Agronomic Spotlight

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Water Management for Fresh Market Tomatoes

- Water management is used to help optimize plant growth and fruit production in fresh market tomatoes.
- Effective water management will maintain adequate soil moisture with minimal losses of water to run-off and leaching.
- Reference evapotransporation measurements and appropriate crop coefficients are used to improve water use efficiency.

Even in regions that receive adequate precipitation during the growing season, the unevenness of amounts and timing of natural rainfall require the use of irrigation for commercial tomato production. Inadequate soil moisture can retard plant growth, cause abortion of flowers and young fruit, and reduce fruit quality.[1,2] Proper water management through irrigation helps prevent these problems.[1,2,3]

Irrigation methods

The methods of irrigation commonly used for commercial tomato production include drip, sprinkler (overhead), and furrow or seepage irrigation. A grower's selection of method(s) depends on the type of equipment available, the size and shape of the field, the quality and abundance of the water supply, the availability of labor, and the overall cost of each system, including equipment, water, and labor costs.[1]

Sprinkler systems include center pivot, linear move, traveling gun, permanent set, and portable pipe systems. A sprinkler system needs to supply enough water to satisfy the needs of the crop, but at a rate that minimizes run-off or leaching of water out of the root zone.[1] In some operations, sprinklers are used to establish seedlings shortly after transplanting before switching to drip irrigation for the remainder of the season.[3]

With furrow and seepage systems, water is pumped into field ditches (furrows) between crop rows. The water then moves horizontally through the soil to moisten the soil in the crop's root zone. Furrow/seepage systems have lower initial and maintenance costs when compared to drip and sprinkler systems, but the water use efficiency levels are usually lower, and fertilization costs can be higher.[3,4]

The use of drip irrigation has become the standard practice for fresh market tomato production in most regions. The higher setup and maintenance costs of drip systems (compared to furrow systems) is usually off-set by lower water use costs as well as higher yields and fruit quality. Drip lines can be placed on the soil surface or buried 2 to 12 inches below the soil surface in sub-surface systems. Surface drip-line systems are most commonly used for fresh market production.[3]

Drip systems usually have high water use efficiencies, and they can use up to 40% less water than some sprinkler systems.[1,4] Soluble fertilizers also can be applied through drip systems as needed throughout the growing season.[5] Drip irrigation does require access to a high-quality water supply, the use of filters, and regular maintenance, such as line flushing, to prevent the plugging of emitters in the drip-tape.[1]

In the major tomato producing areas of Florida and California, the use of drip irrigation has increased, and the use of furrow/seepage systems has decreased. In Florida, drip irrigation is used on 65 to 70% of the current tomato production acres. Seepage irrigation is used on 30 to 35% of the acreage, and sprinkler irrigation is used on a relatively small percentage of acres.[5] The application (water use) efficiency of most drip systems is between 80 and 95%. The efficiency of most sprinkler systems is in the range of 60 to 80%, and furrow/seepage systems have efficiencies in the 20 to 70% range.[6]

Scheduling irrigation

The efficient scheduling of when and how much water is applied ensures that the water needs of the crop are met while also minimizing the amount of water (and nutrients) lost to leaching and run-off. In general, it is best to keep soil moisture levels in the root zone at 70% of the moisture-holding capacity of the soil.[2] The amount of water that needs to be applied to do this depends on the water needs of the crop and the application efficiency of the irrigation system: **irrigation requirement = crop water requirement/ application efficiency**.[6]

The methods used by growers to schedule irrigation applications include guessing (not recommended), the "feel and see" method of examining soil and crop conditions, systematic irrigation (e.g. one inch every fifth day), soil moisture monitoring using tensiometers or soil moisture sensors, and "adjusting irrigation to plant water use, and using a dynamic water balance based on a budgeting procedure and plant stage of growth, together with using a soil water tension measuring tool or soil moisture sensor" (the recommended method).[6]

Evapotranspiration is a sum of the loss of water through transpiration by the plant and evaporation of water from the soil. A "reference evapotranspiration (ETo) represents

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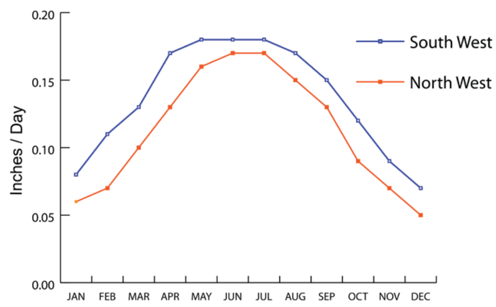

Figure 1. Average reference evapotransporation (ETo) values during the year for two regions of Florida.[6]

the water use for a uniform green cover surface, actively growing, and well-watered (such as turf or grass cover area)."[6] ETo is usually expressed as inches/day or gallons/acre/day. ETo estimates for an area are often available from modern weather stations, or through organizations such as the California Irrigation Management Information System (CIMIS) or the Florida Automated Weather Network (Figure 1).[3,7] However, different crops vary in their water needs, and the water needs of a crop vary with developmental stages. The evapotranspiration value for a crop at a given time and growth stage (ETc) is estimated by multiplying ETo by a number known as the crop coefficient (Kc); **ETc = ETo x Kc**. The crop coefficient varies over the season with the stage of growth and with climatic and soil conditions, which means that Kc values are time and region specific (Figure 2).

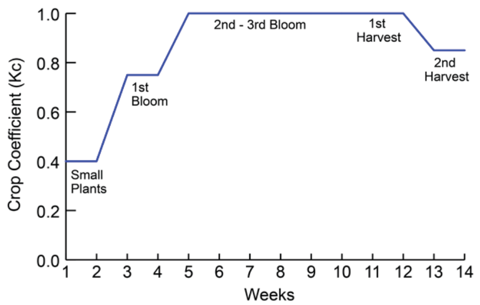

Figure 2. Crop coefficients for Florida-grown tomatoes at various stages of growth/production.[6]

The ET value for tomatoes at the peak of production is approximately 0.2 inches of water per day, but that will vary with crop growth stage, temperature, humidity, solar radiation, and wind speed.[1] Adding up the ETc values over time tells the grower how much water the crop is using during that time of the season.

Soil moisture levels in the root zone (to a depth of 12 inches) should be maintained at levels between the field capacity and the permanent wilting point of the soil. The difference between those two moisture levels equals the amount of plant-available moisture. It is best to irrigate when 50% of the plant-available moisture has been depleted. Sandy soils usually have a water holding capacity of about 1 inch per foot of depth. Therefore, water should be applied before 0.5 inches of water are used. Heavier soils can have water holding capacities as high as 2 inches per foot of depth. Therefore, water should be applied before 1 inch of water is used in those soils.[1] The application efficiency of the irrigation system needs to be included in the calculation of how much water to apply. If 1 inch of water is needed to maintain soil moisture levels, and the irrigation system has an application efficiency of 80%, then 1.25 inches of water will need to be applied:

Total water requirement = 1 inch/0.80 = 1.25 inches.

IRRIGATION FREQUENCY

The frequency of irrigation using drip systems can vary from once or twice a week to several applications per day depending on the crop growth stage, environmental conditions, and soil type. Sandy soils with limited water holding capacity require smaller, more frequent applications to maintain soil moisture levels but limit losses to leaching. Applications can be split into several applications over the course of a day. Larger, less frequent applications can be used on loam and clay soils with higher water holding capacities.[3,7]

Depending on soil type and weather conditions, a sprinkler system may need to provide 1 inch of water every 4 days, but apply at no more than 3 inches per hour on sandy soils and no more than 1 inch per hour on heavier soils.[1] It is common to apply 0.6 inches of water 2 or 3 times per week on sandy soils during periods of peak water use. On heavier soils, it is common to apply 1.25 inches of water every 5 days.[1] In furrow and seepage systems, scheduling applications on 7 to 14 day intervals is common.[3]

Sources:

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[3] Le Strange, M., Schrader, W., and Hartz, T. 2000. Fresh-market tomato production in California. University of California Division of Agriculture and Natural Resources, Publication 8017.
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[5] Eugene McAvoy, UF-IFAS – personal communication, 01/22/2020.
[6] Zotarelli, L., Dukes, M., Liu, G., Simonne, E., and Agehara, S. 2018. Chapter 3. Principles and practices of irrigation management for vegetables. In Vegetable Production Handbook of Florida 2018-2019. UF-IFAS Extension.
[7] Shukla, S., Knowles, J., and Shrestha, N. 2014. How to determine run time and irrigation cycles for drip irrigation: tomato and pepper examples. UF-IFAS Extension. Publication AE500.

For additional agronomic information, please contact your local seed representative.

Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. The recommendations in this article are based upon information obtained from the cited sources and should be used as a quick reference for information about tomato production. The content of this article should not be substituted for the professional opinion of a producer, grower, agronomist, pathologist and similar professional dealing with this specific crop.

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