Considerations for Improving Surface Irrigation Efficiency

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Irrigation System Performance

- Crop ET uniform throughout the field
- Water replacement needs to be uniform
- Irrigation efficiency greatly influenced by the uniformity of applied water.
Field Factors influencing DU and IE

- Opportunity time
- Infiltration rate

Key Elements

- On-flow rate
- Irrigated area
- Slope
- Surface roughness

$$OT \times IR = \text{Applied water}$$
Complications in achieving uniform applications

- Surface irrigation issues differ from those of pressurized systems.
- Surface irrigation design and operation is governed in part by soil infiltration rates.
- Variable surface intake rates can complicate management.
Soil Controlled Water Infiltration

Initial rate

Infiltrated Water in./hr

5.0

0.2

Time (hr)

1 2 3 4 5

Basic rate
Complications in achieving uniform applications: Infiltration rates vary throughout the season.
Large pores conduct water and air

Small pores hold water

Sandy soils more large pores

Clayey soils more small pores
Soil Crusts & Access to Soil Pores
Depositional Crust

layered

undisturbed soil

0.1 - 0.5 inches
Structural Crust

- Compacted & sorted zone
- Washed in zone
- Undisturbed soil zone

0.04 inches
<0.04 inches
Managing Water Penetration

• Water Management
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• Water Management

• Organic Matter Management
Organic Matter Management

- Manure, composts, lagoon water
- Residues (Chipping)
- Cover crops
Managing Water Penetration

- Water Management
- Organic Matter Management
- Tillage, cultivation
Improving Water Penetration

- Water Management
- Organic Matter Management
- Tillage
- Chemical Treatment of Soil and Water
Infiltration and Management

- Management influences water infiltration in soils
  - Tillage
  - OM content
  - Additions of organic amendments
  - Additions of salts (gypsum)
  - Method of irrigation (crusting)
Infiltration and Uniformity

- Furrow advance time reflects rate of infiltration.
- High infiltration rates often result in low DU, IE in surface systems.

![Graph showing infiltration rates over time and distance for Hanford Sandy Loam - Conventional Tillage with data points for 14-May, 9-Jun, and 6-Aug.](image-url)
Summary

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• Soil infiltration rates vary from event to event and system operation needs may need to vary.
• Fields having water penetration problems may have a high DU and IE but may be difficult to manage.
• Good soil and water management practices combined with proper system design and operation can result in highly uniform and efficient irrigation.
Problems with Surface Irrigation Methods

- Modifications help but uniformities and efficiencies still lag.
Water Penetration

Water entry
into soil surface

Water Infiltration

Water movement through soil