

Drought Gardening

by Sue Hakala

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Introduction

What do we mean by drought? From a gardener's point of view, a drought is any extended period of time when the water needs of a garden are not met by the available rainfall. A drought period may last only a few weeks; but in parts of this country, droughts occur which may last years.

Water shortages are in the news these days. Parts of the country are gripped by an extended drought. And, as the population expands, urban and suburban gardeners in many parts of the country are finding that water is becoming expensive, or, in some cases, unavailable in large quantities.

Most vegetables require about an inch of water a week for healthy growth. But even in a dry year you can have a successful garden. Successful vegetable gardening under dry weather conditions will be a challenge as you learn to create the best possible growing conditions for your plants, become sensitive to the needs of your plants — how they look when they are thriving and healthy, how they look when they *need* water — and make the best use of the water you have. That is what this bulletin is all about.

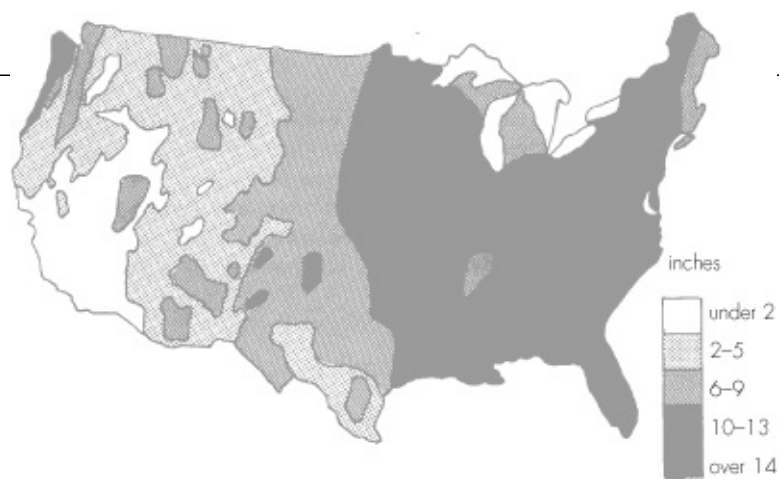
Water Shortages

A major cause of water shortages these days seems to be pollution. We have all heard about industrial dumping in rivers, streams, and coastal waters. Runoff water carrying sewage, fertilizers, and agricultural chemicals also contaminate fresh water. Chemical dumps and nuclear wastes are seeping deep into the earth and polluting the centuries-old groundwater. Over half of all large cities in the country are not able to meet the drinking water standards set up by the Clean Water Act of 1977. In many areas of the country, deep underground reservoirs, or aquifers, are being pumped out faster than nature can replace them by rainfall or snow. Water tables and groundwater levels are dropping precariously low.

Additionally, rain does not fall evenly across the country. Looking at the map below, we can see that the country is pretty much divided between the arid west and the humid east. This map is based on average summer precipitation only; recent droughts in both the East and West have resulted in local reservoirs and waterways dropping to their lowest levels in years.

Rapidly growing metropolitan areas, a higher standard of living (more appliances and more bathrooms per household), and industrial growth have necessitated the careful regulation of water consumption. In some areas, water use has been restricted. We are all familiar with an occasional ban on car washing or lawn sprinkling. In the very near future, such restrictions on water usage could become commonplace.

Average Summer Precipitation (June–August)



The best hedge against being caught short of water is to learn to conserve water now. Using less water in your home (or reusing household “gray” water) will leave you with more water for your garden.

Planning the Garden

Choosing the best location for your garden and selecting the best varieties to grow can make a significant difference in the yields you will be able to expect.

Selecting the Site

When determining the size of your garden, keep in mind the availability of water. If you are a beginner, a garden that is ten feet by fifteen feet is a good size to start with. In times of drought, a small, intensively grown garden is recommended. It will yield the most produce, yet require the least water.

Most gardening books tell you to locate your garden to receive the maximum amount of sunlight. But locating the garden in an area where part receives the morning sun and afternoon shade will help to keep moisture in the soil. The garden should receive at least six hours of direct sunlight a day. Cool-weather crops, such as peas, lettuce, carrots, and members of the cabbage family can stand more shade than warm-weather crops, such as tomatoes or sweet corn.

The easiest way to provide shade is to locate your garden near buildings. Although trees and shrubs will provide shade, they will also compete with your garden plants for scarce water supplies, and so are best kept at a distance.

Locating your garden near buildings will give you the added bonus of providing a wind break. Wind robs plants of precious moisture by speeding up evaporation losses. Wind breaks and shade can be provided by fences also. Living fences, such as sunflowers, are just as effective as man-made fences; but remember that they will require water to thrive also.

You can make dual-purpose wind and shade breaks by stretching burlap over a framework of 1x1 boards. These can be portable to enable you to move them about as the wind direction changes or to give a plant more or less sun.

Take care to locate your garden in a level area. If the area is sloped, precious water will run off the garden. Often, topsoil and nutrients will be carried away with that water — a real waste. Also, a south-facing or west-facing slope will be drier than a level area or a northern or eastern slope.

Is the best soil available on the site you are considering? If not, relocate to richer soil, if possible. Although we will give you plenty of tips on how to improve your soil, start with the best possible location.

Finally, if water supplies are severely restricted in your area, consider growing just a few vegetables in containers. (More on container growing later.)

Choosing the Best Varieties to Grow

Water restrictions during the summer vegetable-growing season can severely affect crop production of some varieties. Unfortunately, very little scientific research has been done on the effects of drought on small-scale vegetable production. But we do know a few facts about vegetables that we can put to use.

Some vegetables are considered water-efficient because they produce the greatest amount of food with the least amount of water. These water-efficient vegetables include beets, carrots, lettuce and other greens, onions, and turnips. They are water-efficient because we eat the entire plant (with the exception of carrot tops). Did you know that a single corn plant will use fifty-four gallons of water

during the season to produce just two ears of corn? Corn is considered a very inefficient water-user.

We can rate vegetables by the amount of water they require over a season for healthy growth.

- Less than twelve inches of water Cabbage and cole family members, peas, spinach
- Between twelve and twenty inches of water Beets, turnips.
- Over twenty inches of water Tomatoes, potatoes, celery.

That last group of vegetables — tomatoes, potatoes, and celery — are long-season crops; they do not require that much more water, if you consider their needs over the growing season.

Another way to evaluate plants is to consider whether they are sensitive to prolonged periods without water. Among the most sensitive are lettuce, cauliflower, onions, and corn. Those least sensitive to drought are sweet potatoes, watermelons, and pumpkins.

So you see, there are no absolutes on what you should or should not grow. If you can provide drip irrigation, then by all means grow a variety of vegetables, including those sensitive to periods without water. If you do not plan to irrigate, then those sensitive to drought might not do as well, unless you are careful to water properly.

After you decide what *types* of vegetables to grow, select the best varieties for your dry season ahead. Choosing the “best varieties” can be somewhat of a mystery. This means selecting varieties that grow well in your area of the country. An experienced gardener can give you the best advice about varieties. Another excellent source of information will be your local agricultural extension agent. Begin the hunt for the best varieties well in advance of planting time. Browsing through seed catalog is most enjoyable in front of a winter fire, when thoughts of the coming warm summer are most appreciated.

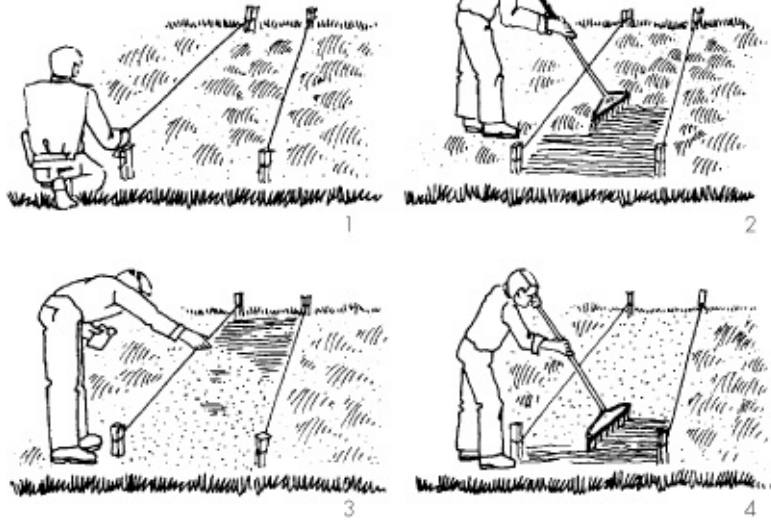
When you look through your seed catalog, you will not find many varieties that are described as “drought-resistant.” Apparently, little work has been done to identify varieties that thrive on less water. If you live in an area where rain is likely in the spring and fall, time your planting to avoid the dry summer heat. Some gardeners have found that the early-maturing varieties need more care and better growing conditions to take advantage of their fast-growing pace. On the other hand, slower growing, older varieties, such as Rutgers tomatoes, are better able to withstand the stress of a drought. Plant some of each type — the early varieties and the slow-growing, older ones — and see what works best for you.

Drawing Up a Garden Plan

Plan your garden out on paper, remembering to use wind breaks and shade effectively. Group together plants with similar moisture requirements to make watering easier.

Most seed packages will tell you to space your plants in a single row. In a dry season (especially) we strongly urge you to use wide-row planting. Space between rows can allow for irrigation furrows, if necessary.

Wide-Row Planting. Wide rows, where seeds are broadcast across a bed at least one foot wide, are a real bonus in dry weather because they enable you to grow more plants in less space, thus using less water. A lush green band of vegetables forms a living mulch that reduces water loss by evaporation and keeps plant roots cool. Also, watering is simpler with wide rows. You can place a soaker hose directly on the seed beds, without wasting water on the walkways.



Planting a Wide Row

- 1) After cultivating or tilling deeply, mark your rows by stretching string between stakes at least one foot apart.*
- 2) Rake the area between the two strings smooth. Do not walk on the row.*
- 3) Broadcast your seeds evenly over the row.*
- 4) Firm the seeds into the soil with the back of a hoe. Cover the seeds by sprinkling compost over them, or rake soil over them from outside the row.*

Companion Planting. The concept of companion planting is still under research. The idea is that some plants are healthier and more productive when planted with certain other plants; while some plants produce gases and seem to have a “foul breath” to surrounding plants, which limits their growth. Because a garden in dry weather is under stress, why not enhance the plants’ productivity as much as possible and try some companion planting ideas? Some companion plants are:

- cabbage and celery
- carrots and tomatoes
- eggplants and green beans
- horseradish and potatoes.

Some plants seem to act as insect repellents. Garlic, onions, and chives keep away insects and actually contribute flavor to surrounding plants. This group of aromatic plants seems to grow well with everything except members of the legume family (peas and beans. Roses are more fragrant and have less black spot when grown with onions. Parsley reduces aphid attacks on asparagus and tomatoes. Marigolds repel nematode insects when planted around tomatoes and eggplants. Consult *Carrots Love Tomatoes* by Louise Riotte (Storey Books) for additional information.

The Importance of Good Soil

Soil that is rich in nutrients and organic matter, that is well aerated and retains moisture, will be more productive in a dry season. Plants in a healthy soil will grow vigorously, developing strong root systems to seek out water.

Know Your Soil

Learn about your soil with a soil analysis. Soil test kits are available at most nurseries and lawn and garden stores. Or you can contact your county extension agent who will recommend a private soil-testing laboratory.

The soil test should tell you what nutrients, if any, are missing or in short supply from the soil. It will also tell you whether the soil is within the optimum pH range. Soil pH refers to the acidity/alkalinity of the soil. Most garden vegetables do well in a soil with a pH of 5.5 to 7.5

Soil Texture. The size of the mineral particles that make up your soil affect its moisture-holding capacity. A “squeeze test” will help determine the soil texture. A very sandy soil feels gritty and will crumble in your hand. Sandy soils have relatively large soil particles and poor moisture retention. Clay, on the other hand, is very sticky and will form a ball readily. Clay soils are made up of fine individual particles, which hold moisture for a long time. Although this is sometimes a blessing, the fine particles of clay can hard-pack so tightly that rain will bounce off the surface and not be absorbed.

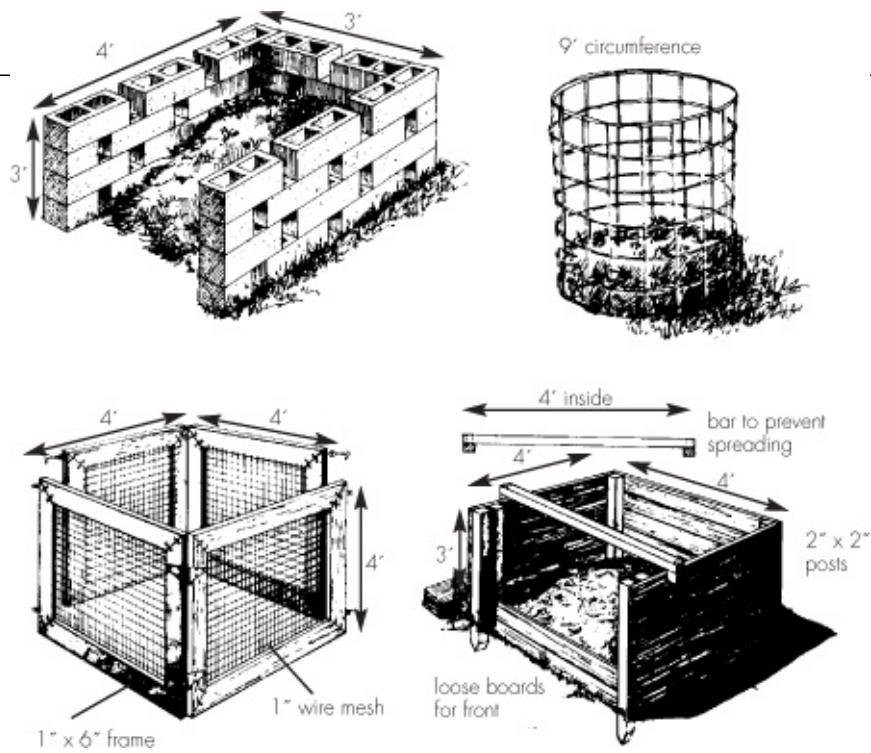
Soil Composition. The ideal soil is a sandy loam, rich in organic materials. It is the organic materials that improve the ability of the soil to retain water and make it friable and fertile. Also, plant roots are able to grow more vigorously in soil rich in organic matter. If your soil test indicates some nutritional deficiencies, it is best to add organic matter — well-rotted manure, alfalfa meal, bone meal, blood meal, or cottonseed meal, depending on which nutrients are lacking. Lime can be added to raise the pH, or “sweeten the soil,” and make it less acid. Add five pounds of lime to each ten-foot by ten-foot area to raise the pH one point.

Improving the Soil With Organic Matter

Adding organic matter to the soil is very important. Start conditioning your soil in the fall, before the gardening season. Till under all your garden residues and weeds. If you used hay as a mulch on your garden, be sure to chop it and till it in also. If you did not use a hay mulch, you can buy bales of hay or straw, peat moss, or dried manure and add that to your garden. Compost, leaves, and grass clippings are excellent organic materials you can add to your soil. Sowing a green cover crop in late fall will protect the soil from erosion, prevent nutrient leaching, and hold in valuable moisture.

Making Compost

Compost is composed of decaying organic matter. It benefits the soil by improving aeration and releasing a small, steady supply of nutrients. Heavy soils actually loosen up with each addition of compost. Light soils are better able to retain moisture, a necessity in times of drought. Compost provides a rich environment for soil microorganisms, which break down the raw compost materials, making nutrients available to plants to take up through their tiny root hairs.



Compost bins come in many shapes and can be built out of any materials you find convenient.

Piles Versus Compost Bins. Lazy gardeners say that the easiest way to make compost is to create a pile of layers of leaves, grass clippings, or other organic matter, and an activator. They turn the pile over at least every six months (preferably every three months). The pile is shaped with the base wider than the top so it will not tumble over, and rainfall will seep into the lower layers.

I find composting in a container is easier. You don't have to worry about shaping the pile, and the compost bin is a tidier sight than a compost pile. There are a number of suitable containers for compost — from a box made of wood (see illustration) to a round cage made of woven chicken wire fencing. An ideal pile is about four feet tall. Don't let your pile become too big, or turning it will be a chore.

Adding the Compost Ingredients. Begin by breaking up the soil beneath the bin to a depth of twelve to fourteen inches. This will encourage microorganisms and earthworms to enter the bin and assist in breaking down the organic matter. If you are working with a bin that has a base of three feet by three feet, start your pile by adding two inches of vegetation — straw, grass clippings, leaves, kitchen garbage — one to two inches of manure, and two inches of soil. Keep alternating layers to a height of four feet.

Everyone is afraid of adding the wrong things to the compost pile and ending up with an obnoxious stinky mess. With a little thought, this sad situation can be avoided. Never add meat, fat scraps, or grease to the bin. These things will draw animals and flies. Avoid thickly piled grass clippings, which can become a thriving fly breeding ground. Also avoid weed and grass clippings that have gone to seed. Some seed coats are really tough and can withstand higher heat than the compost bin can generate. To add these seeds to the compost bin is as good as sowing them directly into the garden. Avoid the use of such poisonous plants as castor bean, hemlock, and oleander.

Generally, the smaller the size of the raw materials, the quicker the decomposition takes place. Unfortunately, finely ground material can quickly settle into an airless mass, which is definitely undesirable. How big should the organic matter be? A general rule is to use pieces about the size of a finger. Small prunings, dry weeds, wood ashes, vegetable peelings, coffee grounds, and eggshells are all excellent materials for the compost bin. Materials that decompose rapidly, help maintain the

fermentation process, and are a rich source of nitrogen are fresh alfalfa hay, lettuce leaves, and grass clippings. ~~Materials that decompose slowly and have a higher ratio of carbon to nitrogen are dry leaves, small twigs, and sawdust.~~ Be sure to add sufficient nitrogen-rich materials along with these materials.

Heat and Moisture. Once you have filled the compost bin, make a small basin in the top and add water to wet thoroughly without flooding. The presence of moisture encourages the plant-decaying microorganisms and speeds the composting process. However, if the compost pile remains in a saturated state for very long, it will smother many of the beneficial bacteria (actually drown them for lack of air).

Heat, caused by the concentrated decomposition of the organic matter, is essential for killing weed seeds and plant roots. If the compost pile is too low, it loses heat rapidly, delaying the process. If the compost bin is too tall, the pile becomes compressed by its own weight, slowing down the process. If the pile really gets hot, it can kill the helpful bacteria. To avoid this situation, it is necessary to turn the pile.

Turning is done after the first few weeks when the pile packs down. Turning rearranges the pile, bringing the outer, less-decomposed matter to the center where the heat can work on it. The pile will heat up again briefly, then cool, and will then be ready for use. It is a good idea to sift the compost, returning large pieces to the bin. Spade the fine compost into the soil to a depth of about twenty inches. It is important to put this rich plant food into the root zones and not just in the top few inches of the vegetable garden.

Planting the Garden

Prepare the soil about two weeks before planting. If winter snow or rain has been scarce, start by soaking the soil to a depth of about three feet. Then allow the soil to dry slightly so that it crumbles when squeezed. Spade or till to a depth of fifteen to eighteen inches. Many gardening books will recommend that you spade the earth to a depth of eight inches. We recommend deeper tilling because it is the top layer of soil that dries out in a drought; but it will take a very severe, prolonged drought to dry the soil beyond a foot. If you can build fertility and moisture into your garden at those depths, at least the deeply rooted plants will thrive.

After tilling, allow the soil to rest and mellow for about a week. Then break up the large clods and work in at least two inches of organic matter — compost or dried manure. Allow the soil to rest at least one week before planting seeds and irrigate the soil a day or two before planting (depending on climatic conditions).

Timing

Under dry weather conditions, you may want to adjust your normal planting schedule. Planting earlier or later than usual may help you beat the summer's worst dry spell. If your soil is frost-free and dry enough to be worked early, plant early. You can protect young plants from frost at night with cold frames, cloches, and plastic tents.

Starting Seeds

Start as many of your plants indoors as you can. There are two reasons for this. For one thing, seeds need moisture to germinate. It requires a great deal less water to keep a small seed flat moist than a large garden bed. Likewise, the young potted seedlings can be watered as needed more efficiently. Also, by starting the seeds early in the season, your plants will have established good root systems before the intense summer sun is at its height.

Containers. There are many containers you can use for starting seeds — everything from recycled milk cartons to peat pots to plastic flats. The main requirement at this stage is that the pots have holes in the bottom to allow excess water to drain.

Fill your potting container with a sterile potting soil mix. You can make a batch of soil using garden soil, vermiculite, and peat moss or compost. It is a good idea to sterilize your homemade soil mix by spreading the soil on a cookie sheet and baking it in the oven at 300° to 350°F for about one hour.

Water. Generously water your newly planted seeds. It is a good idea to use a fine spray or allow the pot to sit in a pan of water until the top soil is thoroughly moistened. In this way the seeds are not disturbed. Cover the flats or pots with plastic bags to hold the moisture and place them in a warm place — about 70° to 75°F. As soon as the seeds begin to germinate, remove the plastic bags.

Transplanting. You will want to encourage these plants to develop extensive root systems. You can do this by transplanting the seedlings to progressively larger pots. There will be less moisture loss through glazed or plastic pots than through peat or clay pots.

Transplant when the first set of true leaves appears. Lift the plant out of the soil by holding on to the leaves, never the stem. Transplant the seedlings a little deeper than they were before. Although the shock of transplanting may seem to set the plant back, most plants will make an admirable comeback.

Tomatoes can be transplanted two, three, or even four times to encourage healthy root development. Each time set the plant deeper than it grew before. (Roots will grow along the tomato stem.) Prune off the lower leaves to give the roots the advantage.



This pepper transplant shows practically no set-back in spite of the dry weather because heavy mulch is helping to keep moisture in the soil.

The plants should be hardened off before they are transplanted in the garden.

- Decrease the amount of water each plant receives about ten days before transplanting.
- Set the plants outside for a few hours each day. Place them in a sheltered location where they will be neither wind-blown nor sunburnt.
- Gradually increase the number of hours the plants are left outdoors, until they are left out day and night.

Transplant to the garden on a damp, cloudy day, if possible. Thoroughly water each pot a few hours before transplanting. This will guarantee that the plants will lift from the pot with a good ball of soil protecting the roots. Insert the seedling in a hole dug wide enough for the roots and firmly press the soil down to eliminate any air pockets which might dry out the roots. After planting, water thoroughly again. Provide shade with some fencing.

Some gardeners plant their seedlings in peat pots and then transplant the seedling, pot and all, directly into the garden. In moist soils, the peat will biodegrade rapidly. But in dry soil, the peat may not decompose as quickly, and the roots will remain within the peat cup, unable to get the moisture they need. Therefore, remove the peat pot before planting in dry soil.

Sowing Seeds Directly

Practically speaking, often there is not enough space in the house to allow you to start all your plants indoors. Some plants will do best sown directly in the garden — peas, beans, carrots, beets, and spinach. To plant, mark off the wide row you have set aside for that crop. Rake the moist soil smooth (Remember that you watered the soil thoroughly a few days before.) Broadcast the seeds evenly over the row. Finally, tamp down the soil surface and cover the seeds lightly. If you are planting the large seeds of peas or beans, rake extra soil from the sides of the rows over the seeds. Then firm the soil with your hoe.



Here we mulched the garden heavily, then raked to expose a row of soil. The pea seeds are covered with finely sifted compost. By mulching before the plants are up, we are conserving the more abundant spring moisture. The compost provides a very fertile environment for the seeds, and we have saved ourselves the labor of making a seed row with a hoe.

Cultivating

A gardener's definition of a weed is any plant growing where it is not wanted. Doubtless, there will be plenty of them in your garden. They will compete with your vegetables for moisture and nutrients and should be removed.

During your regular inspection of the garden, keep a sharp eye out for weeds. As soon as the first set of leaves has formed on your vegetable plants, you should be able to distinguish between weeds and vegetables. If the soil surface is on the dry side, it is best to hoe the weeds under as green compost; otherwise, you may find yourself pulling the weed stalk and leaving the weed roots to continue stealing moisture and nutrients from crop plants. Never, never, never allow weeds to go to seed. Shallow cultivation is best during a dry season because it causes less evaporation from the soil. It also prevents injury to plants' roots, a factor that puts them under great stress in dry weather.

To control weeds effectively, carpet the vegetable garden with a thick layer of mulch as soon as possible.

The Importance of Mulching

Mulching means blanketing the soil surrounding garden plants with a layer of material. It has several beneficial effects and is a boon to gardens in dry and normal seasons.

- **Reduces the loss of soil moisture.** Wind and sun speed the evaporation of water from the upper six to eight inches of soil. Merely shading the ground reduces evaporation by 30 percent. With a thick application of straw mulch, evaporation can be reduced by as much as 70 percent.
- **Prevents weeds.** Keeping the weed population small means less work for you and more water and nutrients for the vegetables. In order for the mulch to reduce the weed population, it must be spread thickly. Any weeds that do grow through usually can be pulled up easily as their root systems will be poorly anchored.
- **Insulates the soil.** Mulching will keep the soil temperature even. It will keep the soil temperature cooler on hot days, which will mean less moisture loss by evaporation and transpiration. Also, it will keep the soil warmer on cool nights, and this will speed growth.
- **Prevents a soil crust from forming.** Clay soils have a tendency to bind together and form a hard crust that prevents water absorption. A mulch allows the water to seep into the soil slowly and prevents crusting.
- **Adds nutrients.** Organic mulches add nutrients to the soil. They can be tilled into the soil along with other garden residues each fall, adding to the organic content of the soil.

Mulching Materials

Mulch can be composed of organic or inorganic materials. Black plastic sheeting and aluminum foil are two common inorganic mulches. Commonly used organic mulches include straw, hay, peat moss, leaves, pine needles, wood bark, and newspapers.

Many gardeners find that black plastic holds the heat in the soil, which speeds growth and subsequently yields better results in many warm-weather crops, such as melons, eggplants, peppers, and squash. Also, the plastic sheeting allows you to mulch close to the stem. But the plastic sheeting may cause excessive heat buildup, which can harm the plants. Likewise, aluminum foil can heat up the underside of plants, a positive effect in early spring, but detrimental in the heat of the summer.

Inorganic mulches add nothing to the soil. But organic mulches slowly decompose and add nitrogen, potassium, and other minor elements to the soil. At the end of the growing season, organic mulches can be tilled into the soil along with other garden residues, adding humus and improving the water-retaining qualities of the soil. For these reasons, we recommend the use of organic mulches.



Make a slight depression in the mulch mound surrounding your plants to catch rainwater.

When to Mulch

Because mulch acts as a soil insulator, wait until the soil has warmed up in the spring before mulching. Once the soil is warm, spread the mulch right around the young, emerging plants.

Get the most water retention from mulches by spreading your mulch after a good rain. Try spreading the mulch over the entire garden surface in the spring, then clearing a space for your seeds and transplants. You will be able to mulch much closer to the plants in this way. Keep the mulch away from the tops of root crops, such as carrots, beets, and potatoes, to avoid crown rot.

As the season progresses, add new mulch as the old mulch decays and becomes compacted.

Mulching in the fall will keep the soil temperatures warm and extend your growing season. Using mulches around cold frames and plastic tents will keep plants growing beyond the first frosts.

How Much Mulch to Apply

A good rule of thumb is the smaller the individual particles of mulch, the thinner the layer of mulch should be. A half an inch of coffee grounds can be as effective a mulch as twelve inches of coarse straw. If mulch is spread too sparsely, weeds will thrive and soil will dry out easily. Too much mulch and the plants will not be able to breathe; they will not be healthy plants. Common sense should be your guide.

Fertilizing

Healthy plants will tolerate a drought better, so be sure your plants have all the nutrients they need. Your soil test, done before you planted, should have alerted you to correct any deficiencies.

Some mulches, as they decompose, will remove nitrogen from the soil. This is most likely to occur with fresh sawdust, wood chips, ground corncobs, and some cereal straws. Some signs of nitrogen deficiency are a yellowing of the foliage, and a stunting of the plants. Remedy this situation with a side-dressing of blood meal, cottonseed meal, bone meal, manure tea, or fish emulsion. Water well after you side-dress to get the nutrients down to the roots. Just about any garden plant will benefit from a good side-dressing of fertilizer as it starts to blossom.

Dry Weather Growing Tips

- Do not stake or heavily prune your tomatoes during a drought. Let them sprawl on the ground. The foliage will shade the soil, keeping the roots cooler and reducing evaporation of water from the soil. A determinant variety will sprawl less than an indeterminate, making harvesting easier. Mulching under the plants keeps the fruits cleaner.
- In an extreme drought, try planting tomatoes and other water-loving, fruit-bearing plants in large plastic bags. Dig a hole in the garden large enough to accommodate a large, plastic garbage bag filled with soil. Water the soil to saturate it. Insert the young tomato plant deeply inside the bag, removing all but the top leaves, and covering the rest of the stem with soil. Secure the bag around the stem. The bag will hold the moisture in, and you will not have to water more than a few times a season.

- During a drought, do not grow vines on a trellis; allow them to sprawl on the ground.
- Interplant tall and short crops so that the tall plants can provide shade for the shorter ones.
- When mulching with newspapers, do not use the funnies. The colored ink in most newsprint contains lead, which is harmful to the plants.
- Herbs are a good dry season crop because most originated from the hot, dry Mediterranean area.

Watering Your Garden

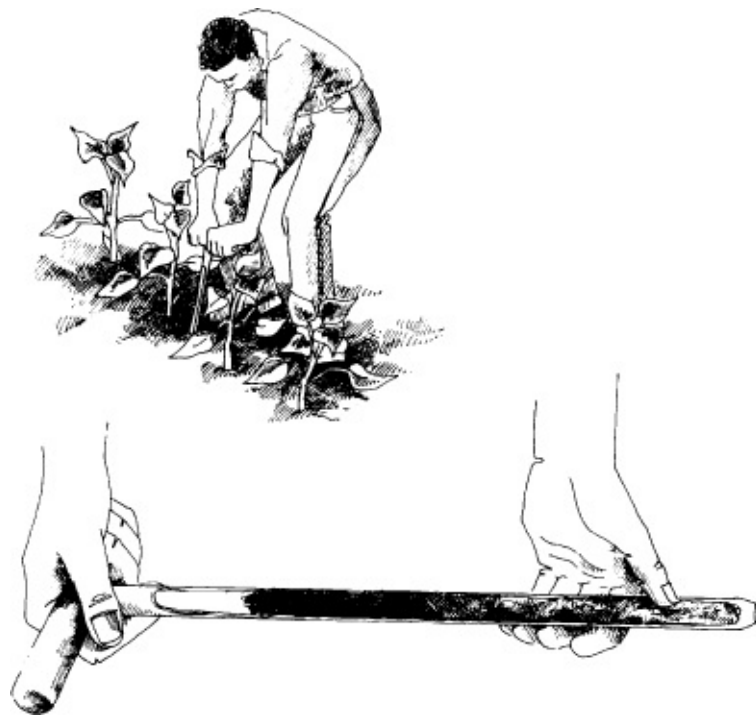
Water only when plants need it. A simple statement, but how can you tell when they need water? Get to know your plants. Look at them, really look. Feel the leaves. How do they look the day after a deep watering, three days after, one week after? There will be a change in leaf gloss, and subtle changes in leaf color and the height the leaves are held.

Most plants are about 90 percent water. This fluid is necessary to carry on vital functions, such as photosynthesis, respiration, and transpiration. (Often, more than three-quarters of the water absorbed by plants is transpired, or given off for cooling.) Water pressure (within the cells) helps to keep plants without woody stems, erect. When they do not have enough water, plants droop and wilt. Plants will often wilt in the heat of a hot afternoon because they are giving off more water than they are absorbing. With this type of wilting the plant usually recovers by late evening or the next morning. If plants are still wilted in the morning, the soil is too dry; water immediately.

For healthy growth, plants need about one inch of water a week (which is about sixty-two gallons for 100 square feet). The best way to be sure your vegetables are getting their weekly water is to set up a rain gauge in your garden. A wide selection of gauges is available for sale in garden centers and through seed catalogs. They are easy to use and simple to monitor. Or, you can make your own rain gauge by using a tin can with the top removed. Measure the rainfall in your homemade gauge with a ruler.

Check the gauge after every rainfall and note the amount of water that fell. Mark it in a journal or on your garden calendar. Add it up each week to see if the one-inch quota has been fulfilled. If rainfall was too low, water.

One inch of water will wet a sandy soil down about one foot; a loam soil about eight inches; and a clay soil four to six inches. Sandy soils drain more quickly and often need more frequent watering. Know your soil type and adjust your watering accordingly.



Taking a moisture sample with a sampling tube.

Many people purchase moisture meters to tell them when to water. These have metal probes that g

into the soil and dials that show when the soil is too wet or dry or just right. Some people take a soil sample with an auger (which can be purchased at a nursery center or hardware store). It is a metal tube that is stuck down into the soil several inches. When pulled up, the soil sample is easily read for moisture content. Try using a finger; it does the same thing, is free, and puts you in closer contact with the plants and the soil. It is important to check the soil moisture in the plant root zone, not just on the surface.

Allow the soil to dry *slightly* between slow, deep waterings. This enables air to mix with the soil particles to aid in plant growth. The perfect soil is 50 percent soil particles and 50 percent spaces, optimally filled half and half with air and water.

Watering Tips

- For a plant, the most critical period of growth, when adequate water is essential, is just after blossoming when the fruit is beginning to form.
- Always cultivate before watering to ensure that the soil is loose and will absorb the most water. Otherwise, the water will cause a hard crust to form on the surface of the soil, preventing both water and air from circulating.
- Rain barrels and other containers set out to catch rainwater should be tightly capped when not collecting to prevent evaporation. Add a few drops of oil to discourage mosquitoes from breeding in the water.

Water Properly

Ideally, a vegetable garden should receive about one inch of water each week as measured in a rain gauge. That is about 620 gallons for each 1000 square feet (a plot measuring 20 feet by 50 feet, for example). If you must supplement the rainfall, be sure to follow these guidelines to use the water most effectively.

- Apply water slowly, deeply, and uniformly. Watering to a depth of five to six inches encourages the growth of deep roots, enabling the plant to seek out water at different levels in the soil. Plant growth is interrupted if the soil is allowed to become very dry and then soaking wet. Constant moisture supply is very important for continuous growth and maximum yields. With frequent, shallow watering, a large percentage of moisture is lost in evaporation.
- Apply water when the air is still. This way all the moisture goes into the soil and is not carried away by wind.
- Water in the morning when humidity is usually the highest and temperatures the lowest. Watering during the heat of the day sacrifices a lot of water to evaporation, while watering late in the day or in the evening may encourage fungus disease.

Water Systems

When water is in short supply one of the easiest and most efficient ways to water plants is with a drip irrigation system. The drip system applies water in the root area of the plant one drop at a time, rather than wetting the entire area as a conventional system would. If you do not want to invest money in the drip equipment, you can dig irrigation trenches or basins.

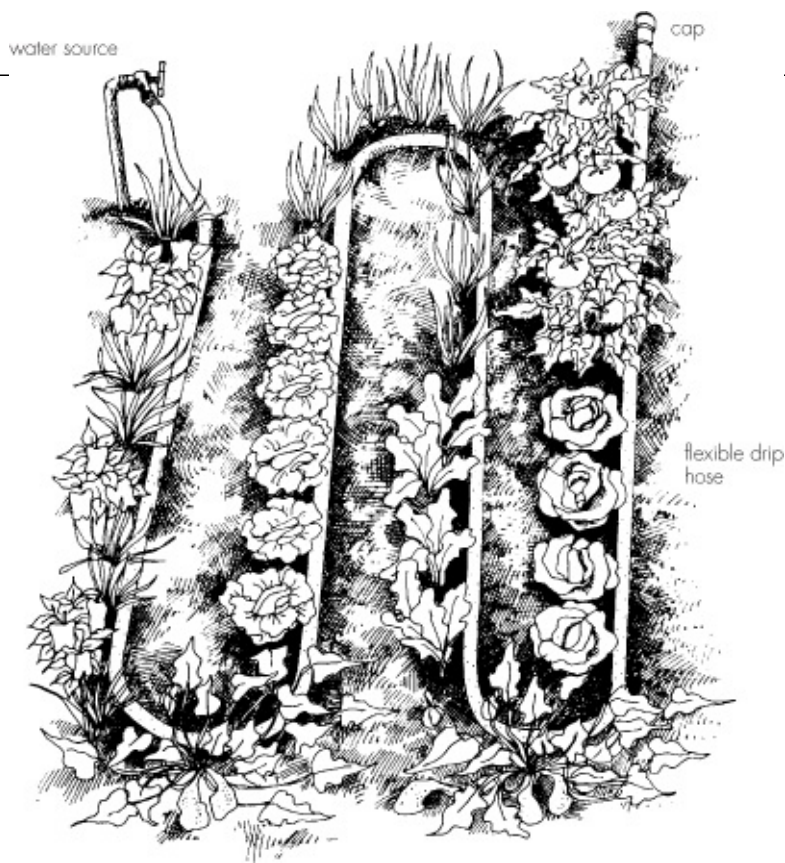
Drip Irrigation

A drip system, which can be buried or left on the soil surface, consists of ½-inch PVC (polyvinylchloride) pipe, which connects to the main water valve at the house. The ½-inch PVC pipe branches off to ¼-inch PVC pipe that branches off to lateral lines that are connected to water emitters. The emitters may have bubbler or spray heads or flexible tubing to disperse the water.

Through the use of pressure valves, water is emitted in a very slow, controlled way directly to the root zone. The system is automatically controlled to apply water at the same rate that the plants absorb it. The correct mixture of moisture and air is maintained in the soil so plants do not suffer between wet and dry conditions. The controlled moisture content of the soil results in large, healthy, quick-growing plants. Run-off problems virtually disappear. Weed growth is significantly diminished.

The water in a drip system moves down through the soil as gravity acts on it. The really high-quality water emitters will wet only the soil surface in an area the size of a quarter so loss of moisture to evaporation is greatly reduced. Beneath the surface the soil is moistened to a depth of 2½ to 3 feet. Water moves through sandy soil rapidly; thus with a drip system, the soil is wetted in a narrow, deep area. As water moves more slowly through clay soil, the area beneath the surface is saturated in a wide and shallow area.

A water savings of 40 to 60 percent can be realized with a drip system. Some vegetable gardeners feel that production can increase as much as 15 percent. The system can be made completely automatic. With special attachments, a drip system can apply fertilizer with the water. What a time saver! There are certain disadvantages, such as having to flush out the emitters from time to time, but self-flushing emitters can be purchased, making the system practically self-sufficient.



Drip Irrigation System

Drip irrigation systems can be obtained from nurseries, hardware stores, mail-order garden catalogs; or check in the yellow pages of the telephone directory under landscape architect, sprinkler systems, or irrigation systems. Parts for the average garden-size system cost approximately fifty dollars. Compare that price to that of a high quality, long-lasting garden hose.

If the idea of a drip irrigation system is appealing but a bit too costly, devise one of your own. Turn a soaker hose face down and apply water *very* slowly to avoid run-off. Another homemade drip system consists of large coffee cans or milk cartons with the top removed and holes punched around the bottom of the sides. Place the cans at regular intervals in the vegetable garden (before you set the plants in so you don't disturb the roots). When necessary, fill with water. The water will slowly stream out. Cans need to be refilled several times to provide moisture to the correct soil depth.

Dry Season Growing Problems

- Irregular water and heat may produce these physiological disorders in your plants:
 - growth cracks and blossom end rot on tomatoes,
 - sunscald on peppers and tomatoes,
 - knobby potatoes,
 - tip burn on head lettuce.

You can still eat these plants. Drip irrigation will prevent these problems.

- Drought-weakened plants are particularly vulnerable to disease. Powdery mildew is a real threat in dry weather. And when a dry period is followed by a wet period, downy mildew or blight is likely. Contact your extension agent for the best controls of these diseases.
- Overwatering can cause root rot and may lock up the magnesium in the soil. The symptom

of magnesium deficiency is a yellowing of the lower leaves between the veins, which remain green.



Irrigation trenches are dug 6 inches deep and 12 inches wide. Plant on the sides of the trenches to protect the roots from salt buildup.

Irrigation Trenches

Irrigation trenches should be dug before the vegetable garden is planted. The trenches should be twelve inches wide and six inches deep with a very *slight* slope to one end. Water is applied at a very slow rate to the upper end of the trench and allowed to penetrate the soil surface gradually as it works its way to the end of the trench. Soil erosion is practically nil. There is little compaction of the soil immediately around the root zones so that less cultivation is needed. When using trench irrigation, plants are placed to the side of the furrows, not on the top (see the illustration). The reason for the side placement is that the crown of the furrow will accumulate salts, which can damage tender roots.

Irrigation Basins

Another method of applying water to plants, especially vine crops, such as pumpkins, melons, squash, and cucumbers, is to dig a basin for three to four plants. Plant seeds in the center and train the vines to grow outward so only plant bases will come into contact with water. Basins can be arranged in a figure eight to streamline watering further. When applying water, use a bubbler head on the hose or tie a sack on the end to further prevent soil erosion.



An irrigation method suitable for large plants, such as squash, is shown here. Watering basins are

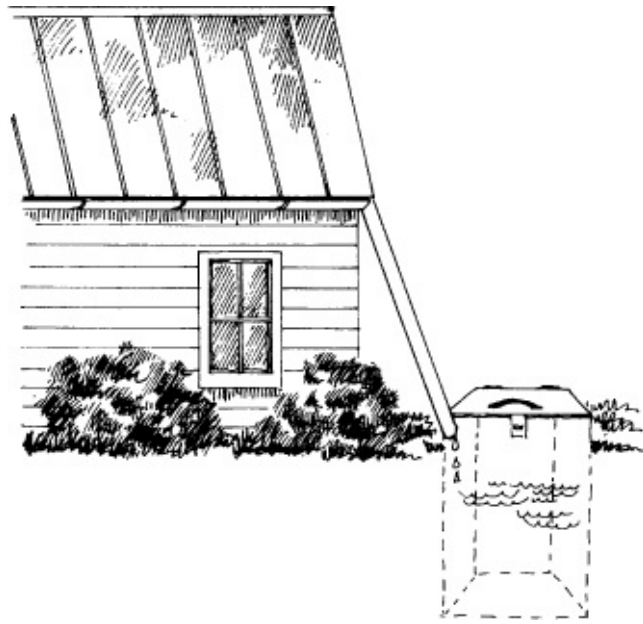
linked together to ease watering. The mound of soil in the center keeps the plant above the water level.

Sprinklers: Not Recommended

The use of an overhead sprinkler to water a vegetable garden is not recommended due to the high rate of evaporation. If you decide to sprinkle irrigate, do it in the early morning when the temperature is coolest so there is less evaporation. Also, if you water in the morning, foliage will dry before sundown, making the plants less susceptible to disease.

Additional Sources of Water

Where every drop of water counts, it is important to collect all the water you can. Rain can be collected in rain barrels, buckets, and cisterns. “Gray water” can be recycled from the house and used in the garden.



A partially underground cistern of poured cement can collect rainwater from your roof. Be sure it is kept tightly sealed.

Cisterns

What is a cistern? Any waterproof container that can be used to catch and store rainwater for future use is a cistern. It can be built as easily as putting a plastic bucket under a drain spout. A clean fiftyfive gallon drum or a series of drums or rain barrels is an even better bet.

If you decide to build a cistern, you need a collector, piping, and a holding tank. Usually the rooftop of a house or other building serves as the collector. The roof must be rust-free, noncorrosive, and not painted with a lead-base paint.

The rainwater strikes the roof and flows by gravity down a gutter pipe. The pipe must be rust-free and angled so that the water flows freely. The pipe channels water into a holding tank.

Where to locate the holding tank? Underground is the recommended location, as the temperature is kept cooler in the summer and warmer in the winter, so water will not freeze. The earth will help to support the walls, which need to be thick (six inches of poured concrete or another noncorroding material such as stone plastered over with cement) to withstand the pressure exerted by the water if a large tank is planned.

Be certain the holding tank is sealed against pollution from grazing animals or from any nearby septic tanks; better yet, situate the holding tank on higher ground than septic tanks. The tank should have a tight seal so that sunlight cannot enter; otherwise, slime grows quickly. A heavy, reinforced, hinged lid that can be locked is important to keep children out. The tank should be drained and thoroughly cleaned every two years, so make provision for this important step when designing the system. The roof and drainpipe should be flushed out occasionally.

The water can be pumped out of the holding tank by using an old-fashioned pump handle or with a

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