USDA Natural Resources Conservation Service

Irrigation Toolbox: Chapter 1

Lesson Plan 2

Water Intake

Title: Water Intake

Objective: To obtain an understanding of the characteristics of water intake into irrigated soil.

Method: Lecture - Demonstration.

Water intake is the movement of irrigation water from the surface into and through the soil. Water intake is the expression of several factors including infiltration and percolation.

Infiltration

The downward flow from the surface into the soil.

Key Points:

- Water enters though pores, cracks, worm holes, decayed root holes, and tillage craters.
- Restricted by surface sealing, crusting.

Percolation

Downward movement of water though the soil profile.
- Permeability: quality of soil which enables it to transmit water.
- Hydraulic Conductivity: an expression of the readiness of a soil to let a fluid flow through it for a given potential gradient, according to Darcy's Law V=ki.

Key Points:

HC dependent on swelling potential, hard pans, bed rock, dispersion, flocculation.

Factor Affecting Intake Rate Intake

- Rate reduces with time.
- Limited by any restriction of flow through soil.

Key Points:

- surface sealing
- soil compaction
- soil cracking
- tillage
- crop rotations
- soil and water salts
- sediments in irrigation water
- soil erosion
- land leveling
- temperature

Variation in Intake Rate by Irrigation Method

- Teaching Aid: Transparency of Figure 1-7.

Key Points:

- Sprinklers
- Compaction due to droplets
- Surface sealing due to rearrangement of fines in surface soil
- Flooding
    - Surface completely covered
    - Puddling
    - Crusting
- Furrows
    - Erosion
    - Radial Flow
- Intake characteristics
- Intake is variable
    - soil to soil
    - field to field
    - irrigation to irrigation
    - season to season

Relation of Total Intake to Time

- Teaching Aid: Transparency of figure 1-8, also, film of same curve plotted on log-log paper.

Key Points:

- Intake
    - continues as long as water is available.
    - Can be described by an algebraic equation.

Relation of Intake Rate to Time

- Teaching Aid: Transparency of Figure 1-9, also film of plot on log-log paper

Key Points:

- Decreases with time.
- May become nearly constant near end of irrigation period. (May depend on mount applied.)
- Can be described by an algebraic equation.

Average Intake Rate and Basic Intake Relationship for Design

Intake values used vary with method of application.

Key Points:

- Sprinklers
  - Application rate is less than the intake rate at end of irrigation.
  - Intake rate is maximum allowable application rate.
- Flooding Methods.
  - Application rate is greater than intake rate.
  - Total intake to time relationship is basic for design
  - Water must be held on all parts of field until intake takes place.

Intake Families

- Teaching Aid: Transparency of Figure 1- 10.

Key Points:

- Each type of soil has characteristic intake curve. (total intake to time)
- 16 groups developed based on range in basic intake rate.
- Reduce to 8 shown on figure.
- Cylinder tests made, plotted , each test assigned intake family (by placing overlay over curve)
- Several, preferably 5 or more, tests on each soil type should be run.
- Design Family is weighted family.

Variability in Intake

- Teaching Aid: Film for overhead projection, Figure 1-1 3

Key Points:

- Correct soil identification will narrow the spread.
- Test should be run on same crop.

- Mature alfalfa at least 3 years old.
- Test should be run when antecedent moisture is about same level for all tests.

Methods of Determining Intake

- Teaching Aid: Pictures or visual aids of test being run and/or equipment used.

Key Points:

- Sprinklers
  - o Catch cans set last 1/4 of irrigation period.
  - o Cans set properly: in areas where moisture has just receded from soil surface when next sprinkler pass comes across can.
  - o Expressed in inches per hour (in/hr.).(Center Pivot system will require slightly different procedure)
- Borders
  - o Five cylinders used.
  - o Data for each cylinder secured.
  - o Cylinders averaged for one test or may be plotted separately.
  - o See ARS Publication 41-7. (Use of Cylinder Infiltrometers.)
  - o Express Expressed in inches per hour (in/hr.)
- Furrows
  - o Correlated from results of above tests see Irrigation Memo EWP-2.
  - o Tests can be run according to instructions in ARS Publication 41-31
  - o Expressed in gallons per minute per 100 feet of furrow or in/hour over surface of field.

References:

Cornell Infiltrometer:
> http://www.css.cornell.edu/research/precisionag/infiltrometer.htm