Agronomic Spotlight

Water Management in Onion

- Water management is used to help optimize bulb yield and size in onion production.
- Effective water management will maintain adequate soil moisture with minimal losses of water to run-off and leaching.
- Reference evapotranspiration measurements and appropriate crop coefficients are used to improve water use efficiency.

The methods of irrigation commonly used for commercial onion production include drip, sprinkler (overhead), and furrow 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]

In the past, furrow irrigation was used extensively for onion production. Drip irrigation has become the new standard practice in many onion growing regions.[2,3,4] However, many acres of onions are grown under center pivot systems in the Pacific North West, the southeastern U.S., and northern Texas.

Irrigation and water use efficiency

Water use efficiency or application efficiency (AE) is the fraction of the water applied that is available to the plant. Water losses from evaporation or wind drift, surface run-off, deep percolation out of the root zone, and leaks in irrigation pipes lower the AE of the system. Furrow irrigation systems have AEs between 20 and 70% (over 50% if tailwater is recovered). Overhead sprinkler systems have AE values of 60 to 80%, and drip systems have AE values of 80 to 95%.[2,5,6]

Because drip systems apply water directly to the root-zone, less water is lost to evaporation from the soil surface. Drip tape or tubing is available with emitters at various spacings and flow rates. It is important to select a combination of drip-line spacing (lines per bed), emitter spacing, and flow rate that will apply water at an appropriate rate for the type of soil in the field. In lighter soils, a closer line spacing and faster rate of application are needed to have the water move horizontally to reach the outer rows and uniformly wet the root zone across the bed. On heavier soils, water tends to move more horizontally, and lower flow rates and wider drip-line spacing can achieve uniform application across the bed with fewer losses to leaching (Figure 1).[3] Irrigation experts can help growers design systems to best fit their needs and conditions.

When using sprinkler systems, the nozzles used should have an output rate that matches the water infiltration rate of the soil. This helps prevent problems with water being applied too fast, resulting in run-off.

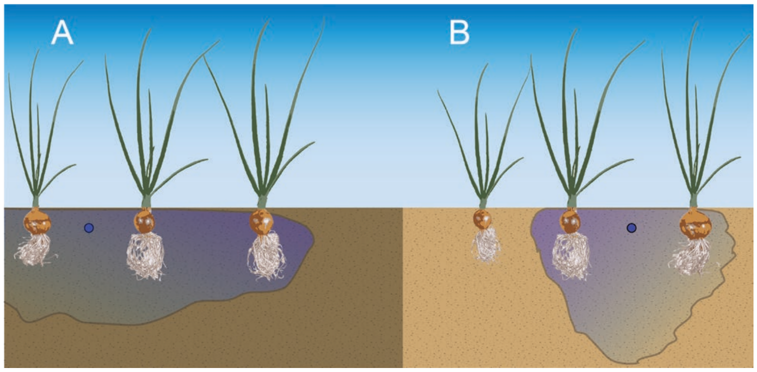

Figure 1. (A) Heavier soils and higher application rates allow water to move horizontally through the soil more quickly. (B) In lighter soils or with lower application rates, water tends to move downward in the soil.

Water use

Irrigation is usually required for stand establishment of onions following direct-seeding or transplanting, but onion seedlings do not use much water early in the season.[3] Water use by onion plants increases as the plants grow, with maximum water use during the bulb formation stage in the middle of the season. Water use declines as growth slows and the crop nears maturity (Figure 2).

Onions have a relatively high water demand and show a strong yield and grade response to soil moisture levels in the upper 12 inches of the soil.[3,7] Frequent irrigations are usually needed to keep moisture levels high enough to produce optimal yields.[8] Soil moisture 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. For onions, plant-available water should not drop below 75%, as the rate of uptake declines below that level.[7] Adequate soil moisture promotes bulb development over root growth leading to higher marketable yields. Deficit irrigation of onions leads to water stress, which results in less leaf growth, a lower bulbing ratio, reduced bulb fresh weight, smaller bulb size, and decreased marketable yields.[2,8] A study on onion irrigation in Texas found that reducing the amount of applied water to 75% of the recommended level resulted in a moderate reduction in marketable yield but a substantial reduction in the number of higher-value, large bulbs.[2]

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Many growers rely on visual evaluations of soil and crop conditions or calendar-based systems (one inch every fifth day) to schedule irritation for onions. More accurate scheduling can be achieved by monitoring soil moisture using tensiometers or soil moisture sensors along with estimates of crop water use based on evapotranspiration data.

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 the water use for a uniform green cover surface, actively growing, and well-watered (such as turf or grass cover area)."[9] 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. 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 (ETc) at a given time and growth stage 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.[3,10]

Irrigation amount and frequency

Using regional or on-site microclimatological data and appropriate crop coefficients can help growers avoid the over-application of water, keep moisture levels in a range to best meet crop demands, and improve water use efficiency.[10] Finding the appropriate Kc values can sometimes be a challenge, but these values are often available through irrigation companies or agencies such as CIMIS. The FAO lists general Kc values for onion production. Kc values of 0.4 to 0.6 are used for the initial growth stages, 0.7 to 8.0 for the vegetative crop development stages, 0.95 to 1.1 for the mid-season bulb formation stages, 0.85 to 0.9 for the late-season maturation stages, and 0.75 to 0.85 during the harvest stage.[7] The FAO recommends that irrigation should begin when 25% of the available soil moisture in the top 12 inches is depleted, with applications commonly every 2 to 4 days. Irrigation should be discontinued 15 to 25 days before harvest.

A more detailed estimation of Kc values for onions grown in southern Texas was developed in 2009 (Figure 2). The values for this region follow the same general pattern of the FAO estimates of Kc values for onion, with low levels during the seedling and vegetative stages, maximum water use during bulb formation, and lower levels during crop maturation.[10]

Individual water applications should not exceed the water-holding capacity of the soil, as this will lead to water loss through leaching and run-off.[3] When using drip or furrow irrigation, each application should result in water reaching the plants furthest from the drip line or furrow. With drip irrigation, pulsing water in short, frequent applications can establish a larger wetted sphere of soil than the use of fewer, longer applications. Shorten the duration of applications if the soil below the root zone becomes excessively wet. Lengthen durations if the wetting front does not reach the bases of plants furthest from the drip line. Tensiometers and granular matrix sensors placed in the root zone at various locations in the field can be used to verify that applications are resulting in the desired soil moisture levels.

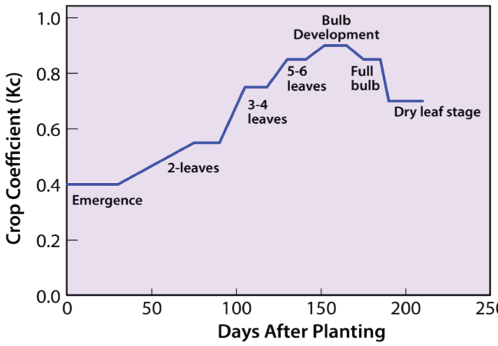

Figure 2. Seasonal crop coefficient (Kc) values for onions grown in southern Texas.[10]

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

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