Texas EARTH-KIND™

Gardening Guidelines

A new age is dawning in America and around the world. It is an age of environmental awareness, the knowledge that we must act now — not tomorrow, not next week — to protect our environment.

To promote environmental awareness, the Texas Agricultural Extension Service has implemented the EARTH-KIND™ program. This program combines the best organic and traditional gardening principles to create a new horticultural system for the 1990s and beyond, a proven system based on real-world effectiveness and environmental responsibility.

Scientific studies show that by faithfully using EARTH-KIND™ gardening and landscaping techniques, you can enjoy success with your plants and protect our fragile environment. There is no magic, no miracle product, no secret formula involved; just sound, workable technology which can be easily understood and explained.

EARTH-KIND™ products and procedures offer all the opportunity to do their fair share to protect the environment. After all, each of us is and should be responsible for our own landscapes and gardens. If we do our fair share and practice environmentally-responsible landscaping and gardening techniques, a major step will be taken toward ridding the world of the polluting effects of waste and contamination.¶

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Inside. . .

Make Gardening Economical

Some vegetables are more “space efficient” than others. That is, they return a higher monetary value for the garden space they occupy.

Vegetable value can be obtained either by price per pound or by yield. For example, broccoli may yield a 2-pound head, which would usually be moderately expensive at the supermarket. By comparison, zucchini squash may cost only one-third as much per pound at the store, but one plant can easily produce 10 or 15 pounds of fresh squash.

Some vegetables mature so rapidly that they take up garden space for only a short time. Therefore, multiple crops can be grown, increasing the dollar-per-square-foot return during the growing season. Recently, garden experts across the United States cooperated in a survey to rate vegetables by their value. They considered total yield per square foot, average value per pound harvested and time from seed to harvest. Vegetables were rated with 10 points being the maximum. No vegetable hit the 10-point rating because no single vegetable performs well under all soil and climatic conditions.

The top ranking vegetables were tomatoes grown on supports to save space (9), green bunching onions (8.2), leaf lettuce (7.4), turnips for greens or roots (7.4), squash (7.2), onion bulbs for storage (6.9) and pole beans (6.8). An intermediately-economical group included beets grown for green tops and roots (6.6), bush beans (6.5), carrots (6.5), cucumbers grown on supports (6.5), peppers (6.4), broccoli (6.3), kohlrabi (6.3), Swiss chard (6.3), mustard greens (6.2), spinach (6.2), pole Lima beans (6.1), radishes (6.1), cabbage (6.0), leeks (5.9), collards (5.8), okra (5.7), kale (5.6), cauliflower (5.3) and eggplant (5.2). The “losers,” as far as economical production is concerned, are Brussels sprouts (4.3), celery (4.3), peas (4.3), sweet corn (4.1), winter squash (3.8), melons (3.8), water-melons (3.8) and pumpkins (1.9).

With this information on potential yields of vegetable crops, survey your family to decide what to grow. If they won’t eat it, don't grow it!¶

Tools of the Trade

Basic gardening tools include a spading fork, shovel, rake and hoe. Other tools may be purchased to make gardening easier, but should not be considered absolutely necessary for successful gardening. When purchasing garden tools, make certain they are well built and sturdy. Avoid bargain tools which obviously will not last more than one or two gardening seasons.

Rototillers make the task of soil preparation much easier, but for many gardeners they are not a wise purchase. Such equipment is expensive, but can serve a purpose in a larger garden. For most small backyard gardens, it may be better to rent a rototiller from a local rental center rather than to buy one. Rototillers may be used only once or twice a year, and it is difficult to justify such an expense.¶

Plan Garden--Then Plant

You have decided to grow a garden. So, where do you start?

First, make sure you have room for a garden. You won't need a lot of space if you are a beginner with an average-size family. Your garden may only be 20 feet by 30 feet or even less.

Whatever size garden you have, plan it around four basic requirements. First, your garden needs sunlight. All vegetables need some sun and most vegetables must have full sun to achieve the highest yields of quality produce. Unless you are concentrating on leaf or bulb crops, such as broccoli, collards, spinach or onions, your crops need every available ray of sunshine.

Next, consider the location of your garden. Locate your garden close to the house so that watching it will not be a chore. A garden does not demand constant care and attention, but it does much better if you visit it once a day. If you do not check your garden regularly, insects, diseases or lack of water can destroy it in a short time.

Next, consider the soil. Ideally the soil should be fertile and easy to till with just the right texture — a loose, well-drained, loamy soil. If your soil does not meet these specifications, don't panic. You can work it into shape without breaking your back.

Avoid areas heavily infested with Johnson grass, nutgrass and other weeds. Don’t put your garden on a rocky ledge or in a poorly-drained area. These things make gardening more difficult.

Next, consider the availability of water. Place your garden near a spigot or where it can be easily reached with a garden hose. In a typical year, watering is necessary about once a week.

Now you are ready for the planning stage. The first step is to select the vegetables you want to grow. Plant vegetables you like to eat, and avoid those that your family doesn’t usually buy at the local grocery store. With few exceptions, you can grow almost any vegetable you enjoy.

After you have selected your vegetables, make a rough diagram of your garden. Indicate the number of rows and different vegetables you wish to plant. Also, show the desired location of each crop, the number of plants or feet of rows you want to plant and the optimum time to plant each crop.¶

Prepare Soil Properly

Regardless of the soil in your garden, it can be improved by adding organic matter. This is one of the keys to successful EARTH-KIND™ vegetable gardening.

If your soil is heavy clay, the addition of organic matter improves both drainage and aeration and also allows better root development. Liberal amounts of organic matter help sandy soil hold water and nutrients.

Where do you get organic matter? This magical stuff which improves soil and serves as a food source for soil fungi and bacteria comes in the form of peat moss, compost, hay, grass clippings, barnyard fertilizer, shredded bark, leaves or even shredded newspapers.

When adding organic matter to soil, supply enough to physically change the soil structure. Ideally, at least one-third of the final soil mix should be some type of organic material. To accomplish this, spread a 2- to 4- inch layer of organic material over the garden surface and till it to a depth of at least 6 to 10 inches. Apply the recommended rate of fertilizer over the garden surface at the same time, and till it in along with the organic material.

Some gardeners prefer a shovel or spading fork to the rototiller for working garden soil, but many look for an easier way to handle this chore. For gardeners with rototillers or those who are considering renting or buying one, here are some tips to make the tilling job much easier.

- Tilling the garden will be easier if you leave an untilled row between passes. Wide turns are easier to make with a tiller than "about faces." Also, the machine won't pull itself and you toward the next row, which it tends to do if you come close to overlapping rows.

- When tilling heavy clay soils or breaking ground for a new garden, reduce the tiller's engine speed so that it turns the soil more thoroughly with less bucking and bouncing.

- When tilling ground for the first time, don't try to work it to the maximum depth in the first pass. The first time around, set the brake stake to half the desired depth. Then set it for full depth and go over the ground a second time.

- Till only when the soil is slightly dry and friable. Tilling when it's too wet leaves large clods which become rock-hard when dry. Mud clumps clinging to tiller blades upset its balance, causing undue wear on you and the tiller.¶

Fertilizer Provides Three Major Nutrients

Sixteen nutrients are considered essential to plant growth and development. Thirteen of these nutrients are furnished by the soil.

Under natural conditions, plant nutrition is not a problem (note the forests, woods and plains). However, for a successful and productive vegetable garden, some type of fertilizer usually must be added.

But what's in a fertilizer that makes it so important? And what do those three numbers mean? The numbers stand for three major nutrients — nitrogen, phosphorus and potassium, in that order. The numbers tell how much of each nutrient is present as a percentage of the total weight of the fertilizer.
Thus, a 50-pound sack of 10-20-10 contains 5 pounds of nitrogen, 10 pounds of phosphorus and 5 pounds of potassium, or their chemical equivalents. That's only 20 pounds total — the rest of the fertilizer is simply an inert carrier or filler, such as sand, perlite or rice hulls.

Nitrogen is necessary for all vegetative growth — roots, leaves, stems, flowers and fruits. Among other functions, it is partially responsible for the green color of chlorophyll, and it is essential to protein formation. A nitrogen deficiency causes lower leaves to turn yellow.

Phosphorus is essential to cell division, root formation, flowering and fruiting. It’s also involved in the storage and transfer of energy vital to all growth processes. Consequently, a phosphorus deficiency causes stunted growth and poor flowering and fruiting.

The role of potassium is not well defined, but experience shows that plants cannot grow properly without it. Potassium deficiency symptoms vary, but stunted growth and dark or purple discoloration are common symptoms in many plants.

Iron, another problem element in many areas, is essential to chlorophyll formation and the growth process. New growth on plants with an iron deficiency have yellow leaves with green veins.¶

Some Common Organic Fertilizers

	Analysis in percent			
Name of fertilizer	N	P	K	Remarks
Blood	10	1.5	0	A very rapidly-available organic fertilizer
Fish scrap	9	7	0	Do not confuse with fish emulsives which are generally quite low in fertilizer content
Guano, bat	6	9	3	Partially decomposed bat manure from caves
Guano, bird	13	11	3	Partially decomposed bird manure from islands off coast

Kelp or seaweed	1	0.5	9	
Meal				
Bone, raw	4	22	0	Main value is nitrogen since most of the phosphorus is not soluble
Bone, steamed	2	27	0	As a result of steaming under pressure, some nitrogen is lost, but more phosphorus is soluble for use by plants
Cocoa shell	2.5	1	3	Primarily a conditioner for complete fertilizers
Cotton seed	6	2.5	2	Generally very acid; useful in alkaline soils
Hoof and horn	14	0	0	The steam-treated and ground material is a rather quickly-available source of nitrogen
Manure				
Cattle	0.5	0.3	0.5	Although manures in general are low in fertilizer, when used
Chicken	0.9	0.5	0.8	in relatively large amounts to
Horse	0.6	0.3	0.6	improve soil structure, damage
Sheep	0.9	0.5	0.8	damage may occur because
Swine	0.6	0.5	0.4	of too much fertilizer
Mushroom manure (spent)	1	1	1	
Oyster shells	0.2	0.3	0	Because of their alkalinity, oyster shells are best used for raising pH rather than as a fertilizer
Peat (reed or sedge)	2	0.3	0.3	Best used as a soil conditioner rather than as a fertilizer; breaks down too rapidly
Rice hulls (ground) 0.5	0.2	0.5		
Sludge				
Sewage	2	1	1	Examples of activated sludge
Sewage activated (special microorganisms added)	6	5	0	are Milorganite (Milwaukee, WI) Hu-Acinite, (Houston, TX) Chicagrow (Chicago, IL) and Nitroganic (Pasadena, CA)
Tankage				
Cocoa	4	1.5	2	
Garbage	3	3	1	
Process (leather, hair, wool, felt, feathers, etc.)	8	2	0	
Wood ashes	0	2	6	Quite alkaline; do not use on high pH soils

EARTH-KIND™ Garden Fertilization

Just as people need nourishment, plants must have nutrients to grow and flourish. Plants need a balanced diet with all of the necessary nutrients readily available for their use. Plants will grow at optimum rates if nutrition is furnished on a "when needed-as needed" basis.

If you incorporate the knowledge that plants need a continuous source of nutrition with the realization that the major pollutant of ground water is nitrates from plant fertilizer applications, then the idea of using slow-release fertilizers to feed plants small portions of the nutrition they need makes EARTH-KIND™ sense. Fertilizers which gradually feed plants rather than deluging them with excessive nitrogen are not only environmentally-sensible, but they also enable plants to grow at optimum rates. This is why slow-release formulations are recommend-ed for all plants, whether they are vegetables, flowers, trees, shrubs, groundcovers or lawns.

When fertilizing gardens, use a product containing slow-release fertilizer, a sulfur-coated or plastic-covered urea. When choosing a slow-release fertilizer, it is important to note that the higher the percentage content of sulfur-coated or plastic-covered urea, the more EARTH-KIND™ the product is. The chance of groundwater contamination from excessive nitrates washing through the soil is lessened when greater amounts of slow-release, sulfur-coated or plastic-coated urea are present. Of course, the more slow-release fertilizer present, the more expensive the product, but safeguarding the environment is certainly worth the cost difference!

Some of the better fertilizers will have at least 50 percent of the total nitrogen content of the bag as sulfur-coated or plastic-coated urea. This information can be determined by reading the Guaranteed Analysis found on each bag of fertilizer. Remember, the higher the percentage or units of sulfur-coated or plastic-coated urea, the more you and the environment benefit. To insure that you have the ultimate EARTH-KIND™ product, you should not only look for the "slow-release" nomenclature on the bag, but you should also examine the Guaranteed Analysis which indicates what percent of nitrogen (the first number on the bag) is derived from sulfur-coated or plastic-coated urea.

So why should you use slow-release fertilizer in your gardens? It has the following advantages:

- Makes more nitrogen available as a nutrient to the plant.
- Resists leaching or washing through the soil into the water supply.
- Deceases risk of fertilizer burn associated with heavy applications of conventional fertilizers.

- Releases independently of microbial and bacterial action.
- Offers controlled-release feeding for 10 weeks.
- Stimulates a more drought-tolerant plant.

The use of slow-release fertilizer for gardens can insure better growth and a healthier environment — truly an EARTH-KIND™ concept.¶

Banding of Phosphorus Fertilizer in the Spring

In order for crops to grow and develop, soil nutrients (chemical elements) need to be absorbed by roots and distributed throughout the plant. These nutrients, coming from soil parent material or from added fertilizers, function in structural and metabolic systems, enabling the plant to carry on living processes. To obtain full yield potential and to produce high-quality crops, the soil must contain enough nutrients to support vigorous plant growth throughout the life cycle. Since the weathering of soil parent material is a slow, long-term process, assuring proper nutrition for crop plants generally requires the addition of fertilizers to the soil.

When a gardener decides to fertilize, he is faced with the choice of which fertilizer to use and the task of determining how much fertilizer to apply. No universal guidelines are available for answering these questions as soils differ in fertility and crops differ in their nutritional requirements. The gardener must apply what seems to be correct amounts of fertilizer based on soil tests, plant analysis, previous experience and advice from others. Modifications can be made during the season or in the following year based on how the crop is growing and on the amount of time remaining in the current season.

In the fertilization of crops, growers must first be concerned with supplying the primary macro-nutrients — nitrogen, phosphorus and potassium. Since organic or natural fertilizers have variable chemical composition, a balanced or adequate supply of all of the primary macronutrients from a single organic fertilizer is unlikely. Therefore, more than one kind of organic fertilizer is usually needed to provide sufficient crop nutrition in any system of organic gardening. This situation differs from that of synthetic fertilizers which are manufactured to contain one, two or all three of the macronutrients and can be purchased in practically any formulation.

The organic grower has a limited number of phosphorus fertilizers to choose from. Plant residue, farm manure and compost are, practically, too low in phosphorus to be considered for any purpose other than maintaining soil fertility following a build-up of this element in the soil. Residues from the bodies of animals are excellent sources of phosphorus, with bone meal being the most significant among available animal residues.
Rock phosphate, mined from deposits, has a high phosphorus content, but must break down into a clay form before it can be utilized by plants. This process may require

from 2 to 3 years or longer depending upon the pH of the soil.

Colloidal rock phosphate, taken from a lower grade ore than regular rock phosphate, is more readily available to plants because of its infinite fineness and a process whereby nutrients in the soil are carried to the plant roots through the exchange of tiny electrical charges between the roots and the soil.

Superphosphates are manufactured by treating rock phosphate with sulfuric or phosphoric acid, thus simulating the action of acid soil and the rock.

If soil pH is too high or alkaline, essential elements such as phosphorus and iron become unavailable for plant use even though they may be present in the soil. Unavailability of mineral elements is caused by temperature, physical encapsulation by soil calcium or chemical changes associated with added nutrients.

The unavailability of phosphorus and iron can cause serious plant problems. Phosphorus is represented by the middle number on every fertilizer analysis and is responsible for flowering and root development. A phosphorus deficiency resulting in lack of flowering and poor root development clearly causes problems.

The obvious answer to rectify a mineral deficiency would seem to be to add additional quantities of the needed mineral. However, minerals must be added in such a manner that they are available for plant uptake over a period of time rather than immediately. If released too quickly, the minerals may be unavailable or inaccessible because of cold soil temperature, physical encapsulation or chemical change.
One successful approach is to concentrate the deficient or unavailable minerals in a mass or bank which cannot be acted upon as rapidly as if the minerals were evenly distributed throughout the growing area. The mineral band offers seedling plants or transplants a continuous, reliable source of needed nutrition in a concentrated zone. This approach can increase the availability of phosphorus and iron in the area of the band.

When banding superphosphate
(0-20-0) to insure phosphorus availability, make a furrow 3 inches deep (for seed) or 6 inches deep (for transplants) in the planting area. Into this furrow, evenly distribute 1/2 pound (1/2 cup) of superphosphate (0-20-0) per 10 linear feet of bed. This band of phosphorus will provide a concentrated source of available phosphorus (for use as a “starter” solution) for young and growing plants. Cover the band of super phosphate with 2 inches of soil. When planting in an iron deficient, plant chlorosis-prone soil, add 1/2 pound (1/2 cup) of iron sulfate (copperas) to the 1/2 pound (1/2 cup) of superphosphate (0-20-0) per 10 linear feet of bed. If seeds or transplant roots are planted directly into this concentrated mix, growth could be stunted. The 2 inches of covering soil serves as a buffer zone. If colloidal rock phosphate (0-2-0) is used, seeds and transplants can be planted at the standard planting depth directly into colloidal rock phosphate banded into the planting furrow at the rate of 5 pounds per 10 linear feet.¶

Compost Pile Valuable

Is plant debris trash or treasure?
It can be treasure if you don't dispose of it, but rather convert it to compost! Leaf mold has a miraculous ability to hold moisture. To compare, subsoil holds a mere 20 percent of its weight in water and good topsoil will hold 60 percent. Leaf mold can retain 300 to 500 percent of its weight in water. Leaves and plant material can be used to improve growing conditions. Composting is the “natural” way of doing things. Nature has been successfully composting for millions of years.

Compost is a mixture of decomposing and rotting debris which can be used to add fertilizing elements to the soil. Composting is a process which returns plant and animal matter to the soil and completes the natural life cycle. This cycle began when you planted the seed. As the small plant of the seed grew, it took nutrients from the soil to make cells and metabolites. As the plant grew larger, more minerals were required and accumulated. When the plant dies, it decomposes and the "borrowed elements" are returned to the soil, thus completing the cycle.

The advantage of using organically-released fertilizer elements is mainly one of economics. They are free! Gardeners should realize that organically-released fertilizer elements do not differ in any form or fashion from fertilizer elements obtained from other sources. Organic combinations of elements must be reduced to some soluble, inorganic form before being absorbed by plants again. These inorganic forms are also found in commercial fertilizers. However, the main advantage of fertilization with decomposed organic materials, other than the economical advantage, is that when organic matter is added to the soil, it improves soil tilth and moisture retention. These factors encourage optimum plant growth and maximum yields when proper culture practices are followed.

Basic items which can be used for composting are:

- Grass clippings - Grass clippings are relatively high in nitrogen and make good compost. Mix green, fresh grass clippings with soil or dry plant material, such as leaves. Be sure that large sprigs which could root and propagate are eliminated. A thick layer of fresh clippings usually compacts when it settles, preventing air from entering the pile and slowing or stopping the composting process. To avoid this problem, add thin (no more than 3 inches deep) layers of green grass clippings and allow them to dry. Another solution is to add denser organic materials with grass clippings to prevent compaction.

- Dry leaves - These are plentiful in fall and winter. Most leaves compost faster and more thoroughly if they are shredded before being added to the pile. If you don't have a shredder, pile the leaves in a row in your yard and cut them up with a rotary lawnmower. Rake the chopped leaves and add them to the compost pile. Shredding greatly increases the total surface area of any material. The conversion of raw organic material into colloidal humus is accomplished by a series of fermentations. These fermentations consume plant residues like a living fire. The finer the particles, the faster they will be consumed. The faster a compost is made, the better it is because

there is less time for the dissipation of valuable gases and the leaching out of essential elements.

- Kitchen scraps - Fruit and vegetable trimmings and leftovers are good items for the compost pile. However, don't use animal products, such as grease, fat and meat trimmings, since they break down very slowly, attract rodents and other pests, and have an unpleasant odor. No one appreciates a rat sanctuary or buzzard roost in a neighbor's compost area! Offensive odors will also develop if the compost piles become soggy or anaerobic (lacking sufficient oxygen).

- Other materials - These include sod removed from the lawn, hay, shredded newspaper and hedge clippings. Don't use large twigs because they break down slowly. Bone meal is a good addition to the compost pile because it is high in nitrogen.

Most people have problems with compost piles when they make them with a single ingredient. If only one ingredient is used, sometimes no decomposition will occur, regardless of additives and techniques used. It is essential to add some nitrogen-rich material, such as fresh or dried manure or commercial fertilizer, because the nitrogen in these materials is needed nutrition for the decomposing bacteria.

If a compost pile is properly made and maintained, an excellent composted material should be ready for use in 90 to 120 days. The compost pile can be free-standing or in an enclosure of some type. The most practical is close-mesh wire (n to 1/4 inches between strands), 3 to 4 feet wide, 9 feet or longer, joined together to form a circle. A 9-foot length will make about a 3-foot circle. The larger the circle or compost pile, the better it can retain heat and moisture. Do not place this circular wire enclosure where water from the roof can drip into it. To build the compost pile, start adding organic materials as they become available, in no special order. Use all organic waste from the yard. Adding up to 25 percent of horse or cow manure or up to 10 percent of chicken manure makes a good, rich compost. Too much manure, however, may cause compost to have an offensive odor if it's not aerated enough or if the composting material gets too wet. Green grass clippings have ample nitrogen if manure isn't readily available.

After the first pile is ready, use some of it to inoculate the next. The pile should be kept slightly moist, like a squeezed-out sponge. Too much water smothers the micro-organisms. The compost pile must be aerated. If the compost pile is made of material which does not compact, the pile will have to be aerated only once a month. A tight, heavier pile will require more aeration, but no more often than every third day. The pile can be turned with a garden fork or shovel, but the easiest way is with a compost turning probe. This probe is a tool about the size and shape of a walking cane. It has two wings that fold into a streamlined point when pushed into the pile, but spread open when pulled up. On the up stroke, the pile is torn open, and some of the bottom is brought toward the top. This doesn't require a lot of strength and it’s a quick, easy way to aerate a home garden compost pile.

Another easy way to turn the pile is to unpin the wire cage, take the wire from around the pile and pin it back together, now empty, right next to the original compost pile.

Then put the compost material back into the wire frame. For proper aeration and composting action, each pile should be turned at least once like this to ensure that the organic material on the outside ends up in the middle of the pile so it can go through the intensity of the heating process. If you have a large garden and enjoy making compost, a number of these wire circle cages can be used. You can keep building them until the first pile is ready, then you empty it and start over. The compost is ready to use when the materials have turned brown. Most of them have lost their identity and the composted material has an earthy smell. Some people think the finished product of their composting should be crumbly like old leaf mold. However, for gardening purposes, it is not necessary to allow the material to completely decompose since final decay can take place in the soil. When compost is added yearly, the soil will become fluffy, easy to work, fertile and will hold soil moisture better.

If your soil is lacking in certain elements, the best way to add them is through the compost pile. Add colloidal phosphate (organics) or superphosphate for phosphorus and wood ashes for potash. Composted organic materials can also be used as a cheap iron chelate (a slow-release source of iron) to remedy the adversities of iron chlorosis, i.e., yellowing plants. Gardeners can make a "synthetic chelate" in their compost pile by mixing 1 cup of iron sulfate (copperas) for each bushel of moist compost. Particles of iron will adhere to the surface of the compost material and will be released for plant use as the material decomposes while it is being used as a mulch around plants or when incorporated into the soil.

Unwanted insects, such as pill bugs and ants, will get in the compost pile. Turning the pile often and keeping the moisture just right so that the temperature reaches up to 140°F to 160°F will discourage them. Making compost is as much an art as it is a science. The best way to learn to make good compost is by doing it and not giving up. Most home garden compost failures are caused by simply keeping it too wet. In a rainy season, you may need to cover the top with plastic, but not for too long. Heap up the center of the pile so it sheds water like a thatch roof. It is absolutely essential that the compost pile be well ventilated so that there is a sufficient flow of gases between the atmosphere and the interior of the compost pile. The soil organisms which break down plant residues and convert them into compost are aerobes, i.e., they must have oxygen to live. If these organisms suffocate and die because of lack of oxygen, the composting process will stop.

The whole point of composting is to produce a beneficial soil additive. Moreover, humus is recognized as an excellent soil conditioner. Besides increasing the soil’s water-holding capacity, improving its tilth and aeration, compost also makes the plant nutrients that are already in the soil more available to plants.¶

Raised Beds for Gardens

If you haven't had much luck with gardening efforts in the past, your soil may be the problem. Tight, heavy, poorly-drained soils are common in many areas of Texas. With good management practices and the addition of liberal amounts of organic matter, many of these soils can be improved so that they grow satisfactory vegetables. But if

you are interested in a quick, highly-productive vegetable garden, consider constructing a raised garden. Raised gardens are often the simplest solution to a difficult soil problem.

Advantages of raised gardens are:

- Vegetable yields are increased because the depth of topsoil is increased.
- Raised gardens filled with a good soil or soil mix drain faster and warm up quicker.
- Water usually soaks in rather than running off.
- Soil compaction is eliminated or reduced.
- Weeds, soil insects and soil-borne diseases are more easily controlled since recommended treatments are more effective in raised gardens.
- Raised gardens do not have to be expensive. Construct frames of railroad ties, bricks, flagstones or other materials. Small raised bed gardens may even be constructed from 2x8's or 2x10's.¶

Seeds or Transplants?

Many gardeners become confused about whether vegetables should be planted from seed or transplants. Transplants insure a reliable plant population and usually produce earlier than crops planted from seed. The main disadvantage of transplants is the cost per plant.

Because of cost, only certain vegetable crops should be transplanted. Consider: (1) the cost of seed, (2) the plant population needed, (3) the earliness of desired crop maturity, and (4) convenience. Vegetables which should always be transplanted in spring include eggplant, onions (bulb), pepper, sweet potatoes and tomatoes. Vegetables which can be seeded into the garden in early spring or transplanted a little later include broccoli, collards, cabbage, lettuce and cauliflower. Seed all other vegetables directly into the garden area because transplants are not economical. Timing and varietal selection determine the success or failure of directly-seeded crops and transplanted vegetables.

Success in seeding vegetable crops depends on factors such as seed vigor, soil moisture, planting technique and soil fertility. Use new, viable seed to insure a good plant population. Seeds need to absorb moisture before growth can begin. During dry weather, water several days before planting the seed.

When planting, do not cover the seed with too much soil. A general rule of thumb is to cover seed approximately 2 to 3 times their widest measurement. Seed thickly with the intention of thinning to an optimum stand later.¶

Spring Planting Guide for Vegetable Crops

Vegetables	Region I	Region II	Region III	Region IV	Region V
Asparagus	After March 1	After Feb. 15	After Feb. 1	After Jan. 15	Not recommended
Beans, snap-bush	April 15-May 15	April 1-May 5	March 5-May 1	Feb. 10-April 15	Feb. 1-March 15
Beans, snap-pole	April 15-May 1	April 1-May 1	March 5-April 15	Feb. 10-March 15	Feb. 1-March 15
Beans, Lima-bush	May 1-May 15	April 15-May 15	March 15-April 15	March 1-April 1	Feb. 15-April 1
Beans, Lima-pole	May 1-May 15	April 15-May 15	March 15-April 15	March 1-April 1	Feb. 15-April 1
Beets	March 1-June 1	Feb. 15-May 20	Feb. 1-March 1	Jan. 15-April 15	Jan. 1-March 5
Broccoli	March 1-June 15	Feb. 15-March 20	Feb. 1-March 1	Jan. 15-Feb. 25	Jan. 1-Feb. 15
Brussels sprouts	Feb. 15-April 1	Feb. 15-March 10	Not recommended	Not recommended	Not recommended
Cabbage	March 10-April 15	Feb. 15-March 10	Feb. 1-March 1	Jan. 15-Feb. 10	Jan. 1-Feb. 1
Carrots	March 10-April 15	Feb. 15-March 10	Jan. 15-March 1	Jan. 15-Feb. 10	Jan. 1-Feb. 1
Cauliflower (transplant)	March 1-April 15	Feb. 15-March 10	Feb. 1-March 1	Jan. 15-Feb. 15	Jan. 15-Feb. 15
Chard, Swiss	March 1-June 1	Feb. 15-May 1	Feb. 1-March 10	Jan. 15-April 1	Jan. 1-April 1
Collards (kale)	March 1-May 1	Feb. 15-April 10	Feb. 1-March 25	Jan. 15-March 15	Jan. 1-March 15
Corn (sweet)	April 1-May 20	March 15-May 1	Feb. 25-May 1	Feb. 15-March 15	Feb. 1-March 15
Cucumber	April 15-June 1	April 1-May 15	March 5-May 1	Feb. 10-April 10	Feb. 1-April 1
Eggplant (transplant)	May 10-June 1	April 10-May 1	March 15-May 1	Feb. 20-April 1	Feb. 1-March 15
Garlic (cloves)	Jan. 1-Jan. 15	Not recommended	Not recommended	Not recommended	Not recommended
Kohlrabi	March 1-April 15	Feb. 15-March 1	Feb. 1-March 1	Jan. 15-Feb. 15	Jan. 1-Feb. 15
Lettuce	March 1-May 15	Feb. 15-May 1	Feb. 1-March 15	Jan. 15-March 15	Jan. 1-March 1
Muskmelon (cantaloupe)	May 1-June 1	April 10-May 1	March 15-May 1	Feb. 20-April 15	Feb. 1-April 1
Mustard	March 1-May 15	Feb. 15-May 1	Feb. 1-April 1	Jan. 15-March 15	Jan. 1-March 1
Okra	May 15-June 15	April 25-July 1	April 1-June 1	March 15-Jun 15	March 1-June 1
Onion (plants)	March 1-April 15	Feb. 15-March 10	Feb. 1-March 1	Jan. 15-Feb. 10	Jan. 1-Feb. 1
Parsley	March 1-April 15	Feb. 15-March 10	Feb. 1-March 1	Jan. 15-Feb. 10	Jan. 1-Feb. 1
Peas, English	Feb. 15-March 15	Feb. 15-March 1	Feb. 1-March 1	Jan. 15-Feb. 1	Not recommended
Peas, southern	May 1-June 15	April 20-May 15	March 25-May 20	March 15-April 15	March 1-April 15
Pepper (transplant)	May 10-June 1	April 10-May 1	March 15-May 1	Feb. 20-March 10	Feb. 1-March 10
Potato	March 15-April 7	March 10-April 1	Feb. 15-March 1	Jan. 15-Feb. 15	Jan. 1-Feb. 1
Potato, sweet (slips)	May 15-June 15	April 25-May 15	April 10-May 15	March 15-May 10	March 1-April 15
Pumpkin	May 15-June 1	April 25-May 20	April 1-April 20	March 10-May 1	March 1-April 1
Radish	March 1-June 1	Feb. 15-May 20	Feb. 1-May 1	Jan. 15-April 15	January 1-April 1
Spinach	March 1-April 1	Feb. 1-March 1	Jan. 1-Feb. 15	Jan. 1-Feb. 15	Jan. 1-Feb. 1
Squash, summer	May 1-June 1	April 10-May 1	March 5-May 1	Feb. 10-April 10	Feb. 1-April 1
Squash, winter	May 1-May 15	April 1-April 25	March 5-May 1	Feb. 10-April 10	Feb. 1-April 1
Tomato (transplant)	May 10-June 1	April 10-May 1	March 15-April 10	Feb. 20-March 10	Feb. 10-March 10
Turnip	March 1-June 1	Feb. 15-May 20	Feb. 1-March 10	Jan. 15-April 15	Jan. 1-March 1
Watermelon	May 10-May 15	April 10-May 1	March 15-May 1	Feb. 20-April 1	Feb. 1-April 1

Check Soil Temperature

Soil temperature is a factor few gardeners check before planting, yet it is probably the most important factor affecting seed germination and plant growth.

Soil temperatures at which vegetable seed will grow include the minimum temperature required for seed growth, an optimum temperature and a "realistic" soil temperature. The realistic soil temperature is somewhere between optimum and minimum; it is the temperature at which you should plant to insure maximum success.

For instance, the optimum soil temperature for seed germination of vegetable crops, such as cucumber, cantaloupe, okra, pumpkin, squash and watermelon, is 95°F. However, if planted late enough during the year for soil to reach this temperature, summer heat will decrease plant vigor and yield. The minimum soil temperature for these crops is 60°F; yet, at this temperature the seed will not grow vigorously. Thus, there must be an intermediate soil temperature that is more realistic. Realistic soil temperatures for the best plant production are cucumber (64°F), cantaloupe (68°F), okra (73°F), pumpkin (75°F), squash (70°F) and watermelon (72°F).

Crops such as beans, beets, cabbage, chard, eggplant, pepper, radish, tomato, turnip and corn have an optimum soil temperature for seed germination of 85°F. The minimum soil temperature required for some of these cold-tolerant crops, such as beets, cabbage, chard, radish and turnip, is as low as 40°F. The realistic soil temperatures recommended for these crops are beans (72°F), beets (45°F), tomato (55°F), turnip (50°F) and corn (55°F).
As might be expected, vegetables which are really cold-tolerant, such as carrots, parsley, lettuce and spinach, have lower optimum soil temperatures for seed germination. For instance, the optimum soil temperature for seed germination of carrots is 80°F, for parsley and lettuce 75°F, and for spinach 70°F. The minimum temperature required for these crops is 35°F. The realistic soil temperature at which all of these crops should be planted is 45°F.¶

Days From Planting To Emergence

Beans	5-10	Okra	7-10
Beets	7-10	Onion	7-10
Broccoli	5-10	Peas	6-10
Cabbage	5-10	Parsley	14-21
Carrots	12-18	Pepper	10-14
Cauliflower	5-10	Radish	3-6
Corn	5-8	Spinach	7-12
Cucumber	6-10	Squash	4-6
Eggplant	6-10	Tomato	6-12
Lettuce	6-8	Turnip	4-8
Mustard	4-6	Watermelon	6-8

Fall Direct Seeding Guide

Vegetables	Region I	Region II	Region III	Region IV	Region V
Beans, snap bush	July 15	August 1	September 1	September 10	October 1
Beans, Lima bush	July 15	July 25	August 20	September 1	September 15
Beets	August 15	September 1	October 15	November 1	December 15
Broccoli	July 15	August 1	September 1	October 1	November 1
Brussels sprouts	July 15	August 1	September 1	October 1	November 1
Cabbage	July 15	August 1	September 1	October 1	November 1
Carrots	July 15	August 15	November 10	November 20	December 15
Cauliflower	July 15	August 1	September 1	October 1	November 1
Chard, Swiss	August 1	August 15	October 1	October 20	December 15
Collards	August 1	August 15	October 10	October 20	December 15
Corn, sweet	July 1	August 10	August 20	September 10	September 20
Cucumber	July 15	August 1	September 1	September 10	October 1
Eggplant	July 1	June 15	July 1	July 10	August 1
Garlic (cloves)	July	August	October	November	December
Kohlrabi	August 15	September 1	September 10	October 1	November 1
Lettuce, leaf	September 1	September 15	October 10	November 1	December 1
Mustard	September 1	October 1	November 1	December 1	December 15
Onion (seed)	not recom'd	not recom'd	November 1	December 1	December 15
Parsley	September 15	October 1	October 10	November 1	December 1
Peas, southern	June 15	July 1	August 1	August 15	September 1
Pepper	June 1	June 15	July 1	July 15	August 1
Potato	not recom'd	August 1	September 1	October 1	not recommended
Pumpkin	June 1	July 1	August 1	August 10	September 1
Radish	September 1	October 1	November 25	December 1	December 15
Spinach	August 15	September 1	November 15	December 1	December 15
Squash, summer	August 1	August 15	September 10	October 1	October 10
Squash, winter	June 15	July 1	August 10	September 1	September 10
Tomato	June 1	June 15	July 1	July 10	August 1
Turnip	September 1	October 15	November 1	December 1	December 15

Use Plant Covers for Insect, Disease Protection

This season, you may want to try a technique which will not only enable you to have early production, but may be the difference between whether you produce an abundant crop or no crop at all. This technique will also enable you to grow a pest-free crop without applying pesticides.

Gardeners blame everything from vengeful neighbors to dishonest nurserymen for stunted, nonproductive plants which are infected with a virus. No person is to blame — thousands of insects, such as thrips, feed

on a plant which already has a virus and then transmit the virus to another plant. Not all insects spread viruses. Insects which have been known to cause problems include aphids, thrips, white flies and leaf-feeding beetles. Aphid mouth parts puncture an infected plant and draw the virus particles and cell contents into their body.

Some aphid-borne viruses are carried only on mouth parts, but others are taken into the gut, circulatory system and eventually the salivary glands. All the aphid has to do is "slobber" on a healthy plant to cause infection. This is why virus prevention is so difficult — 100 percent insect control is both impossible and impractical. Even if you could grow a plant full of pesticide which would immediately kill any insect that damaged the foliage, the virus is delivered the instant the plant tissue is penetrated. Insect sprays are not the answer!

The remedy for insect damage and contamination is a physical barrier. Transplant tomatoes and peppers into the garden. Immediately install concrete reinforcing wire cages. Cages are nothing more than cylinders made of reinforcing wire, hog wire or similar material to support the plant and keep the fruit off the ground.

Make the cylinder 18 to 20 inches in diameter and 2 i/2 (called half cages) to 5 feet tall (the length of the roll of wire becomes the height of the cage). Concrete reinforcing wire, generally considered to be the best, is available in rolls of varying lengths. A 5-foot length makes a tomato cage 18 to 20 inches in diameter. Cages are held together by bending and crimping the wire ends around one of the vertical wires.

To keep the cage supported and standing, snip off the bottom ring of the cage and push the remaining prongs into the ground. Install cages around young transplants
and anchor all sides well with wire stakes in the soil. For a barrier, cover the cages to the ground with clear plastic or a translucent, fabric-like material known as spunweb (Grow-web™). Adequate anchorage is essential for cages covered with plastic or spunweb during windy periods.

Covered transplants will be protected from virus-carrying thrips and aphids until the plant touches the sides of the cage and plastic has to be removed. Plants covered with spunweb never have to be uncovered. Plastic covering must be removed when foliage begins to touch the edges

and bunch against the sides of plastic. This will usually be about the time the plant has marble-sized fruit. Because of excessive heat build-up, the plastic covering must be removed when temperatures regularly begin to reach the high 80s.

Spunweb will never overheat plants since the temperature inside the fabric-like material will not exceed 15°F above the daytime high temperature. Spunweb can also be used for the fall crop, planted in July, since it will not overheat plants and seems to act as a shading cloth. Plastic-covered cages need to be closely monitored since temperatures will be 30°F warmer inside the plastic. Ventilation from the bottom, by raising the plastic 4 to 6 inches, as well as opening the top, may be necessary when daytime temperatures above 75°F occur.

The tops of these miniature greenhouses which are covered with plastic will have to be left open during warm days to avoid excessive heat build-up, but most insects do not enter from the top. Most insects are blown in by the wind. The covered plants are "hidden" from contaminating insects and not as attractive to them as unprotected plants. Leave tops open when daytime temperatures get above 75°F. On cold nights, tops should be closed to provide extra protection. One of the advantages of the spunweb is that it never requires ventilation. However, this web-like material does not provide as much cold protection as plastic; each web-covered cage will have to be artificially heated (with Christmas lights, etc.) if temperatures fall below freezing.

One of the greatest benefits of this system will be protection from wind. Findings indicate that winds as low as 15 mph can significantly slow plant growth, delay harvest and decrease yields of vegetable crops. You may wonder if plants will set fruit when covered with plastic or spunweb since no bees or insects are able to enter. Tomatoes, peppers and eggplants are 85 percent self-pollinated; that is, they don't need movement of pollen by insects. If you want to insure adequate pollination, vigorously shake the covered cages every day after bloom begins or thump bloom clusters daily with your finger. You can also artificially set early blooms by spraying bloom clusters with Blossom-Set, a plant hormone spray. Resulting fruit will have fewer seeds.

Protect tender transplants as soon as possible from virus-carrying insects and environmental adversities with the covered cages. The larger

a plant is before infection occurs, the more productive it will be, and conversely. To protect seedlings from birds or other varmints and vine crops (such as broccoli and cole crops) from leaf-eating caterpillars, cover them with spunweb. You can also use spunweb to "vine ripen" fruit. Spunweb products can be found in local nurseries or ordered directly from the manufacturer through the mail. One address is: Indeco Products Incorporated, P.O. Box 5077, San Marcos, Texas 78666 (Telephone: 512-396-5814 or 1-800-782-7653 Ext. 173 ¶

Thin is Beautiful

Thinning vegetables is one of the most important follow-up activities in gardening. Most gardeners use more seed than necessary for a healthy plant stand. This is a good idea since some seeds may not germinate and grow. Extra seeds will insure enough plants. However, having too many plants in an area is just as bad, if not worse, than having too few. Plant thinning or removal is necessary to insure a successful garden. Properly-spaced plants also make insect and disease control easier.

It's difficult to destroy plants when you have worked so hard to grow them. But remember, it is for their good as well as yours. To make the job less painful, try periodic thinning. For example, if snap beans are to be thinned to 4 inches between plants, thin the small plants until they are 2 inches apart. Then allow the remaining plants to grow until they start to look crowded. At that stage, complete the thinning process so that plants are the recommended 4 inches apart. This system helps avoid replanting if you initially thinned your plants to 4 inches apart and a cutworm, dog or bird thinned them to 8 or 12 inches apart.

When removing larger plants, use a knife to cut the stem at ground level. This thins the plant population effectively and does not damage root systems of remaining vegetables.

Size of mature vegetables dictates distance between plants. For instance, larger vegetables, such as broccoli, cabbage, cauliflower, cucumber, eggplant, cantaloupe, okra, squash and tomato, require 12 to 24 inches or more between plants. Smaller vegetables, such as beans, beets, carrots,

lettuce, onions, southern peas, spinach and turnips, require only 1 to 4 inches between plants. Cultural techniques, such as caging or staking, also influence spacing of larger plants.¶

Various Mulches Available

Mulch is defined as any material spread on the garden to protect root plants from heat, cold or drought; to reduce problems with weeds; and to keep fruit clean. Mulching materials can be:

- Clear plastic - Clear plastic warms the soil more than most other mulches, stimulating weed seed germination and growth. It also can be laid over seeded rows to stimulate early vegetable seed germination. Remove the plastic as soon as seedlings emerge. If weeds are not a problem, clear plastic is an excellent mulching material.

- Black plastic - Black plastic makes the soil warmer early in the season and greatly reduces the weed population. Black plastic, however, will not control nutgrass. Adequate soil moisture should be available when black plastic is applied. Cut holes through the plastic after it is applied over the bed to allow for seeding or transplanting. Water by using drip systems or water soakers beneath the plastic, by furrow watering or by sprinkling. If sprinklers are used, it may be necessary to cut T-slits in the plastic for water penetration.

- Paper - Various types of paper are used as mulches, with newspaper being by far the most common. Several sheets of newspaper laid flat over the surface of the garden row work well as a mulch. However, paper reduces soil temperature. Paper mulch used early in spring when the soil is cold causes delayed maturity of many garden vegetables, such as tomatoes, peppers, squash, etc. For these crops, paper can be applied after crops are growing and the soil has warmed up. Paper mulch will not delay cool-season, spring-planted crops such as lettuce, broccoli and cabbage, as much as warm-season plants. As with black plastic, apply paper when the soil

contains adequate moisture. Unlike plastic, paper deteriorates and does not have to be removed at the end of the gardening season.

- Organic mulches - Organic mulches are by far the most common. Benefits of organic mulches are gained primarily in summer because they reduce soil temperature and save soil moisture. Do not use organic mulches too early in spring. If applied to cold garden soils, the soils warm up more slowly and crop maturity is reduced. Organic mulches prevent soil crusting, control weeds, prevent erosion, lessen fruit rot, conserve moisture and reduce soil temperatures during summer.

  After the soil warms, apply organic mulches to a depth of 1 to 2 inches around growing plants. With organic materials such as sawdust, leaves, rice, hulls, etc., it usually is necessary to increase the amount of garden fertilizer by about one-fourth to compensate for the nutrients used by microorganisms during the breakdown process. At the end of the season, turn organic mulches under to improve the soil's physical condition.¶

When to Water

To many people, one of the most enjoyable aspects of home gardening is watering. It is also very important. However, many gardening problems, such as poor yield, poor quality, poor fertility, bitter fruit, sunscald, disease problems and a dozen other things, can be related to poor or improper watering techniques. Gardening is a form of relaxation, so it is not unusual for many gardens to be watered two, three or more times a week. This can result in poor root development. Light, frequent waterings cause a concentration of roots in the top inch or two of soil. Undeveloped root systems do not pose any serious problem early in the season when the plants are relatively young and sufficient moisture is available. But, as the season progresses and moisture becomes scarce, the limited root system needs more frequent watering. Consequently, you may need to water several times a week just to keep the plants from wilting severely. This problem can be prevented by adequate early and mid-season watering.

Determine when to water the garden by examining the soil, not the plants.

If the soil surface appears dry, scratch the surface to a depth of about an inch to determine if moisture is present. If the soil appears relatively dry, watering is necessary. If sufficient moisture is available an inch beneath the surface, wait a couple of days before watering. Another consideration is the type of soil in your garden. Obviously a light, sandy soil that drains quickly requires more frequent watering than a heavy soil which holds water. Therefore, check sandy soil more often than heavy clay soil.

How much water should you apply? Soak garden soil to a depth of at least 6 inches. If moisture is available at this depth, adequate moisture has been applied. After doing this several times, you learn by experience when adequate water has been applied. An inch or two of water applied once a week usually is sufficient for most vegetable gardens in Texas.¶

Harvest Hints

Harvest all vegetables as they mature, at their best stage for eating. Many vegetables, such as beans, okra and squash, quit producing if not harvested on a regular basis.

Harvesting at the right stage is also a must if you plan to do any canning or freezing. The final quality of your preserved vegetables is no better than the quality you begin with. Many gardeners consume most of their vegetables fresh and can or freeze what is left over. Avoid this practice if at all possible. Vegetables that you can or freeze should be identical in quality to those that are consumed fresh.

To maintain quality after harvest, handle vegetables very carefully. Avoid bruising or damaging them as this encourages decay and a short storage life. Some vegetables, such as sweet corn, peas, asparagus and leafy vegetables, should be cooled to between 35°F to 40°F as soon as possible. Keep the time between harvesting and eating or preserving vegetables as short as possible. Many vegetables lose flavor and vitamin content if stored too long.¶

Use Drip Irrigation

One of the best ways to water a garden is with a drip irrigation system. Drip irrigation is the controlled application of water at a very low flow over a prolonged period. It differs from conventional watering systems in that the soil is not supersaturated with water. When the rate of drip irrigation is adjusted correctly, there are no puddles of water and no runoff.

Some drip systems use small water-releasing mechanisms called emitters which drip a certain volume of water when a certain amount of water pressure is supplied. Many of these systems are prepackaged and allow little versatility or adaptation to various garden sizes and shapes.

Several systems currently available in garden centers can be easily adapted to almost any garden size and situation. The most common system has small holes in plastic tubes which allow the water to come out in small amounts. The tube is placed along the row so that the root zone is moistened by the dripping water. Holes are pre-punched in the tubing at 12-inch intervals so that adequate water is available for all vegetable crops.

Once the drip irrigation system is in place and operating, the question always arises as to how long it should be used. A general recommendation is to operate the system three hours a day on alternating days, such as Monday, Wednesday and Friday. When rainfall is adequate, it is not necessary to water for several days. To insure adequate moisture when the garden is planted, apply at least 2 inches of water to the planting zone before seeding or transplanting (pre-irrigation). Be sure the rows are well-firmed at the time of pre-irrigation so the water moves laterally in the soil at well as downward. In many cases, sprinkling the entire garden area may be necessary to settle the soil enough for drip irrigation water to move horizontally and not go straight down in the rows. This is especially necessary in gardens with sandy soil.¶

Plan for Disease Prevention

Home gardens are often pestered with diseases that deplete yields at

harvest. Many gardeners have found that proper planning and following recommended control practices keep vegetable losses to a minimum.

Select a well-drained garden site to prevent damping-off and other problems associated with wet soil.

Organic matter (straw, leaves, crop residue) is essential to productive soil, but can also increase the occurrence of southern blight. To avoid a buildup of southern blight, bury organic matter below the expected root zone of next year's crop. This should be done in the fall if possible.

Watering plants in the evening causes leaves to remain wet for an extended period and increases the chance of leaf diseases. Plants watered in the morning dry quickly, resulting in fewer problems. Drip irrigation also reduces foliage diseases.

Grow vegetables in the same location only once every 3 to 5 years. If this cannot be done, at least plan your garden so that you don't grow vegetables of the same family group in the same area season after season. Family groups are: (1) watermelon, cucumber, squash, cantaloupe, honeydew melon, pumpkin; (2) cabbage, cauliflower, Brussels sprouts, rutabaga, kale, turnip, mustard, radish, collard; (3) Swiss chard, beets, spinach; (4) pepper, tomato, potato, eggplant; (5) carrot, parsley, parsnips; (6) onions, garlic, leek; (7) sweet corn; and (8) beans, peas and southern peas.

Certain vegetable diseases are seed transmitted. Don't save seed from the garden for planting the following year.

A number of diseases attack vegetable foliage and fruit. Diseases caused by fungi cannot be cured, so they must be prevented. When you see a fungus problem, irreversible damage has already been done. Cloudy, damp mornings encourage the growth of fungus spores. When such conditions exist, you may want to follow a preventive spray schedule or remove contaminated plants.¶

Environmentally Safe, Effective Worm Control

We should be cautious when using pesticides because, obviously, they are poisonous. If they weren't poisonous, pesticides wouldn't kill pests. There is, however, an alternative to pesticide use.

Insect larvae, or worms and caterpillars, can cause considerable damage to gardens. Good news! There is a pesticide which kills worms but is not poisonous to man or beast. The worm-killer is the bacteria Bacillus thuringiensis, or BT for short.

When ingested, BT produces a toxic substance within the cells of its victims. Only certain species of caterpillars are affected by BT. The infection occurs only when the caterpillars feed on plant foliage which is being protected by BT. Adult insects which feed mainly on plant nectar are not affected. Only the destructive caterpillars are killed; the good bugs are spared.

BT is not a merciful killer. Death is slow and painful. The first symptom experienced by a BT victim is "gut" paralysis. This means an immediate cessation of foliage ingestion. But BT doesn't stop there. Eventually, it causes a breakdown in the gut wall and leakage of contamination into the body cavity of the larvae. Since the body cavity tissues of a caterpillar are bathed by blood in an open circulatory system, the larval blood offers an ideal growing condition for growth of this contamination.

BT contamination produces spores which rapidly divide. In fact, a new generation of spores is produced every 20 minutes. Therefore, after just 12 hours, one spore can produce 6,719,476,736 new BT's. Obviously, this quantity needing nourishment from caterpillars has a devastating effect.

BT is terminal. All infected larvae become sick and most die. This is because insects do not have an effective immune system as humans and other mammals do. In theory, lack of an effective immune system dictates that susceptible species will not develop a resistance to BT.

Outward symptoms of caterpillars infected by BT are manifested as behavior, color and morphological changes. As soon as they are infected, larvae quit feeding. They usually move from their normal feeding sites to exposed leaf surfaces. Before dying, they become sluggish, discolored and

usually exhibit regurgitation and diarrhea. Cadavers of large larvae become limp, but do not "liquefy" as viral-infected larvae do. Cadavers of small larvae are often difficult to find because they turn black and shriveled.

Usually, one taste of BT is enough to destroy susceptible larvae. However, in some instances a larva may not die from BT, but suffer a fate worse than death. These symptoms include:

- A predisposition to other naturally occurring pathogens, such as other bacteria, fungi and viruses.

- Starvation due to digestive track disruption.

- Failure to pupate due to physiological malfunctions.

- An increased susceptibility to predators and parasites as a result of sluggish movement and migration to exposed leaf surfaces.

- Increased sensitivity to harsh climatic factors, such as high or low temperatures.

- Reduced reproductive potential. Infected larvae that do successfully mature are abnormally small and weak adults. They are significantly less fertile than normal adults and incapable of successful mating.

Anything which causes as many horrible symptoms as BT does should certainly be respected. The alkaline pH gut (pH greater than 7.0) of susceptible caterpillars activates BT. Acid-gutted or stomached creatures cannot be affected; thus, humans and mammals are not in any way affected by BT. Only susceptible caterpillars have the necessary combination of pH, salts and enzymes in their digestive system to activate BT.

BT was discovered in 1915 by a German named Berliner. He isolated this unique pathogen and named it Bacillus thuringiensis after the town of Thuringia, Germany. BT is a naturally-occurring bacterium that causes a deadly disease specific to certain Lepidopterous (caterpillar) insects.

BT products do not have any of the hazards sometimes associated with

chemical insecticides. BT is biodegradable in the environment, and rapidly deactivated in soil with a pH below 5.1. Rainfall, exposure to sunlight and, in some cases, the type of foliage on which it is sprayed may cause BT spores and crystals to lose their viability over time. The bacteria may remain effective for as long as 22 days, or may become ineffective after 24 hours, depending on conditions. Under normal conditions, BT products are active for three to seven days after spraying. In comprehensive spray programs on some crops, repeated application is recommended at regular intervals.

BT is available in local nurseries under the names of Thuricide, Dipel, Bactus, Biological Worm Control, Leptox, SOK, Novabac or Tribacture. Since BT is such an effective plant-damage deterrent, it should be spread around — especially on the surface of leaves. This can be accomplished by adding a teaspoon of liquid soap per gallon of spray. The soap breaks the surface tension on the leaf's surface and allows the BT product to spread evenly. This allows more leaf area to be protected by BT.

With BT, you can rid plants of those devastating worms without endangering yourself or the environment, a truly EARTH-KIND™ practice.¶

Cereal Rye for Nematode Control

Nematodes are small, microscopic, worm-like animals that live in the soil and feed on the roots of developing plants. Although several different types of nematodes occur in vegetable gardens, the root knot nematode, which causes galls or swellings on plant roots, is the most damaging. Infested plants usually are stunted, yellow in color and often die prematurely.

When removing garden plants, examine root systems for the presence of nematode "knots" or galls. In extreme infestation, knots may slough off and not be present when plants are removed. Good healthy roots should be white and firm if not damaged by nematodes. Roots which are decayed or rotted may indicate the presence of nematodes.

If nematodes are found in your garden soil, plant cereal rye (Elbon) in the fall to lessen nematode damage to your spring garden. After several

years of testing, cereal rye has proven to be the fastest growing, most cold-tolerant annual grass available to home gardeners in Texas. Plant cereal rye in the fall for a thick mat of grass 10 to 15 inches high by late winter.

This grass should be shredded with a lawn mower or flexible string trimmer and tilled into the soil so that decomposition can occur before you plant in the spring. Usually, shredding and tilling one month before planting will allow for adequate decomposition.

There are many advantages to this practice of planting cereal rye in your garden. It beautifies the area with greenery. It will add high levels of organic matter to the garden soil. This type of "green manure" crop decomposes rapidly.

If these benefits were not enough, the roots of cereal rye serve as a trap-crop for nematodes. Once nematodes enter the cereal rye roots, they cannot escape and are doomed. When cereal rye decomposes, it releases organic acids and stimulates soil microorganisms which further reduce the nematode population.

Be careful to purchase cereal rye (Elbon) rather than annual rye. Annual rye is used to overseed lawns and should not be used in your vegetable garden. Cereal rye can be planted by merely seeding directly on top of the garden soil and raking in. Apply seed at the rate of 3/4 to 1 pound per hundred square feet of garden area to insure good coverage and adequate growth. Be sure to water the rye regularly and lightly fertilize every three weeks to encourage maximum growth.

Remember that the majority of the organic material produced is in the root system rather than the top foliage. This is a case of "what you don't see is what you actually get!" Always mow or shred the cereal rye before it forms seed heads since sprouting rye seed in early spring may become a nuisance. There is no danger of cereal rye seeded in the fall becoming a weed problem during the spring since the plants cannot withstand the hot Texas temperatures. Shred the plants and till the soil one month before planting your spring garden so the massive root system will have adequate time to decompose.¶

EARTH-KIND NEMATODE CONTROL DURING SUMMER MONTHS

If you have nematodes in your garden sooner or later they will decrease or end production. Nematodes will severely damage all garden crops except corn, onions, garlic and nematode- resistant tomatoes. Even these nematode-tolerant crops will be adversely affected if a severe nematode population is present.

How does one know if nematodes are a problem in their garden? Above ground symptoms of nematode infestations are similar to many other root diseases or environmental factors limiting water and nutrient uptake. These symptoms consist of wilting during periods of moisture stress, stunted plants, chlorotic or pale green leaves and reduced yields. Most characteristic symptoms are those occurring on underground plant parts. Infected roots swell at the point of infection and form knots or galls. Several infections may occur along the same area resulting in large fleshy galls. The appearance of the galls will depend in part upon the plant being affected and the nematode species involved. Fast growing annuals will have a large fleshy gall and woody perennials, small hard galls. Infected roots are retarded in growth and lack fine feeder roots. Rotting of roots develop late in the season. When tubers, corns or other edible root portions are infected, small swellings or pimpling is evident on the surface.

Vapam was the most effective nematicide available. Unfortunately, the chemical control for nematodes named Vapam is no longer available. Organically, only the planting of cereal rye (Elbon) in the fall to grow during the winter will decrease nematode populations. Excessive drying of the soil during July will also help. Another possible solution may be the solid planting of marigolds for 3 months in areas heavily contaminated with nematodes. The marigold, when grown on soil infested with nematodes, suppresses the population of these nematodes and reduces the numbers found in the roots of susceptible host plants. Three compounds of an a-terthienyl type, toxic to nematodes, have been identified in root exudates from these plants. Terthienyls are released from growing roots, even without their decay, but benefits require three to four months to become clear. There is some evidence that a-terthienyl is inhibitory to some plant-pathogenic fungi too. Marigolds also function as a trap crop since larvae which penetrate the roots do not develop beyond the second larval stage and do

not lay eggs.

Marigolds have never been used for a biological nematode control because Vapam was less trouble-some and more economic. Since Vapam is no longer available and since cereal rye does not survive in hot weather, use of the marigold for nematode control must now be examined. Of course, you will want to follow proper planting procedure. Marigolds perform best if planted in a well drained location which receives at least 8-10 hours of sun daily. Incorporate generous amounts of organic material (pine bark mulch, peat moss, or compost), or fill with a commercially available landscape mix. Then add slow-release lawn fertilizer (no herbicide, please!) at 2 pounds per 100 square feet. Soak the bed immediately after transplanting and, depending on the weather, irrigate when the soil becomes dry and the plants begin to wilt slightly. (CAUTION: DO NOT keep these plants wet after they become established! Keep the soil feeling slightly moist to the touch but not wet. Continuously soggy, wet soil in the planting bed will stunt MARI-MUM growth and eventually kill them.)

Buy transplants which are completely green or those that are just forming buds. Transplants covered with open blossoms will not produce the normally expected growth after planting. Bloom removal and/or fertilization WILL NOT overcome the detrimental affects of transplanting a MARI-MUM in full bloom. MARI-MUMS are among the most durable of transplanted annuals and are also the easiest to transplant. Unlike impatiens, begonias, petunias and bluebonnets, MARI-MUMS cannot be planted too deep. Other annuals rot if planted too deep; MARI-MUMS root. In fact, many times roots can be seen on the stems of transplants when purchased at nurseries. Transplanting depth does not affect ultimate plant height. Because of this never-too-deep transplanting phenomenon, large, leggy transplants can be salvaged by planting deeper to provide support during establishment.

The name marigold conjures up thoughts of pests. Some people think marigolds repel certain pests while other folks fear the devastating spider mite which the beautiful flowering plants seem to attract. Marigolds DO NOT repel rabbits, other rodents or deer. Marigolds also don't repel insects; in fact, they are attacked by and shelter the formidable spider mite.

So why should anyone who fears a spider mite invasion plant MARI-MUMS? MARI-MUMs are recommended for transplanting in August because spider mite populations decline in cooling fall temperatures. The optimum temperature for spider mite reproduction is 97 degrees F. during which the mite population can double every 5 days. As fall temperatures cool to 77 degrees F., mite populations require as many as 20 days to double. Because mite populations are virtually eliminated when planting beds are renovated for MARI- MUM establishment in August and since mite populations do not have an adequate time of favorable temperatures to regenerate their masses, spider mite damage to fall MARI-MUM plantings is minimal, even without a single pesticide application!

MARI- MUMS ARE NOT spider mite resistant; the lack of mites on fall plantings is merely a function of temperature and population control. Interested gardeners who have a nematode infested area should transplant marigolds 12 inches apart in August and allow them to grow there until fall planting of cole crops begins in October. Tops of the marigolds should then be removed and the root system tilled into the soil. By using marigold in the summer, you can rid the planting area of those devastating nematodes without endangering yourself or the environment, a truly EARTH-KIND™ practice.¶

Garden Problem Guide

Symptoms	Possible causes	Possible cures
Dying young plants	Fertilizer burn	Mix fertilizer thoroughly with soil
	Disease (damping off)	Use treated seed
Stunted plants, pale to yellow	Low soil fertility	Soil test for fertilizer
	Poor soil drainage	Add organic matter
	Shallow or compacted soil	Work soil deeper
	Insects or diseases	Identify and use control measures
	Nematodes	Use approved chemicals
Stunted plants, purplish color	Low temperature	Plant at recommended time
	Lack of phosphorus	Add phosphorus fertilizer
Holes in leaves	Insects	Identify and use control measures
	Hail	Be thankful it was not worse
Spots, molds, darkened areas on leaves and stems	Disease	Identify, spray or dust; use recommended rate and time
	Chemical burn	Use recommended chemicals at recommended rate and time
	Fertilizer burn	Keep fertilizer off plants
Wilting plants	Dry soil	Irrigate if possible
	Excess soil moisture	Avoid over-watering
	Disease	Use resistant varieties if possible
Weak, spindly plants	Too much shade	Move garden to sunny area
	Plants too thick	Seed at recommended rate
	Too much nitrogen	Avoid excessive fertilization
Failure to set fruit	Improper temperatures	Plant at recommended time
	Too much nitrogen	Avoid excessive fertilization
	Insects	Identify and use control measures
Tomato leaf curl	Heavy pruning in hot weather	Do not prune; use cages

Garden Problem Guide (continued)

Symptoms	Possible causes	Possible cures
Dry brown to black rot on blossom end of tomato	Low soil calcium Extremely dry soil	Add gypsum Irrigate and mulch
Misshapen tomatoes (catfacing)	Cool weather during blooming	Plant at recommended time
Abnormal leaves and growth	2,4-D weed killer	Do not use sprayer that has previously applied 2,4-D; do not allow spray to drift to garden
	Virus disease	Remove infected plants to prevent spreading; control insects that transmit

What to do About Weeds

Weeds are a problem in home gardens just as they are in large fields because they compete with desirable plants for water, soil nutrients, sunlight and air. They also harbor many insects and diseases.

Hand-hoeing is still the best answer. It is inexpensive, quite selective, accurate, effective, and for some, even enjoyable. A great deal of emotional satisfaction can come from viewing a clean, freshly-hoed row where weeds stood only minutes before. Some pulling usually is necessary to remove weeds near the base of plants. Vegetables may be damaged if weeds get too large before being pulled.

Other weed control alternatives are mulching and using herbicides. Mulching controls weeds by keeping light away from seedlings and by providing a mechanical barrier to emergence. It works best against weeds that grow from seed each year. Weeds that break through the mulch are easily spotted and can be pulled from the moist soil.

Good mulching materials include compost, straw, leaves, hay, sawdust, wood shavings, bark, paper and plastic sheeting. Black polyethylene film is the most popular synthetic material.

Be sure to have moist soil before applying mulches. While straw and leaves may be raked back to feed and water plants, plastic sheeting is fairly permanent once applied. Apply most of the fertilizer before the mulch is put down.

At present, herbicides have limited value in home vegetable gardens. They are difficult to use where a wide assortment of vegetables occupies a small space.¶

Search for These Texas Varieties

Why is selecting the proper vegetable varieties so important? If you've been gardening for any length of time, you are well aware that there are many, many different varieties of garden vegetables. However, only three or four varieties of any one vegetable are well suited or adapted to your particular area of Texas.

Get the varieties that do well in your area of the state. Planting proven varieties is much better than picking varieties because of catchy names or availability. Listed below are the vegetable varieties recommended for use in Texas gardens. Your local county Extension agent may also have a listing of additional varieties worthy of use in your area.

Asparagus - UC 157, Jersey Giant, Jersey Gem

Beans:

Snap - Topcrop, Tendercrop, Tendergreen, Kentucky Wonder, Greencrop

Pinto - UI-114, Dwarf Horticultural, Luna

Lima - Jackson Wonder, Florida Butter, Henderson Bush

Beets - Pacemaker, Detroit Dark Red

Broccoli - Galaxy, Packman, Crusier, Baccus, Green Comet

Cabbage - Bravo, Rio Verde, Red Rookie

Carrots - Texas Gold Spike, Orlando Gold

Cauliflower - Snow Crown, Snow King

Chinese Cabbage - Jade Pagoda, Monument, Napa, China Pride

Cucumbers:
- Slicers - Poinsett 76, Sweet Success, Dasher II, Sweet Slice
- Pickling - Calypso, Carolina

Eggplant - Florida Market, Florida High Bush
- Oriental Eggplant - Tycoon

Garlic - Texas White

Greens:
- Collards - Blue Max, Georgia Southern
- Chard - Lucullus, Ruby

Kale - Vates, Blue Knight

Lettuce:
- Crisp Head - Mission
- Loose Leaf - Prizehead, Red Sails, Black-Seeded Simpson
- Butter Head - Buttercrunch

Melons:
- Cantaloupe - Mission, Primo, Caravelle
- Honey Dew - TAM Dew, Honey Star

Mustard - Green Wave, Tendergreen, Southern Giant Curl

Okra - Clemson Spineless, Lee, Emerald

Onions:
- Bulb - Texas 1015 Y, Early Grano 502, Granex 33
- Green - Evergreen Bunching, Crystal Wax

Pepper:
- Bell - Shamrock, Jupiter, Grande Rio 66, Supersweet 860
- Hot - TAM Mild Jalepeño, TAM Vera Cruz, TAM Hidalgo, Long Red

Cayenne
Sweet Jalepeño-shaped - Rio Grande Gold
Potatoes:
Irish - Red: Red LaSoda, Norland;
White: Kennebec
Sweet - Beauregard, TAMU Corder, Centennial, Jewel

Pumpkin:
Large - Connecticut Field, Big Max
Medium - Jack O'Lantern, Funny Face
Small - Jack-Be-Little

Radish - Cherry Belle, Sparkler, White Icicle

Southern Peas:
Purple Hulls - TX Pink Eye
Cream - Cream 40, Champion
Black Eye - California #5
Crowder - Mississippi Silver, Zipper

Spinach:
Savoy - Green Valley II, Ozarka II, Fall Green, Coho (semi-savoy)

Squash:
Summer - Goldie, Gold Bar, Multipik
Zucchini - President, Senator
Butternut - Waltham, Early Butternut

Sweet Corn - Summer Sweet 7800, Sweet G-90, Kandy Korn, Silver Queen

Tomato - Bingo VF, Carnival VF, Heatwave VF, Celebrity VFNT, President VF, Merced VF, Sunny VF, Surefire VF
Cherry Tomato - Small Fry, Cherry Grande

Turnips - All Top, White Lady, Royal Globe II

Watermelon:
Standard - Jubilee, Royal Charleston, Royal Jubilee, Royal Sweet, Sangria, All Sweet
Seedless - Tri X-133, King of Hearts ¶