

# **Water Use of Double Crops in Oklahoma**

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# Take home messages

1. Global agricultural demand is expected to increase, but soil and water resources are limited.
2. Our crops currently use only a fraction of the precipitation we receive.
3. Biological intensification may be a key strategy in increasing the efficiency and productivity of rain-fed agriculture.

# You are here.



NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation).

So are quite a few others.

No-till Oklahoma



And we're having lots of these.

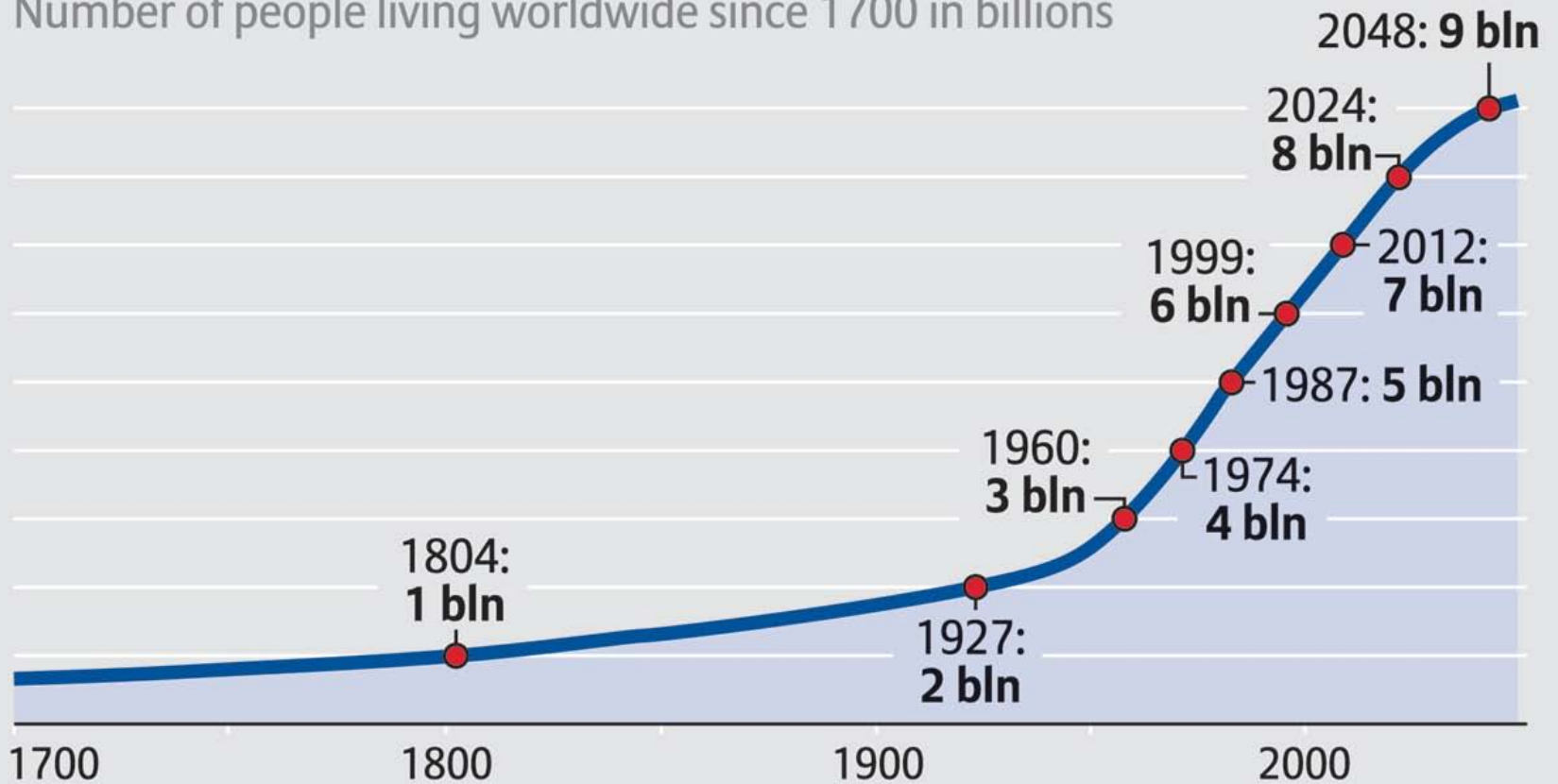


# Population projection

## POPULATION OF THE EARTH

Allianz 

Number of people living worldwide since 1700 in billions



Source: United Nations World Population Prospects, Deutsche Stiftung Weltbevölkerung

For further information please visit: [www.knowledge.allianz.com](http://www.knowledge.allianz.com)

# Projected increases in demand by 2050

- Cereals: up 55-80%
- Meat: up 70-155%
- Sugar, oil, vegetables, and fruit: up 70-110%
- Bioenergy: up ?? %

Source: de Fraiture et al., 2010. Agricultural Water Management 97:495-501.

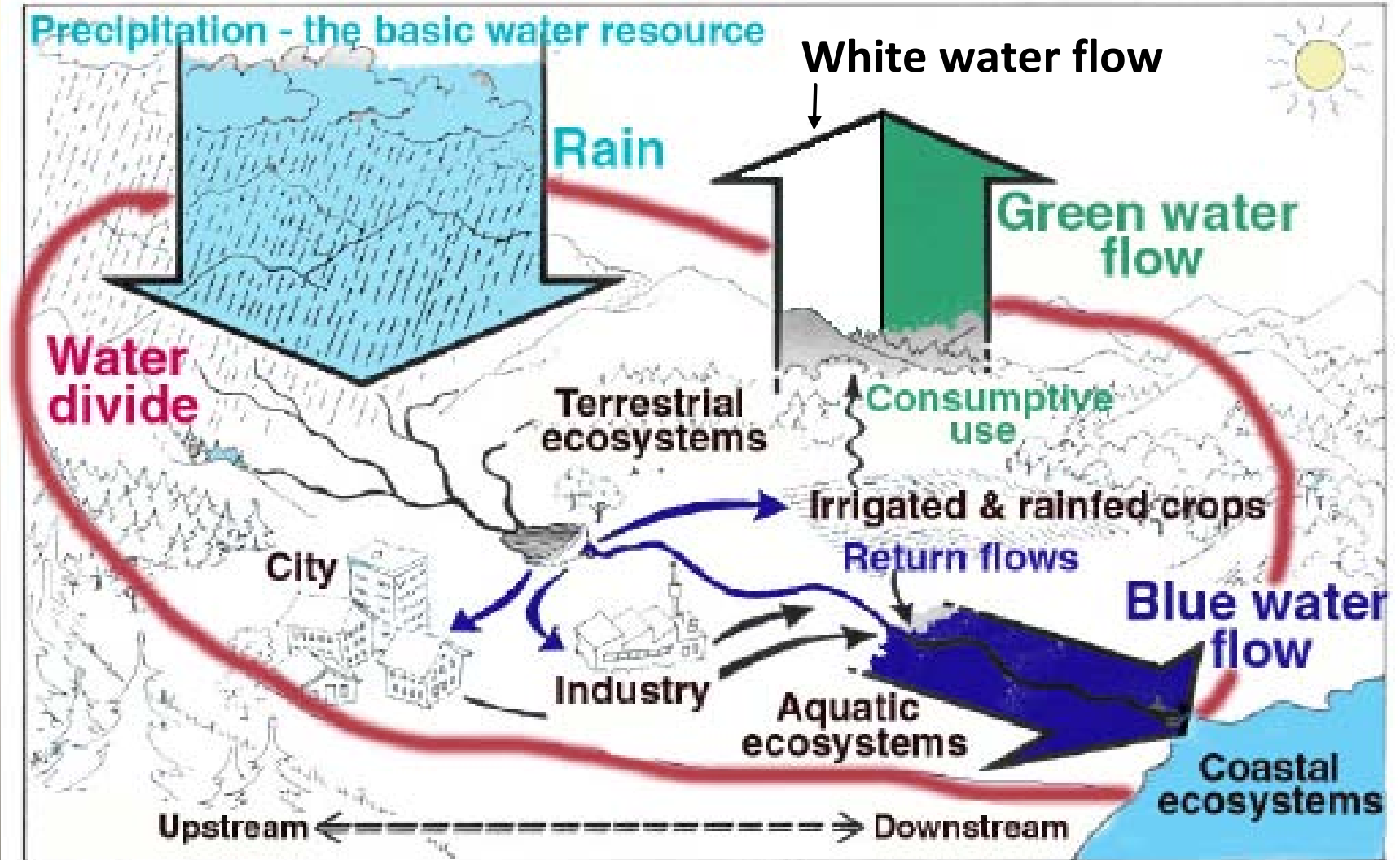
# The challenge

- Produce more food, fiber, and energy
- Using existing land and water resources
- In an increasingly uncertain climate
- With fewer negative impacts on the environment.

Key question: How efficiently are we using our water resources?



# Classifying our water resources



# Oklahoma's average water budget

<u>Item</u>	<u>Positive Effects?</u>	<u>Size (in)</u>
Precipitation: the renewable resource	+	34
Blue water: flow through the surface water and groundwater systems	+	7.6
Green water: transpiration through plants	+	7.9
White water : evaporation from the land surface (excluding transpiration)	?	18.5

Can we shift a portion of the flow from white water to green water through biological intensification?

# Biological Intensification

- **Is** the process of intentionally increasing the number of species in an agricultural system
- **Involves** raising complementary species in beneficial arrangements and sequences
- Is pursued with the **intent** to
  - Increase agricultural land productivity
  - Conserve and improve the soil
  - Create positive off-site environmental impacts



## Integrated crop-livestock systems

Cattle and winter wheat, KS

<http://flickr.com/photos/59526103@N00/137649071>



## Forage double cropping

Rye silage following corn silage, MN



## Relay cropping

Soybean and winter wheat, NE

<http://cropwatch.unl.edu/archives/2003/crop03-23.htm>



## Living mulch

Corn and kura clover, WI

# Lahoma Crop Rotation Experiment

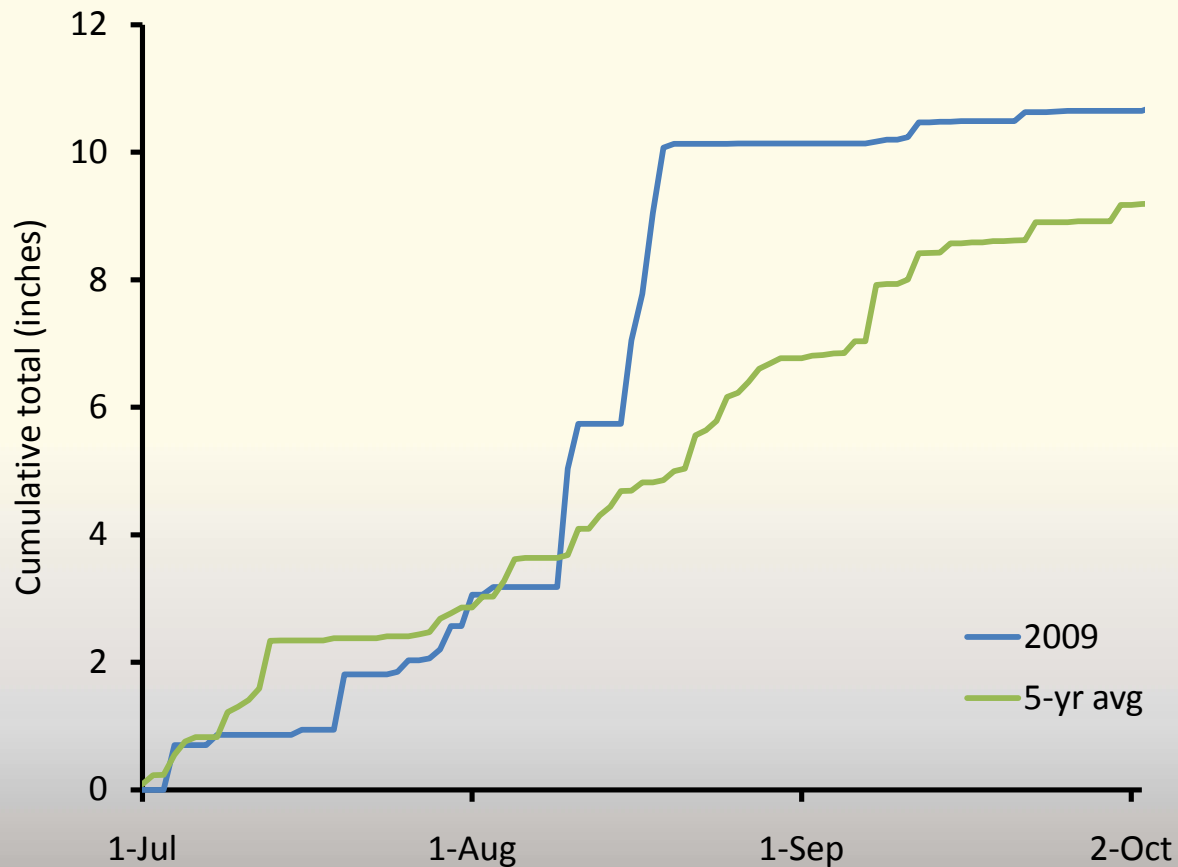
- Pond Creek silt loam, 0-1% slope
- Average rainfall ~33"
- Soil moisture monitored in:
  - Conventional tillage (CT) wheat
  - No-till (NT) wheat
  - Double crop (DC) sorghum
  - Double crop (DC) soybean
  - Double crop (DC) sunflower
- Double crops followed by summer crops in 2010

# Soil moisture measurements

- Weekly measurements with neutron probe
- Every 8", down to 6'
- Calibration incomplete
- Data are preliminary

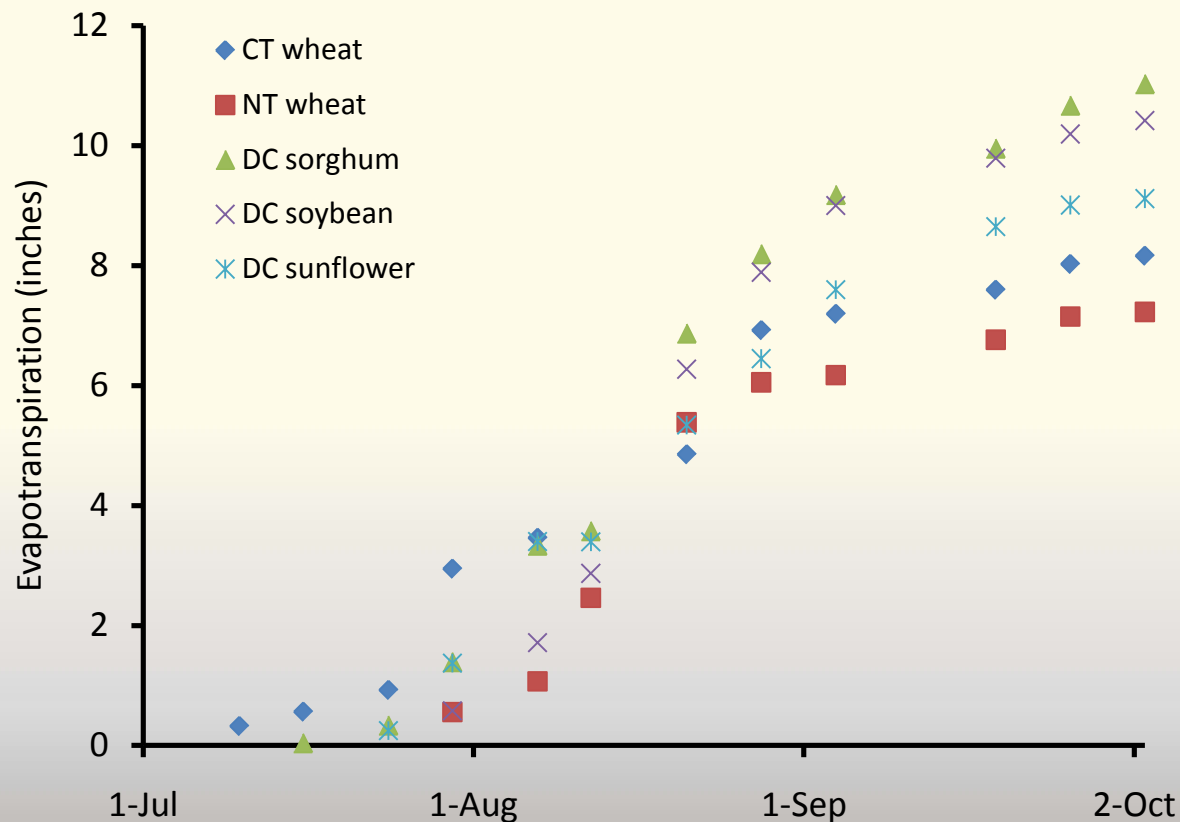


# Rainfall



The summer of 2009 rainfall (11") was higher than average (9").

# Evapotranspiration



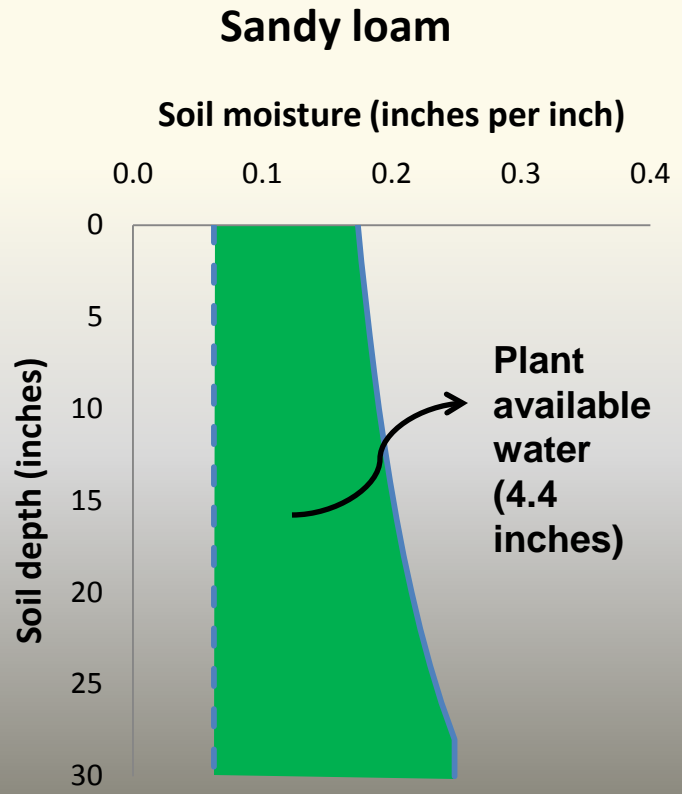
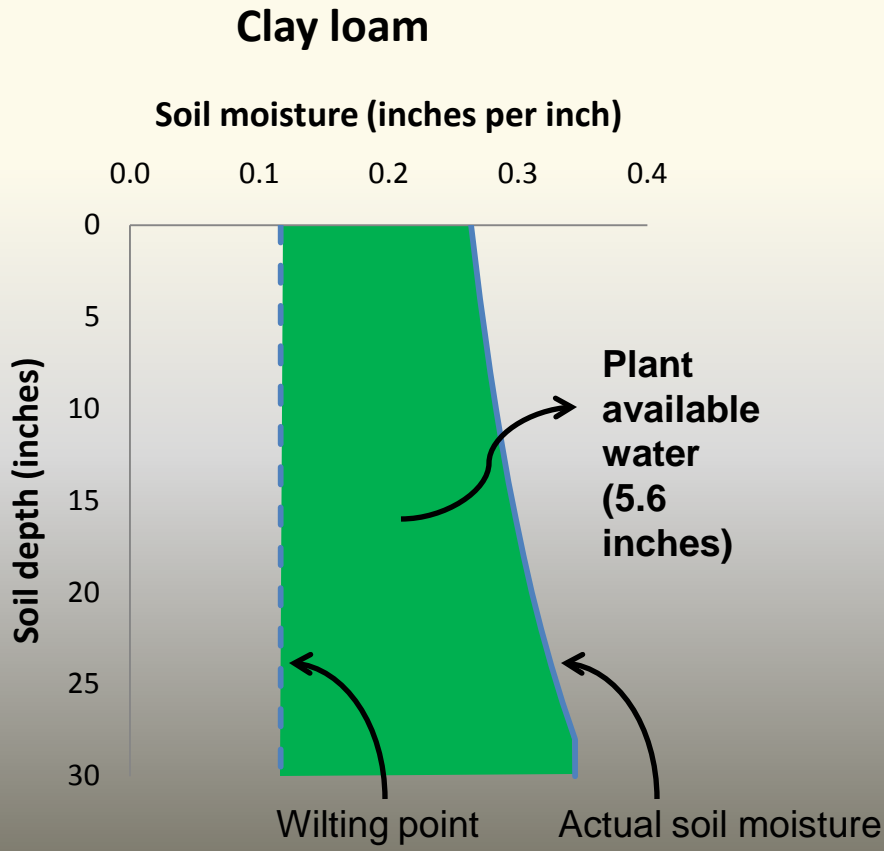
Sorghum and soybean double crops had ~2" more ET than sunflower.

No-till summer fallow had the lowest ET but still lost ~7" of water.

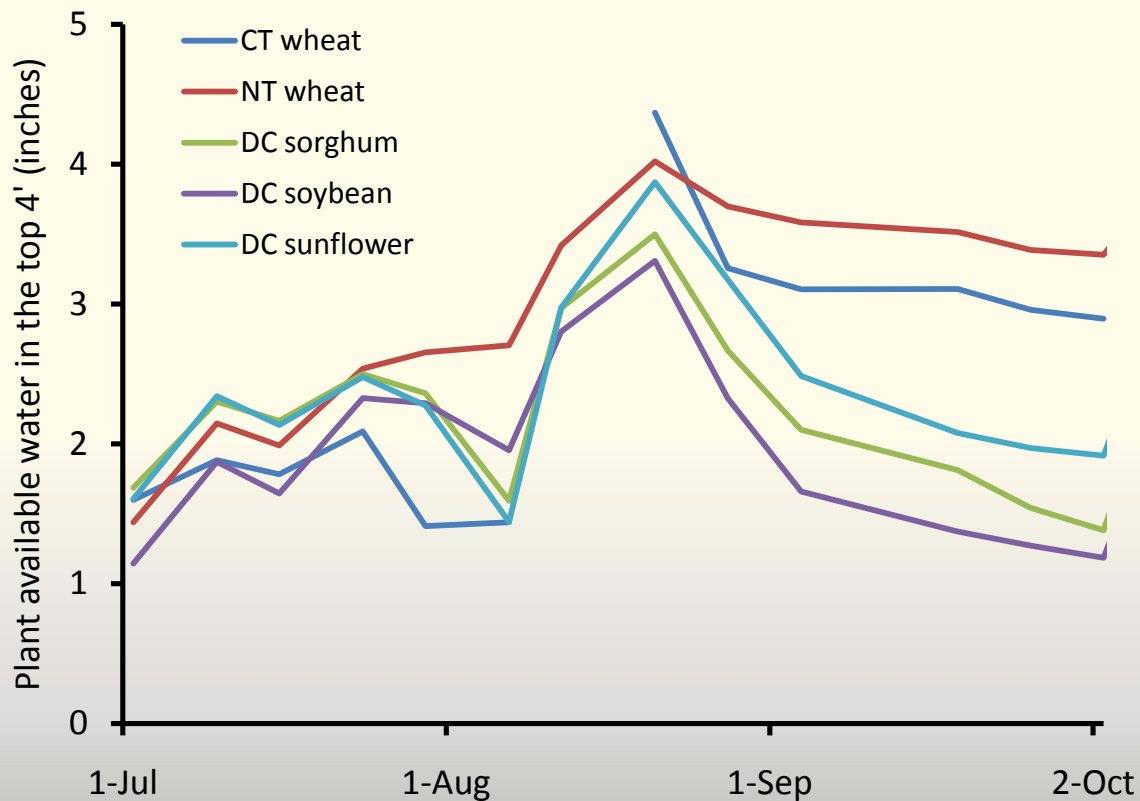


# Plant Available Water

- the amount of soil moisture which is available for plant uptake



# Plant available water

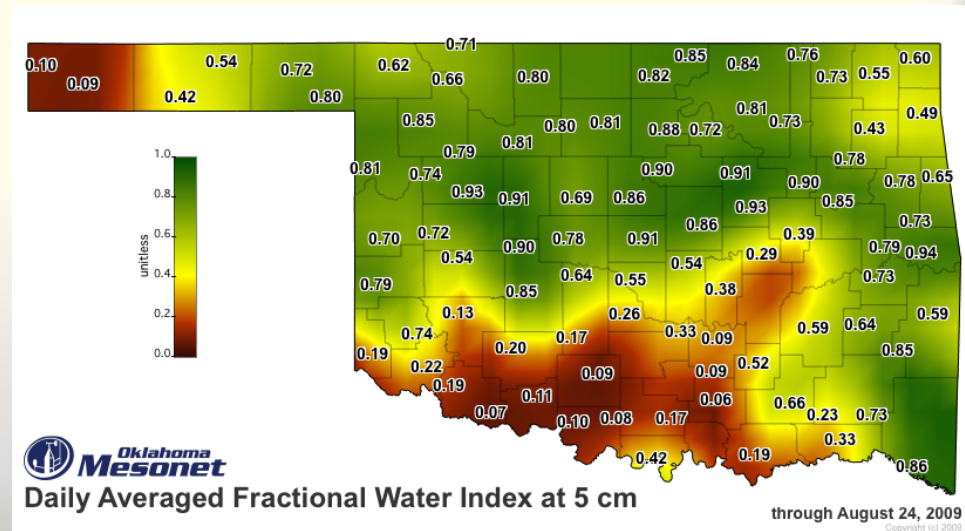


Available water in the soil was low at the start of the summer.

Summer fallow stored only 1.5" to 2" of the 11" rainfall (15-20%).

# Next steps

- Multiple years and locations
- Systems for monitoring plant available water
- Flexible, opportunistic, biologically-intensified agricultural systems



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