

THE TENNESSEE VEGETABLE GARDEN

PLANT MANAGEMENT PRACTICES

Natalie Bumgarner, Assistant Professor and UT Extension
Residential and Consumer Horticulture Specialist
Department of Plant Sciences

Vegetable production is increasingly popular for Tennessee residents. Growing vegetables at home provides financial and nutritional benefits through the bounty of a fresh harvest, and the activity enhances personal health and well-being. However, a basic understanding of soils, site selection and crop maintenance is required before backyard growers can take full advantage of these benefits of home food production. To meet these needs, this series of fact sheets has been prepared by UT Extension to inform home gardeners and propel them to success in residential vegetable production.

MANAGEMENT OF THE HOME GARDEN

Managing vegetable plants in the home vegetable garden is the critical link between planning and knowledge and a successful harvest. Managing weeds, providing adequate water, and carrying out plant maintenance as well as controlling insects and diseases are essential. This publication will focus on garden and plant management while pests and diseases in the home garden are covered in separate UT Extension publications (W 316 and PB 595).

WEED MANAGEMENT

Definitions of the term “weed” vary, but in this discussion a weed is a plant competing with the intended garden crop for water, nutrients and sunlight. Weeds also can host insects and diseases that can reduce crop yields and quality. Weeds may have advantages over crops in adaptation, root structure, seed characteristics, or flexibility in adjusting to growing conditions. Since weeds often have competitive advantages, steps must be taken to maintain crop productivity. In the home garden, weeds are often more consistently problematic than insects or diseases, which may occur only at certain times or under certain conditions. Weed management may

well be the most important factor in producing success or frustration in the home garden.

It is important to know whether weeds in a garden are annuals or perennials. Annual weeds germinate, grow, mature, produce seeds and die in the same growing season. Perennial weeds live for three years or longer and reproduce by seed or vegetatively through other plant structures, such as rhizomes, tubers and bulbs. It is these storage organs that make perennial weeds particularly challenging in home gardens.

CULTURAL CONTROL FOR WEEDS

The most effective method of garden weed control is prevention. Most of the cultural methods discussed below are intended to reduce weed prevalence over time by reducing their seed germination and/or vegetative reproduction.

Mulches

A mulch is essentially any material that covers the surface of the soil (Table 1). Mulching has several benefits including reducing weed pressure, retaining moisture, moderating temperatures, and improving soil structure. Mulches

can be divided into two broad categories of organic and inorganic.

Organic mulches

This term refers to materials that are or were living and will not refer to certified organic as described by the U.S. Department of Agriculture's National Organics Program. Organic mulches include hay, straw, bark, wood chips, compost and leaves as well as newspapers and cardboard. All of these materials help prevent weeds from emerging and competing with crop plants. Organic mulches are most effective in preventing annual weeds because perennial weeds often can grow through organic mulches. Organic mulches also add to the organic matter content of the soil as they decay. This decomposition reduces waste and removal time at the end of the season. An additional advantage is that they are porous to water, so irrigation is not required as it is with many plastic mulches. Use caution when using bark or other woody mulch materials. Microbial processes that break down these high carbon mulches make use of soil nutrients [especially nitrogen (N)] and can compete with crops for these nutrients. If left on the soil surface, breakdown will occur slowly and pose less risk of disrupting plant uptake of soil nutrients.

Options in organic and biodegradable mulches are becoming more varied and available for home gardeners.

Starch and a range of other polymers can be manufactured into sheets and installed and used much like plastic mulch. These materials are designed to be broken down by microorganisms in the soil so that removal is not needed. Current research is still underway to better understand how adequately weeds are controlled and how environmental conditions affect breakdown.

Inorganic mulches

There are a range of inorganic mulches, such as black polyethylene plastic, available for use by the home gardener. Black plastic mulch warms soil in the spring and suppresses most weeds if it remains intact (Figure 1). Clear plastic is not as useful because it allows light to pass through and can actually, under some conditions, encourage weed growth. White plastic generally prevents weed growth because it reflects light. Reflecting solar radiation can also be beneficial under warm summer conditions in keeping the soil cooler. There are also other colors of plastic specifically designed to reflect or transmit certain wavelengths of light. Irrigation (generally drip as discussed below) is required with all of these non-porous plastic mulches.

Landscape cloth, which is often woven plastic, is permeable to rain. It also can be used sometimes for more than one crop rather than being thrown away seasonally, as is the case for most.

	Black plastic mulch	Woven ground cover	Biodegradable mulches (manufactured)	Straw, hay	Sawdust, wood chips	Grass clippings	Compost
Benefits	Cost-effective, preserves soil moisture, retains heat	May be reused, permeable to water and air	Does not have to be removed at end of season, acts much like plastic mulch	Biodegradable, will add organic matter, low cost	Will add organic matter over time, can often be free	Biodegradable, will add organic matter, low cost	Will add organic matter, will add essential nutrients
Possible Drawbacks	Must be used with irrigation, difficult to recycle, typically only used 1 year	More expensive, must be removed	Timing of breakdown uncertain (depends on location and weather), cost may be higher	Can add weed seed, slows soil warming in early season	Can tie up soil N if incorporated	Can add grass or weed seed	Must be properly composted or can add weed seeds or fungal inoculum

Table 1. Potential benefits and drawbacks of common mulching materials for home gardeners.



Figure 1. Perennial weeds, such as sedge, can be an issue with biodegradable mulches or plastic mulches with holes.

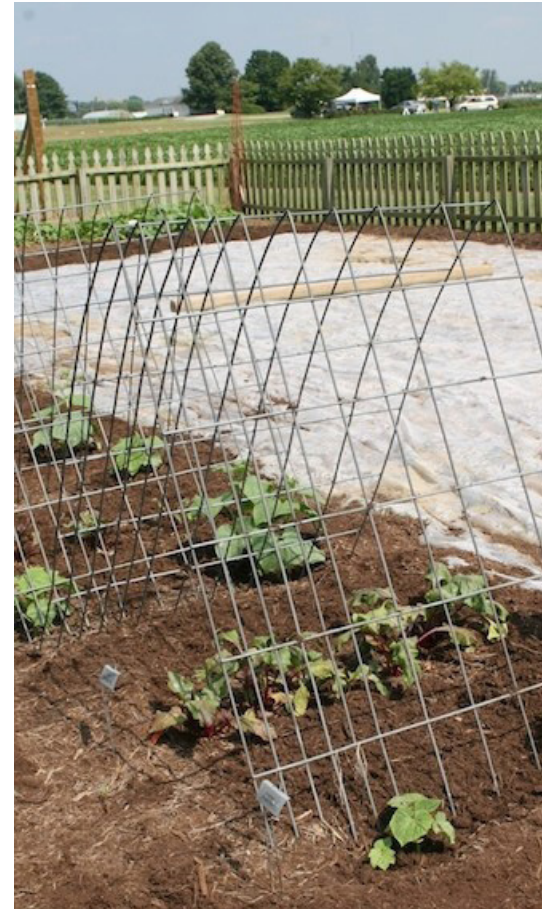


Figure 2. A section of garden being solarized during the main growing season. (Image from PB 1578)

Solarization

The practice of solarization uses clear plastic to trap solar radiation and heat the soil under the plastic to kill weed (primarily annual weeds) seeds (Figure 2). The concept of using heat to eliminate viable weed seeds in the soil is sound, but there are several critical elements needed for success. First, it is necessary to have a summer fallow period because temperatures under the plastic will not be high enough to work well in spring or fall in Tennessee.

Second, make sure that the soil is bare and moist because moist or wet soil will transfer heat needed for solarization. Plastic applied over a smooth soil surface is best. Third, select clear plastic that will withstand four to six weeks outdoors without degrading. Plastic that is UV stabilized (generally 1.5-4.0 mils thick) works well. Used greenhouse or other appropriate plastics can be used for solarization, but make sure that plastic is removed before it degrades or it will be quite

difficult to collect. One or two layers of plastic should be installed over the area being treated. A double layer of plastic will do a better job of minimizing nighttime temperature losses because the air between the layers will serve as an insulator. Use foam or wood spacers to separate the two layers of plastic. The edges of plastic are tightly held down by soil. Keep the plastic as clean as possible to maximize light penetration.

The goal of solarization is to increase soil temperatures to approximately 120 F to 130 F. Plastic is left in place for four to six weeks to ensure that these temperatures have been reached. Keep in mind that this treatment will typically be most effective for weed seeds in the top 2 to 3 inches of soil. Do not deep till after solarization or viable seeds from cooler soil locations will be brought to the soil surface. Many fungal and bacterial diseases can also be reduced by solarization.

Cropping practices

Row spacing is one of the most overlooked methods for reducing weed competition in vegetable gardens. One example is the use of a double or triple row. Crops such as beets, radishes or leaf lettuce can be planted closely in multiple rows to enable their leaves to cover soil more quickly. This covering of bare soil by crops is referred to as canopy closure and is a very effective way to reduce the competitiveness of weed seedlings by reducing the amount of sunlight they receive for photosynthesis. Never space vegetable crops further apart than is recommended. Cover crops, such as annual rye or buckwheat, can also reduce weed pressure by smothering, or quickly forming a thick cover, to prevent weed seed germination. Ryegrasses can also produce substances that reduce weed seed germination.

MECHANICAL CONTROL OF WEEDS

HAND OR MACHINE WEED MANAGEMENT

Mechanical weed control removes young weeds to prevent them from competing with crops and maturing to produce seed. Mechanical methods include hand pulling or hoeing and the use of a range of tillage equipment. A major benefit of mechanical weed control is that the results are immediate. However, it is quite time consuming and sometimes effects are rather short lived. It helps to understand the life cycle of the weed. If dealing with an annual weed that germinated from seed, pulling it before it has a chance to produce more seeds can be very effective. If dealing with a perennial weed that has underground stems or other storage organs capable of producing new plants, tilling or hoeing will break up these structures and often lead to further spreading of the weed.

When mechanically removing weeds, be sure to till or hoe only in the top 2 inches of soil to prevent damage to the crop roots and conserve soil moisture. Deeper tillage will also expose more soil to sunlight and enable more seeds to germinate.

In addition to tillage practices, a flame or torch can be used to control weeds. Propane torches are the most common types of flamers. While flaming can be time consuming, it can be effective for a range of broadleaf weeds and some weedy grasses. Flaming is also considered organic. Care should be taken to protect crops when flaming in close proximity.

Some gardeners discontinue weed removal when vegetable plants become more mature. This can be a time saver and it may not impact yield in the crops nearing maturity. However, these remaining weeds may mature and produce seeds to cause problems again the next year. Periodic mowing and/or tilling after the garden is abandoned will also reduce seed production.

STALE SEEDBED TECHNIQUE

The stale seedbed technique combines mechanical tillage with other weed control practices. Soil is prepared two to three weeks prior to the desired planting time with the intent to expose weed seeds to conditions that cause them to germinate. During one to two weeks of reasonably moist soil and warm temperatures, many weed seeds will germinate. Then, prior to planting, these young weeds are killed either by flaming or by using herbicides (see below). It is important not to till or otherwise disturb the soil after treatment or other weed seeds will be brought to the soil surface to germinate. If properly done, this technique can provide a good planting surface with many fewer weed issues as young plants are becoming established.

CHEMICAL CONTROL FOR WEEDS

Herbicides are probably the least commonly used tool for weed control by home gardeners. While herbicides are increasingly common in production agriculture, there are often fewer products available for homeowner use. Additional challenges of herbicide use for home gardeners are familiarity with materials, purchase and calibration of sprayers, and application technique.

Gardeners should know some basic concepts before deciding whether to use herbicides. The first important concept is the difference between pre-emergence and post-emergence herbicides. To be effective, pre-emergence products must be applied before a weed seed germinates. As their name implies, post-emergence herbicides only control actively growing weeds. Pre-emergence products have the advantage of being applied when crops are not present. However, they have a more narrow range of application times than post-emergence products. It is important to weigh the risks versus the benefits of both types of products. Within the categories of pre- and post-emergence are products that are selective for specific weeds

and those that are effective against a range of plants (non-selective). No matter the product that is chosen, always carefully read and follow the application instructions on the label. Further information can be found in UT Extension publication W 245.

WATER MANAGEMENT

Soil moisture is critical for seed germination, transplant establishment and proper plant development. Due to different rooting patterns, there are differences in the ability of warm- and cool-season crops to tolerate low soil moisture or extended periods of drought. Cool-season crops often have shallow root systems that do not handle the stress of water deficiency well. Warm-season crops often have deeper tap roots and are better able to survive under low water conditions. Regardless of the plant type, yield and often crop quality will be reduced if water is not consistently available throughout the growth season.

General estimated water needs for garden crops are 1 to 1.5 inches per week. If rainfall does not reach these levels, then supplemental watering is needed. In Tennessee, late summer and early fall are often the lowest rainfall times of year. Many crops are setting fruit and filling fruit or germinating (fall cool season crops) during this time, so irrigation is often needed to optimize crop productivity.

OVERHEAD IRRIGATION

One of the most common methods of watering home gardens is overhead. This can be accomplished by carrying water and delivering it by hand or by using a water hose. Other overhead methods are using sprinkler systems commonly used to water lawns. Benefits of sprinklers include their relative cost efficiency and ease of use. They can be connected to water hose and moved to different areas of the



Figure 3. Drip irrigation used with organic mulch for peppers.

garden as needed. Drawbacks include non-uniform water delivery and the fact that water is always applied to the leaves. Care must be taken to allow the leaves to dry before nightfall when using overhead irrigation or there is an increased risk of disease. Finally, overhead irrigation often results in more water use because all crop rows and walkways are irrigated and water evaporates from both soil and leaf surfaces.

DRIP IRRIGATION

Soaker hose

These hoses are readily available and can be an easy and more efficient method of watering than overhead irrigation. A drawback is that hundreds of feet of soaker hose can be expensive for large gardens or the gardener must move hoses to water different areas of

the garden. Another limitation is that soaker hoses do not always deliver water evenly along their length.

Trickle or drip tape

Simple drip irrigation systems can be relatively economical and work quite well for the home gardener (Figure 3). Leaf surfaces remain dry, water is conserved by being placed directly where it is needed, and an even application can be achieved. Some of the most common drip irrigation systems are installed using drip tape. This tape is a thin wall plastic that has water emitters embedded in the plastic or at specific intervals. The space between emitters can be varied based on soil type (closer for sandy soils than clay soils), plant type or seeding rate. Drip systems can be installed to automatically operate by using timers or they can simply be connected to a water hose when irrigation is required.

SOIL WATER MANAGEMENT AND OTHER PRACTICES

Soil water management is related to many other practices in the home garden. Mulching can reduce soil water loss and the need for irrigation. Maintaining proper soil moisture is also useful in making the best use of fertilizers. When the soil is dry, plant nutrient uptake is limited because most nutrients are taken up with water by the roots and move in water throughout the plant. Side-dressing and other fertilization practices are often recommended in conjunction with watering to make the nutrients more available to the plants. Conversely, excessive watering can leach the nutrients away from the plant roots and cause nutrient runoff and soil erosion. Proper water management supports both production and stewardship in the garden.

PLANT MAINTENANCE

SUPPORT

Physically supporting certain vegetable plants in the garden can help produce the best harvest. Plants that are supported:

- Can better intercept light to optimize fruit production.
- May be healthier due to increased air movement around the leaves and less splash of soil particles that can spread disease.
- May take up less space and reduce management time in the home garden.

VEGETABLE CROP SUPPORT OPTIONS

Stakes — Metal or wooden stakes can be used to support single plants. This method is common for tomatoes, peppers, eggplants or other upright fruiting crops. Stakes can improve access to the fruit, but they also require additional time to tie each plant to the stake multiple times during the season. Stakes can also be used to form

support tents or teepees often used for pole beans.

Cages — These structures are generally freestanding metal units to support tomatoes, peppers, or a range of vining bean and pea plants. While they do allow easy access to the fruit, the cage must be carefully sized to support the weight of the mature plant. Metal panels can also support vine crops (Figure 2).

Trellises — A trellis system can be constructed of wood, plastic or twine. The general principle is to provide a flat, vertical structure or a string to support plants as they grow and bear fruit. It is most common to see trellises used for plants that have tendrils or the means to attach themselves to the trellis. Cucumbers, beans, peas, winter squash and melons are all crops that can be trellised easily. For the larger fruited vining crops, support must be added for the fruit. Clips or string can be used to attach plant stems to the string or trellis if needed for tomatoes (primarily indeterminate- see below), peppers and other crops without tendrils.

Stake and twine systems — One of the most common methods of growing tomatoes commercially (mostly

determinate tomatoes that have a more compact plant habit- see below) can also be adapted for the home garden. The system is essentially a combination of stakes and twines that creates a twine basket for a whole row of tomato plants by weaving twine among the plants and around the stakes. Figure 4 illustrates this training system, which can be time efficient and effective for gardens with few or many tomato plants.

PRUNING

There are several reasons that vegetable plants are pruned, and different methods serve different purposes. Pruning is more complex in perennial plants because pruning impacts production for several years into the future. In vegetable crops, the results of pruning occur more quickly.

Use support for optimum production/health	Use support for space efficiency	May benefit from support	Do not need support
Pole beans, snap and shell peas, tomatoes	Vining cucumbers, watermelons, muskmelons, winter squash	Bush beans, compact cucumber and winter squash cultivars, peppers, eggplant, okra	Lettuce, beets, spinach, cabbage, broccoli, cauliflower, kale, radish, carrots, Swiss chard, summer squash

Table 3. Vegetable crops categorized by their need for vertical supports.



Figure 4. The stake and weave system (also called the Florida weave) that combines wooden stakes with multiple levels of twine to support plants in a row.

- Pruning increases light and air flow and/or decreases the risk of disease. This type of pruning is common in fruit trees and grapevines, but can also be done for vegetables. Any damaged or diseased leaves that could spread disease are removed. Sometimes the lower leaves that could have contaminated soil splashed on them are also removed.

- Pruning can increase the quality or size of the fruit. One of the most common reasons for pruning is to manage the fruit load. This is common in tomatoes as well as muskmelon, winter squash and watermelon. If a plant is allowed to continue to set fruit without any “control,” there may not be enough plant sugars to support all of the fruit. By carefully removing

some fruit, what remains can receive more support from the plant in order to reach a better size and even quality. An example would be heirloom tomatoes that may set more fruit than they can fill to a nice, large size or pumpkins where one large fruit may be more desirable than five smaller ones.

- Pruning manages growth and pushes plants to invest energy in fruit production. Indeterminate tomatoes are one of the crops most commonly pruned for this reason. Indeterminate means that the primary growing point continues to produce leaves and flowers for the whole life of the plant. New fruit is constantly being produced while older fruit is maturing. To maintain a balance between growing new leaves and fruit and maturing

older fruit, new branches are removed from the plant. This is called removing suckers. Determinate tomatoes are not commonly pruned this heavily because they will produce a set number of leaves and then stop. Fruit is produced over a shorter window of time and there is less need to prune the plant to maintain balance between leaves and fruit.