Growing Tomatoes in the Home Garden

David A. Hillock
Extension Consumer Horticulturist

Brenda Sanders
Extension Consumer Horticulturist

Susan E. Gray
Extension Horticulturist - Tulsa County

Tomato is one of the most popular home garden crops in Oklahoma. Tomatoes can grow in a small area, bear through most of the season, are easy to grow, and have many culinary uses in the home. They are low in calories and a good source of Vitamin C.

Selecting Growing Area

Tomatoes should be grown in full sunlight and planted away from trees and shrubs to obtain highest yield. Tomato plants require abundant moisture for best growth, so arrange for easy watering. The area selected should be well drained since poor drainage promotes root loss. Tomatoes grown on heavy or poorly drained soils should be planted in raised beds or mounds four to six inches high.

Soil Preparation

Tomatoes grow well in many types of soil but prefer deep, fertile, well-drained soil that is amply supplied with organic matter and is slightly acidic (pH of about 6.5). The soil should be worked only when it is dry enough that it will not stick to tools. Garden soil may be improved by adding rotted manure, leaf mold, peat moss, or other organic materials.

Fertilizers should be added when the soil is prepared for planting. A soil sample should be taken for testing if fertilizer needs are not known. Collect and submit the sample for testing at least six weeks prior to planting time. Your OSU County Extension office has information on how to collect, prepare, and send a soil sample.

Fertilization

When needed, a complete garden fertilizer should be added to the soil when it is prepared for planting. Tomatoes prefer a fertilizer low in nitrogen, high in phosphorus, and medium to high in potassium. Prior to transplanting, use one to two pounds of 10-20-10 or similar fertilizer for each 100 square feet if you do not have soil test information.

All fertilizers should be worked into the top six inches of soil. For additional details on fertilization and soil preparation, obtain OSU Fact Sheet HLA-6007.

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://osufacts.okstate.edu

Tomato Varieties

Productivity, fruit characteristics, and resistance to diseases should be considered in selecting tomato varieties for the home garden. One may want to consider selecting varieties resistant to Fusarium wilt and nematodes since these are problems in all areas of Oklahoma.

The following list provides some varieties that have proven satisfactory for Oklahoma. However, it is not a complete list. The variety determination will also depend on the personal taste preferences of the home gardener.

Small Fruit	***Large Fruit***	***Paste***
Juliet	Better Boy VFN	Milano VF
Mountain Bell VF	Big Beef VNF$_2$AST	Roma VFN (canning)
Small Fry VFN	Bigset VF$_2$NAS	San Remo VF
Sweet 100	Brandywine	
Pixie	Carmello VNFT	
Sungold FT	Carnival VNF$_2$	
Sweet Million FNT	Celebrity VNF$_2$T	
Yellow Pear	Flora-dade VF$_2$	
	Heatwave VF$_2$	
	Jet Star VF	
	Mountain Pride VF	
	Pik-Red VNF$_2$	
	Summer Flavor 5000 VNF$_2$	
	Sunny VF$_2$AS	
	Sunray F (yellow)	

Disease resistance or tolerance codes: Verticillium wilt (V), Fusarium wilt, Race 1 (F), Fusarium wilt, Races 1 & 2, (F_2), Root-Knot nematode (N), Tobacco mosaic virus (T), Alternaria stem canker (A), and Stemphylium (gray leaf spot) (S).

Producing Tomato Plants

Earliness of production and quantity of fruit produced are influenced by the quality of the plant and the time it is transplanted in the garden.

The ideal tomato plant should be six to eight inches tall and dark green, with a stocky stem and well-developed root system. Normally, six to eight weeks are required to produce this type of plant from seed.

A family interested in having only fresh fruit should plant three to five plants per person. If fruit is wanted for home processing, then five to ten plants per person should be grown.

To get best results with only a few plants, and to minimize trouble, buy plants from your local plant grower at the proper planting time. Ask for improved varieties by name. Plant growers need assurance of the sales of new varieties before they are willing to risk growing a new variety.

Plants may be started from seeds in a pasteurized seedling mix, such as vermiculite. After the seedlings have emerged and developed the first set of true leaves, transplant them at least two inches apart and give them plenty of light for stocky stem development. The seedlings should be transplanted into a pasteurized potting mix. Use either a commercial potting mix or a mixture of one part sand, one part peat moss, and one part good garden soil.

If started in the house, expose seedlings to a south window and rotate the containers regularly to give them uniform light. The temperature should be kept below 80°F but above 45°F.

Planting

Tomatoes should be set in the garden when the weather has warmed and the soil temperature is above 60°F. These conditions usually occur about April 5 in southern Oklahoma and about April 25 in northwestern Oklahoma. Temperatures below 50°F impair tomato growth.

Before planting, remove pots or bands from the transplant root ball. Peat pots can remain. Set the plants slightly deeper than they originally grew so lower leaves are close to the ground. If only leggy plants are available, lay them down in a trench long enough to leave only the top six inches of the plant exposed after covering the stem. This will allow roots to develop along the buried portion of the stem. If the plant is growing in a peat pot, be sure the pot is covered with soil, as exposed portions of the pot act as a wick, allowing the root ball to dry rapidly (Figure 1).

Make the transplant holes three to four inches deep and two to four feet apart in the row. Space rows at least three feet apart for staked or caged plants. For unsupported plants, leave three to five feet between rows.

Set out tomato plants in the evening or on a cloudy day to keep the plants from wilting and getting too dry. Before planting, fill the transplant holes with water and let it soak in. Pack the soil loosely around the plant.

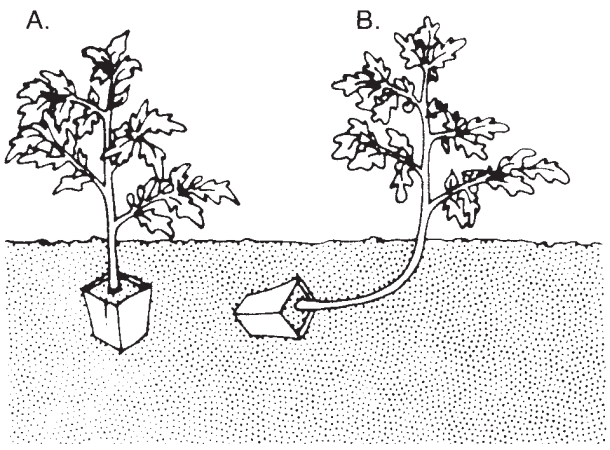

Figure 1. Plant tomatoes slightly deeper than they were first growing (A). If plants are leggy set them as shown (B).

Leave a slightly sunken area around each plant to hold water. After transplanting, water each plant with a starter solution. If soil is heavy or slow to drain, set out tomato plants on raised beds of soil about six inches high (Figure 2).

Care During the Season

Mulch the tomatoes for highest yields. Place a two to three inch layer of organic material such as compost, leaves, or hay around the growing plants. Mulching helps stop weed growth and water loss from the soil.

Tomatoes can be grown on the ground or supported by staking or caging. When staking tomatoes, put the stake in shortly after transplanting to lessen root damage. A six-foot stake set ten inches deep in the soil will work well. As the plant grows taller, tie it loosely to the stake every 12 inches with pieces of rag or twine (Figure 3).

Prune the staked tomatoes to produce a more orderly vine. Remove the small shoots that grow out of the point where each leaf joins the main stem. Remove the shoots by bending them sideways until they snap (see Figure 4). For two main vines, remove all but the shoot immediately below the first flower cluster. It will develop into a second branch.

Caging is another way to train tomato plants. A good cage can be made with a piece of concrete reinforcement wire. Indeterminate (vining) varieties such as Jet Star and Better Boy need a cage five feet tall. Determinate (bush) varieties such as Sunny and Bigset can be grown in cages two and a half feet tall. The cage should be 15 to 18 inches in diameter. Pieces of wire 48 inches long can be used to form a cage about 15 inches in diameter. Put cages over the young plants. Push the cages down into the soil to keep them from blowing over. This way, the vine has support without being tied. (Figure 5). Tomatoes growing in cages do not need to be pruned.

Side Dressing

Fertilizer applied at planting time will not supply adequate nutrients for the entire season. Excess nitrogen in the beginning will create heavy vegetative growth and poor fruit set.

Sidedress the first time when the first fruits are one-third grown. One pound of ammonium nitrate (33-0-0) or equivalent fertilizer per 100-foot row or one level tablespoon per plant can be used. 10-20-10 fertilizer can also be used for sidedressing. Apply three pounds per 100-foot row or about two tablespoons per plant. Mix the fertilizer into the soil then water, being careful not to get the fertilizer on the foliage.

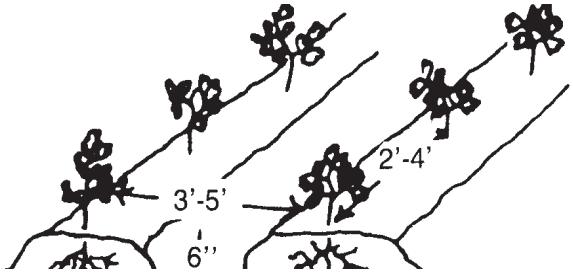

Figure 2. Tomatoes grow best on beds raised to about six inches. Leave enough spacing between rows and plants. For bush varieties that will not be staked or caged, leave two to four feet between plants, and leave three to five feet between rows.

Figure 3. Tomato plants should be tied loosely to support stakes.

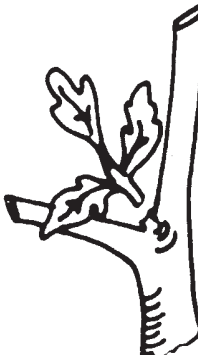

Figure 4. Prune tomatoes by removing small side shoots or suckers as they grow.

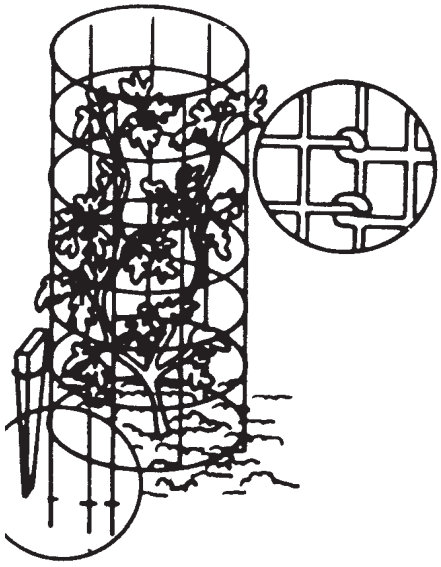

Figure 5. Cages made from reinforcing wire give good support to tomato plants.

A second application should be made two weeks after the first ripe fruit and a third application one month later. Water the plants thoroughly after fertilizing.

Cultivating and Controlling Weeds

Weeds compete for soil moisture and nutrients and may serve as places for harmful insects to reside.

Use mulches to reduce hand weeding and hoeing. Mulches also reduce moisture loss from the soil. Hay, straw, grass clippings, black polyethylene sheeting, or newspapers may be used. Apply organic materials (hay, straw, grass clippings) three to four inches thick to prevent weeds from developing.

Weeds may also be controlled with herbicides. However, chemical weed control in the home garden is difficult because of the diversity of the crops grown in the garden. It is hard to find a herbicide that is selective enough to remove a specific weed without the potential or probability that it will also kill or damage some of the crops being grown in the garden. With several types of plants located close together in a small area, some may be seriously damaged by any herbicide that you might select. The best weed control in the home garden is a sharp hoe and good mulch.

If you cultivate or hoe around the plants, work the soil only deep enough to kill the weeds. Do not damage the plant roots.

Watering

Tomatoes require at least one inch of water per week during May and June and at least two inches per week during July, August, and September.

The soil should be watered thoroughly once or twice per week. Apply enough water to penetrate to a depth of 12 to 18 inches.

Simple, inexpensive equipment for drip irrigation of gardens is available. By this technique plants receive water more efficiently. None of the water comes in contact with the foliage, thereby reducing leaf and fruit disease problems.

The total amount of water applied by the drip irrigation method might be less than half the amount applied in the more conventional way.

Your OSU County Extension educators as well as many garden equipment suppliers have information concerning methods and equipment needs for applying water by drip irrigation methods. See OSU Fact Sheet BAE-1511 for more information.

Harvest

During warm weather tomato fruit should be harvested twice a week. The red color in tomato fruit does not form when temperatures are above 86°F. Fruits allowed to ripen on the vine may be yellowish orange in extreme summer heat. For this reason, it is advisable to pick tomatoes in the pink stage and allow them to ripen indoors for optimum color development. About 70°F is ideal to ripen tomatoes. Light is not necessary to complete this ripening process. After tomatoes are ripened, they may be stored in the refrigerator for about one week at 45 to 50°F.

If fruit is left on the vine to ripen it should be removed from the plant while it is still firm. Allowing the fruit to remain

on the plant until full maturity increases the chances of the fruit cracking. Cracking is more of a problem after rain.

Just before frost in the fall, remove the green tomatoes on the vines, remove the stems, and wipe with a soft cloth. Wrap each tomato in newspaper or waxed paper. Store in a cool, dark area about 55 to 60°F, and check frequently to remove any decaying or damaged fruit. As the fruits begin to turn pink, remove them and ripen at 70°F. You should have ripe tomatoes until Thanksgiving or Christmas using this technique.

Canning

Tomato is one of the most popular foods for home canning. Tomatoes can be safely processed in a water-bath canner. Select only top quality tomatoes for canning. Avoid overripe, decayed, or bruised fruit and fruit picked from dead vines. Tomatoes should be canned using the hot pack method. Add two tablespoons of bottled lemon juice to each quart or one tablespoon per pint. Process pints 35 minutes and quarts 45 minutes. For more information on canning tomatoes, see OSU Circular E-3405, "Selecting, Preparing, and Canning Tomatoes and Tomato Products: Guide 4."

Common Tomato Problems

Physiological Disorders

***Leaf Curl*—**Curling or rolling of the leaves occurs in hot weather or after cultivation or severe pruning. It does not affect yield or quality. Keep plants well watered and do not hoe deeply around plants.

***Blossom End Rot (BER)*—**This condition develops due to moisture shortage when the fruit is forming. Some of the cells die due to insufficient calcium. Then 20 to 30 days later, a dry, leathery depression appears on the blossom side of the fruit. BER is the result of a calcium deficiency in the young fruit due to fluctuations in available moisture in the plant. It can occur when the soil is too dry or when the soil is excessively wet which reduces the root system's capacity to absorb sufficient water.

Provide uniform watering. Use mulch under and around the plants, and do not over fertilize with nitrogen. Protect plants from drying winds.

***Blossom Drop*—**Tomatoes do not set fruit well when the night temperature is below about 60°F or above about 70°F or when the day temperature is consistently above about 92°F. When these conditions occur, flowers will drop or fruit will be misshapen. Hormone-type "blossom-set" sprays can reduce spring bloom drop from low temperatures. "Blossom-set" sprays have very little effect upon the set of tomatoes during high temperature conditions. Avoid excessive nitrogen fertilization.

***Cracking*—**Sudden summer rains or watering after drought may cause fruit cracking. Choose a crack resistant variety since varieties differ in their tendency to crack. Pick fruits in the pink stage and allow them to ripen indoors. Usually tomatoes grown on a trellis show more fruit cracking than non-trellised plants of the same variety. Mulching and regular watering may reduce the problem of cracking. Rainfall and favorable growing conditions after a hot, dry period can cause fruit cracking even on plants that have been thoroughly watered.

***Weed Spray Damage*—**Phenoxy herbicides such as 2,4-D in very small quantities may cause twisting and distortion of tomato stems and leaves. Avoid the use of these sprays close to your garden. Those plants that survive exposure to a herbicide may return to near normal growth and production later in the summer.

Diseases

***Fusarium Wilt*—**The causal fungus is a special form of *Fusarium oxysporum* (*F. oxysporum* f. sp. *lycopersici*). On field-grown plants lower leaves usually turn yellow and die. One or more branches may be affected while others remain symptomless. In addition, leaflets on one side of a petiole may exhibit symptoms while those on the other side appear healthy. Woody vascular tissues of affected stems and petioles become brown. During latter stages of disease development, foliage is wilted and plants eventually die. In gardens, affected leaves may desiccate prior to wilting; in greenhouses, wilting usually occurs during midday when sunlight is bright. The pathogen is both seed and soilborne. The pathogen may reside in soil indefinitely or colonize fibrous root systems of several non-host crops and weeds. Planting resistant tomato cultivars controls Fusarium wilt. There are two common races (one and two) of the pathogen; race three was reported in California, Australia, and Columbia. Nearly all tomato cultivars are resistant to race one. When seed catalogues report Fusarium wilt resistance without reference to race, resistance is conferred to race one. Race two resistance usually is specified when present.

***Verticillium Wilt*—**The causal agents, *Verticillium dahliae* (most common) and *V. alboatrum*, also are soilborne. The pathogens affect nearly 200 plant species including flowers, field crops, trees, fruit, weeds, and most horticultural crops grown commercially or in home gardens. Symptoms of Verticillium wilt often are confused with Fusarium wilt. Plants do not exhibit outward symptoms unless exposed to drought stress or until bearing a heavy fruit load. Early infections may result in stunted plants. Leaf yellowing and death can start at margins and progress inward on oldest leaves. Leaf withering may progress up the plant until only a few leaves remain at shoot tips. Stunted plants occasionally wilt during the day and eventually die. The woody vascular tissue at the base of infected plants is discolored; this symptom, however, may not progress up the plant as far as in *Fusarium* infected plants. Suggested controls for Verticillium wilt include crop rotation (three or four years with corn or grasses is recommended), removal or destruction of infected roots and vines after harvest, and soil solarization. Use of resistant tomato cultivars, however, is most effective and practical.

***Nematodes*—**Root Knot (*Meloidogyne* spp.) is the most common nematode parasite of tomato. Infected roots produce galls that resemble a string of pearls. Many garden tomato cultivars are resistant to Root Knot nematode. Home gardeners have few options for nematode treatment because all nematicides and soil fumigants are restricted-use pesticides. However, several safer methods have been developed which are best suited to home gardens. These include:

- Incorporating green manure crops (small grains) to increase the organic matter content of the soil.
- Chitin applications. University research has shown that the application of chitin will lower nematode numbers.
- Garden site rotation is an excellent method of control but is not practical in most home gardens.

- Crop rotation utilizing non-host crops such as corn and onions. The location of crops within the garden should be moved yearly.
- Sanitation. Roots of infested plants should be removed from the soil soon after harvest. Infested roots should be removed from the garden site and destroyed, preferably by burning or burying in a landfill. Good sanitation practices also involve keeping nematode infested soil out of non-infested sites. Care should be taken to insure that gardening implements, hoe, shovels, rakes, etc., and gardening equipment such as rototillers are free of soil before moving from one gardening site to the next. Wash soil from implements, tools, and equipment.
- Soil solarization – refer to OSU Fact Sheet EPP-7640.

Note: No nematode control method will eliminate nematodes from the garden soil. Some methods will effectively reduce nematode numbers for a short period of time, but the nematode population eventually rebuilds.

Blight and Other Foliar Diseases - Foliar diseases are most prevalent during periods of rainfall and/or warm, humid weather. Important foliar diseases of tomato caused by fungi include early blight (*Alternaria solani*) and Septoria leaf spot (*Septoria lycopersici*). Symptoms of early blight are first evident on older leaves near or in contact with soil. It is characterized by very small yellow lesions that turn black. Lesions enlarge and appear as zonate target spots. During periods of frequent rainfall, fruit are infected and plants defoliate. Exposed fruit are vulnerable to damage by sunburn, and susceptibility to blossom end rot also increases. Symptoms of Septoria leaf spot often are difficult to differentiate from early blight. Plants are susceptible to infection by the fungus during all stages of growth. Small water-soaked lesions are evident on the underside of leaves. As developing lesions enlarge, tissues become sunken, and margins assume a dark brown or black appearance with white or gray centers. Very small, round, black structures (pycnidia) develop in lesions and produce spores that infect healthy tissue. *A. solani* and *S. lycopersici* are soilborne, and rotation out of contaminated garden plots for three to five years is recommended. When purchasing transplants, select disease-free material from reputable distributors, or produce disease-free plants in greenhouses, hot beds, or cold frames. *S. lycopersici* is seedborne; thus, Septoria leaf spot is controlled, in part, by planting pathogen-free seed. Cultural practices (i.e. stake and weave trellis systems or cages) that reduce the duration of leaf wetness result in control of early blight and Septoria leaf spot. Several fungicides available through major garden supply outlets and distributors catering to home garden and farmer's market merchants also are recommended for control.

Common foliar diseases caused by bacteria are bacterial speck (*Pseudomonas syringae* pv. *tomato*) and bacterial spot (*Xanthomonas campestris* pv. *vesicatoria*). Both pathogens produce numerous leaf and fruit spots. Bacterial speck is characterized by very small superficial lesions while symptoms of bacterial spot include water soaked lesions on leaves and raised dark lesions with irregular margins on fruit. The pathogens are seedborne and controlled, in part, by purchasing disease-free seed or transplants. Sanitation practices that include elimination of infected tomato residue and alternate hosts are effective methods of control. Foliar applications of copper fungicides may control bacterial speck and spot; some strains of the bacteria, however, are resistant to copper compounds.

Soil and Foliar/Fruit Surface Pests

(See OSU Extension Facts EPP-7313)

Monitoring Pests: Examine a set number of plants on a weekly basis and record numbers of insect pests noted. If numbers increase from week to week or pests are destroying fruit, control methods should be taken.

White Grubs and Wireworms—Soil-dwelling insects such as wireworms and white grubs may cause serious damage to garden tomatoes, particularly when the area planted was recently occupied by sod or is in an area that is traditionally weedy. Larvae of wireworms are long, cylindrically shaped, tan-brown in color, and resemble a short, thick piece of wire. White grubs are the c-shaped, light-colored larvae produced by May beetles (June bugs). Damage by both pests occurs from larvae feeding on the roots of young plants. When populations of wireworms or white grubs are high, severe stand reduction may result.

Grasses and a variety of weeds serve as alternate hosts; thus clean cultivation and good bed preparation is helpful to prevent damage by soil pests. If the garden area has a history of white grubs or wireworm problems or the tomatoes are to be planted in an area that was grassy or weedy the previous season, an appropriate insecticide should be broadcast and lightly tilled into the soil in the area to be planted prior to planting. However, routine treatment for soil insects is generally not warranted; rather it should be based on a history of the garden area. Control of soil insects on a "rescue" basis after planting is usually not successful.

Cutworms—Cutworms include several insect species whose larvae chew plant stems at the soil surface shortly after transplanting, cutting them at ground level. In general, cutworm problems are sporadic but can occasionally be severe. The dark-colored cutworm moths are active at night and lay eggs on leaves or stems close to the soil surface soon after plants emerge. After hatching, young larvae may feed on leaf surfaces for a short time, but older larvae tunnel into the soil and emerge at night to feed. Dark-colored cutworm larvae may be distinguished from other larvae in tomatoes by their habit of curling into a c-shape when disturbed. Plant stems being cut partially or completely at the soil surface characterize damage by cutworms. Plants begin to wilt and usually die soon.

After transplanting, check daily for wilted plants with completely or partially severed stems. Once you find damaged plants, look for cutworms by digging around the base of plants and sifting the soil for caterpillars. You will not normally find cutworms on the soil surface during the day. A good time to find them is at dawn or at night with a flashlight. Damaged plants often occur in a sequence of four or five within a row.

An effective method of controlling cutworms on tomatoes is to use "collars" around each new transplant to protect young tomatoes from attack. Collars should be removed after about two to four weeks from transplanting so that they do not interfere with normal plant growth. Also, remove weeds in and around the garden to help eliminate sources of additional cutworms. If an insecticide is used, effectiveness is increased by banding the insecticide at the base of the plant, preferably at dusk or shortly before.

***Aphids*—**Aphids are small, soft-bodied insects that remove plant sap through their sucking-type mouthparts. Aphids are recognized by their cornicles ("exhaust pipe-like" appendages) on their abdomen, visible under light magnification. Several aphid species may be serious pests of tomatoes. Aphids live in small compact colonies formed after the immigration of winged adults. Females reproduce asexually and may give birth to several nymphs per day. Because generation time is short (less than two weeks), many generations per year are produced, allowing for tremendous reproductive potential. Damage to tomatoes by aphids is manifested as stunting of growth, distortion of leaves, and potentially a reduction in fruit yield.

Biological and natural control can sometimes be effective in maintaining aphid populations, especially during fall production. Biological control of aphids by small parasitic wasps and predators (such as lady beetles and lacewings) as well as natural mortality from environmental factors (e.g. heavy rain) may cause reductions in aphid populations. Chemical control can be achieved by an array of insecticides provided care is taken to insure good coverage.

***Spider Mites*—**These pests are tiny, barely visible to the naked eye, and have eight legs in the adult form. They may have two dark spots on their backs or be reddish in color. Many generations per year are possible with the life cycle requiring five to twenty days, depending on temperature. Damage by mites results in yellowed patches appearing on leaves and the damaged areas eventually turn bronze or white and become dried up. Once mite colonies are established, the underside of leaves becomes covered with the silken webs. Damage by mites can become quite severe, especially under hot, dry conditions. Early detection of this pest is important to avert damage to tomato plants. To check for spider mites, shake leaves over a white piece of paper to dislodge and locate them.

The key to controlling spider mites is to keep plants healthy and growing fast. However, excessive amounts of nitrogen fertilizer or the repeated use of Sevin insecticide may make mite problems increase. Treatments with miticide (products containing Kelthane work best) should be initiated when mites are detected. Retreatment is generally needed three to five days after the first treatment to kill mites that have recently hatched. Care should be taken to obtain good coverage of the plant with the miticide, especially on the undersides of leaves.

***Flea Beetles*—**Flea beetles are tiny beetles that vary in color from metallic green to dark brown and chew on the foliage of tomatoes.

When present in large numbers, flea beetles can cause severe defoliation of plants. Although larvae can feed on the roots of plants, it is the adult beetle that causes the greatest damage. Through feeding, they make small pits in leaves, which create a "shothole" appearance in the leaf. Their host range is broad and they sometimes move into crops from adjacent weeds in large numbers.

Many of the current cultivars planted provide some resistance to flea beetles. It is important to provide good weed control in and around the garden to reduce the source plants for the beetles. The use of an insecticide becomes necessary when beetles are present in fairly large numbers and a significant amount of defoliation is imminent.

***Tomato Fruitworm*—**This caterpillar varies in color from green, pink, red, yellow, or brown and causes severe damage by boring directly into fruit. Each worm will feed on several tomatoes and generally will feed on the smaller fruit first. They do not eat all the fruit but usually leave it in an unsuitable state. Fruitworms can reach up to one and one half inches in length when full grown. Adult moths lay tiny, white, dome-shaped eggs at night on leaves. Control can best be achieved with sprays of *Bacillus thuringiensis* based insecticides soon after eggs are detected. Control must be achieved before larvae penetrate fruit and before they get large (greater than one fourth inch long).

***Tomato Hornworm*—**These large, green worms with the "horn" on the tail end are mainly foliage feeders; however, they occasionally feed on the fruit. When they feed on fruit, they prefer the large green fruit, and their damage appears as though someone took a bite out of the green tomato. As they feed on the foliage, they eat the entire leaf and small stems, leaving only the larger stems. Hornworms can defoliate large parts of a plant or the entire plant. Control is best achieved by hand picking and squashing the worms or spraying with *Bacillus thuringiensis* based insecticides . Hornworms leave large amounts of compact fecal pellets in their wake, which aids in their detection. If fecal material is found, larvae should be nearby. Generally, these insects are considered nuisances rather than severely damaging pests.

***Tomato Pinworm*—**This small worm is usually difficult to detect. Larvae are small and pale red to purple in color. They first feed on foliage and as they mature begin feeding on fruit. On foliage, young larvae fold and mine leaves, giving leaves a ragged appearance. They enter fruit just beneath the stem attachment and may bore into the core of the tomato fruit. Detection of young larvae is essential for good control. If larvae are allowed to penetrate fruit, control is very difficult. *Bacillus thuringiensis* based insecticides can provide good control when applied as soon as young larvae are detected.

***Colorado Potato Beetle (CPB)*—**Adults are the large, round, yellow, and black striped beetles which are common pests on potatoes and eggplant. They are less common on tomatoes but can occasionally cause severe defoliation to the plants. CPB prefer eggplant and may invade tomato plants as eggplants become less attractive for feeding. Eggs are orange, bullet-shaped, and laid in tight clusters of 5 to 15 eggs. Larvae are gray, balloon-shaped, and may also defoliate plants. This pest may be managed by hand picking if only a few are present but sprays may be needed if the beetles are numerous. Because plants such as nightshade and horsenettle serve as hosts for the beetle, it is helpful to destroy such weeds in and around the garden. Formulations of *Bacillus thuringiensis* based insecticides, specifically designed for beetles (such as Trident or M-one), can provide excellent control of CPB if sprays are targeted against young larvae.

***Blister Beetles*—**Blister beetles are occasional pests that can damage tomatoes by causing extreme defoliation to plants. Several kinds of blister beetles are common in Oklahoma. All have an elongated body with a drooping head. Beetles vary in color, but the yellow and black-striped, black colored, and the gray are the most common. The greatest potential for damage by blister beetles lies in their habit of moving plant to plant in large numbers. By sheer numbers, they can consume an entire plant within a day or so. Early detection and prompt action using an insecticide spray is often necessary

to avert severe damage by this pest. Applying an insecticide to the plants on which they are feeding easily controls blister beetles.

***Thrips*—**Thrips are tiny insects with narrow, elongated bodies. Adult thrips range in color from a pale yellow to dark brown and have feather-like front wings that can be seen under magnification (10-15X). Immature thrips are wingless and usually pale to lemon yellow. Thrips have a broad host range including many weed species as well as a number of cultivated crops. Thrips damage takes on a "silvering" appearance from the rasping of the leaf tissue with their mouthparts. Small black fecal specks are also usually found. Damage to fruit appears as a cloudy discoloration and results in uneven ripening of the maturing fruit.

Generally, thrips damage is considered mostly cosmetic and, therefore, the need for control procedures should be questioned. If cosmetic appearance is important, control should be initiated soon after thrips are detected. Once populations are well established, control is often difficult to regain.

***Stink Bugs*—**Stinkbugs are large flattened shield-shaped bugs that can cause damage to fruit with their piercing mouthparts. Stinkbug feeding can cause sunken pits on the fruit at the site of feeding, resulting in a condition known as "catfacing." These sunken areas fail to color normally as the fruit ripens leaving spots with yellow or green halos. Punctures from stinkbugs can also serve as openings for fruit diseases. Control should be initiated after fruit set and whenever stinkbugs are observed.

***Control of Tomato Insect Pests*—**A wide range of products is available for controlling insect pests on home garden tomatoes. Synthetic, biological, and botanical and organic insecticides can be used. Insecticides do not work equally well on all pests; therefore, correct diagnosis is critical to matching the right insecticide to the identified pest (see Table 1). For additional information on home garden insect control see OSU fact sheet EPP-7313.

Table 1. Insecticide Control of Tomato Insect Pests

1. Synthetic Insecticides	***Pests Controlled***
Malathion	aphids
Diazinon	aphids, fruitworm, pinworm
Dimethoate (Cygon)	aphids, mites, thrips
Sevin	blister beetles, Colorado potato beetle, flea beetles
Kelthane	mites
Thiodan	blister beetles, Colorado potato beetle, flea beetles, grasshoppers, hornworm, mites, pinworms, stink bugs, thrips
Pyrenone, pyrellin (pyrethrins blus PBO)	aphids, beetles, stink bugs, thrips
Insecticidal soap	aphids, mites, thrips
2. Biological Insecticides	
Bacillus thuringiensis var. *kurstaki*	fruitworm, pinworm
Bacillus thuringiensis var. *tenebrionis* or *san diego*	Colorado potato beetle larvae
3. Botanical and Organic Insecticides	
Nicotine sulfate	flea beetles, Colorado potato beetle
Natural pyrethrins	aphids, beetles, fruitworm, pinworm, thrips
Neem extracts (Neemix, Margosan)	aphids, Colorado potato beetle, mites

How to Produce High Quality Tomatoes

1. Select or prepare soil high in organic matter and sufficiently loose to allow for extensive vigorous root growth.
2. Apply needed fertilizers and mix into the soil prior to planting.
3. Obtain husky plants of recommended nematode and wilt resistant varieties. Set them into the garden as early as weather and recommended planting dates permit.
4. Water in newly set plants with a starter solution.
5. Provide protection from cutworms and other possible pests of the transplanting season.
6. Use mulching materials around plants within one month following planting.
7. Apply supplemental water as needed, drip irrigation being preferred.
8. Control insects and spider mites as well as leaf and fruit diseases if numbers are increasing week to week.
9. Windbreaks may be especially desirable as hot, dry weather develops.
10. Maintain the identity of different varieties to evaluate their qualities and thus determine the more appropriate kinds for future plantings.

OSU Extension Facts are also available on the World Wide Web at: **http://agweb.okstate.edu/pearl/**

The following Fact Sheets will be helpful to Oklahoma gardeners:

BAE-1511 "Trickle Irrigation Systems"
HLA-6004 "Oklahoma Garden Planting Guide"
HLA-6005 "Mulching Vegetable Garden Soils"
HLA-6007 "Improving Garden Soil Fertility"
HLA-6013 "Summer Care of the Home Vegetable Garden"
HLA-6020 "Growing Vegetable Transplants"
HLA-6032 "Vegetable Varieties for the Home Garden in Oklahoma"
EPP-7313 "Home Vegetable Garden Insect Pest Control"
EPP-7640 "Solar Heating (Solarization) of Soil in Garden Plots for control of Soil-Borne Plant Diseases"
EPP-7625 "Common Diseases of Tomatoes, Part I: Diseases Caused by Fungi"
EPP-7626 "Common Diseases of Tomatoes, Part II: Diseases Caused by Bacteria, Viruses, and Nematodes"
EPP-7627 "Common Diseases of Tomatoes, Part III: Diseases Not Caused by Pathogens"

The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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