W 346-B

THE TENNESSEE VEGETABLE GARDEN

GARDEN PLANNING, PLANT PREPARATION AND PLANTING

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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.

GARDEN PLANNING

Garden planning has the potential to save time, money and space. Garden plans enable growers to allocate space for crops ahead of time, estimate seed quantities to improve economy, and provide a guide when seeding and transplanting time arrives. It is best to lay out the planting arrangement on graph paper or input it into one of many gardening computer programs. This planning will allow visualization of the garden and support the efficient use of space and time. Additionally, proper planning and record-keeping in the garden is an asset in cultural management and disease prevention, as proper spacing and crop rotation in the garden can reduce disease pressure. For more information, see UT Extension publication W 316.

Figure 1. *Young, healthy tomato seedlings.*

SELECTING VEGETABLE CROPS FOR GROWING SEASONS

Vegetable crops are generally classified as warm season or cool season according to the temperature ranges they require or prefer.

WARM-SEASON VEGETABLES

Warm-season vegetables are most productive in higher temperature ranges (late spring, summer) and are better able to grow and produce a quality crop through Tennessee's summer heat. They are damaged or killed by frost and freezing conditions; even cool, non-freezing temperatures may prevent them from growing and yielding well. So, paying attention to local frost dates is especially important in selecting planting dates (Table 1).

COOL-SEASON VEGETABLES

Cool-season vegetables can withstand temperatures below 32 F (how far below varies by crop and situation) and are generally more productive and have higher quality produce when grown during cooler spring and fall seasons. Because of these attributes, cool-season crops are planted in the late winter or early spring to avoid the hottest part of the summer. They can often be seeded again in the late summer to provide another crop during the fall season. Please refer to Table 2 for a general listing of cool- and warm-season crops and planting seasons.

LOCATION	Bristol	Chattanooga	Clarksville	Crossville	Jackson	Knoxville	Memphis	Mountain City	Nashville
Last spring frost	May 3	April 17	April 27	May 10	April 19	April 28	April 9	May 26	April 21
First fall frost	Oct. 6	Oct. 21	Oct. 4	Sept. 28	Oct. 9	Oct. 8	Oct. 30	Sept 18	Oct. 10

Table 1. *Safe planting dates with only a 10 percent chance of temperatures lower than 32 F after (spring) or before (fall) that date as determined by 30-year NOAA weather data from local stations.*

Early to mid-spring planted, vegetables for late spring and early summer harvest	*Seeds*	*Transplant*	*Late-spring to summer planted vegetables for summer and early fall harvest*	*Seeds*	*Transplant*	*Summer-planted vegetables for fall harvest*	*Seeds*	*Transplant*
Beets	X		Beans, Bush/Pole/Lima	X		**Broccoli**		X
Broccoli		X	Muskmelon	X	X	**Cabbage**		X
Cabbage		X	Sweet Corn	X		**Cauliflower**		X
Cauliflower		X	Cucumber	X	X	**Collards**	X	
Carrots	X		Eggplant	X	X	Cucumber	X	X
Kale, Collards	X		Okra	X		**Kale**	X	
Kohlrabi	X	X	Peas, field/southern	X		**Kohlrabi**	X	X
Lettuce, leaf/head	X	X	Pepper, sweet/hot		X	**Lettuce, leaf/head**	X	X
Mustard	X		Pumpkins	X	X	**Mustard**	X	
Onions (also sets)	X		Malabar spinach	X		**Potatoes**	Seed piece	
Peas, English/snap	X		Squash, summer/winter	X	X	**Radish**	X	
Potatoes, Irish	Seed piece		Sweet Potato (slips)		X	**Spinach**	X	
Radishes	X		Tomatoes		X	Squash, summer	X	X
Spinach	X		Watermelon	X	X	Tomatoes (determinate)		X
Swiss Chard	X					**Turnips**	X	
Turnips	X							

Table 2. *List of vegetables and planting seasons in Tennessee (cool-season crops in bold lettering).*

SELECTING VARIETIES AND PURCHASING SEEDS

Selecting varieties of crops for home gardens should be based on the level of disease resistance; whether the growth habit of the crop will fit the garden space and cropping plan; and the taste preference of the gardener. UT Extension trial information on cultivars that perform well in various parts of Tennessee will be added to future publications.

High-quality seed is essential for the home gardener so that garden space and time will not be wasted on poor-quality seed or weak seedlings. Purchase seed from a reputable supplier for the current growing season and store it properly to ensure maximum productivity. Seed can be collected from previous crops in some instances, but be cautious. Many crops are hybrids, which means that the seed was produced from a cross of two specific parents to produce seed with desirable traits. A plant grown from seed collected from a hybrid plant will not have identical attributes to its parent, and it will often produce low yields and inferior quality produce. Only save seed from non-hybrid crops. Additionally, many diseases can be seed-borne, so only collect and reuse seed from healthy plants.

PURCHASING OR STARTING TRANSPLANTS

There are two main methods of planting vegetable crops. The first is directly seeding into well-prepared soil, and the second is to purchase or grow plants for transplanting into garden soil. Most gardeners use both methods and select some crops for direct seeding and others for transplanting (see Table 2). Both warm- and cool-season crops are commonly transplanted. Some of the most common crops to be transplanted are tomatoes (Figure 1), peppers, eggplants, cabbage, cauliflower, broccoli and Brussels sprouts. While roots are somewhat tender in cucumbers, muskmelons, watermelon and summer squash, these plants also can be successfully transplanted if handled carefully. These crops also can be seeded in biodegradable pots so that roots will not need to be disturbed. Large seeded crops — such as beans, peas and corn — as well as root crops — such as radishes, beets and carrots — are almost always direct seeded.

Home vegetable growers can purchase transplants at a greenhouse or garden center, but transplants can also be produced at home with proper care and attention. This scenario can be an advantage in providing preferred or heirloom cultivars for your home garden. Keep in mind, though, that it will take several weeks preparation to have plants ready for transplanting into the garden at the appropriate time (Table 3). Specific practices will be discussed in the next section.

When purchasing vegetable transplants, select carefully. Choose plants that are free from all signs of insects or disease and are stocky and do not have damaged or yellow leaves. Transplants should be a healthy green color to indicate they are not nutrient deficient (Figure 2). Also, choose plants that are not too old or stunted. Very mature transplants (especially broccoli or cauliflower) may not produce well after transplanting. This is not the time to shop for bargains because transplant health often directly impacts production.

Also, consider the conditions that the transplants are being grown in when purchased. Sometimes if purchased directly from a greenhouse, the plants may not have been hardened off. This term refers to slowly subjecting plants to conditions more like what they will experience in the garden, which lowers stress and plant loss when they are transplanted. Typically plants are hardened for one to two weeks prior to transplant in the garden. See Table 3 for additional information on hardening vegetable transplants.

Figure 2. *Tomato transplants that show signs of nutrient stress (yellowed leaves) and insect damage in the greenhouse.*

LOCATIONS AND MATERIALS

The best location for starting vegetable garden transplants is a home greenhouse. A greenhouse can provide the opportunity to control temperature and humidity while maintaining optimum light. However, relatively few people have this option. Transplants can be started indoors if proper conditions, especially light and temperature, can be maintained. Additionally, a cold frame or hotbed can be an economical and suitable location for starting transplants.

The most common materials needed for transplant production are containers and equipment for temperature and light management. Containers, such as seeding flats, and pots are best purchased new or thoroughly cleaned and sterilized before reuse. The horticulture industry offers a large selection of pot sizes in both plastic and biodegradable materials.

MEDIA AND FERTILIZATION

One of the advantages of vegetable transplants is that they can be started in a media optimized for seed germination and young plant growth. Often germination and seedling production mixes are formulated from peat moss, perlite and vermiculite (super-heated rock and clay materials) to provide optimum water holding as well as aeration in the growing media. All of these materials can also be purchased in a pre-mixed, sterile media for seed germination (Figure 3).

Fertilization requirements depends upon the media. Many mixes specifically prepared for seedling transplant production will have fertilizers included that slowly make nutrients available for young plant use. Such slow-release fertilizers may be sufficient for the four to six weeks transplant production period. If using a media without fertilizers included, use a pre-mixed soluble fertilizer provided with plant watering at half strength once to twice each week. This should be sufficient for many young plants. Monitor leaves for strong green color. Yellowing or purpling can suggest nutrient deficiencies or other issues with media pH or temperature (Table 4).

TEMPERATURE CONDITIONS

For optimum germination and young plant growth, temperature is critical. In fact, poor germination is often caused by temperatures below or above optimum levels. Table 3 describes important temperature conditions for a range of commonly transplanted crops. In general, seed germination and seedling production (after germination) temperatures are lower for cool-season crops. Temperatures should be relatively consistent during germination, and an electric germination mat can be useful to ensure optimum temperatures. Heat mats can be purchased in a variety of sizes, and the best types are those with thermostats to enable precise temperature ranges for specific crops.

After germination, young transplants will generally respond well to night temperatures that are slightly cooler than day temperatures. This temperature change will assist in producing shorter, stockier plants ready for successful transplant into the garden.

Vegetable	Approximate growing time (wks)	Germination temperature (F)	Growing Temperature (F)	Conditions for hardening
Cool Season				
Broccoli, cabbage, cauliflower	5 to 7	70°	60 to 65°	50 to 55° for 10 days
Lettuce	4 to 6	70°	60 to 65°	Reduce temperature and moisture
Warm Season				
Cucumber and squash	2 to 3	75°	65 to 75°	Reduce moisture
Eggplant	6 to 8	75°	70 to 75°	Reduce moisture
Pepper	7 to 9	75°	70 to 75°	Reduce moisture
Tomato	5 to 7	75°	65 to 75°	Reduce moisture
Watermelon and muskmelon	3 to 5	80-85°	75 to 85°	Reduce moisture

Table 3. *Germination, growth and transplant hardening conditions required for home vegetable transplants.*
(Revised from a similar table in UT Extension publication SP291-A)

Figure 3. *Tomato seedlings soon after transplant on a greenhouse bench in new trays containing a sterile soilless mix that drains well.*

MOISTURE CONDITIONS

Maintaining appropriate moisture in the growing media is essential for proper plant growth and health. Media should be kept slightly moist, but not saturated from seeding through early growth to avoid "damping off." Damping off is the death of a seed before germination or a young plant soon after emergence. It is caused by a group of diseases affecting seeds and young plants that are most damaging when media is kept too moist. In addition to proper watering, a challenging aspect of maintaining proper moisture conditions for young transplants is ventilation. Maintaining gentle but consistent air movement enables media to slowly dry. This slow drying of media creates a regular need for watering and helps prevent constant saturation and disease development in young seedlings. A small fan is often helpful in the seedling production area.

LIGHTING CONDITIONS

Adequate lighting can be challenging for home transplant production. Even strong light from a south-facing window in the home is generally not sufficient to produce healthy transplants. Higher levels of natural sunlight or supplemental lighting are often needed to produce ideal transplants in the home. Fluorescent grow lights are common and cost effective for small-scale transplant production. Newer technologies, such as light emitting diodes (LEDs) can be good light sources for young plants, but the initial purchase price can be higher than other lighting types. Fluorescent and LED lights provide less heat during operation than high-intensity lights, and they can simplify home production because lights can be placed closer to plants. A general rule of thumb is to place a fluorescent or LED light 4 to 8 inches from plants.

Closely observe seedlings. If stems elongate and have long distances between leaves, "stretching" may be occurring because lights are either too high or need to be on for a longer period (Table 4). Use care to purchase lights from high-quality suppliers that were developed for plant growth to ensure that optimum wavelengths of light are provided. High-quality lights should provide years of reliable, safe service.

COMMON PROBLEM	POSSIBLE CAUSE(S)
Seed does not emerge.	Seed is old or was improperly stored. Media is too wet or dry. Temperature is too low or high. Seed is planted too deeply.
Seedlings look pinched at the soil line and fall over or die (often referred to as damping off, which can be caused by more than one pathogen).	Over watering. Temperature too high or low. Poor ventilation (air movement). Media or containers not sterile. Light intensity is too low.
Tall, straggly seedlings.	Light intensity is too low. Nitrogen fertilization is too high. Night temperature is too high. Plants are too closely spaced
Older yellow leaves.	Nitrogen fertilization is needed.
Purple leaves.	Phosphorus is deficient. Temperature is too low.

Table 4. *Troubleshooting common vegetable transplants production issues.* (Revised from a similar table in UT Extension publication SP291-A)

GARDEN PLANTING

SEEDING IN THE GARDEN

Many crops are seeded directly into well-prepared garden soil. To ensure proper germination, it is important to understand planting times, rates and depth. Planting times correspond to the warm- and cool-season crops previously discussed. Keep in mind that the dates given in Table 5 are estimates and can often vary from one area of the state or season to another.

Seeding rate is important for ensuring that adequate plants are present to provide yield. The rate is also important to prevent overcrowding, which can reduce yield, increase management time and disease risks, and waste seed. Seeding depth is important to enable seeds to take up enough water to germinate and begin rooting at the proper depth. It is common to seed small seeds shallower than larger seeds. A seedbed should have soil that is moist, crumbly and fine so that seed have good contact with soil to quickly take up water (the first step in seed germination, Figure 4). A general rule of thumb is to plant seed at a depth that is two to four times their diameter. Table 5 gives information on seeding rate and season for some of the most common home vegetable crops.

Figure 4. *A young pea plant emerging from uniformly moist and well-prepared garden soil.*

TRANSPLANTING IN THE GARDEN

Transplanting seedlings successfully depends on having quality plants that have been hardened off as described earlier in this document. It also relies on choosing a day and time when the least stress will be applied to the young plant. Transplanting on a cloudy day or during the late afternoon or evening can reduce daytime heat and light stress on the young plant. Good soil preparation and moisture content will also aid the young plant. Most seedlings are placed in the garden soil at or slightly below the soil level in the current container. It is best to slightly cover the growing media with soil to prevent rapid drying and possible damage to young roots. A starter fertilizer and consistent water after transplanting will lower stress and support early growth.

Vegetable	Spring planting	Fall planting	Seeds or plants per 100-ft row	Inches between rows	Inches between plants*	Planting depth (in)
Beans, snap	4/10 to 6/30	7/1 to 8/15	¼ lb. seed	24 to 36, bush 36 to 48, pole	3 to 4	1 to 1½
Beans, lima	5/1 to 6/30		½ lb. seed	24 to 36, bush 36 to 48, pole	3 to 4	1 to 1½
Beets	3/1 to 4/15	9/1 to 10/1	½ oz. seed	14 to 36	2 to 3	½
Broccoli	3/15 to 4/15	8/1 to 9/1	65-80 plants	24 to 36	15	
Cabbage	3/15 to 4/15	8/1 to 9/1	65-80 plants	24 to 36	15	
Cauliflower	3/15 to 4/15	7/15 to 8/15	65-80 plants	24 to 36	15	
Carrots	3/1 to 5/1	8/1 to 9/1	¼ oz. seed	14 to 36	2 to 3	¼
Collards	2/15 to 4/15	7/15 to 9/1	¼ oz. seed	18 to 36	15	¼ to ½
Corn	4/15 to 7/1		¼ lb. seed	36	8 to 12	1 to 2
Cucumber	5/1 to 6/15	7/15 to 8/15	¼ oz. seed	72	12	½ to 1
Eggplant	5/1 to 6/15		50 plants	36	24	
Kale	2/15 to 4/15	8/1 to 9/15	¼ oz. seed	18 to 36	12 to 15	¼ to ½
Lettuce, head	3/1 to 4/15	8/1 to 9/15	¼ oz. seed	14 to 36	12 to 15	¼
Lettuce, leaf	3/1 to 4/15	8/1 to 9/15	½ oz. seed	14 to 36	6	¼
Muskmelon	5/1 to 6/15		¼ oz. seed	72	24	½ to ¾
Mustard	2/15 to 4/15	7/1 to 9/1	¼ oz. seed	14 to 36	5 to 10	¼
Okra	5/1 to 6/15		1 oz. seed	36	6 to 12	1
Onion	3/1 to 4/15		200 to 400 sets, storage 400 to 600 sets, bunch	14 to 36	3 to 6, storage 2 to 3, bunch	1 to 2
Peas, English and snap	2/15 to 4/15		½ to 1 lb. seed	12 to 36	2 to 4	1
Pepper	5/1 to 6/15		60 plants	36	18 to 24	
Potatoes, Irish	3/1 to 4/15	7/1 to 7/31	14 lb. seed	30 to 36	12	3 to 5
Pumpkin	5/1 to 6/30		1 oz. seed	120 to 144	48	1
Radish	3/1 to 4/15	8/1 to 10/1	½ oz. seed	14 to 36	1 to 2	¼ to ½
Spinach	2/15 to 4/15	9/1 to 10/1	1 oz. seed	14 to 36	3 to 4	¼ to ½
Squash, summer	5/1 to 6/30	7/1 to 8/1	1 oz. seed	48 to 60	12 to 24	1
Squash, winter	5/1 to 6/30		1 oz. seed	72 to 96	24 to 36	1
Swiss chard	3/1 to 4/15	9/1 to 10/1	½ oz. seed	18 to 36	6 to 8	½
Sweet potato	5/1 to 6/30		100 slips	36	12	
Tomatoes	4/15 to 6/30	7/1 to 7/15	50 plants	48 to 60	24 to 36	
Turnips (greens, roots)	3/1 to 4/15	7/15 to 9/1	¼ to ½ oz. seed	18 to 36	2 to 4	¼ to ½
Watermelon	5/1 to 6/30		¼ oz. seed	120 to 144	48	1

Table 5. *Guide to direct seeding and transplanting common vegetable crops in the home garden in Tennessee.*
(Revised from similar tables in UT Publications SP-291O and SP-291P)

** Thinning may be needed after plants emerge to achieve this spacing*

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