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Trickle Irrigation for Home Gardens

Trickle irrigation (sometimes called drip irrigation) is an effective method of watering vegetables. It applies water slowly and directly to the root zone through a plastic tube. This system saves from 30 to 70 percent of the water required by overhead sprinkler irrigation, since much of the water applied by sprinklers is never used by plants.

Most of the northeast receives an average yearly rainfall of 36-48 inches which, if distributed evenly, would be enough water to grow vegetables successfully. Unfortunately, rainfall is erratic and lengthy dry periods sometimes occur. During droughts some cities restrict the use of water for gardening. Because the trickle method of water ing uses only a fraction of the amount of water required by sprinkler irrigation, the limited water supplies that may be available for the garden can be used most efficiently.

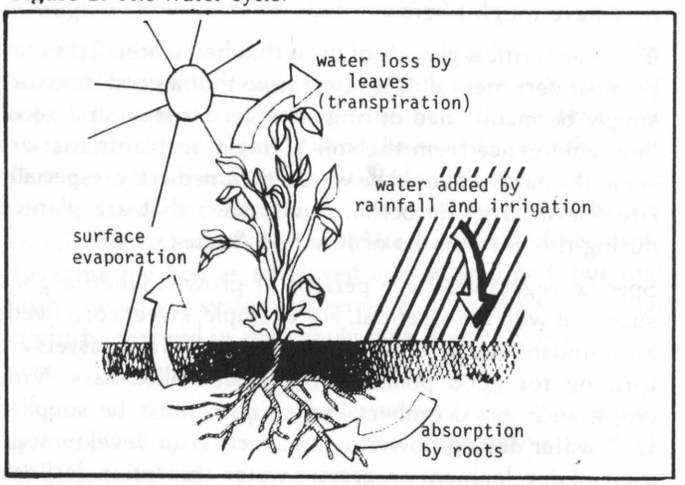
ADVANTAGES

- **Economy of Water Use.** The greatest advantage of trickle irrigation is its low water use.
- **Fewer Weeds Germinate.** Water is directed only to the crop.
- **Easy to Operate.** Once the system is installed, it is simply a matter of opening a valve to water the entire garden.
- **Less Energy for Pumping.** The trickle system requires much lower operating pressure and lower flow rate. Often the flow rate can be controlled to keep a well from running dry.
- **Fewer Leaf Diseases.** The leaves are not wetted which discourages fungus and bacterial plant diseases.
- **Allows Work in the Garden While Watering.** Only a small area around the row of plants is irrigated. Walkways and between-row areas remain dry.
- **Less Fertilizer Needed.** Fertilizer may be applied only to the immediate area adjacent to the row, as compared to conventional broadcasting where the fertilizer is spread over the entire garden.
- **Uniform Watering Pattern.** Interference from the wind results in uneven watering with overhead sprinkling.
- **Minimal Contamination of Ground-Water Supplies.** With the limited volume of soil irrigated, leaching of fertilizer salts into the ground-water supply is largely eliminated.
- **Laborsaving.** You do not have to shut off the faucet and move the hose.
- **Savings of Insecticides and Fungicides.** Pesticides are not washed from the foliage as in overhead irrigation.

DISADVANTAGES

- Trickle irrigation requires some time for initial installation.
- It is more expensive than most sprinkler systems.
- The tiny emission holes can become clogged with soil particles, and sometimes algae or mineral precipitates will block these holes.
- Insects and rodents may damage the trickle line emitters.

Figure 1. The water cycle.



WATER MOVEMENT IN SOILS

When water is applied to the soil, it seeps down through the root zone very gradually. Each layer of the soil must be saturated before water will descend to the next layer. This water movement is referred to as the wetting front. Water will move through a sandy, coarse soil much faster than through a fine-textured soil, such as clay or silt.

If only one-half the amount of water required is applied at a given time, it will only penetrate the top half of the root zone; the area below the point where the wetting front stops will remain as dry as if no irrigation had been applied at all.

Once enough water is applied to move the wetting front

into the root zone, moisture is absorbed by plant roots and moves up through the stem to the leaves and fruits. (Figure 1.) Leaves have thousands of microscopic openings, called **stomates,** through which water vapor is lost from the plant. This continual loss of water, called **transpiration,** causes the plant to wilt unless a constant supply of soil water is provided for absorption through the roots.

The total water requirement for a garden is the amount of water lost from the plant plus the amount evaporated from the soil. These two processes are called **evapotranspiration.** Evapotranspiration rates vary and are influenced by day length, temperature, cloud cover, wind, relative humidity, mulching, type and size of the plants, and the number of plants growing in a given area.

WATER STRESS

Water stress causes flowers and immature fruits to drop from the plant, resulting in low yields. Furthermore, the quality of vegetables will be very poor. Fruits, such as cucumbers, will be small and misshapen. Tomatoes may develop blossom-end rot and salad crops, such as celery, may have tough fibers.

There are critical periods of growth when water stress can be most detrimental. It is imperative that a good moisture supply be maintained during seed germination and seedling emergence from the soil Young transplants that are set in the garden should be watered immediately, especially late-season crops (broccoli, cauliflower) that are planted during the hot months of July and August.

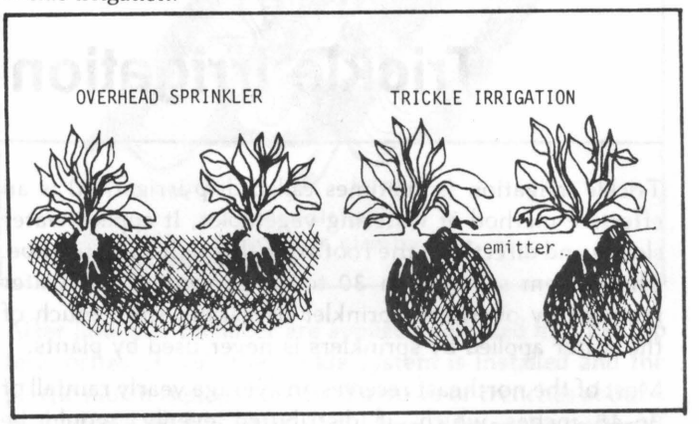
Specific vegetables have periods of growth when a good supply of water is essential. For example, sweet corn needs an abundant supply of water when the silks and tassels are forming for good pollination and well-filled ears. Vine crops, such as cucumbers and squash, must be supplied with water during flowering and early fruit development. As fruit development progresses water absorption declines, so less water is required.

On the other hand, there are periods in the growth of some vegetable crops when water should be withheld. For example, as muskmelons reach maturity, they develop more sugar under dry conditions. Onions cure faster and store better when water is withheld after they attain maximum bulb size and about one-half of the leaves have fallen over.

FREQUENCY OF WATERING

Trickle irrigation uses much less water than overhead sprinkler systems, but requires a longer time to deliver a given amount of water. Water is directed to the root zone and not spread over the entire garden so a relatively small volume of soil is wetted. Figure 2 contrasts the soil-

Figure 2. Wetting pattern from overhead sprinkle irrigation and trickle irrigation.



wetting patterns for an overhead sprinkler and trickle irrigation systems.

There is no need to water the entire area when plants are young. For example, young tomato plants generally have a root system less than 10 inches in diameter. With 36 inch rows the tomatoes use less than one-third of the water applied by sprinklers. Watering areas of the garden not occupied by vegetable roots only encourages weed growth.

When there is no rainfall, shallow-rooted crops (such as lettuce and onions) spaced in rows 18 to 20 inches apart should be watered about 2 to 4 hours every 2 or 3 days. Under these conditions trickle irrigation saves about 30 percent of the water needed by overhead sprinklers.

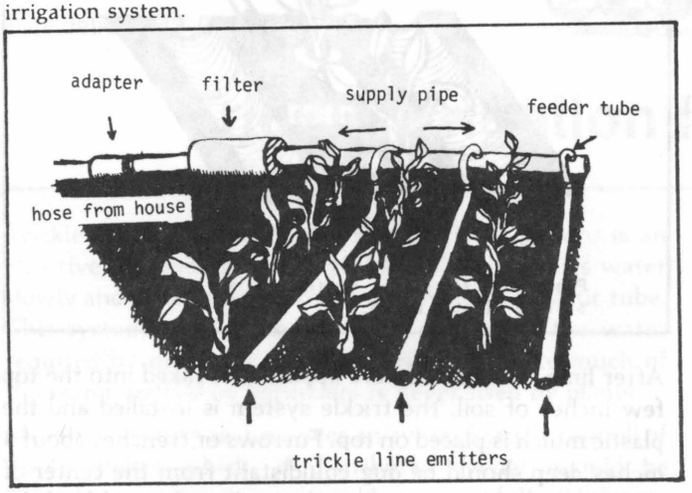
Deeply rooted crops (such as tomatoes and summer squash) spaced in rows 36 inches apart should be watered every 3 to 4 days for 4 to 8 hours when there is no rain. A 70 percent water savings may be realized if a trickle system is used for rank-growing crops in wide rows because water is directed only to the area of the soil occupied by roots.

INSTALLING TRICKLE IRRIGATION EQUIPMENT

You do not need to be a plumber to construct a trickle irrigation system. For the first year you may elect to install trickle irrigation on only a few rows of vegetables. Then in time you may wish to extend it over the entire garden. Trickle irrigation equipment is generally sold by the garden supply stores. Names of dealers may be found in the yellow pages under "Sprinklers-Garden and Lawn" or "Irrigation Systems & Equipment."

Water pressure in most homes ranges from 20 to 60 pounds per square inch. A trickle system operates at a lower pressure—2 to 6 pounds per square inch. The pressure can be lowered by a pressure regulator (reducer) or by running the water through successive tubes of smaller diameter. Figure 3 illustrates how the entire system is installed.

Figure 3. Typical installation of a vegetable garden trickle irrigation system.



Water runs from the source to the garden, generally in a 5/8-inch diameter garden **hose.** Before water enters the trickle tube it should be **filtered**, usually through a fine (80 to 100 mesh) screen, to remove sand and suspended particles. This material will clog the tiny holes in the trickle tube, hence the filter must be cleaned regularly.

A polyethylene or polyvinyl chloride (PVC) **supply pipe** is attached by a hose adapter to the water supply. The supply pipe is laid on the ground at the edge of the garden, perpendicular to the rows. Because most vegetable gardens are rectangular, the supply pipe usually runs the width of the garden. A hole is punched or drilled into the supply pipe to provide an outlet for each row. The hole should be set 4 to 8 inches to one side of the center of the row.

The supply pipe serves as a manifold from which water is transferred to the trickle tubes, called line emitters, that run down the garden rows. The **line emitters** are cut the same length as the garden rows. They can be left on the soil surface or buried a few inches below the surface although it is usually easier to install the line on top of the ground. Emitter outlets should direct water toward the plants. Be sure the line does not become twisted and block the flow of water.

Figure 4. Trickle system for a garden that is too far from a water supply.

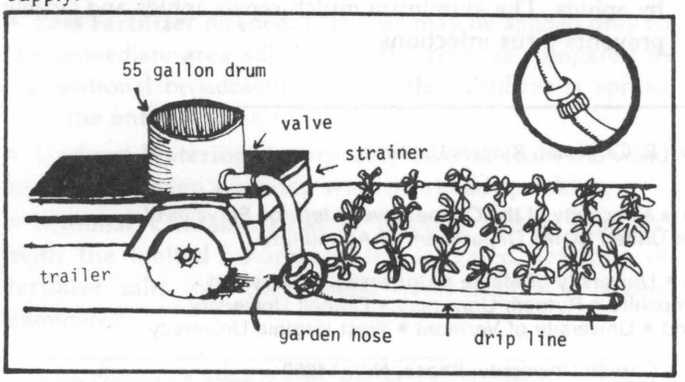
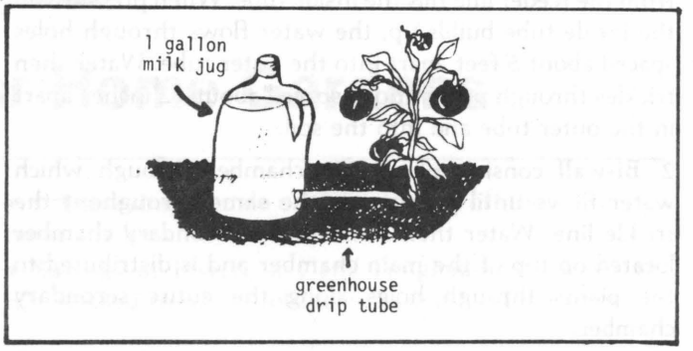


Figure 5. Trickle system for favorite plants (i.e.: giant pumpkin, early tomatoes, etc.).



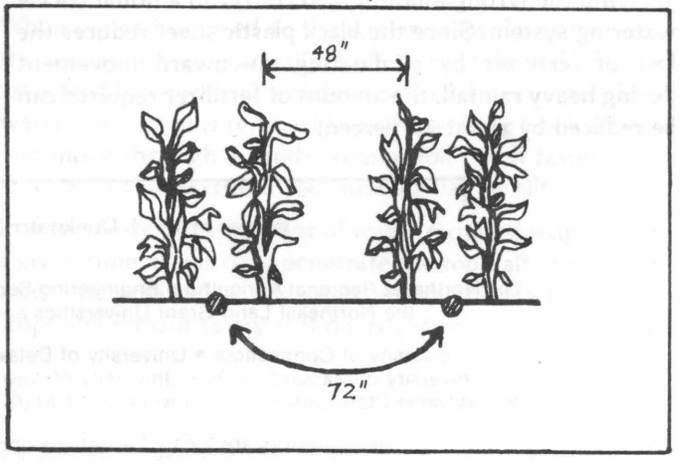
When rows are spaced closely together, such as 12 inches for beets or carrots, one line emitter can supply 2 rows. With rows spaced far apart, such as 60 inches for cucumbers, one line emitter for each row is needed. A single line emitter can often supply two widely spaced rows by staggering the spaces. Figure 4 shows an example for sweet corn.

The end of the trickle tubes may be sealed with a simple overhand knot, or by doubling the hose back on itself and holding it with plastic tape, a clothes pin, or by pushing it through a short piece of plastic tubing.

A **feeder tube** is then inserted into each hole in the supply manifold; the other end is inserted through a hole punched in each line emitter. This hole is made in the center of the line emitter a few inches beyond the sealed end of the tube. The method of installation will vary with the kind of line emitter used. Manufacturers' instructions should be followed. The far end of the line emitter should be closed using the same method as employed at the head end; but first flush the entire system to remove any soil particles that might be trapped in the supply pipe, feeder line, or trickle hose.

Once a short-season crop like lettuce or beets is harvested a second planting can be made without disturbing the trickle irrigation system.

Figure 6. One trickle line for every two rows.



LINE EMITTERS

Three principal line emitters are adapted to growing vegetables:

1. **Twin Wall** is essentially a tube within a tube. Water from the feeder line fills the inside tube. When pressure on the inside tube builds up, the water flows through holes spaced about 5 feet apart into the outer tube. Water then trickles through perforations spaced about 12 inches apart in the outer tube and into the soil.

2. **Bi-wall** consists of a main chamber through which water flows until pressure is the same throughout the trickle line. Water then flows into a secondary chamber located on top of the main chamber and is distributed to the plants through holes along the entire secondary chamber.

3. **Plastic Soaker Hose.** Water seeps through the entire length of the tube and not at defined openings. The soaker hose is ideal for closely spaced crops.

Although not used for vegetables, **point emitters** are available to deliver water to specific locations. These are used to water shrubs and trees.

TRICKLE AND BLACK PLASTIC MULCH

Black plastic mulch can be placed over the line emitter (Figure 7) to increase the effectiveness of watering and to control weeds. Furthermore, the black plastic protects the polyethylene emitter tube from sunlight which accelerates material break down. The tubes can be used for several years if cleaned and stored in a cool, dark place.

If a trickle system is used with plastic mulch, it is imperative that the line emitter be located 8 inches to one side of the center of the row. This precaution assures that the plastic emitter hose will not be punctured when plants are set in the middle of the row. Black plastic mulch, 0.0015 inches (1 1/2 mil) thick, may be purchased at garden supply stores. A 4-foot width is ideal for most vegetables. Figure 6 shows a line emitter installed under black plastic mulch.

Although it is possible to fertilize a crop by injecting soluble fertilizers into the supply pipe, there is a great risk of applying the wrong amount of fertilizer in a home trickle watering system. Since the black plastic sheet reduces the loss of fertilizer by eliminating downward movement during heavy rainfall, the amount of fertilizer required can be reduced by about 25 percent.

Figure 7. Installation of trickle irrigation under black plastic mulch.

After lime and fertilizer are applied and raked into the top few inches of soil, the trickle system is installed and the plastic mulch is placed on top. Furrows or trenches about 4 inches deep should be dug equidistant from the center of the row but about 10 inches closer than the width of the plastic. (Trenches should be about 38 inches apart for a 4 foot wide sheet.) The black plastic mulch is then rolled down the center of the row and held in place by backfilling the trench. A garden hoe works well for making the trenches and also for packing soil firmly against the edges of the plastic sheet.

Once the plastic is installed, it is easy to puncture it in the center of the row and dig a small hole (about 3 inches in diameter) for the transplant. Holes are spaced at intervals to correspond with the recommended between-plant spacing for the specific crop. This works ideally with all vegetable transplants such as tomatoes, peppers, and broccoli. There is a slight risk of overwatering when tubing is laid under plastic. You can check wetness of the soil by cutting a little "door" in the plastic for inspection.

Clear plastic mulch should not be used because it transmits light which stimulates weed growth. The soil must be fumigated to kill weed seeds before clear plastic can be laid. Only licensed pesticide applicators are allowed to purchase fumigants.

Trickle irrigation works well with organic mulches, such as straw or grass clippings. Aluminum foil can be used as a mulch; but, because it is expensive, it is only used on crops such as fall summer squash, Chinese cabbage, and peppers. These crops are very susceptible to virus diseases carried by aphids. The aluminum mulch repels aphids and largely prevents virus infections.

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