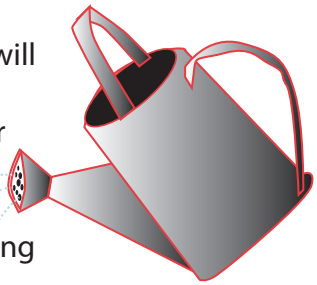
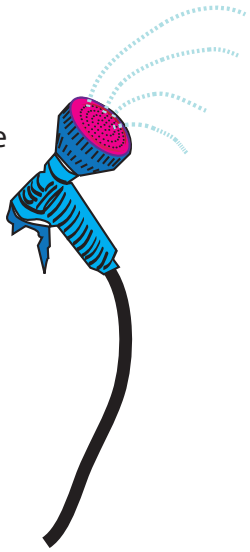
STEP 8: Install Irrigation



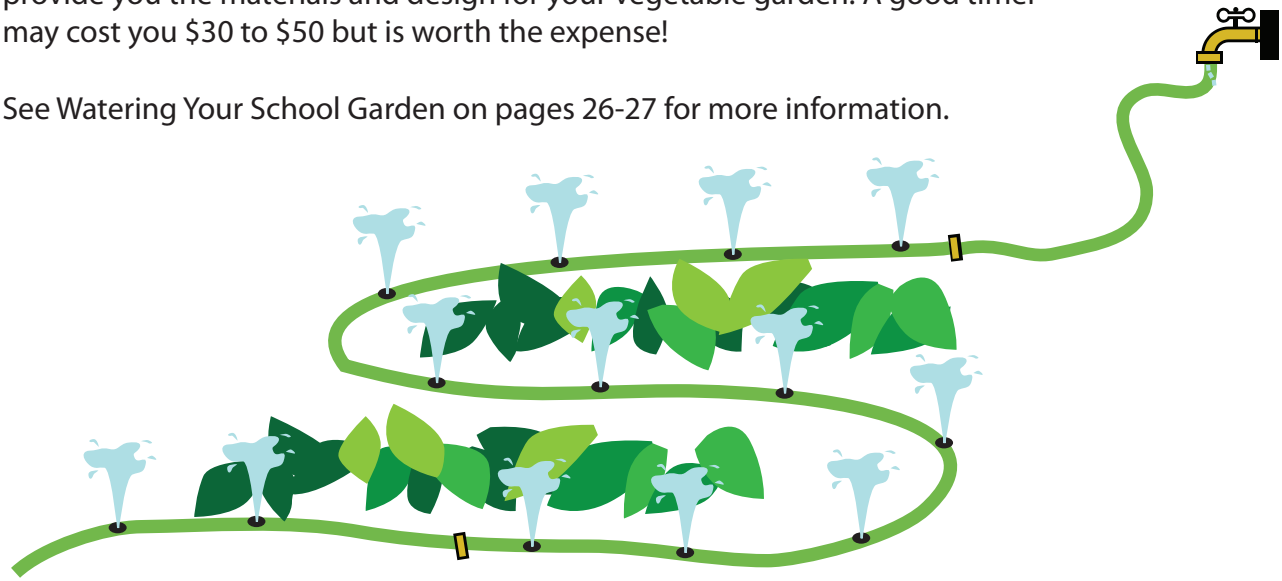
Think about how you are going to water your garden. How large is your garden? Small gardens can be managed by hand watering when school is in session. Who will water when school is out? A simple irrigation system on a timer can provide water when students cannot. There are several irrigation systems that are appropriate for school gardens.

- If the school garden is small and you or a volunteer will water it by hand during the week and on weekends, a simple hose and water wand or watering cans will suffice. If no one will be available to water on weekends and holidays, however, an irrigation system with a timer will need to be purchased. Many irrigation systems are simple, inexpensive, and easy to install. For basic systems, you will need a water source near the garden. Local irrigation companies can work with you to customize the design and materials for the school vegetable garden. The most important component is the timer. A good timer may cost $30 to $150 but is worth the expense! For example, a simple irrigation system can involve just a timer attached to drip hoses or to a hose and water wand. Generally, you want to water 15 minutes twice a day when the transplants and seeds are first planted. Make sure the water softly hits the soil. Be careful so the water doesn't disturb the seeds or wash the soil off of them. After the plants are established, the watering can be scaled back to about 30 minutes a day about three times a week -- unless there is a lot of rain, which would decrease the need for supplemental watering. A general rule of thumb is that most vegetables need 1 inch of water per week.



- If you do not plan on being there to water your garden on weekends and holidays, you should consider an irrigation system. Irrigation systems are simple and can be inexpensive and easy to install. For basic systems, you will need a hose outlet near your garden. Irrigation companies like PolyDrip can provide you the materials and design for your vegetable garden. A good timer may cost you $30 to $50 but is worth the expense!

- See Watering Your School Garden on pages 26-27 for more information.

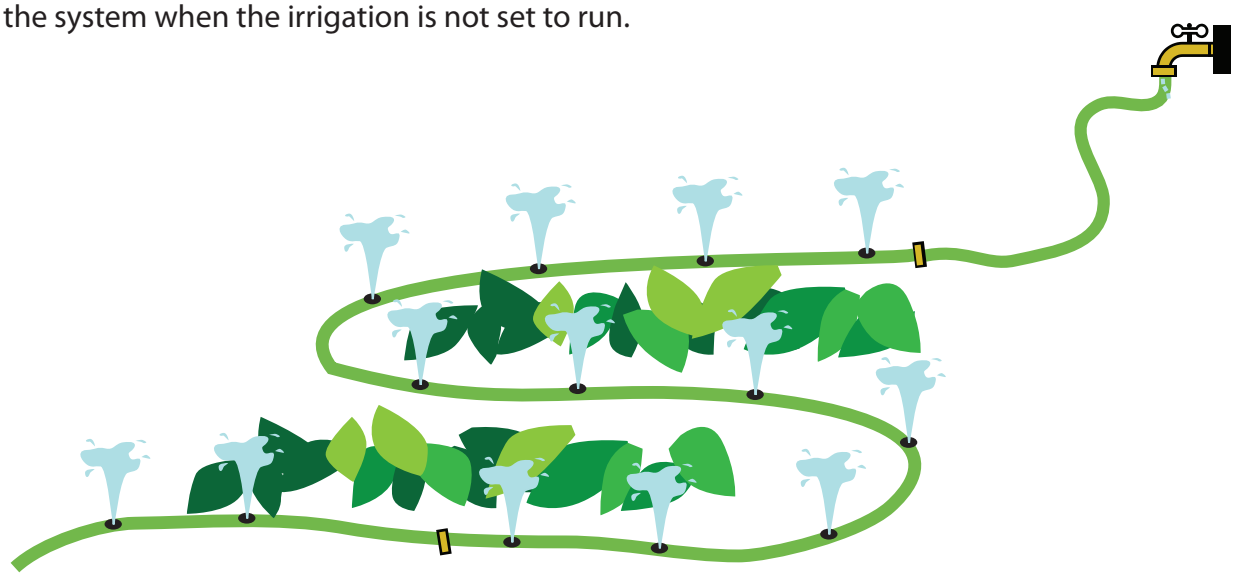


Watering Your School Garden

Irrigation systems come in handy during the weekends, holidays and summer vacations when students and faculty generally are not at school.

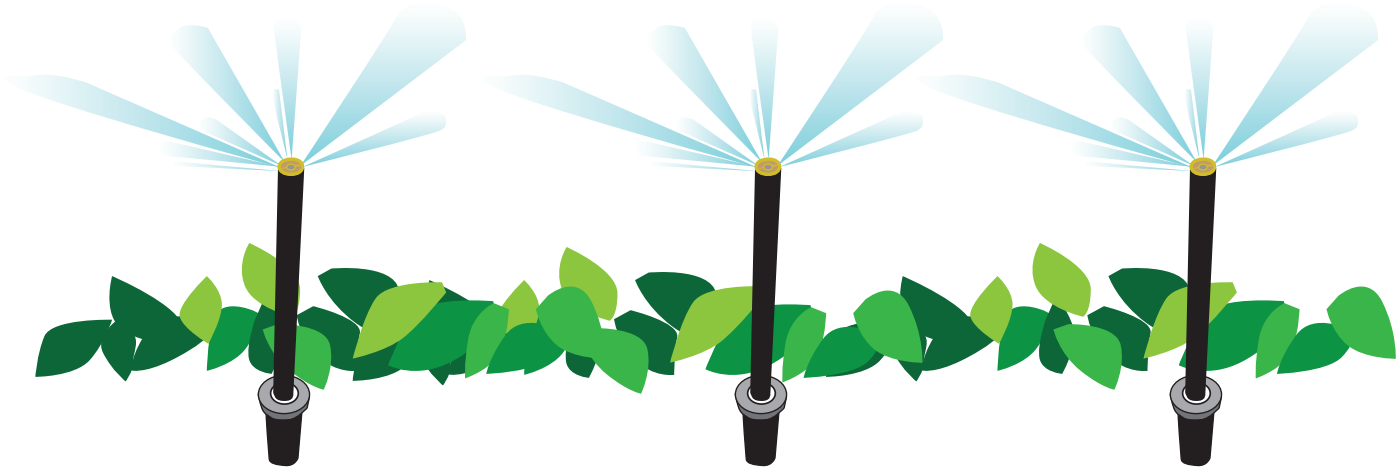
Your school garden can have a simple irrigation system, an elaborate one or a variety of possibilities in between. Your irrigation needs will depend on the size and shape of your garden beds. The different types of irrigation systems are:

1. Drip hoses can be placed in all garden beds.
The first drip hose attaches to the outdoor faucet and then connects to all other drip hoses. The timer should be placed between the faucet and first drip hose. Remember, when using this type of irrigation system, never shut off the water at the faucet. The timer will prevent the water from flowing through the system when the irrigation is not set to run.



2. Hoses with nozzle and sprinkler attachments can be used in a school garden.
These are easy to use, but there are some disadvantages to this type of irrigation system. You must drag the hose and sprinkler out to the garden each time you water. Leaving it strung out across the school yard can be a trip hazard or may lead to it being mowed over with lawn equipment. It is a cheap and effective irrigation method, however.

3. A riser system.
A timer is connected to an outdoor faucet. From the timer, plastic hoses are laid throughout the beds. Risers with spray nozzles can be installed along the plastic hoses, as needed. Risers and nozzles usually screw into one another. The risers are connected to the plastic hoses by using a small tool (provided with the irrigation system equipment) to pop a hole in the plastic hose. The riser is then connected to the hole. Spray nozzles can spray in arrays from 360-degree to 90-degree angles. They also have varying spray diameters. You will need to sketch a drawing of your garden space with all dimensions before going to an irrigation supply store. Irrigation supply stores usually can design a quick irrigation system on the spot.



4. In-ground, pop-up sprinkler systems also can be used in a vegetable garden.
These systems are more difficult to install and require a professionally licensed person for installation. These generally are very reliable systems but can be costly.

DRIP: Watering the Home Garden

The authors are Ralph Strohman, Staff Research Associate and J. L. Meyer, Extension Irrigation and Soils Specialist, Riverside

California home gardeners, increasingly aware of the need to save water, are learning that drip might be a good way to conserve water. Many are asking how to make drip irrigation work for them. This leaflet is designed to help answer that question.

What is it?

Drip watering is the frequent, slow application of water to soil through mechanical devices called emitters. Emitters are built in or attached to small plastic water delivery lines that carry water to each plant. Drip watering results in lower water use by controlled water distribution, less water applied, and lower evaporation losses.

Drip should be part of an integrated watering system. It should be used for vegetable gardens, ornamental and fruit trees, shrubs, vines, and outdoor container plants. Sprinklers can be used for lawns and other ground cover.

Equipment needed

A drip system has three parts (fig. 1), the head (A), which includes controls and a filter; (B) a transmission system of plastic pipes or hose; and (I) the emitters.

The head (fig. 2), includes an on-off valve and a regulating device to reduce the pressure from 40 to 80 pounds per square inch (psi) to the low pressure of 10 to 20 psi for drip systems. If both a vegetable garden and trees or shrubs are to be watered, separate valves will be needed because different flow rates, pressures, and watering times are required. The head must also contain a filter to screen out particles that might clog emitters. It should also have one or more pressure-measuring devices to help in adjusting the pressure regulator.

The transmission system is constructed with polyvinylchloride (PVC) pipe, polyethylene (PE) hose, or a combination of both. In most cases, PVC pipe is used to reach the general area of planting, with the final distribution to garden rows or individual trees and shrubs through PE hose to which emitters are attached. It is desirable to bury PVC pipe to protect it against sunlight, physical damage and to keep the entire installation less cluttered.

Emitters are used for watering trees and shrubs. Several types are available. For home use, the type that is mounted on the PE hose is preferred. New plants can be started with one or two emitters, and more can be added as the plants grow. A punch for installing emitters on the PE lines should be purchased with the emitters to insure correct size of opening.

Drip tape is used for row crops where plants are closely spaced. They include single- or double-walled PE tubing with openings in the outer wall every 8, 12, or 18 inches.

Various accessories and connecting devices are needed to completely install and place the system in operation. These are fittings to change from hose bib threads to standard pipe threads, reducers to change from ¾-inch to ½-inch pipe sizes, barbed fittings to connect PE hose to PVC pipe, and adapters to connect drip tape to the PE hose.

Drip irrigation equipment has become fairly commonplace in retail stores. It is sold in outlets carrying irrigation equipment, garden supplies, and home building supplies.

Designing the system

First, make a diagram of your property to scale. Figure 1 is an example. Draw in the house and garage (M), driveway, sidewalks, and any other permanent features. Locate all trees (G) and plants (J) that you intend to drip irrigate and the position of your present or planned garden (N). Locate the source of water you will use (A).

Next, determine the size of pipe and hose you will need by calculating the rate of flow when the system is in full operation. Drip tape used for vegetables has output rates that depend on the brand, the hole spacing, and the water pressure. Ask the supplier for the output rate of the tubing you plan to use. The average flow listed for drip tape is ½ gallon per minute (gpm) per 100 feet. Determine the total length of tape to be operated at one time. Then, to calculate total rate of flow, divide the total length by 100 and multiply by the rate of flow per 100 feet.

Example: 7 rows, 50 feet long; drip tape output ½ gpm per 100 feet: calculate 7 rows × 50 feet × ½ gpm/100 feet = 1¾ gpm total flow.

In this case, water can be delivered to the garden area through a ½-inch PE hose (see table). If more than 350 feet of tape are to be operated at one time, a larger PE hose is needed.

IDENTIFICATION OF COMPONENTS IN FIGURE 1

A. Head or control center.
B. ½-inch PVC buried main line.
C. ½-inch PE hose for attaching row crop laterals.
D. ½-inch PVC slip tee.
E. ½-inch PVC tee with internal barbed outlet for attaching PE lateral.
F. ½-inch PVC ell with internal barbed outlet.
G. Trees.
H. ½-inch PE hose inserted in barbed outlet E.
I. ½-inch PE hose with emitters added.
J. A row of shrubs, roses, other flowers, or ground cover beside house.
K. ½-inch PE hose, slightly buried, to which emitters can be attached when needed.
L. ½-inch PE hose to which one emitter for each shrub or rose bush has been attached.
M. House.
N. Row crop drip tape in garden.

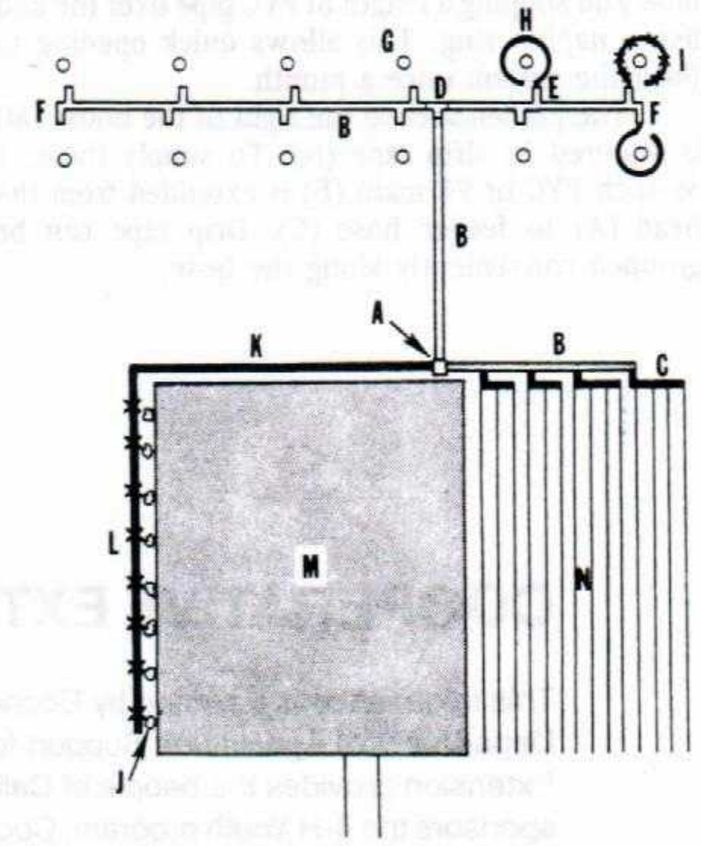


Figure 1. Example layout of a home drip system.

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Emitters are used to water fruit and ornamental trees. They are attached to PE hose that is connected to a buried PVC or PE main line. The number of emitters per tree or plant depends on the plant size. A large fruit or ornamental tree having a canopy spread of 15 feet in diameter or more needs at least six emitters. A smaller tree or shrub needs one emitter for each 2½ feet of canopy diameter. The number of emitters thus determined, multiplied by the rated output per emitter, will give the flow rate needed to water all the trees and shrubs at once.

In figure 1, there are 12 trees (G) with six 1 gallon per hour (1 gph) emitters per tree at 15 psi. The flow needed at D is 1.2 gpm because 12 trees × 6 gph ÷ 60 min/hr = 1.2 gpm. The table shows that a ½-inch main line (B) will be sufficient.

For the eight small shrubs (J) on the side of the house (M), one gph emitter per shrub is indicated (L) on a PE hose (K). Additional plants and emitters may be added later; therefore, a ½-inch PE hose is advisable.

Installation

Techniques for installing the relatively simple system in figure 1 are described in this leaflet. Professional help is recommended for more complicated situations. Check your local city codes for requirements for anti-backflow devices and their locations.

The lot in figure 1 is 90 by 120 feet, with a 40 by 50 feet house (M). It has 12 fruit trees (G) in back, 8 shrubs (J) on the left side of the house, and a 30 by 50 feet garden space on the right (N). Details of the head (A) are shown in figure 2. The main line (B) will be ½-inch PVC, buried about 8 inches. PVC tees (E) and elbows (F) have internal barbs and provide places to connect the PE feeder hose (H) on which individual emitters (I) are placed. Feeder hoses of ½-inch PE (H, K, and C) are laid on the ground or buried 2 or 3 inches. These hoses are closed at the ends by folding back 4 inches of hose and slipping a length of PVC pipe over the fold like a napkin ring. This allows quick opening to flush the system once a month.

The garden area to the right of the house (M) is watered by drip tape (N). To supply them, a ½-inch PVC or PE main (B) is extended from the head (A) to feeder hose (C). Drip tape can be grouped conveniently along the hose.

Installation hints:

1. Valves can be manual or electrical and must be made of plastic or brass.
2. PVC pipe is cemented using slip fittings, and PE hose is friction fit to internal or external barbed fittings.
3. Pressure gauges below each valve are useful.
4. The entire head should be firmly supported to avoid water "chatter" or vibration.
5. During construction, be careful to keep soil particles and chips of plastic out of all lines and connections. After the system is installed, it should be flushed with water before operating.

Operation

Correct operation is important in order to obtain the advantages of drip irrigation. Drip wets a smaller area than sprinkling or flooding; therefore, it must be performed more frequently. It is recommended that water should be applied daily or on alternate days during the watering season. Applying water this frequently may cause excessive wetness, unless the amount put on each time is carefully controlled. The amount of water needed with daily applications usually can be supplied by operating the system somewhere between 15 minutes in the spring to a few hours in the summer. This timing can be adjusted by checking soil moisture. It can be judged by sampling with a soil coring device or auger. Sample 8 to 12 inches from an emitter. Wetness of soil sample can be judged by its feel and appearance. If the soil is drier than it should be, watering time should be increased. If the soil is still quite wet just before the next irrigation, watering time should be decreased.

PLASTIC LINE SIZES FOR LENGTHS LESS THAN 100 FEET

Flow rate (gpm)	Line-size (inches nominal)
½ to 2	½
2 to 4	¾
4 to 8	1

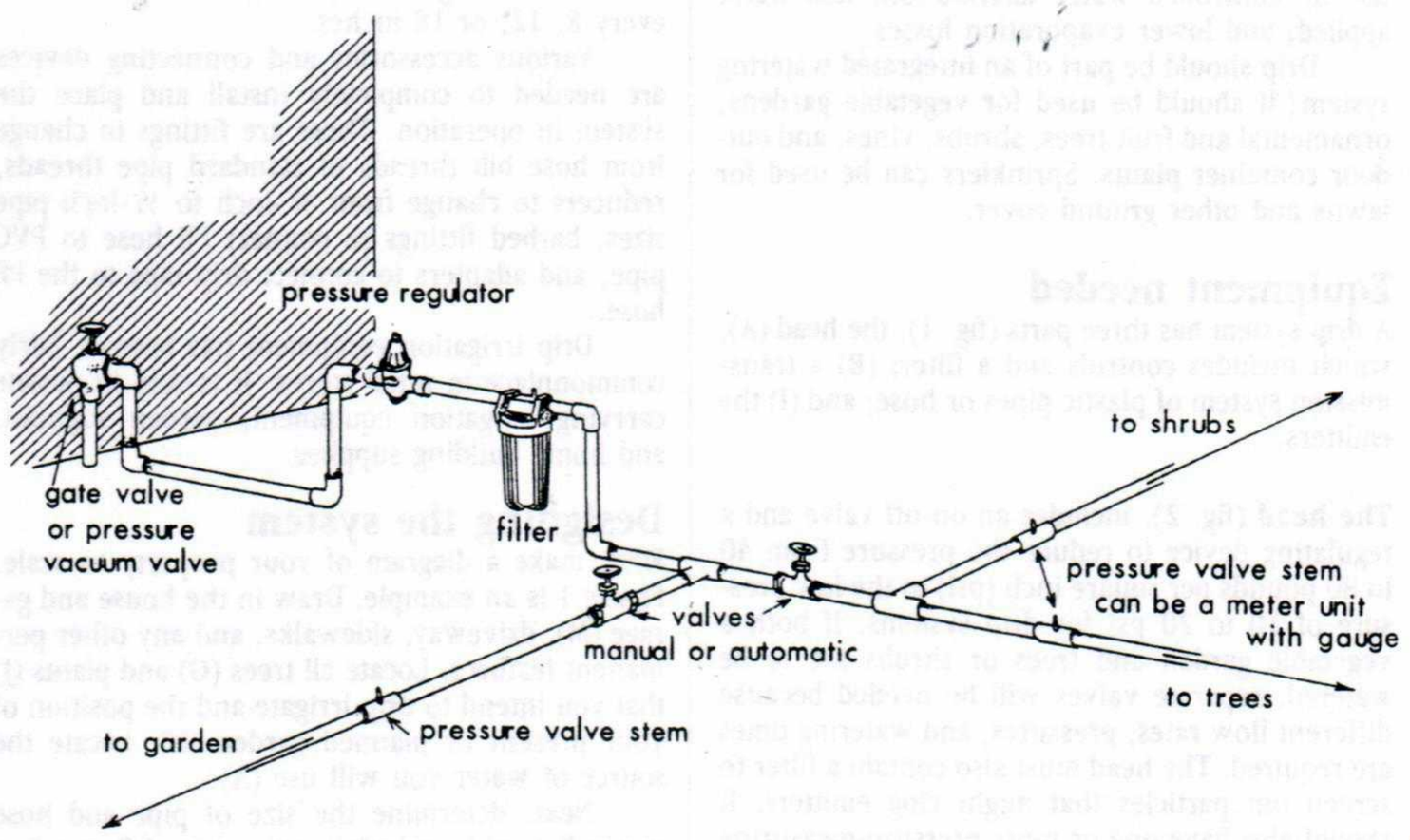

Figure 2. "Head" or control center details.

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Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Jerome B. Siebert, Director of Cooperative Extension, University of California.

5m-rev-5/85-LE/ME

Water Conservation Suggestions for your Home Vegetable Garden

From the UCCE Master Gardeners of Trinity County

Planting Strategies

If you anticipate a dry season, plant shorter season crops and fewer crops

Plant in blocks, rather than rows. This creates shade for roots and reduces evaporation.

Control weeds, they are competing with the vegetables for the water supply.

Use containers or plant vertically to reduce the soil area that needs irrigation

Zones! Group plants with similar water needs (i.e. families) together on the same soaker hose. Cucumber and zucchinis and squash, for example, require similar water applications.

Provide windbreaks to reduce evaporation of moisture from soil and plants.

Amend your soil with organic matter to increase the water holding capacity.

Practice efficient irrigation

Drip or trickle irrigation is ideal in the vegetable garden, reducing water usage by about 50%. The soaker hose is probably the least expensive and easiest to use in a vegetable garden setting. Known as a "leaky pipe", it is a hose that allows water to seep out all along its length at a slow rate. They typically run, at low pressure, for only 10 to 15 minutes per irrigation. There are also tubes with holes for the water to drip out. Another option is a simple 'hose bubbler' which is a hose end attachment to irrigate the base of a plant.

Check soil moisture regularly to avoid over-application. Squeeze soil in your hand; if it sticks together, it is moist and irrigation should be delayed. If the soil has dried out to a depth of 2-4 inches, plan to water. This is especially important if using mulch, where water can be held in the soil for longer periods of time.

Place soaker hoses or drip irrigation under the mulch used in the vegetable garden.

Know the critical watering periods for vegetables and you can target the timing and amount of water to add. As a rule of thumb, water is most critical during the first few weeks of development, immediately after transplanting, and during flowering and fruit production. The critical watering periods for selected vegetables follow:

- **Asparagus** - Spear production, fern development.
- **Cole crops: broccoli, cabbage, and cauliflower** - The quality of cole crops is significantly reduced if the plants get dry anytime during the growing season. Water use is highest and most critical during head development.
- **Beans** - Beans have the highest water use of any common garden vegetable, using ¼ to over ½ inch of water per day (depending on temperature and wind). Blossoms drop with inadequate moisture levels and pods fail to fill. On warm, windy days, blossom drop is common. For the observant gardener, a subtle

change in plant color indicates a need for irrigation. When moisture levels are adequate the bean plant is a bright, dark grass green. As plants experience water stress, leaves take on a slight grayish cast. Water is needed at this point to prevent blossom drop.

- **Carrot and other root crops** - For quality produce, these crops require a constant supply of moisture. They are intolerant of dry soils. Cracking, knobby and hot flavor root crops are symptoms of water stress.
- **Corn** - Water demand for sweet corn is most critical during tasseling, silking, and ear development. Yield is directly related to quantities of water, nitrogen and spacing. Water stress delays the silking period, but not tasseling. Under mild water stress the crop may tassel and shed pollen before silks are ready for pollination. The lack of pollination may reduce yields or even eliminate ear production.
- **Lettuce and other leaf vegetables** - Water demand is most critical during head (leaf) development. For quality produce these crops require a constant supply of moisture. They are intolerant of dry soils.
- **Onion family** – Members of the onion family have an inefficient rooting system making irrigation management a key factor in produce quality. They require a constant supply of moisture and are intolerant of dry soils.
- **Peas** - Water demand is most critical during pod filling
- **Potatoes** - If potatoes become overly dry during tuber development, tubers will be knobby.
- **Tomato family: tomatoes, peppers and eggplant** -- Water demand is most critical during flowering and fruiting. Blossom-end-rot (a black sunken area on the bottom of the fruit) is a symptom of too much or too little water. The tomato family has a lower water requirement than many vegetables and plants are often over-watered in the typical home garden.
- **Vine crops: cucumbers, summer and winter squash, and assorted melons** - Water demand is most critical during flowering and fruiting. Vine crops use less water than many vegetables and are often over-watered in the typical home garden.

Water during early morning, when wind is low and temperatures are cool.

Rain Barrels can collect and store rainwater from rooftops for garden use. It's important to note that the water is not potable, since it can contain bacteria and other disease-causing organisms from birds, metals from your roof and roofing material. If you use it on vegetables, avoid overhead irrigation – drip irrigation is better. Do not use it to wash fruits or vegetables prior to consumption.

Mulching minimizes evaporation of water from the soil surface, reducing irrigation need by around 50%. In the vegetable garden, use an organic mulch to a depth of 1-3 inches, depending upon the particle size of the mulching material. The larger the particle, the thicker the depth of mulch that should be applied. Mulch only after the soil has warmed sufficiently. Do not use wood or bark chips in a garden setting that requires annual soil preparation. The chips will interfere with future seedbed preparation.

Grass clippings make excellent mulch for the vegetable garden. Apply fresh clippings in thin layers (up to ¼ inch thick) and allow each layer to dry before adding more. The clippings quickly dry down and additional layers can be added weekly. Do not place fresh clippings in thick piles, as they will mat, decay and smell foul. Do not use clippings from lawns that have been treated with herbicides or other pesticides in the past month. A couple of sheets of newspaper may be used under the clippings to help control weeds. Do not apply newspapers more than a couple of sheets thick, or a soil carbon to nitrogen imbalance may occur. Do not use glossy print materials, their inks may not be soy based like newspapers.

Black or colored plastic mulch conserves moisture and also increases soil temperatures. They are used on tomatoes, peppers, eggplants and the vine crop family (cucumbers, summer and winter squash, melons). Lay down plastic early in the season so plant growth shades the plastic from extreme summer temperatures. Do not apply plastic in mid summer. Do not use plastic on other crops.

Derived from materials provided by Colorado State University Extension .