drought tips

Number 92-25

Sprinkler Irrigation

Efficient sprinkler irrigation requires applying the right amount of water as evenly or uniformly as possible. Applying the right amount of water, in turn, requires knowing the soil moisture depletion, the application rate, and the depth applied.

Estimating Application Rate and Depth Applied
The following equation can be used to estimate the sprinkler application rate:

i = (96.3 x q) / (Sm x Sl)

where:

i = average application rate (inches per hour)

q = average sprinkler discharge (gal/min)

Sm = spacing along mainline (feet)

S1 = spacing along lateral (feet)

The sprinkler discharge can be estimated by dividing the pump capacity by the number of sprinklers, or by inserting a hose over the sprinkler nozzle and measuring the time required to fill a 5-gallon container.

The average depth of applied water can be estimated by multiplying the application rate by the set time, or:

D = i x T

where:

D = average depth applied (inches);

T = set time (hours)

Estimating Irrigation Efficiency
Irrigation efficiency can be estimated by dividing the depth of beneficial use by the average depth applied, or:

E = BU x 100 /D

where:

E = irrigation efficiency (%)
BU = beneficial use (inches)

The soil moisture depletion is the major component of BU. The soil moisture depletion can be estimated from CIMIS data, soil "feel" method, or neutron probe data. Another common component of BU is the leaching requirement, which is normally less than 5 percent for areas using surface water for irrigation.

Irrigation efficiencies should be 70 percent to 80 percent for hand-move and wheel-line systems, 80 percent to 90 percent for solid-set systems, and 80 percent to 90 percent for linear-move and center pivot systems. If the actual efficiency is less than these values, the set time should be reduced using the following equation:

T = (BU x 100) / (E x i)

where:

E = desired irrigation effciency

Example:
pump capacity = 300 gpm
number of sprinklers = 60
mainline spacing = 60 feet
lateral spacing = 40 feet soil moisture depletion = 3 inches
set time = 24 hours

1. Calculate the average application rate:

   q = pump capacity / number of sprinklers = 300 gal/min / 60 = 5 gal/min

   i = (96.3 x 5 gpm) / (40 feet x 60 feet) = 0.20 inches per hour

2. Calculate the average depth applied:

   D = 0.20 inches per hour x 24 hours = 4.8 inches

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3. Calculate the irrigation efficiency:

   E = 3 inches x 100 / 4.8 inches = 63%

4. Calculate the set time needed for good efficiency for a hand-move system (desired efficiency = 75 %):

   T = (3 inches x 100) / 75 x 0. 20 inches per hour) = 20 hours

Improving Sprinkler System Performance

The performance of a sprinkler system can be improved by the following measures:

1. Know the application rate and average depth applied.

2. Avoid overirrigating. Overirrigation means applying water in excess of the soil moisture depletion in the parts of the field receiving the least amount of water. Reduce overirrigation by decreasing the set time.

3. Irrigate during low wind periods (wind speed of less than 10 mi/h). Sprinkler uniformity is greatly reduced at wind speeds greater than 10 or 15 mi/h.

4. Offset lateral locations to improve seasonal uniformity. In offsetting, the lateral locations of the current irrigation are midway between the lateral locations of the previous irrigation.

5. Use the same nozzle size throughout the irrigation system. Mixing nozzle sizes results in nonuniform application rates.

6. Use flow-control nozzles for excessive pressure variations. Pressure variations of more than 20 percent between the pressure of the first nozzle (closest to the pump) and last nozzle will cause nonuniform application rates. Flow-control nozzles reduce the variability in application rate caused by pressure variability. Flow-control nozzles are sized according to their discharge rates (gal/min).

7. Repair leaks in the irrigation system and replace or repair malfunctioning nozzles.

8. Prevent crop interference by using properly sized risers.

9. Maintain adequate pressure by adjusting the pump impeller (semi-open impellers), repairing or replacing a worn pump, or reducing the number of laterals operating.

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drought tips is a publication series developed as a cooperative effort by the following organizations:

California Department of Water Resources, Water Conservation Office
University of California (UC)
UC Department of Land, Air and Water Resources
USDA Drought Response Office
USDA Soil Conservation Service
USDI Bureau of Reclamation, Mid-Pacific Region

Published 1993