce
Lettuce
Lettuce
Lettuce
Lettuce
Peppers
Peppers
Potatoes
Potatoes
Potatoes
Potatoes
Okra
Okra
Radish
Radish
Radish
Radish
Pumpkins
Pumpkins
Salsify
Salsify
Onions
Onions
OnionSets
Green Onions
Peas
Peas
Spinach
Spinach
Spinach
Spinach
Sweet Potatoes
Sweet Potatoes
Sweet Corn
Sweet Corn
Squash
W. Squash
Squash
Winter Squash
Tomatoes
Tomatoes
Turnips
Turnips
Turnips
Turnips

Publications from Kansas State University are available on the World Wide Web at: ***www.ksre.ksu.edu***

Publications are reviewed or revised annually by appropriate faculty to reflect current research and practice. Date shown is that of publication or last revision.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

S-51 (Rev.) March 2010

K-State Research and Extension is an equal opportunity provider and employer. Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, Extension Districts, and United States Department of Agriculture Cooperating, Fred A. Cholick, Director.