Considerations for Improving Surface Irrigation Efficiency

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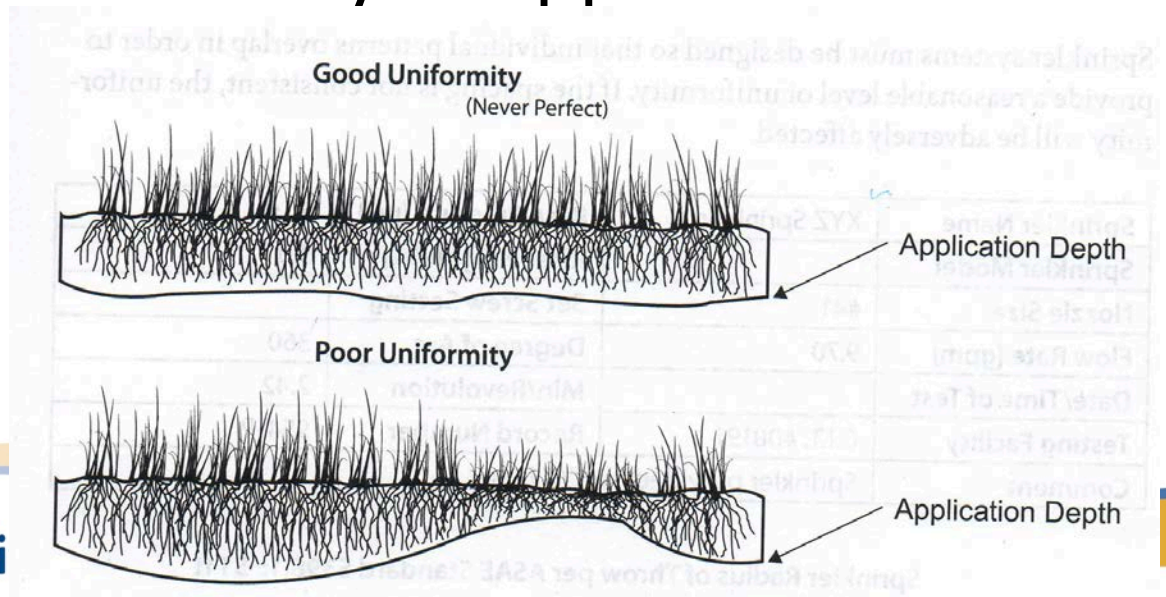
Irrigation System Performance

- Crop ET uniform throughout the field
- Water replacement needs to be uniform
- Irrigation efficiency greatly influenced by the uniformity of applied water.



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Field Factors influencing DU and IE

- Opportunity time
- Infiltration rate
- OT x IR = Applied water

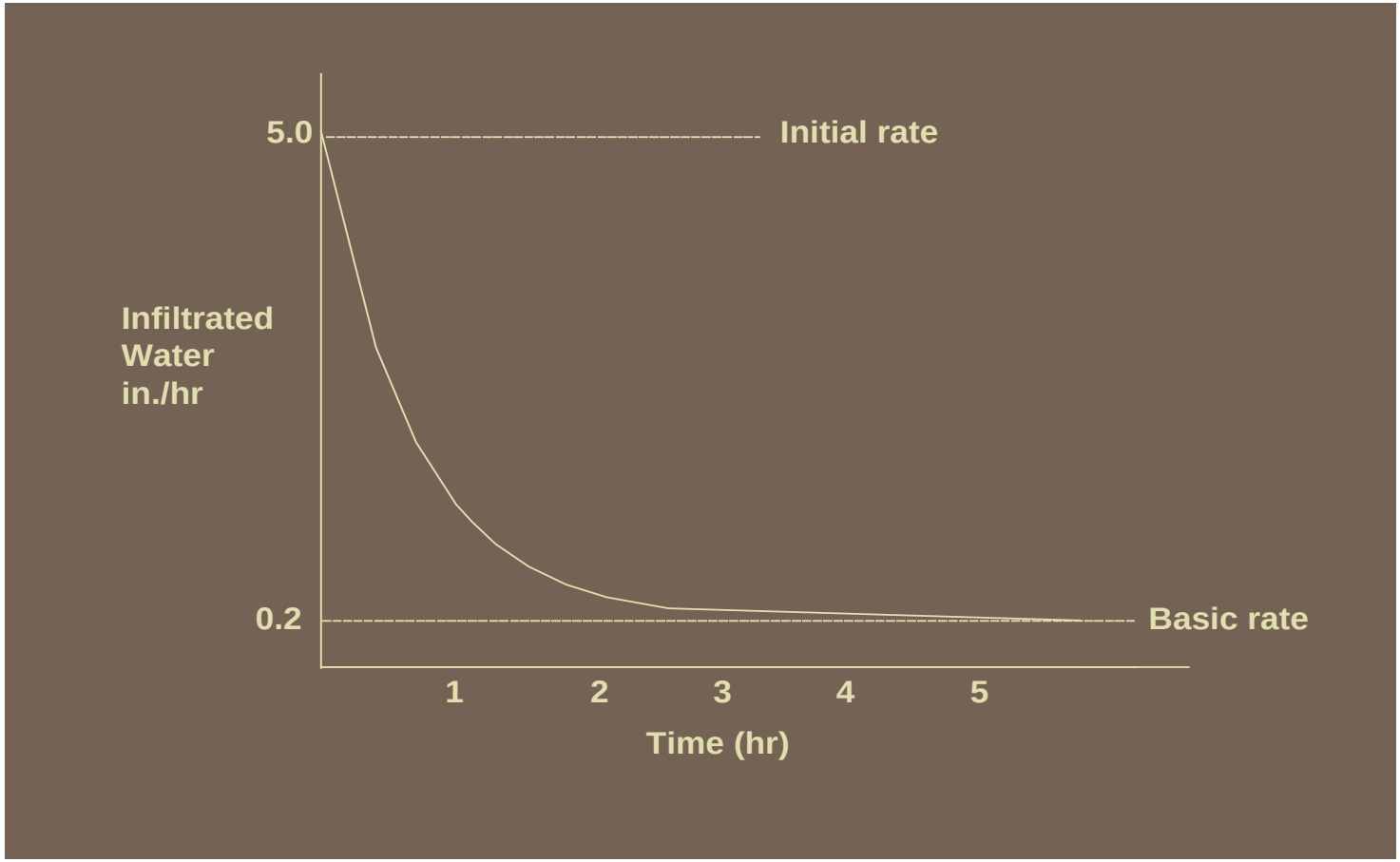
Key Elements

On-flow rate
Irrigated area
Slope
Surface roughness

Complications in achieving uniform applications

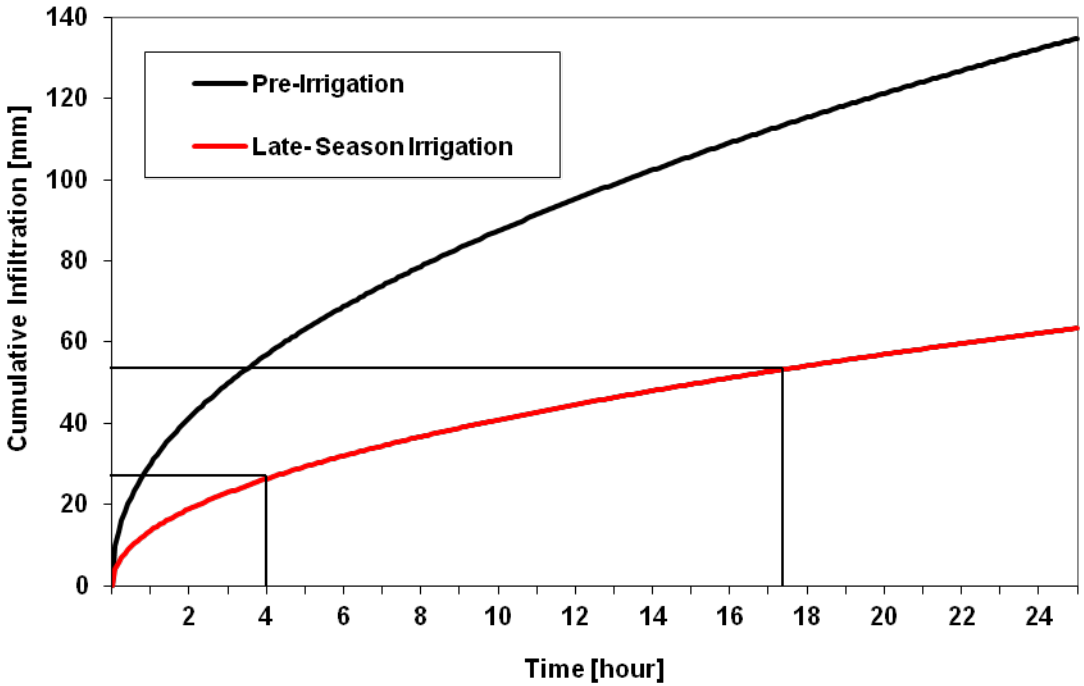
- Surface irrigation issues differ from those of pressurized systems.
- Surface irrigation design and operation is governed in part by soil infiltration rates.
- Variable surface intake rates can complicate management.

Soil Controlled Water Infiltration



Complications in achieving uniform applications:

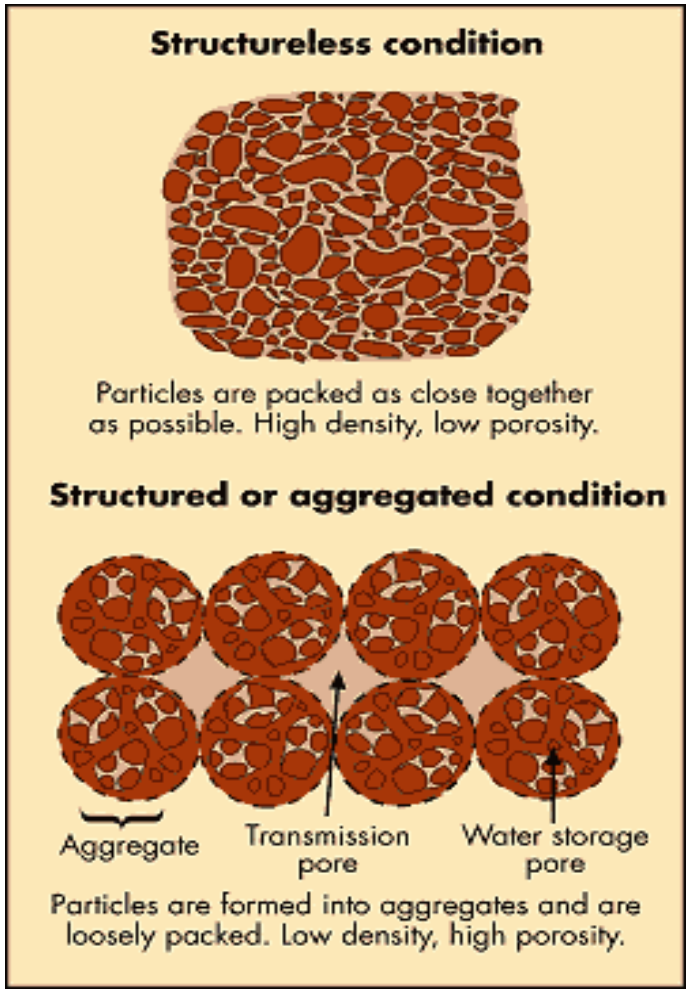
Infiltration rates vary throughout the season



Soil Pores

Large pores conduct water and air

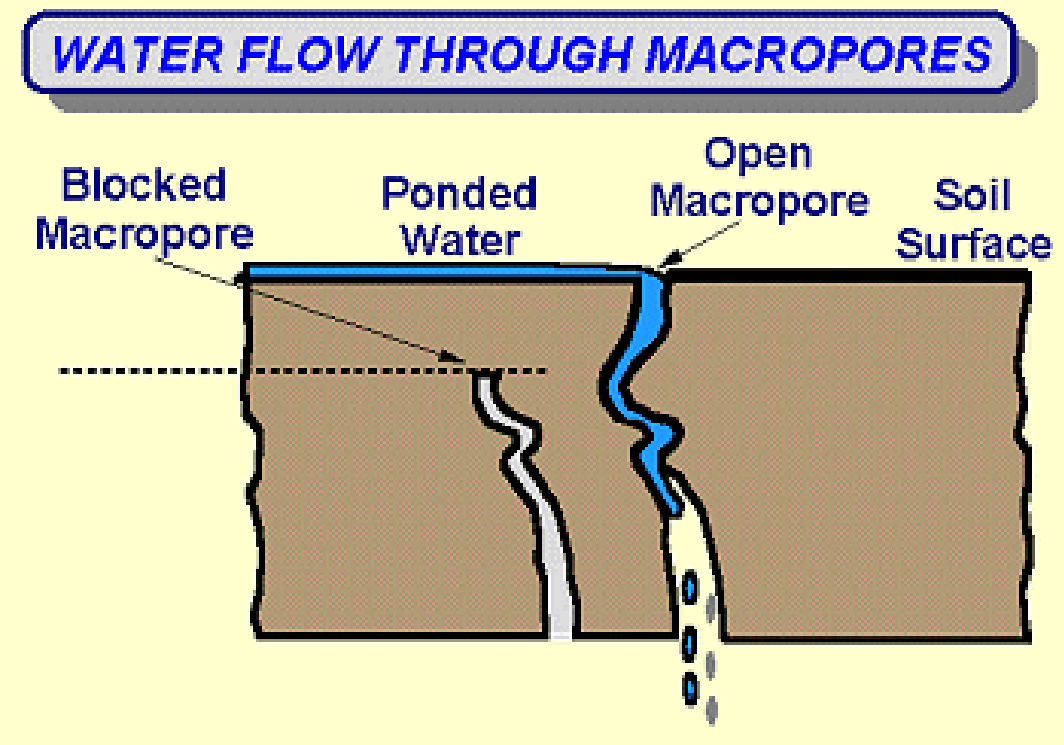
Small pores hold water



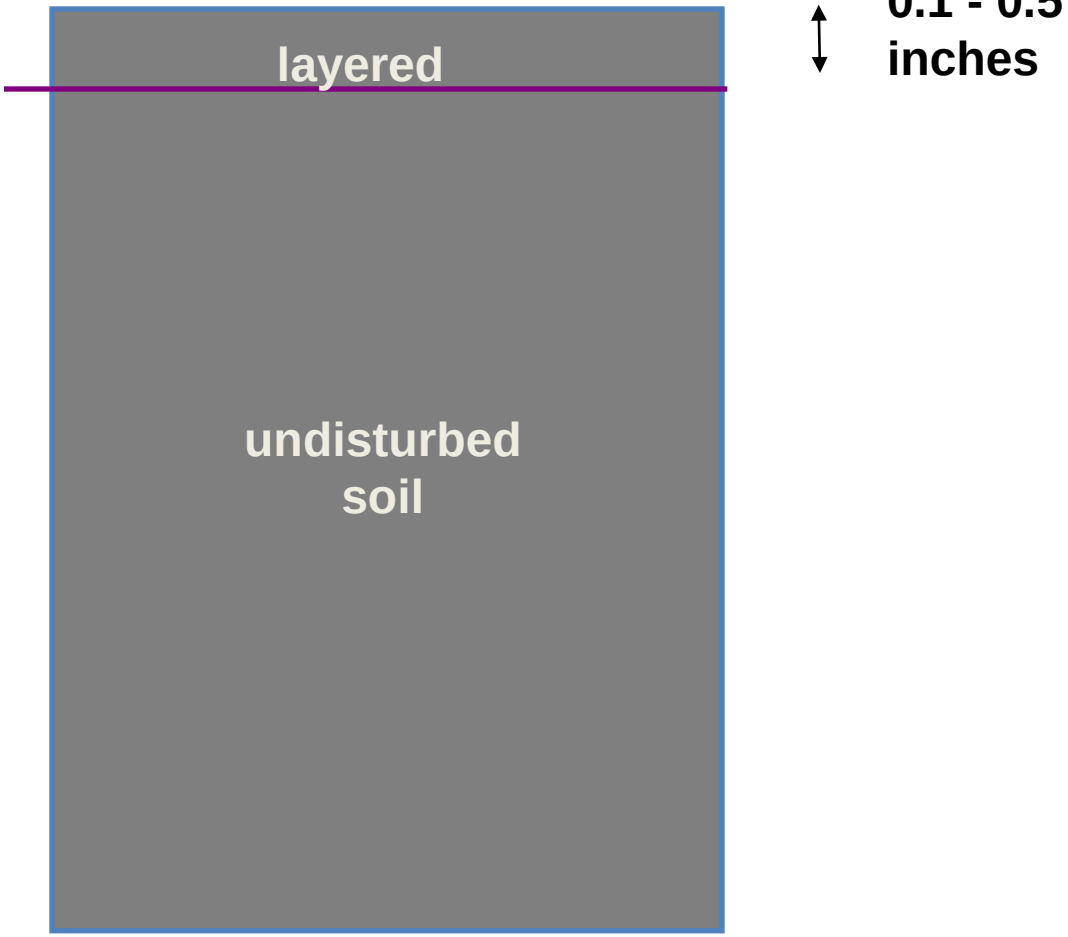
Sandy soils more large pores

Clayey soils more small pores

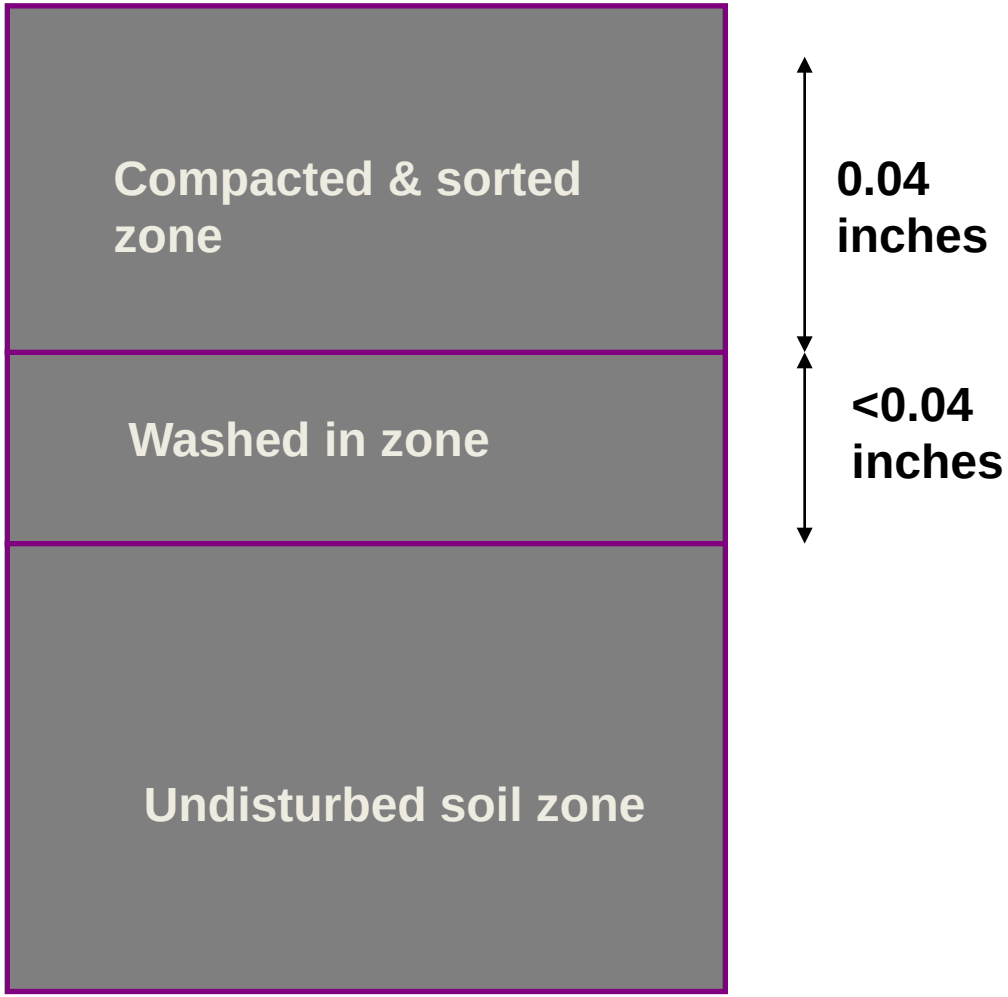
Soil Crusts & Access to Soil Pores



Depositional Crust



Structural Crust



Managing Water Penetration

- Water Management

Managing Water Penetration

- Water Management
- Organic Matter Management

Organic Matter Management

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

Managing Water Penetration

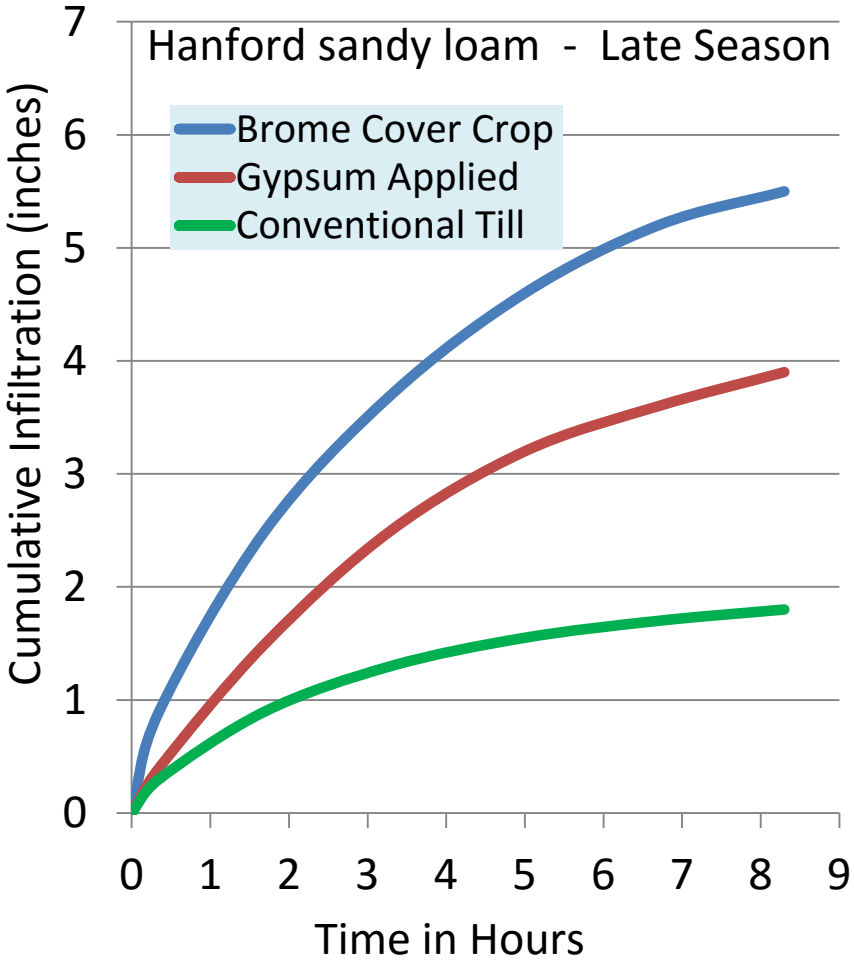
- Water Management
- Organic Matter Management
- Tillage, cultivation

Improving Water Penetration

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

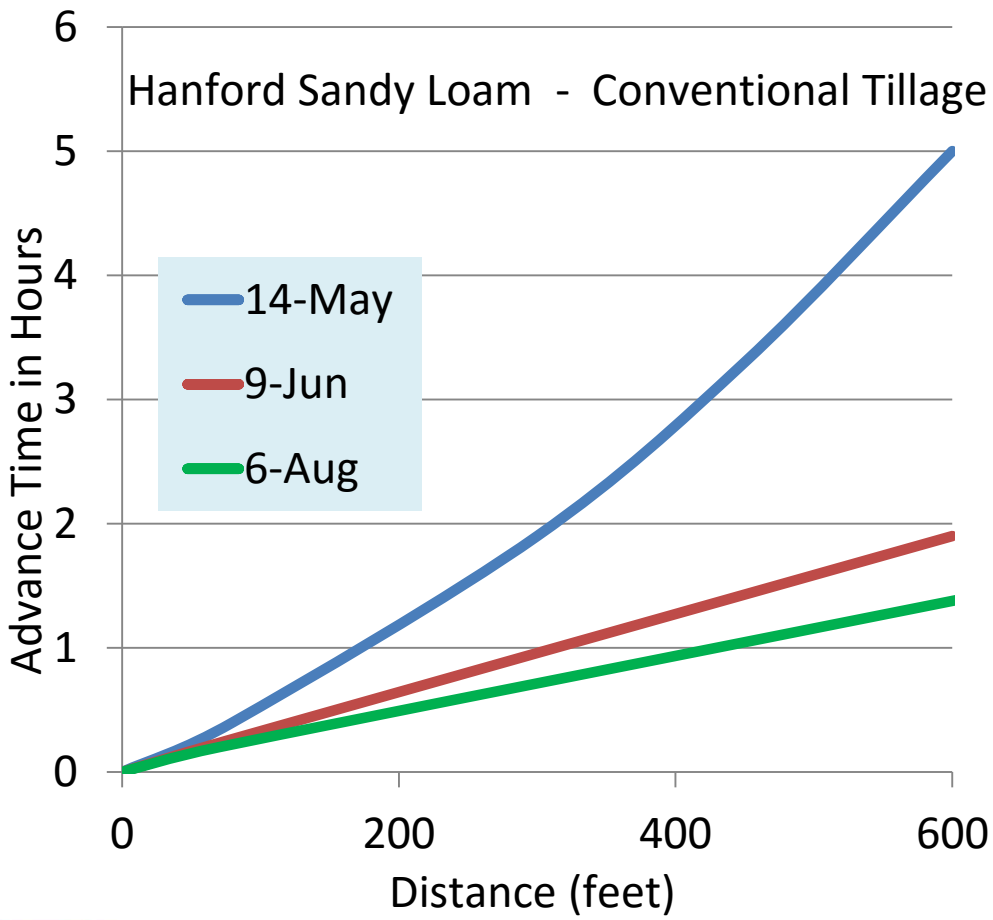
Infiltration and Management

- 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.



Summary

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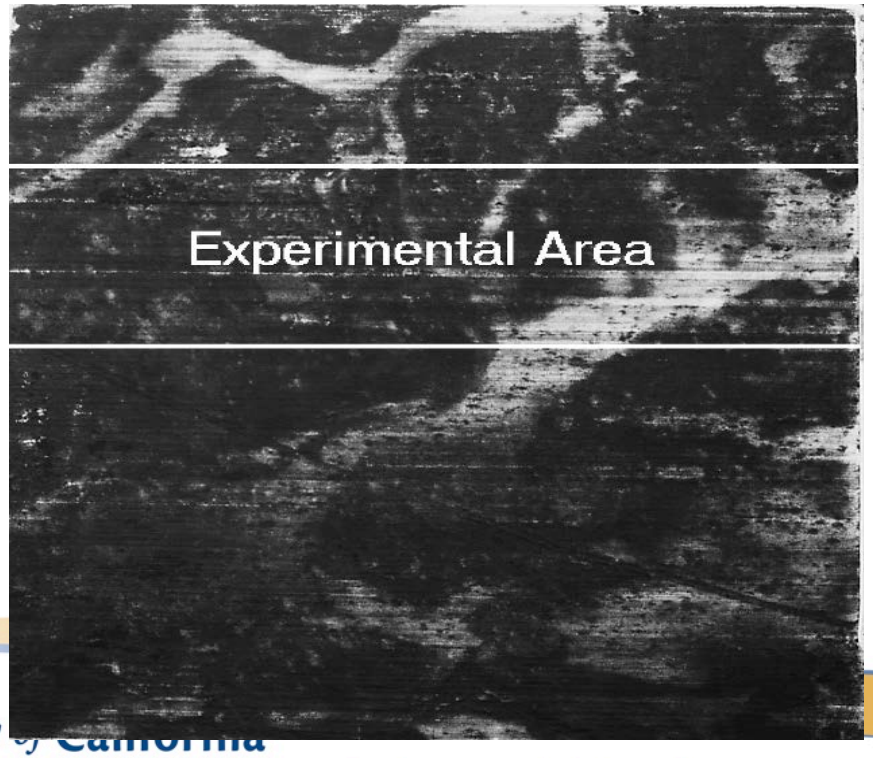
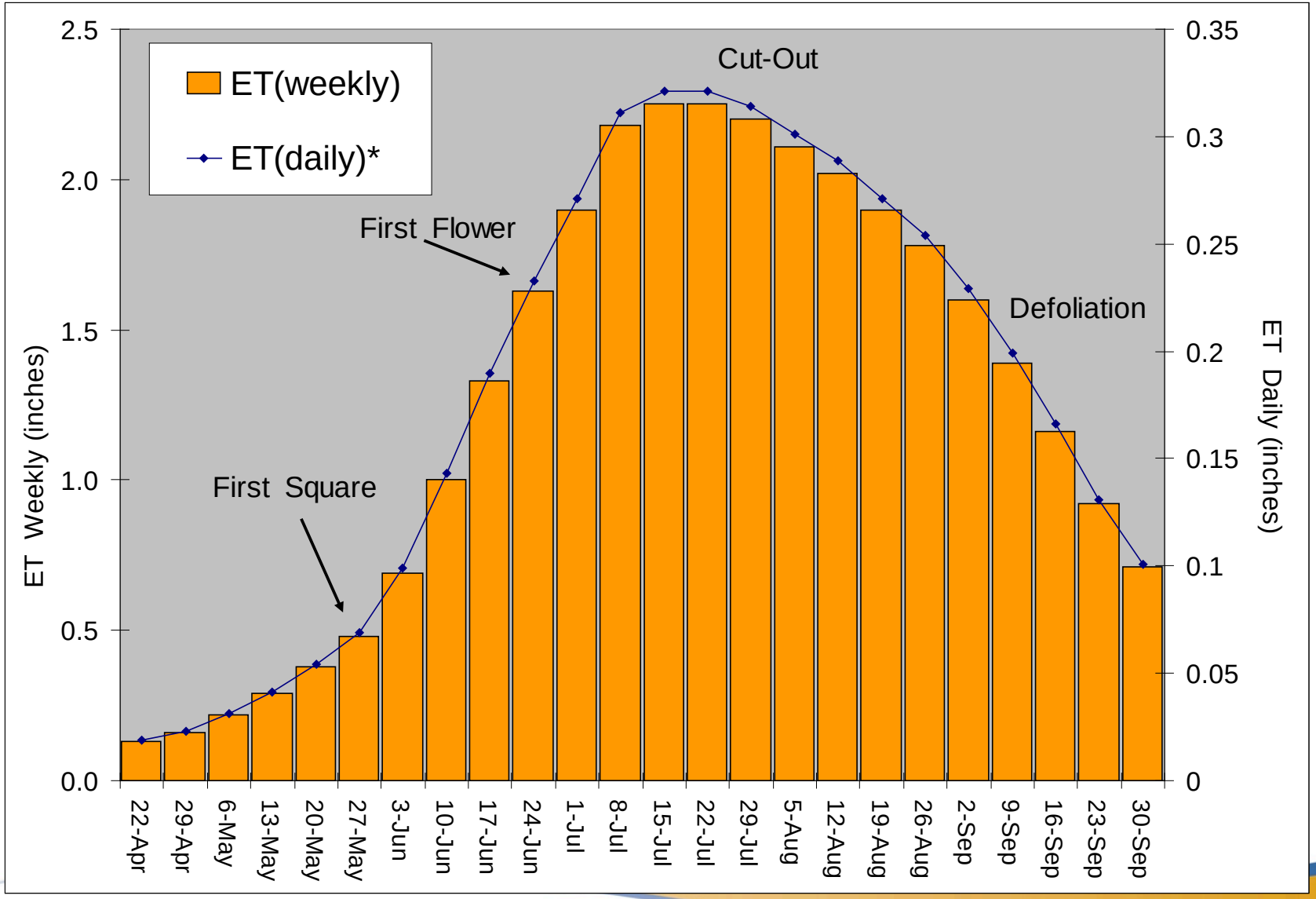
- Soil infiltration rates vary from event to event and system operation needs may need to vary.
- Fields having water penetration problems may have a high DU and IE but may be difficult to manage.
- Good soil and water management practices combined with proper system design and operation can result in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

Problems with Surface Irrigation Methods

- Modifications help but uniformities and efficiencies still lag.

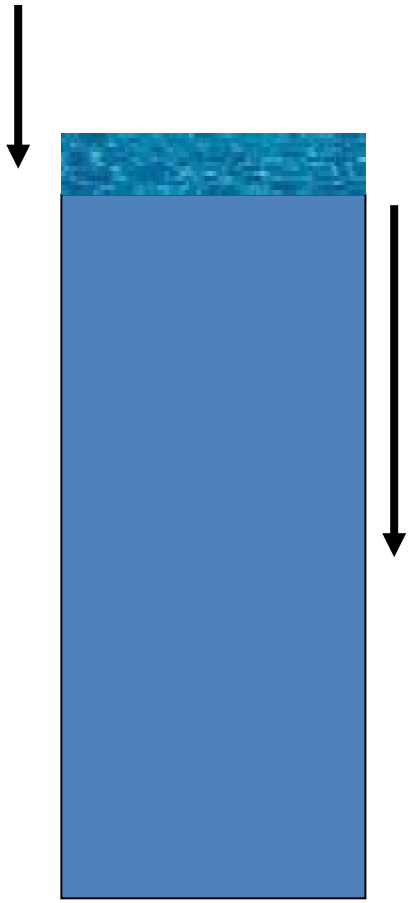



ET(weekly)
ET(daily)*
Cut-Out
First Flower
Defoliation
First Square
ET Weekly (inches)
ET Daily (inches)
2.5
2.0
1.5
1.0
0.5
0.0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
2-Sep
9-Sep
16-Sep
23-Sep
30-Sep

Water Penetration

Water entry

into soil surface



Water Infiltration

Water movement through soil