Using Water in the Home Garden
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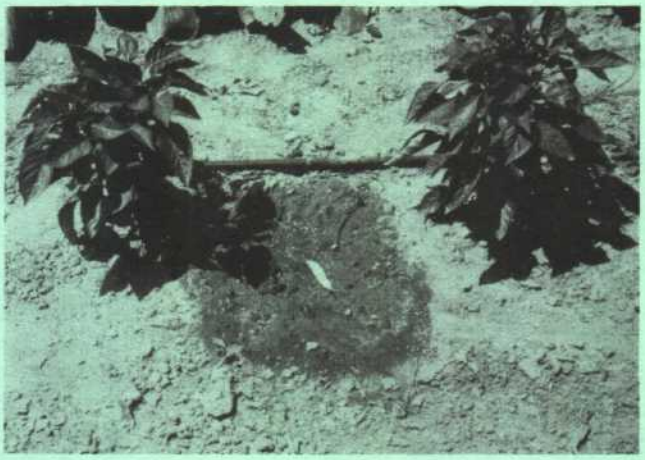

Shown here between two pepper plants is a microtube, a black plastic tube of small inside diameter. This is one of several ways to apply "trickle irrigation" in home gardens. Trickle irrigation is one of the best systems for preventing water stress in garden crops. The dark area in the soil is the wetting pattern of water trickling from the microtubes.

WATER plays an indispensable role in every garden. It is helpful to understand how and why.

An adequate supply of water is essential. In Michigan, the total rainfall is usually sufficient for plant growth. However, plants benefit from irrigation during drought periods, which may occur during the growing season.

Excess water can be a problem, particularly if the soil is poorly drained. Soil that is saturated with water over long periods is not good for most plant growth.

In watering your garden, it is useful to follow these guidelines:
- Some kinds of plants need more water with each irrigation, but less frequently than others.
- Watering at certain times tends to reduce the quality of many edible crops.
- Woody plants watered heavily late in the summer in Michigan may be more susceptible to injury from winter cold.

The Functions of Water

Essential to plant life — Every living cell contains water, which it must have to function properly. Even the least active plant entity, the dormant seed, contains water. Living, active plant tissues are usually 85 or 90% water, including all edible fruits and vegetables. Even seeds that you buy in packets must contain about 5 to 9% *water (depending on the kind of plant) to be viable and germinate in the garden.*

Positioner of plant parts — Leaves maintain a favorable position relative to light needed for food manufacture only when the leaf and soft stem tissues are turgid (distended due to presence of water). When these parts collapse under extreme water stress, the leaf surface area exposed to light is greatly reduced.

Cooling of plants — Many plants would literally cook and die in the heat of summer if it were not for their built-in cooling system. This cooling system function, which the botanist calls **transpiration,** involves the constant evaporation of water from the outer surfaces of all plant parts (especially leaves).

Carrier of nutrients and foods — Nutrients in the soil must be dissolved in water in order to be absorbed by plants through their roots. If you fertilize the garden during the growing season when the soil is relatively dry, the added nutrients will do your plants no good whatsoever until they go into solution. This takes place after the first good rain or following irrigation.

Within the plant, food synthesized by the leaves is translocated by water to all other plant parts such as stems, roots and flowers and fruits, for use in growth or storage.

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Effects of Drought

Appearance — Typical symptoms of plants under water stress or drought are drooping of soft stems and leaves, curling or rolling of edges of leaves, scorching of leaves of evergreens in winter.

Growth in general — When plant growth is greatly reduced due to lack of water, plants become weak, susceptible to disease attack and winter injury, and less able to recover from injuries.

Edible products — Fruits or vegetables in general lack quality when grown under water stress, and are more susceptible to certain serious defects. Lettuce and celery become bitter and fibrous. Strawberries are small and seedy. Tomatoes develop blossom-end-rot. Apples may develop bitter pit, sunken spots on the fruit surface and a bitterness of the flesh close to the spots. Fruits and vegetables are generally less crisp and juicy.

Fruit set — With many fruits and fruit-type vegetables (tomato, bean and others) retention of fruit to maturity is reduced when drought occurs during or shortly after blossoming. The result is lower yields.

Flowers of ornamentals — Flowers are reduced in size and number with inadequate watering.

Effects of Too Much Water

Saturated soil — When this condition continues for extended periods during the growing season, roots of most plants fail to get the oxygen they need for normal growth and development. This may cause the entire plant to weaken and even die in extreme cases. In addition, lack of root development early in the season due to soil saturation will make the plant more susceptible to drought later in the season.

Winter injury — This problem may occur in woody plants in areas where winters are severe and late summer or early fall rains occur, or late irrigation is applied when temperatures are favorable for growth. These circumstances delay the physiological conditioning of the tops of woody plants which ordinarily enables them to tolerate the low temperatures that may occur in late fall or early winter. This combination of conditions can result in serious cold injury to the tree, shrub or vine.

Leaching of nutrients — Leaching, especially on sandy soils, is likely to occur during heavy rains or excessively long irrigation periods. Dissolved nutrient elements are literally washed out of the soil and lost to garden or lawn plants.

Product quality loss — Quality can be reduced by too much water in the garden, especially after long dry periods. Fluctuation in available water can result in deformed carrots, potatoes or cucumbers. It may also cause splitting of cabbage, peaches, tomatoes, and many other fruits or vegetables. Water on the surface of ripening sweet cherries can also cause splitting.

Factors that Influence Water Need

Environmental Factors

Soil — Plants on lighter, more sandy soils usually require more frequent watering than those on heavier, more clayey soils. The amount of water required at each watering is usually less on light than on heavy soils.

Atmospheric conditions — The higher the air temperature and the lower the relative humidity, the greater the need for water by plants. Dry winds also have a dehydrating effect on plants.

Cultural practices — Mulches[3], windbreaks[4], weed control and the addition of organic matter (manure or dead plant materials) to soil tend to conserve water in the garden and decrease the need for rainfall and irrigation.

Stage of Plant Development

Age and size — Young plants and small plants in general are more shallow-rooted than older and larger ones. They need more frequent watering, but less volume at any one time. Transplants of petunias or tomatoes, young fruit trees or forsythia bushes, need less water early in the season, because they are still small and it is cooler than later. The same holds true with the much smaller dwarfed, mature mugho pine tree, as compared with a full-grown white pine tree. On the other hand, smaller plants need more frequent watering when rainfall is insufficient.

Critical stages — Although plants in general do best if they are never under water stress, there are more critical stages, such as: (a) seed germination; (b) flowering and fruit set; (c) rapid fruit growth near harvest maturity, as in stone fruits (cherry, peach, plum), or in (d) the rooting of first runners of strawberry; and (e) head development period of lettuce and cauliflower.

Occurrence of fruit — Fruit trees, bushes and vines bearing moderate to heavy crops of fruit re-

[3] *Mulches consist of sheets of plastic or ground corn cobs, sawdust and other materials which are laid on the surface of the ground in the garden around plants for different purposes.*

[4] *Windbreaks can be non-living fences or walls of wood, brick or stone; or living trees or tall shrubs, used on the windward side of gardens or buildings to block the wind in areas where wind is often a problem in some way.*

quire considerably more water than those with no fruit or only light crops. Also, the need for water is reduced once the fruit is harvested, especially after a heavy crop.

Drought resistance — Species and cultivars of garden plants which have some drought resistance are preferred in areas where rainfall is limited during the growing season, (e.g., in Michigan's northwest Lower Peninsula), and where the soil is very sandy and not very moisture-retentive. Examples of drought-resistant ornamental species are shrubby cinquefoil, Austrian pine, Arrowwood viburnum, marigold, sweet allysum, and portulaca.

Vegetables, in general, because they must be tender and succulent to be most edible, and because they are relatively shallow rooted, are not drought resistant. Asparagus, a fairly deep-rooted perennial, is the only moderately drought-resistant vegetable.

The fruits, with the exception of strawberry, are relatively deep rooted and will not show water stress as quickly as vegetables and flowers. However, all fruits require large quantities of water to produce adequate crops of good quality fruit, and none are therefore considered drought resistant.

When and How Much to Water

Rule of thumb — Generally, mature plants need approximately 1 to 2 inches[5] of rainfall per week (amount depends on factors already discussed). If this much rain does not fall, the difference should be supplied by irrigation.

Before cultivating, tilling, planting or transplanting — Dry soil should be watered to appropriate depth. Dry soil is not easily worked, especially if heavy. The desirable porous, crumb-like structure associated with good soils and good plant growth is broken down if soil is wet and muddy when cultivated or tilled. A moist soil is ideal for working and will also result in best seed germination and establishment of transplants.

Appearance and feel of soil — Dig a sample of soil to a depth of 5 to 12 inches, depending on the depth of the bulk of feeder roots of the plant being watered. Clench the sample in your hand and then release it. If it breaks apart fairly easily, it is too dry and requires water.

Heat of day — Sprinkling in the heat of the day will not burn plant leaves. In fact, if the air is relatively dry, the evaporation that occurs during watering will cool the plant and perhaps increase its rate of growth.

[5] *One inch of rain is equal to about 65 gallons per 100 square feet, or 975 gallons for an average garden, 30 x 50 feet. When you irrigate, you can control amount by checking your water meter, which may be nothing more than a coffee can or similar container having vertical sides.*

How much to irrigate — With vegetables and flowers, wet the soil to a depth of 5 to 12 inches. Deeper-rooted trees and shrubs require wetting to a depth of 1 to 2 feet or more.

Methods of Watering

Surface Irrigation

This is simply a method of applying water at the soil surface. Plant tops are not wetted, which can be an advantage with some crops from a disease standpoint. This method is time-consuming.

Furrow Irrigation — This method involves preparing furrows alongside rows of plants. Water released at one end of the garden flows into the furrows and moves laterally to the plants. For this method to be effective, the soil should be on the heavy side. If soil is too sandy, too much water is lost to the water table. The site should not have too much slope, although this system could be used on terraces built on steep hills.

Basin Irrigation — This method, which involves building saucers of soil around individual plants, is very popular for the small garden. Water is best applied by hand with a hose and soaker nozzle. The method is time consuming but effective for quick response.

Subirrigation

In this system, water is fed into the soil below the surface and rises by capillarity into the plant root zone. It can be applied in the garden by puncturing the bottoms of coffee cans with several holes (about 1/8 inch in diameter) and sinking the punctured cans into the soil to a depth at which the top of the can is just about 1/4 inch above the surface, and close to where vegetable or flower plants are seeded or transplanted. For trees or shrubs, use two or more vertically positioned drainage tiles, placing them at a greater distance from the stems than with the smaller vegetables or flowers. This method uses water very efficiently. In arid climates where soils and irrigation water tend to be more or less salty, it tends to bring salts up to surface, creating a problem. Like surface irrigation, subirrigation doesn't wet foliage.

Sprinkler Irrigation

This method is most effective with lighter (sandy) soils and shallow-rooted plants. It is also a good system on hilly sites. Fine nozzles (5/64 inch) with fixed systems — in which the piping is largely underground, and with numerous sprinkling heads — are useful during emergence of seeded crops, because they cause minimal damage to delicate seedling plants. Sprinklers also provide the most cooling effect. They may, however, create disease problems in some plants, such as roses. Sprinklers require the most water pressure and a good supply of water. Sprinkling is the watering system most commonly used for lawns.

There are many types of sprinkler heads. For example, there are oscillating and rotating heads, all with varying degrees of sophistication and spray patterns. Fixed systems with numerous delivery points can be automatically controlled with time clocks or soil moisture-sensing devices which turn the system on when soil moisture falls below a predetermined minimum level. The uniformity of delivery varies with the specific type. The spacing of individual sprinkling heads in a fixed system should provide adequate overlap of spray patterns to avoid dry spots. The same approach should be used when the position of a single portable sprinkler is changed.

Fixed systems require the least amount of time, eliminate compacting the heavier soil due to being walked on when wet, but are the most expensive. They are very effective for lawns.

Revolving sprinklers can be fixed or portable.

Trickle or Drip Systems

Trickle irrigation[6] was first used for potted plants in greenhouses. Water is delivered very slowly, usually over periods of at least several hours, utilizing ordinary household tap pressure of 3 to 5 pounds per square inch. Trickle is effective on most soils. It creates the least salt problems in arid areas. **It is one of the best systems for preventing water stress in the garden.** It places water close to the plants being watered, where it is needed most, and leaves the paths between rows dry and usable even immediately after irrigating. Water is delivered by trickle systems to the soil through one of the following types of emitters:

Porous hose — A canvas hose is laid on the surface of the garden. Water oozes slowly through the wall of the hose to the soil in the plant row or flower or shrub border.

Double wall plastic tubing — The tubing is laid on top of the soil. Water moves from the source (usually a tap) into the inner tube, and from the inner tube into the outer tube through regularly spaced small holes. It then trickles out onto the soil from the outer tube through somewhat smaller and more numerous holes than those of the inner tube.

Dew hose — This type consists of a tube of heavy plastic film which has a sewn seam along one side. Water oozes slowly onto the soil through the seam the entire length of the hose. This system and the porous hose and double wall plastic hose are especially adapted to closely planted garden crops such as beans, carrots, and onions.

Plastic hose and emitters — The main hose is connected to a header pipe, which is usually placed across one end of the garden. Then a smaller tube (lateral) is coupled with the header for each row. Emitters are attached at varying intervals on the lateral, delivering the water to the plant at a more or less constant, slow rate. A great many different types of emitters are on the market. Some are pressure compensating to adjust to variations in water pressure and to insure a more or less uniform rate of water delivery. Others are non-pressure compensating. Either type is satisfactory for garden use.

Irrigation Water Quality

Soluble salts are most often a problem in arid areas, but may also be a natural contaminant wherever water sources run through veins of salts in the bed rock beneath the soil. Some plants, including many of the cacti, tolerate salts relatively well. Beets, kale, asparagus and spinach have a high salt tolerance. Salt resistant rootstocks can be helpful as is the case of the West Indian avocado rootstocks.

Industrial waste of many kinds, especially chemicals in irrigation water, may be hazardous to plants.

Biological contamination associated with human or animal waste and sewage can be a health hazard if used with water in the garden, especially on plants to be eaten fresh. Shallow wells (about 10 feet or less in depth) are sometimes biologically contaminated and should be avoided. Sewage water which is recycled to remove biological contaminants is successfully being reused for agricultural and uses other than for drinking. Such recycled water is suitable for garden irrigation.

Kitchen and laundry waste water is not usually harmful to plants but eventually may contribute to a breakdown in soil structure.

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[6] *See Michigan State University Research Report 285 for details on installing a trickle irrigation system.*

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