Distribution Uniformity in Surface Irrigation Systems and Soil Moisture Monitoring

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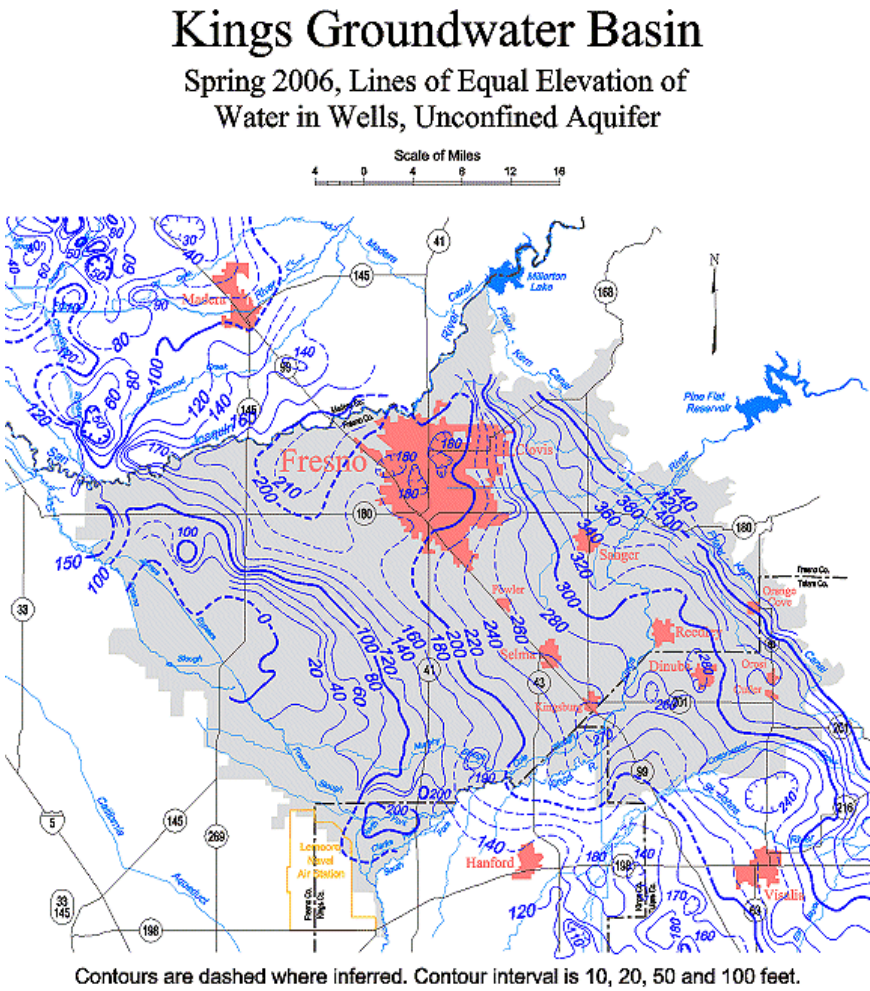
Access to groundwater

- Less Surface water
- Increased pumping
- Depth
- Well yield
- Reduced volume to irrigate



What is Irrigation Efficiency? How do we measure it?

Irrigation Efficiency =

$$\frac{\text{Beneficial Use}}{\text{Applied water}}$$

- Water used by the crop (ET)
- Water needed to leach salts
- Water used for frost protection

What is irrigation efficiency? How do we measure it?

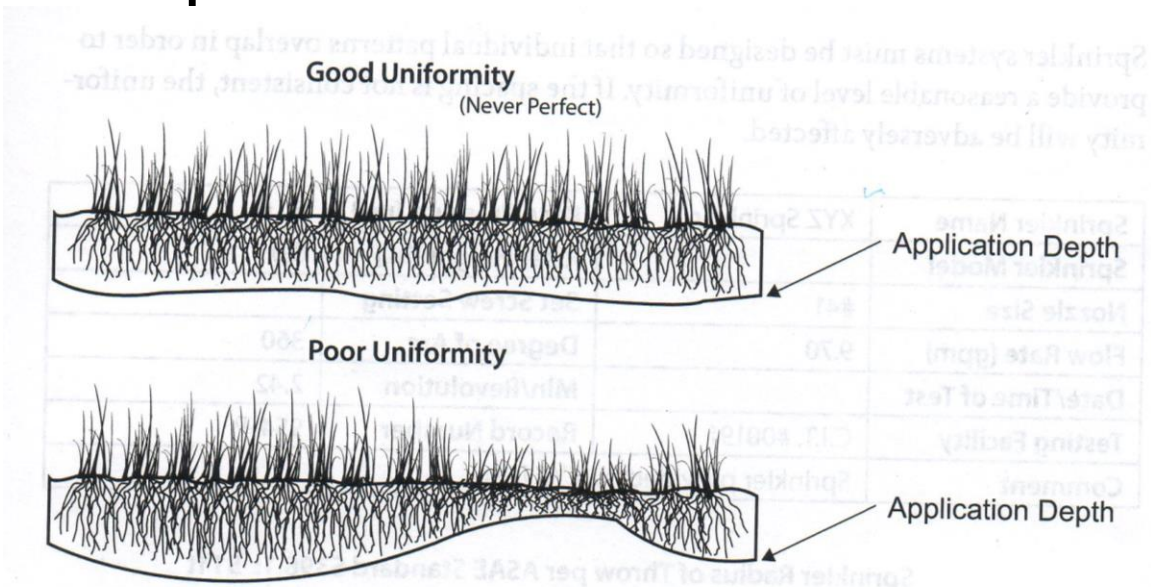
Irrigation Efficiency =

$$\frac{\text{Beneficial Use}}{\text{Applied water}}$$

- Goal is to make all applied water a beneficial use.
- Limiting losses to runoff an deep percolation

Irrigation System Performance

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

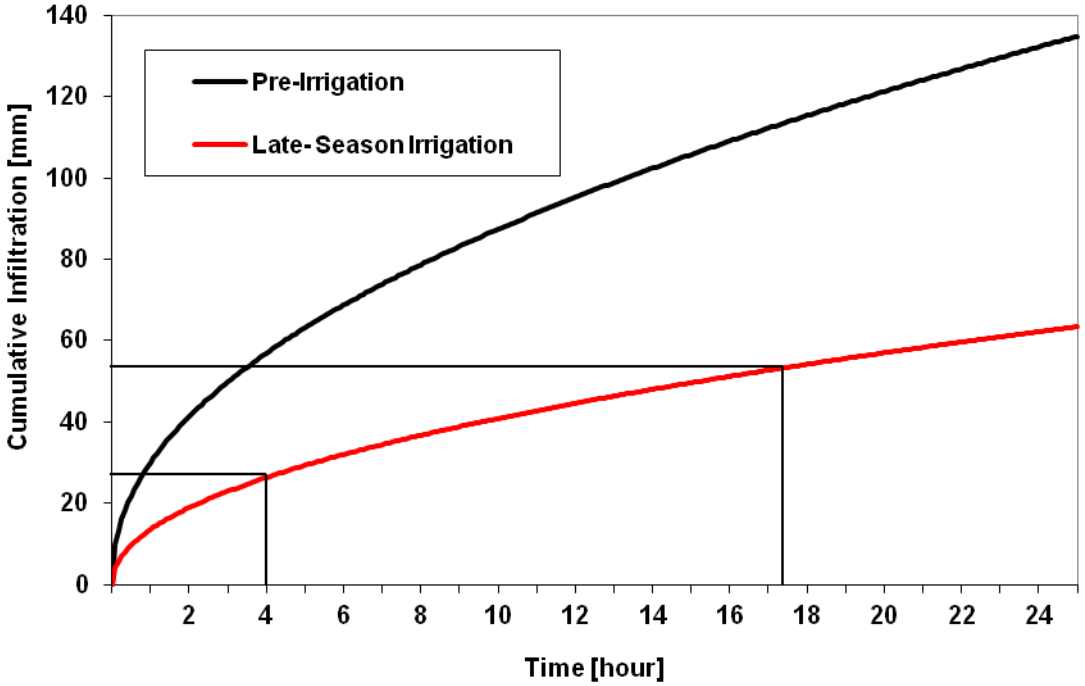


Complications in achieving uniform applications

- Surface irrigation issues are completely different from pressurized systems
- Governed in part by soil infiltration rates
- Variable surface intake rates

Complications in achieving uniform applications:

Infiltration rates vary throughout the season



- Soil properties in fall & winter leave soils open w/ high infiltration rates.

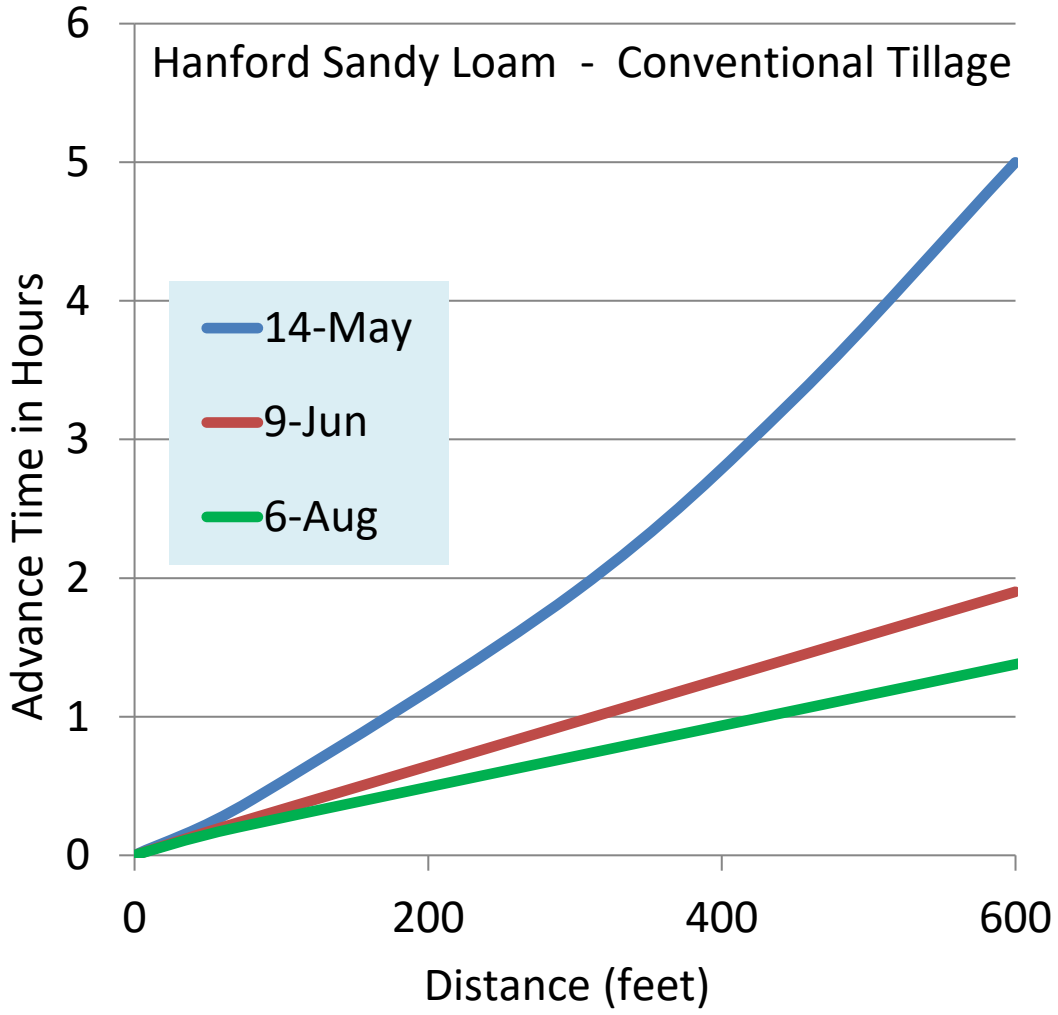
Complications in achieving uniform application:

Infiltration amounts depend on opportunity time

- Amount of time allowed for infiltration.
- Recession time - Advance time

Infiltration and Uniformity

- Furrow advance time reflects rate of infiltration
- High infiltration rates correspond to low DU, esp. in surface systems.



Estimating DU

Advance ratio = $\frac{\text{Total Irrigation time}}{\text{time to reach field end}}$

AR= $\frac{12 \text{ hrs.}}{6 \text{ hrs.}}$ = 2.0

AR > 2.0 is generally an indicator of good uniformity (> 80 percent).

- Applies best when low quarter receives less water than head of field.

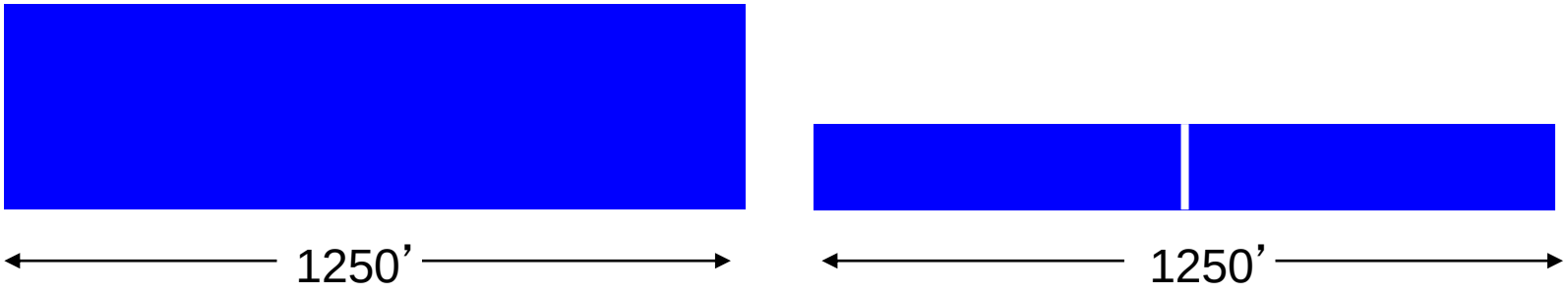
Dealing with low DU fields

- Reduce the time required to advance to the end of the field.
  - Increase flow to check
  - Narrow check
- Shorten run length

Improving DU's and limiting deep percolation losses?

- Reduce field length.
  - Often the most effective option
  - Also often the least popular option

	1250' Field	600' Field
Irrigation Amount	9.1"	5.4"



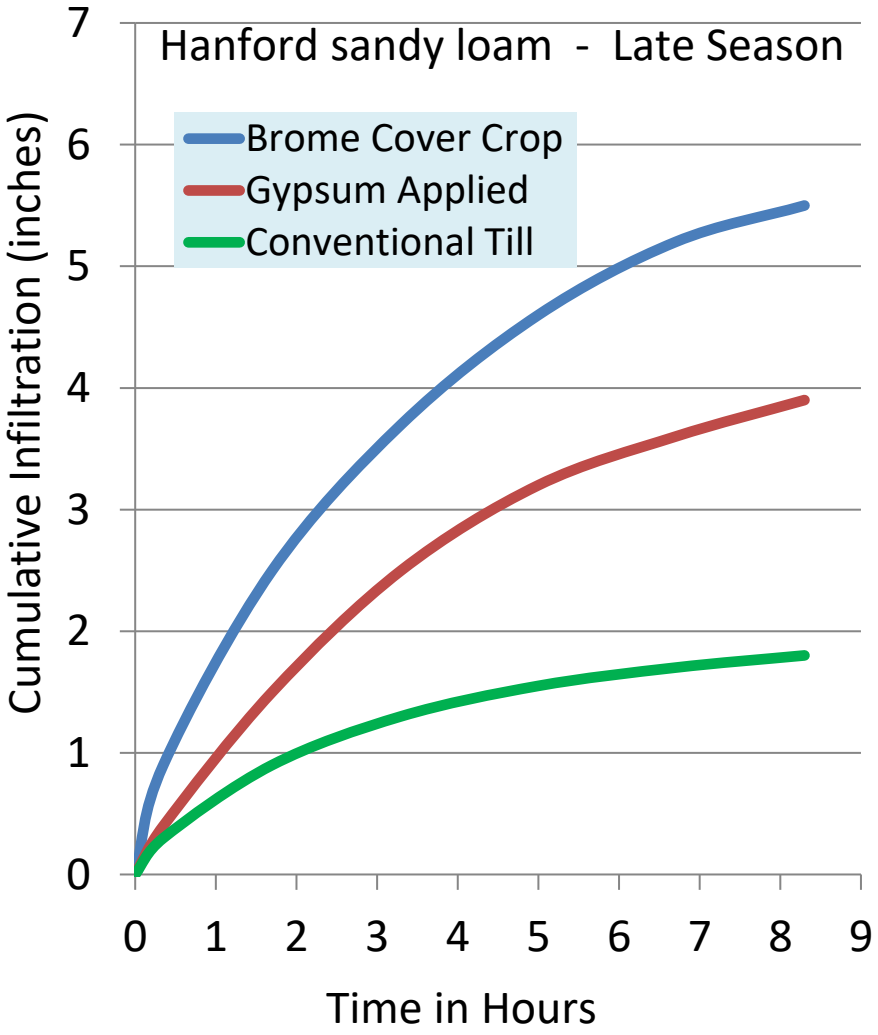
Distribution Uniformity = The “eveness” of water infiltration

$$\frac{\text{low ¼ average applied}}{\text{average applied water}} \quad \frac{2.0”}{3.0”} \quad \times 100 = 67\%$$

Uniformity depends on system design and maintenance!

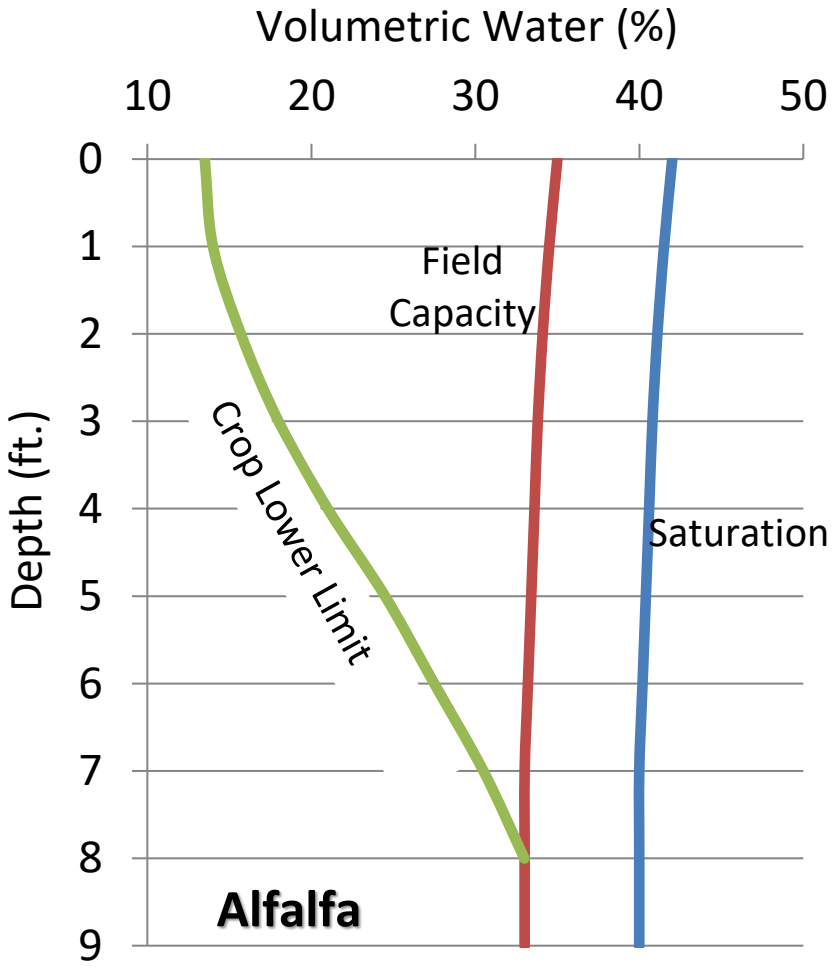
Infiltration and Management

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



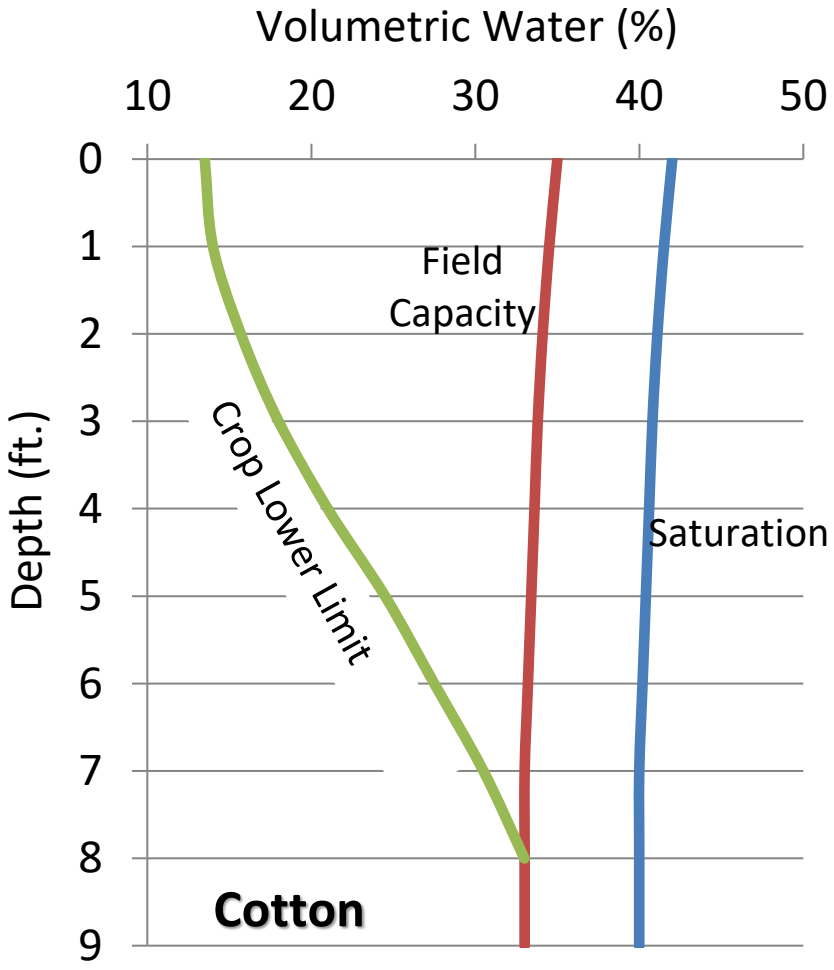
Soil Water Storage and Nutrient Leaching

- Include stored soil water into irrigation planning decisions



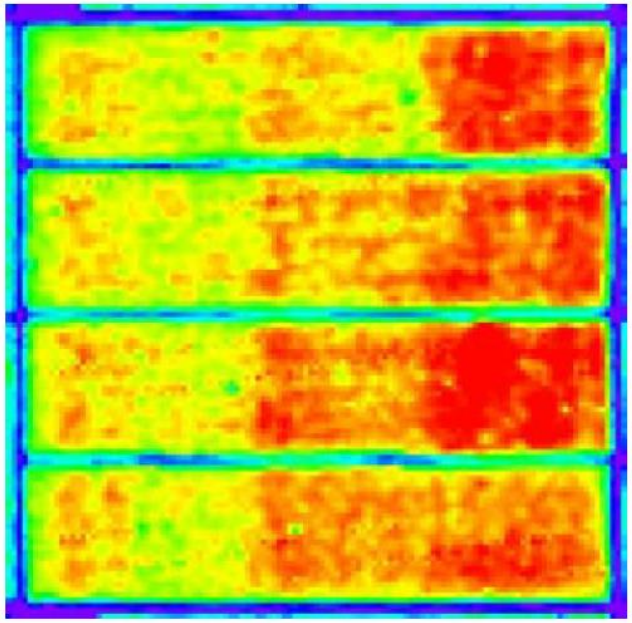
Soil Water Storage and Nutrient Leaching

- Include stored soil water into irrigation planning decisions
- Leaching potential is minimized when:
  - Soil water deficit at time of irrigation is known
  - Good estimate of water applied for irrigation
  - Match application with water deficit

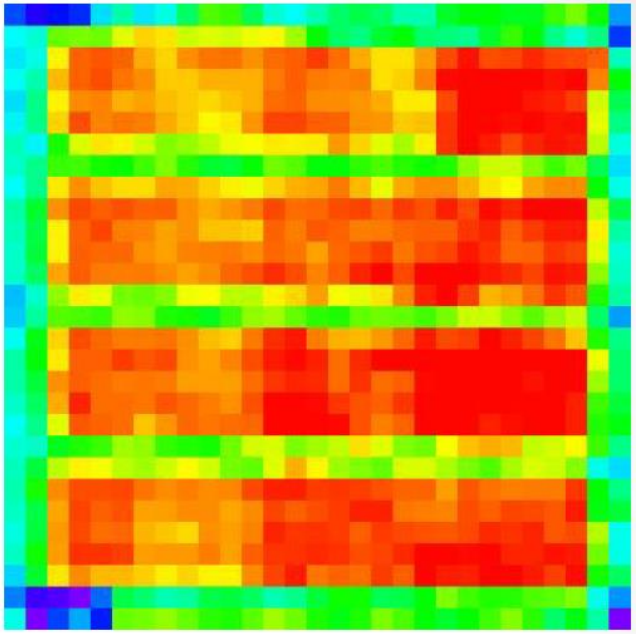


fPAR and LAI maps derived from mNDWI

MASTER



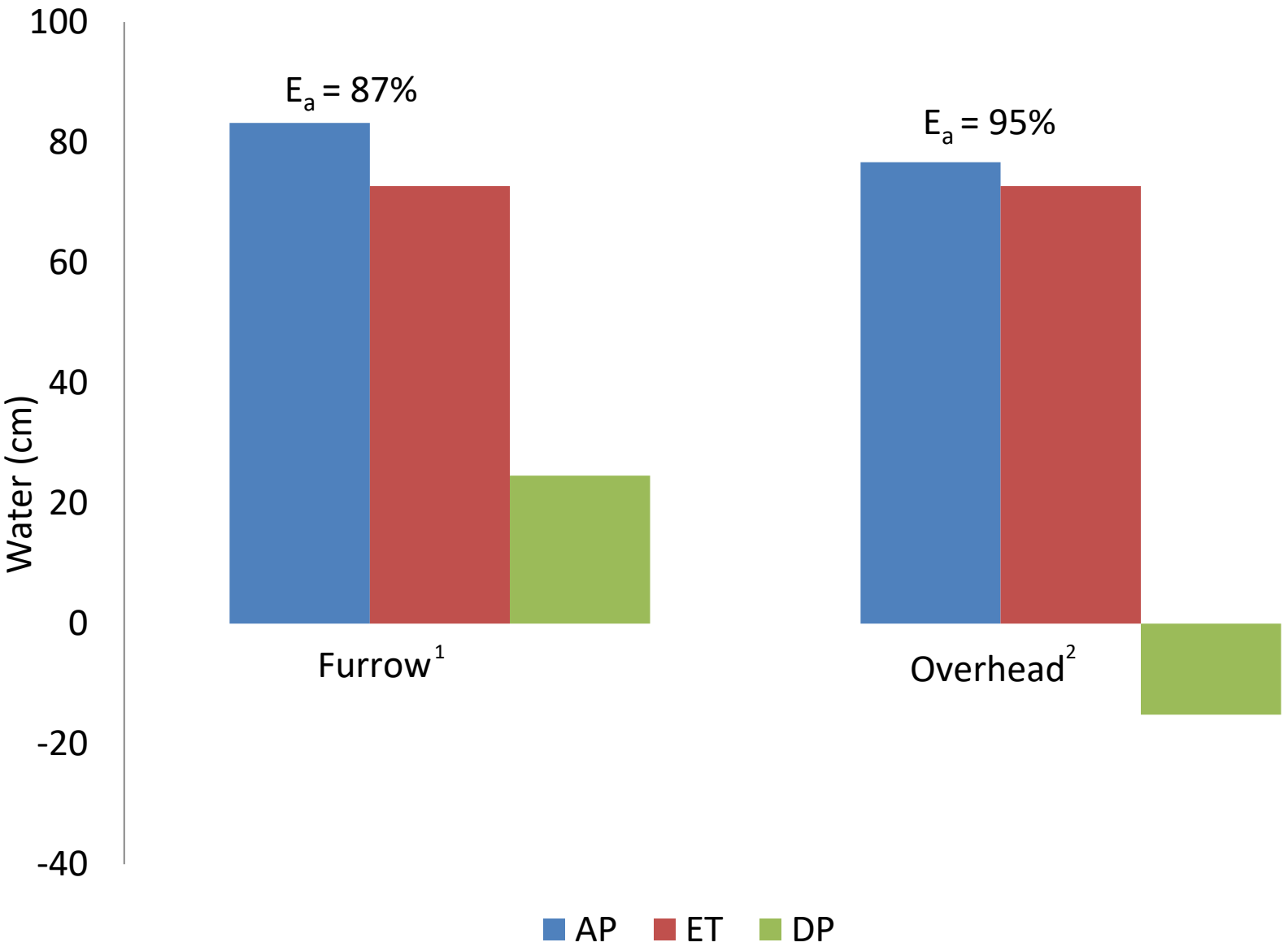
Landsat



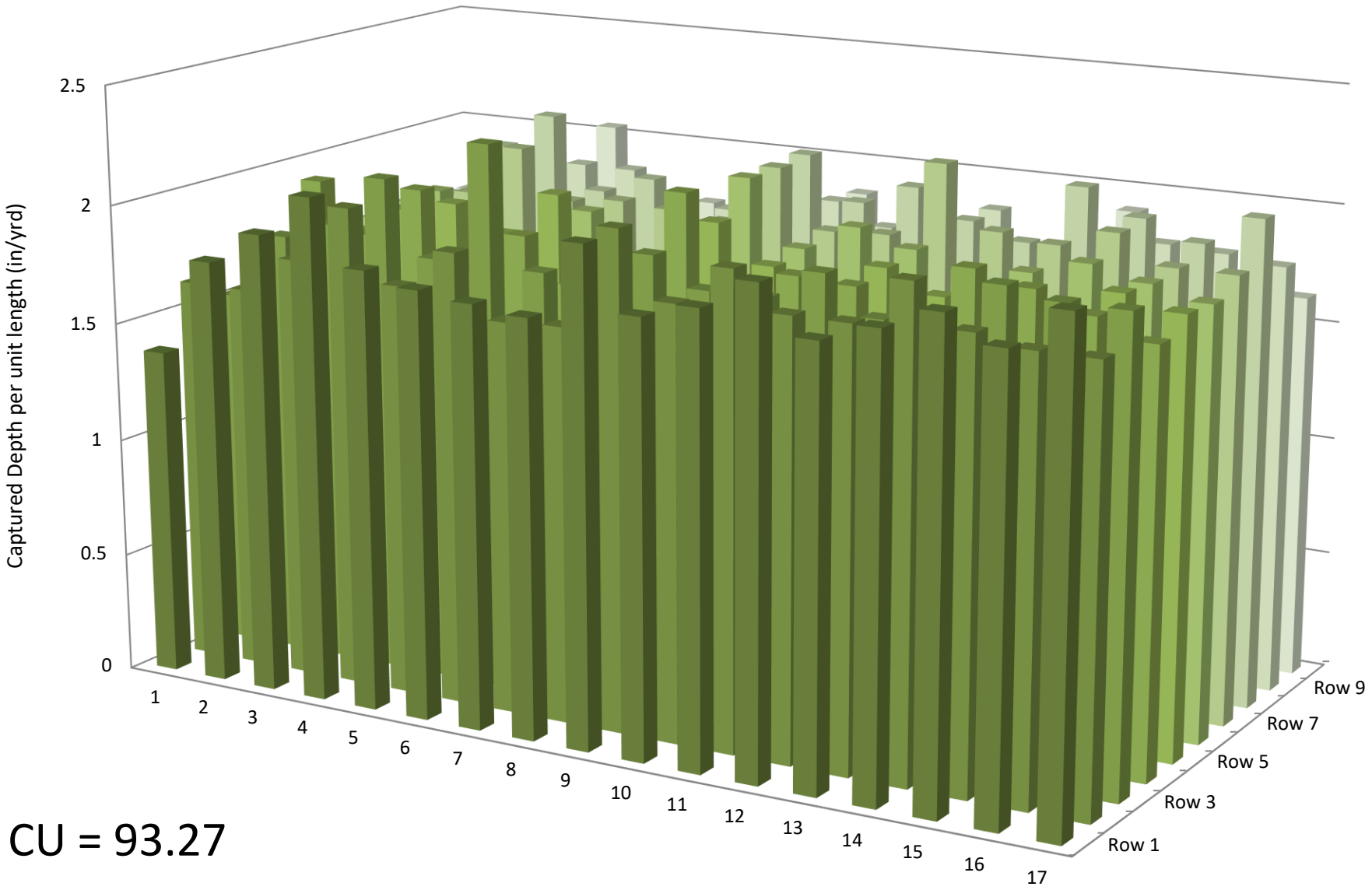
Insanity: doing the same thing over and over again and expecting different results… *Albert Einstein*

Complex field conditions that include rapid infiltration rates, high soil variability and limited options to deal with poor irrigation system performance do exist.

Consider an irrigation system change


Summer 2009: Overhead is more efficient than furrow
100
80
60
40
20
0
-20
-40
Water (cm)
E_a = 87%
E_a = 95%
Furrow[1]
Overhead[2]
AP
ET
DP

Catch-Can Captured Depths - August 21, 2009



CU = 93.27


That's all Folks!