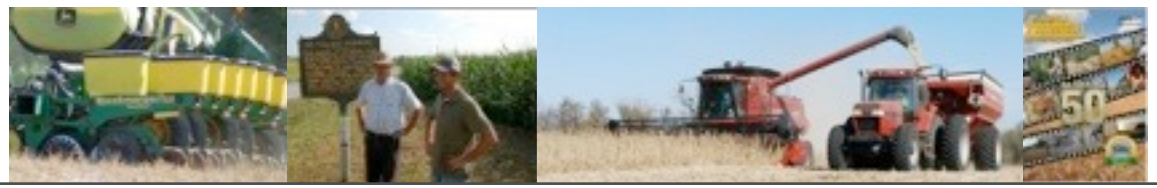
Preparing for the Uncertain Future: Advantages of No-Till in Extreme Weather

Jerry L. Hatfield

January 10, 2013



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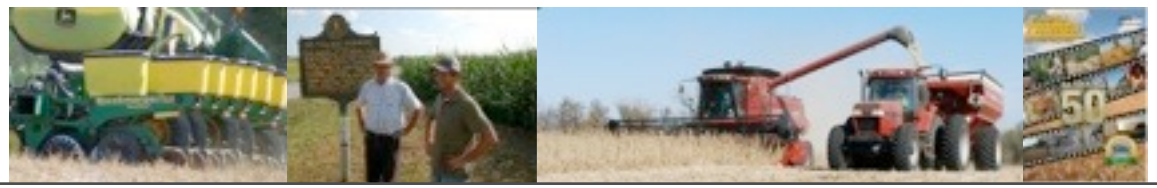
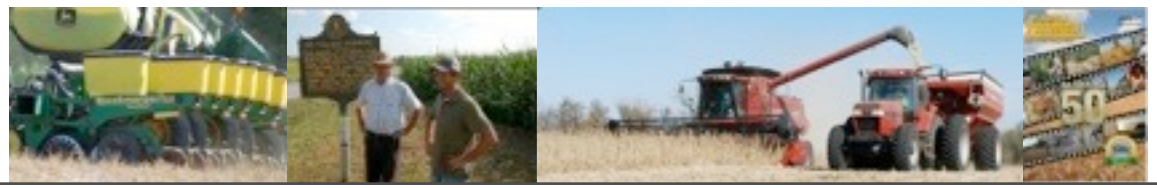


Uncertainty

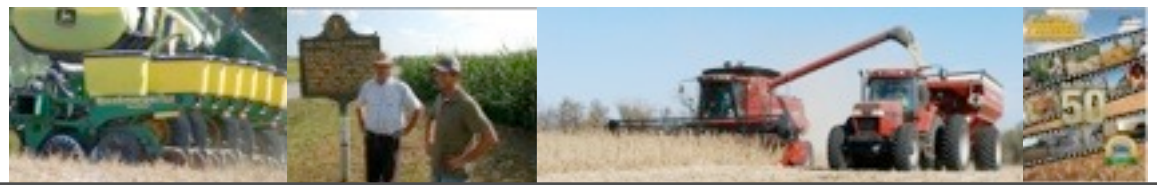
- If you don't plan to handle uncertainty in weather, are you making wise decisions or gambling?
- If you knew what the weather was going to be during the growing season, would you farm differently?
- Can you weather-proof your farming operation?
- What did the drought of 2012 teach us?



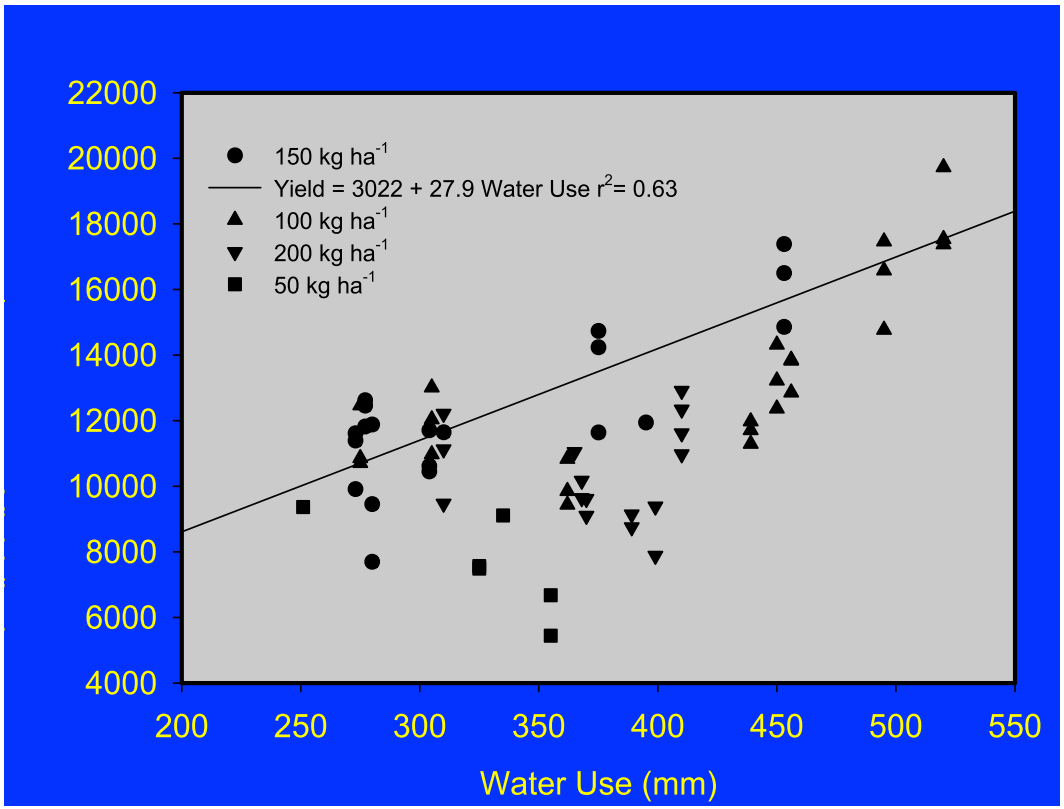
Crop Water Use

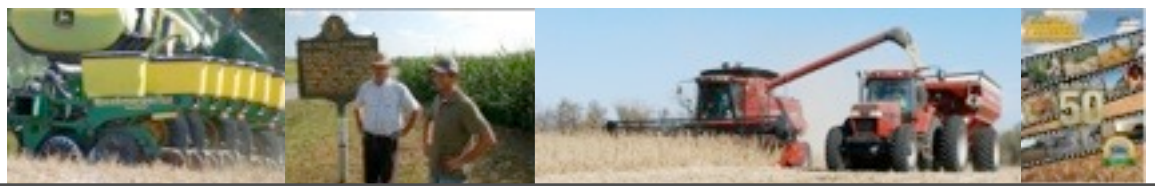
- Water use by a crop occurs in two forms:
  - Evaporation from the soil surface or leaves (dew)
  - Transpiration from the leaves via root uptake
- Total water use is referred to as evapotranspiration (E + T)

- Crop productivity is a direct function of the total amount of water transpired by the crop

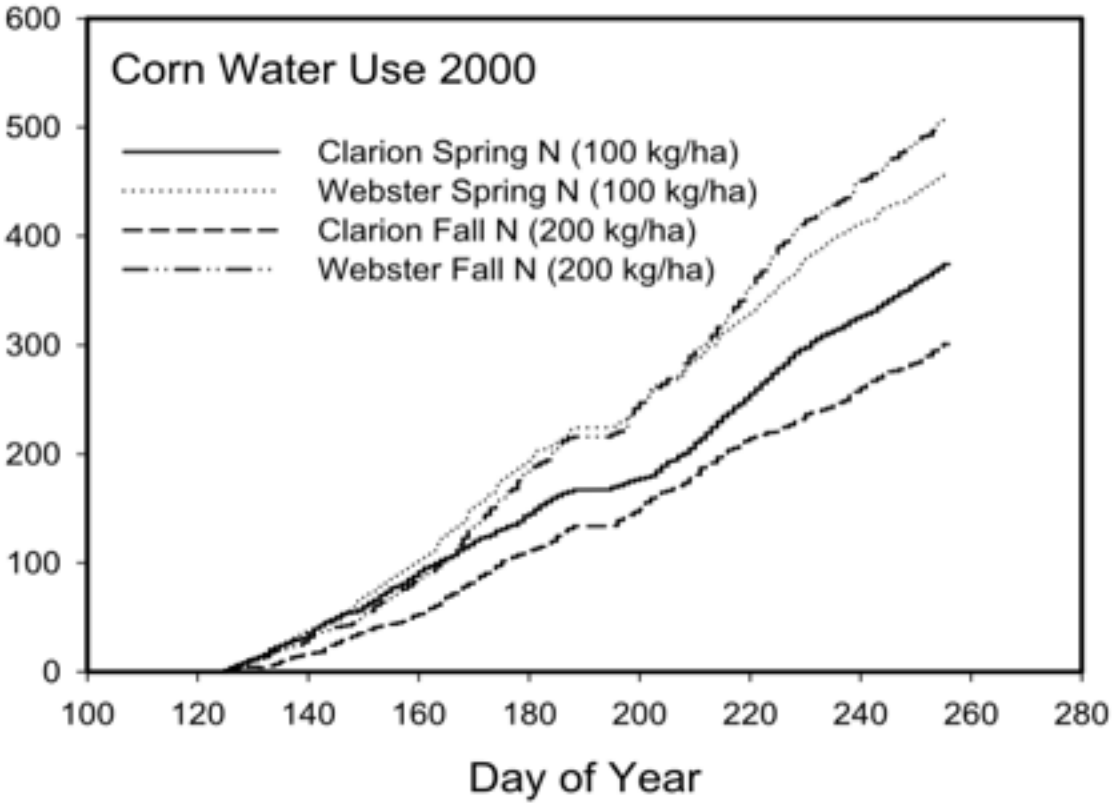


Water Use Efficiency

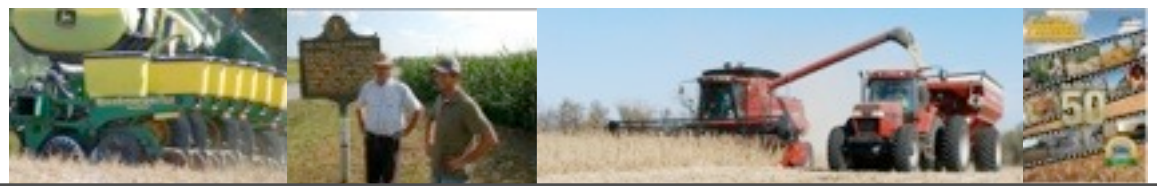




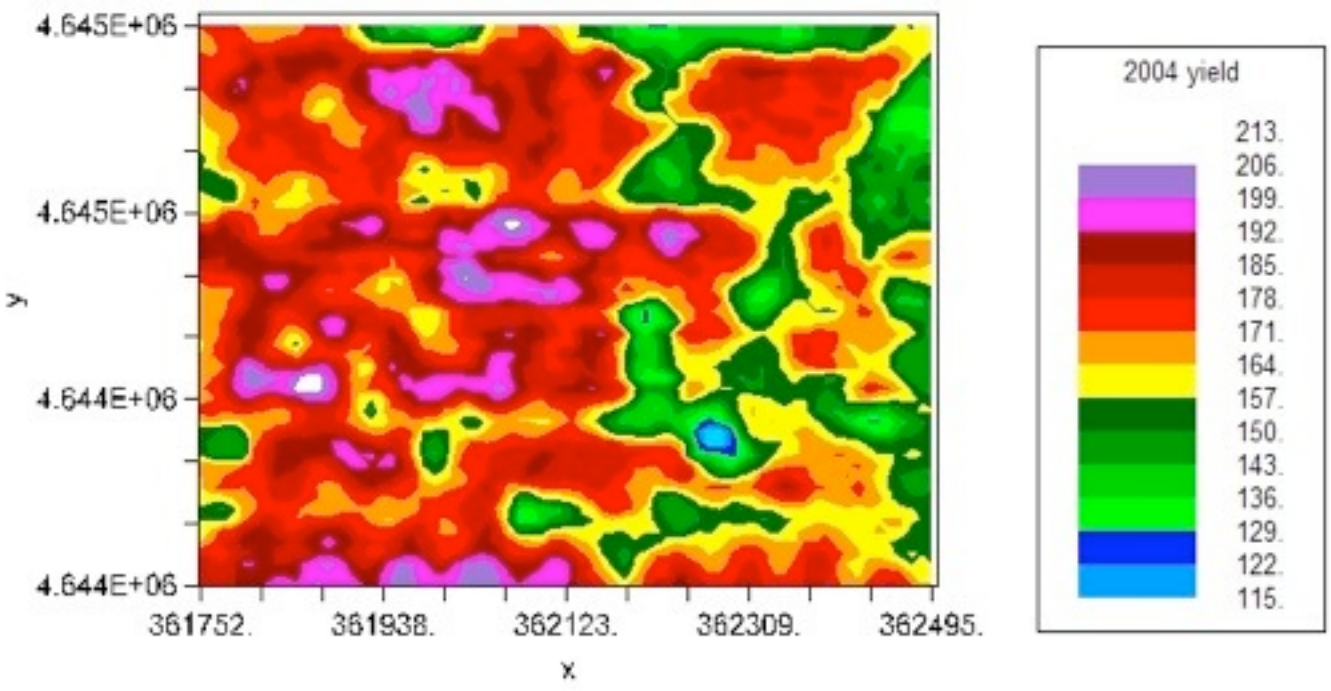
Crop Water Use

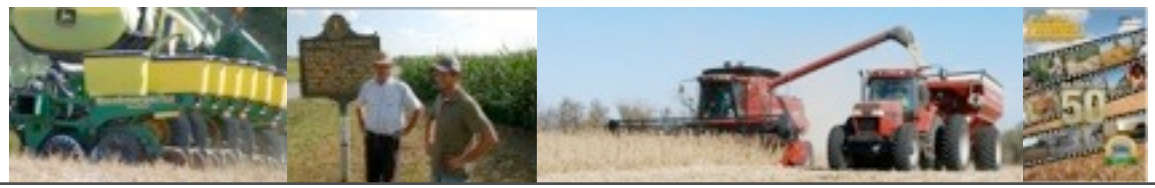


Two-fold difference in water use between two soils in the same field



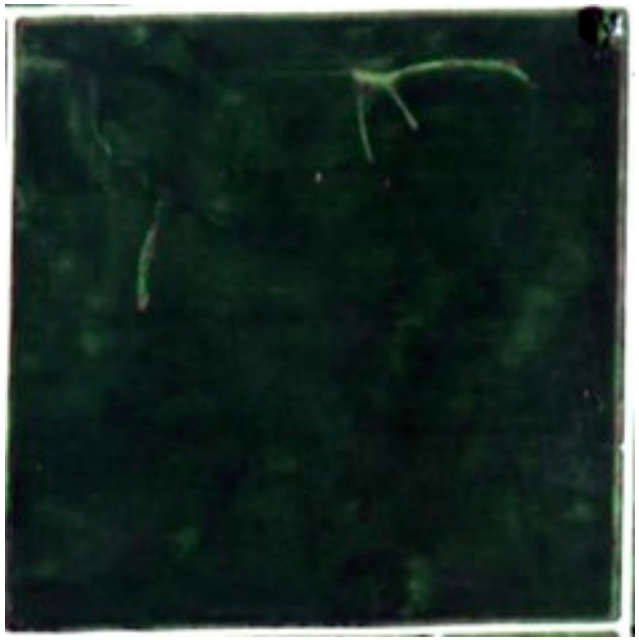
Crop Yield Variation





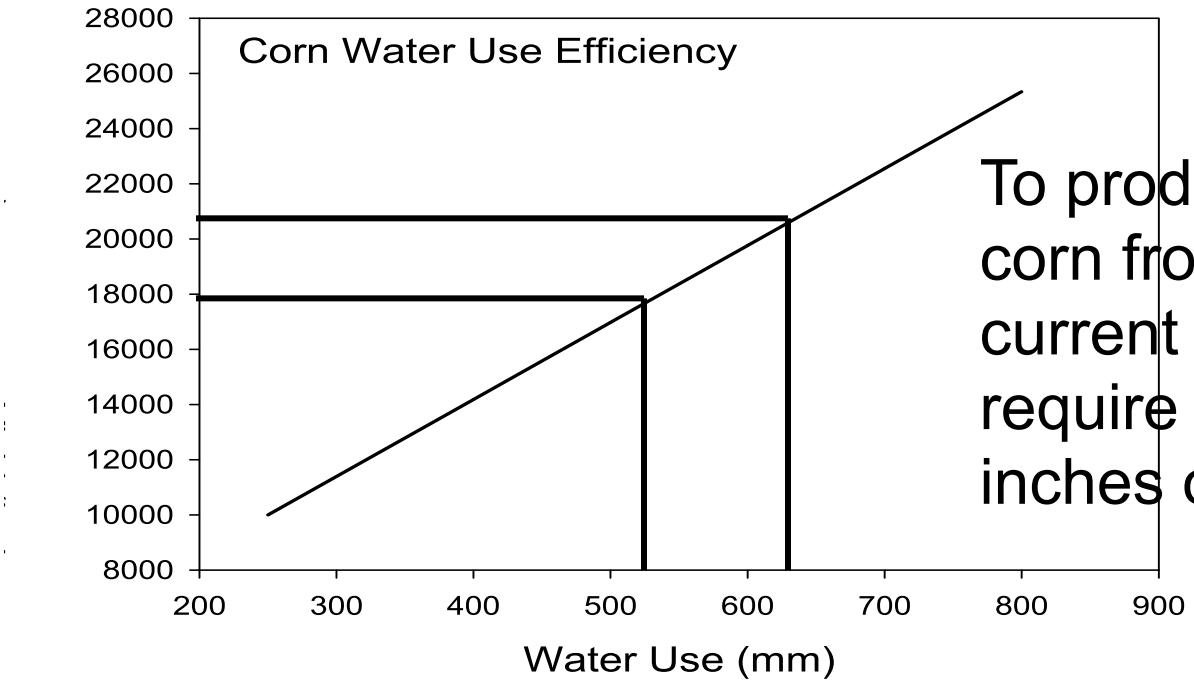
Crop Yields Depend upon

Early August



Late August

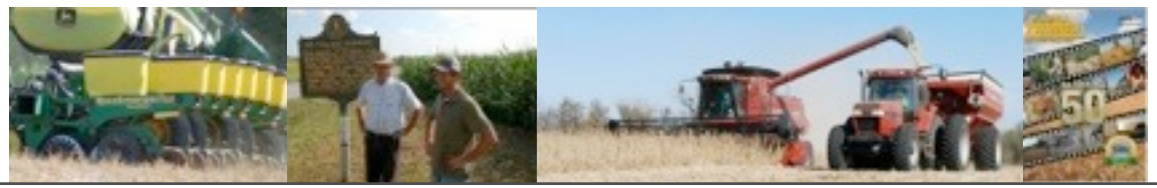
Crop Water Use Efficiency



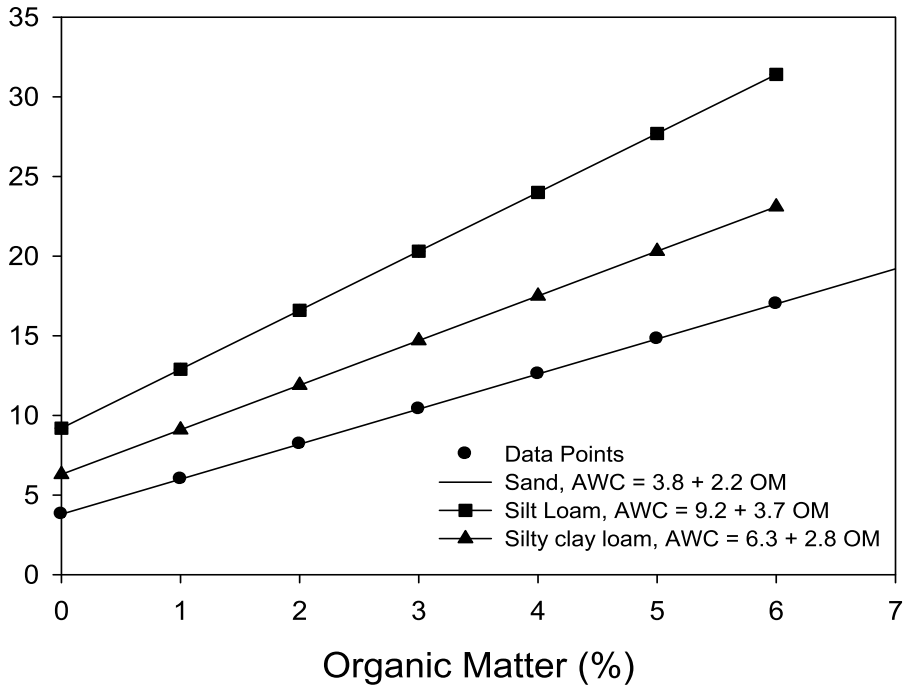
To produce 300 bu corn from our current systems will require 5 more inches of T

Questions

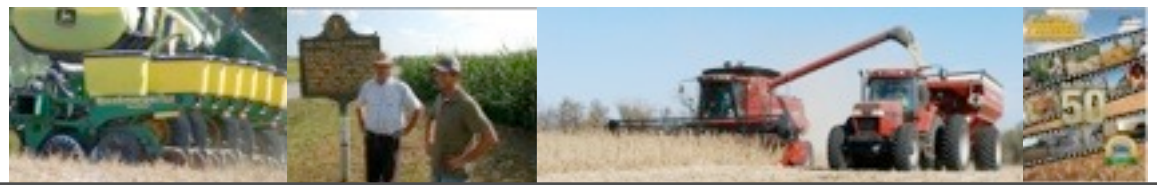
- With rainfall becoming more uncertain, how can we manage soil water?
- Can we enhance water use efficiency?



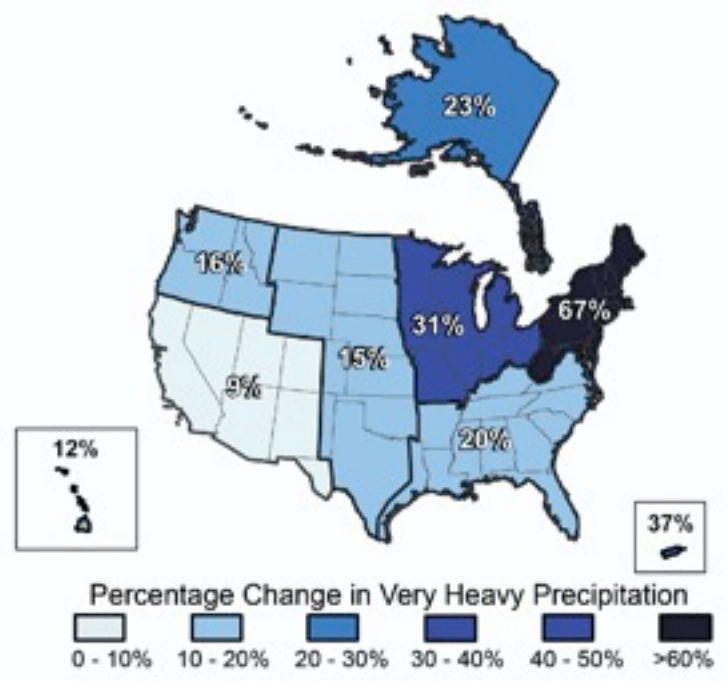
Soil Organic Matter Is Key



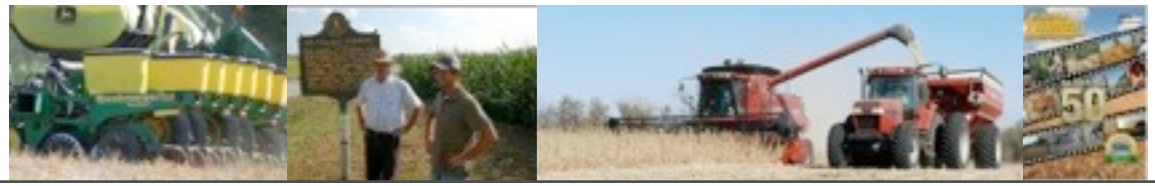
Hudson, 1994



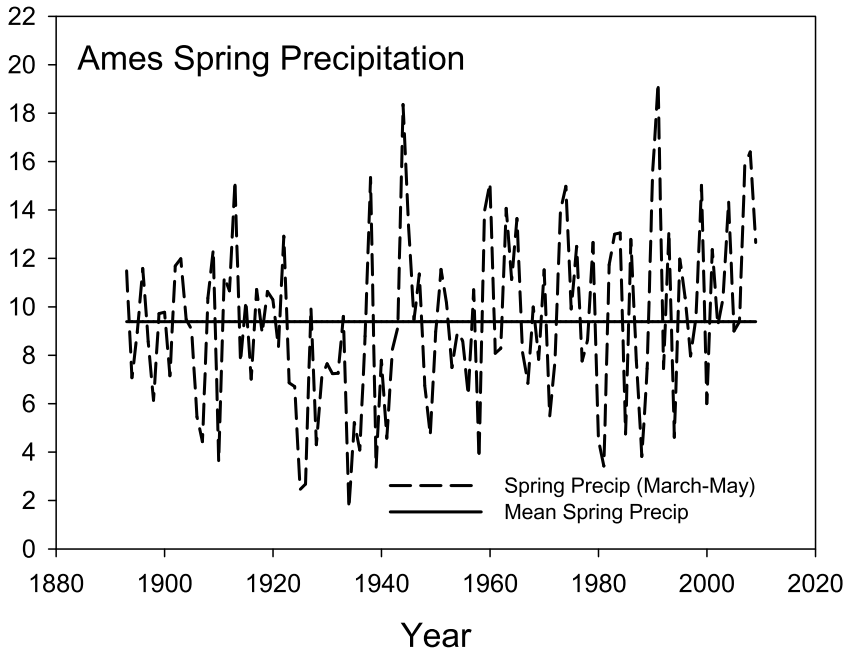
Changes in Precipitation



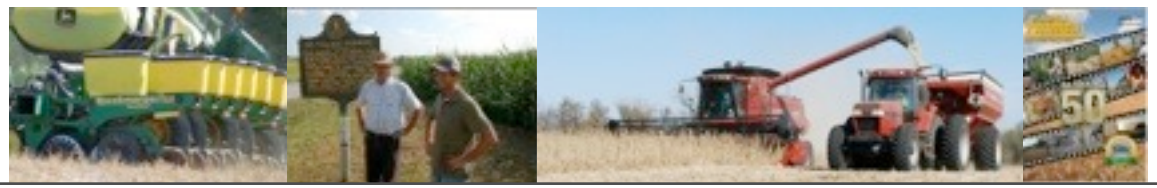
We have already begun to see increases in spring precipitation across the Midwest



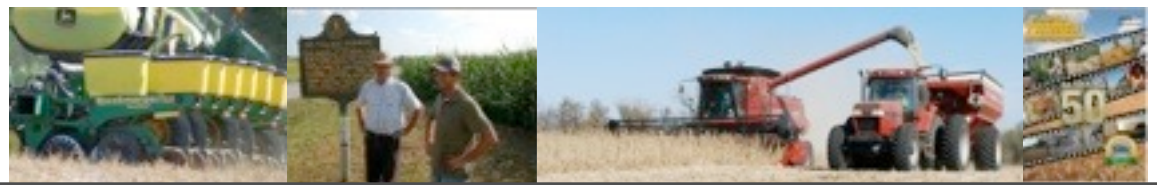
Spring Precipitation (Ames)

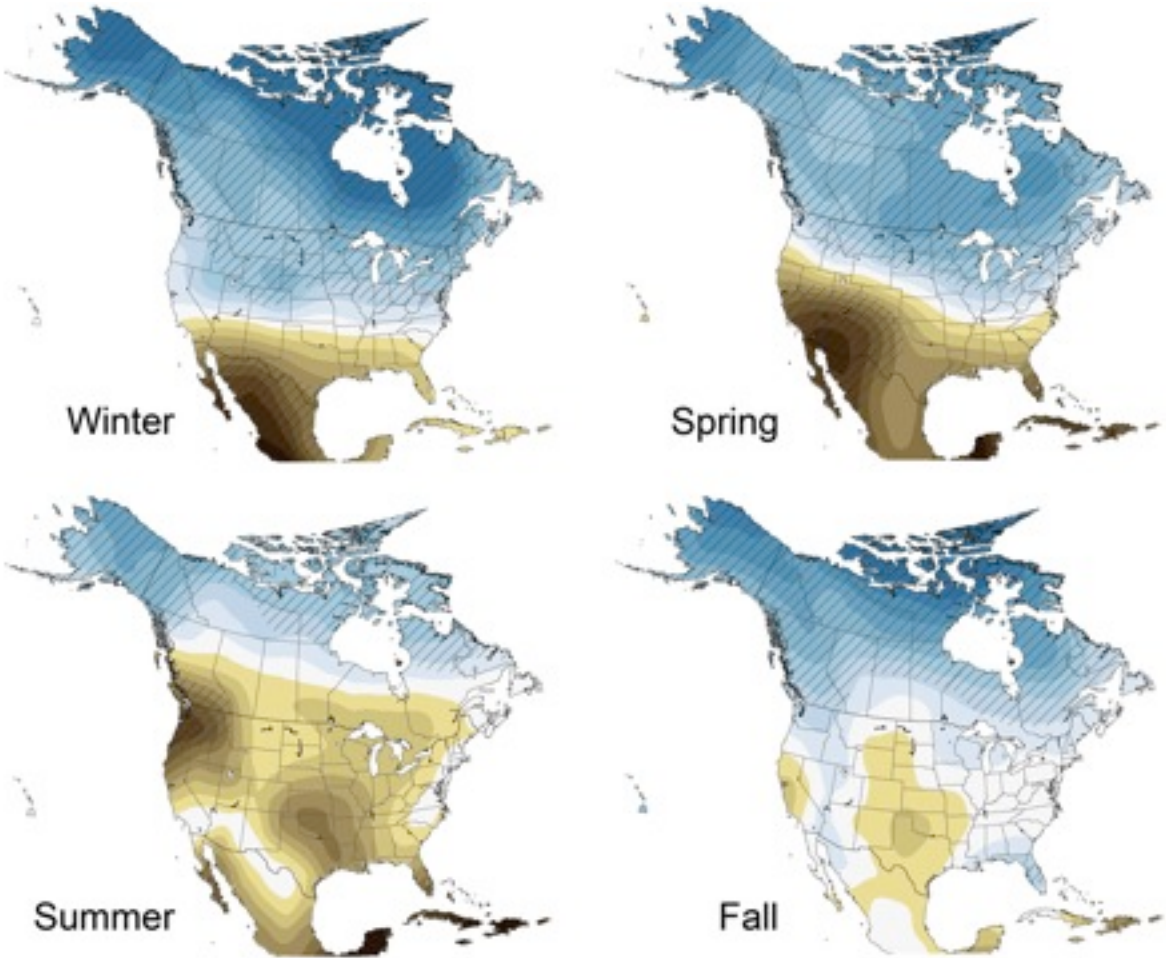


The increase in spring precipitation has decreased the number of workable field days in April through mid-May across Iowa by 3.5 in 1995 to 2010 compared to 1979-1994

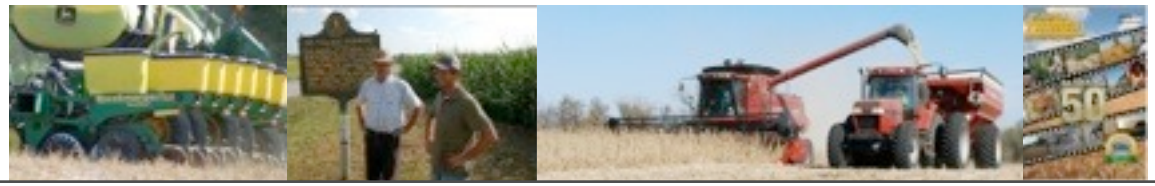


Changes in Large Precip Events

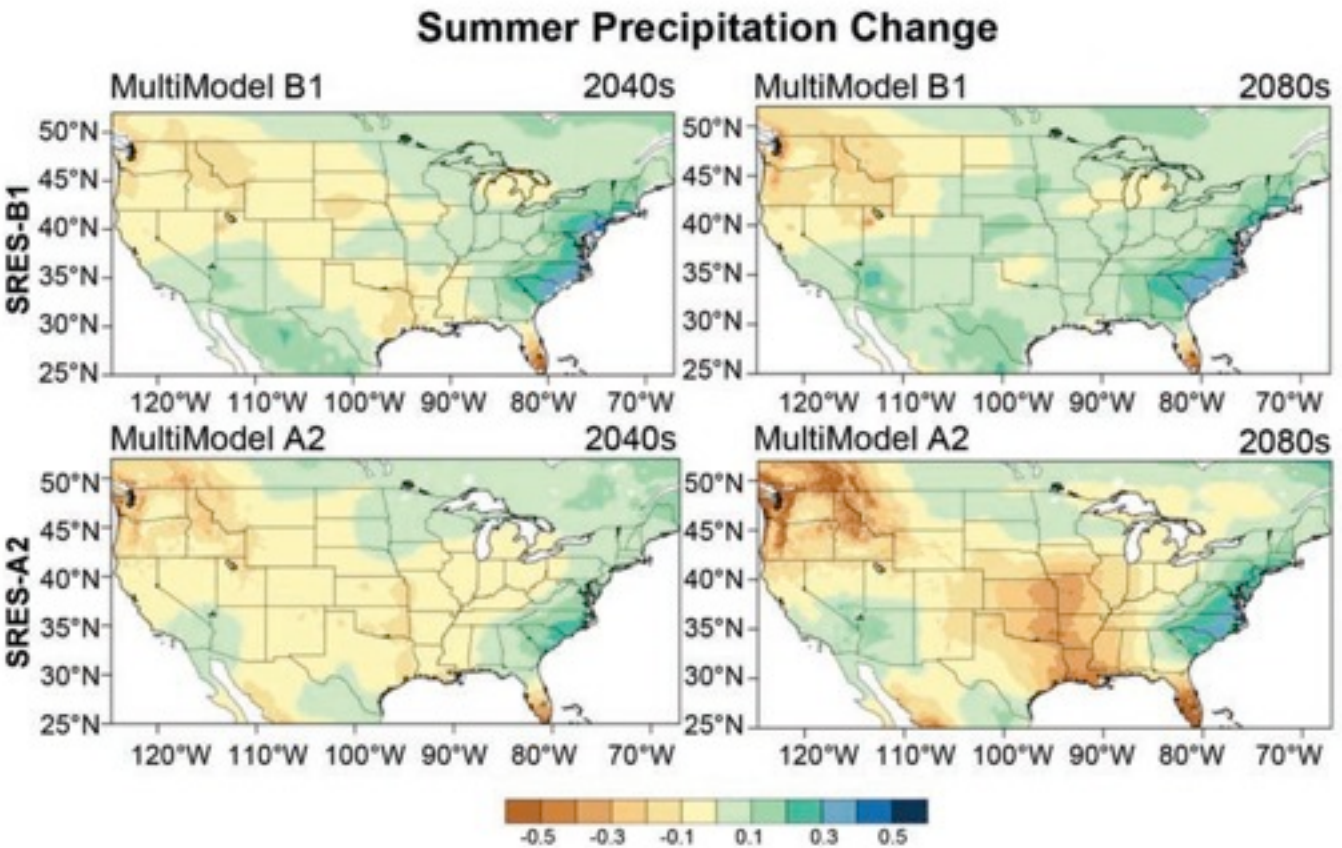


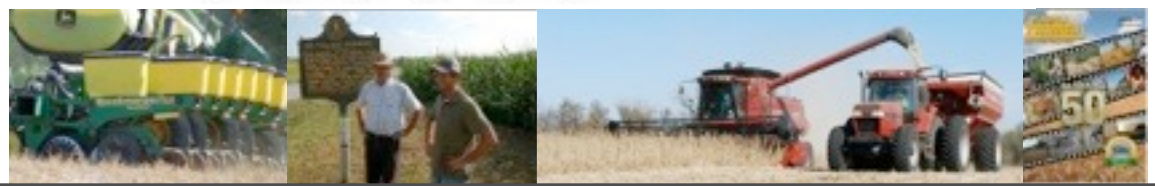


Projected changes in precipitation by 2080-2090



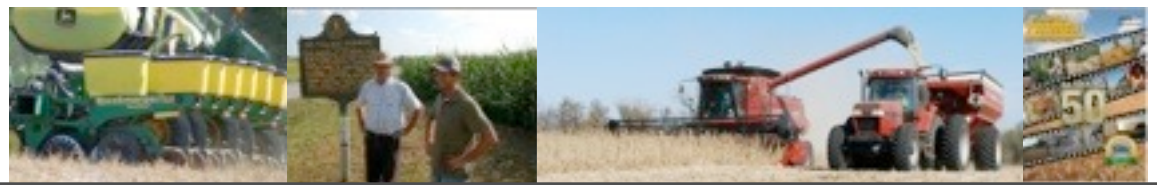
Summer Precipitation





Observations

- Precipitation events are becoming less frequent and more intense
- Shifts in precipitation toward more spring compared to summer precipitation
- Projections are for more shifts from summer precipitation

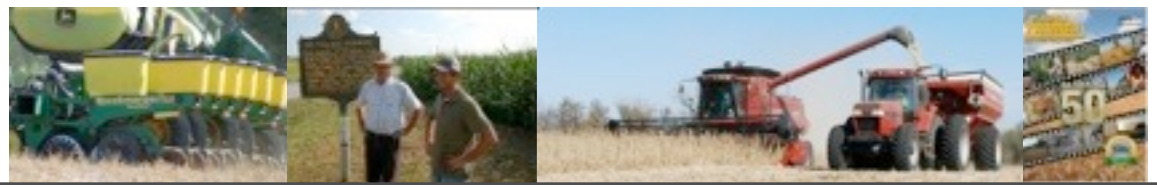


Soil Erosion

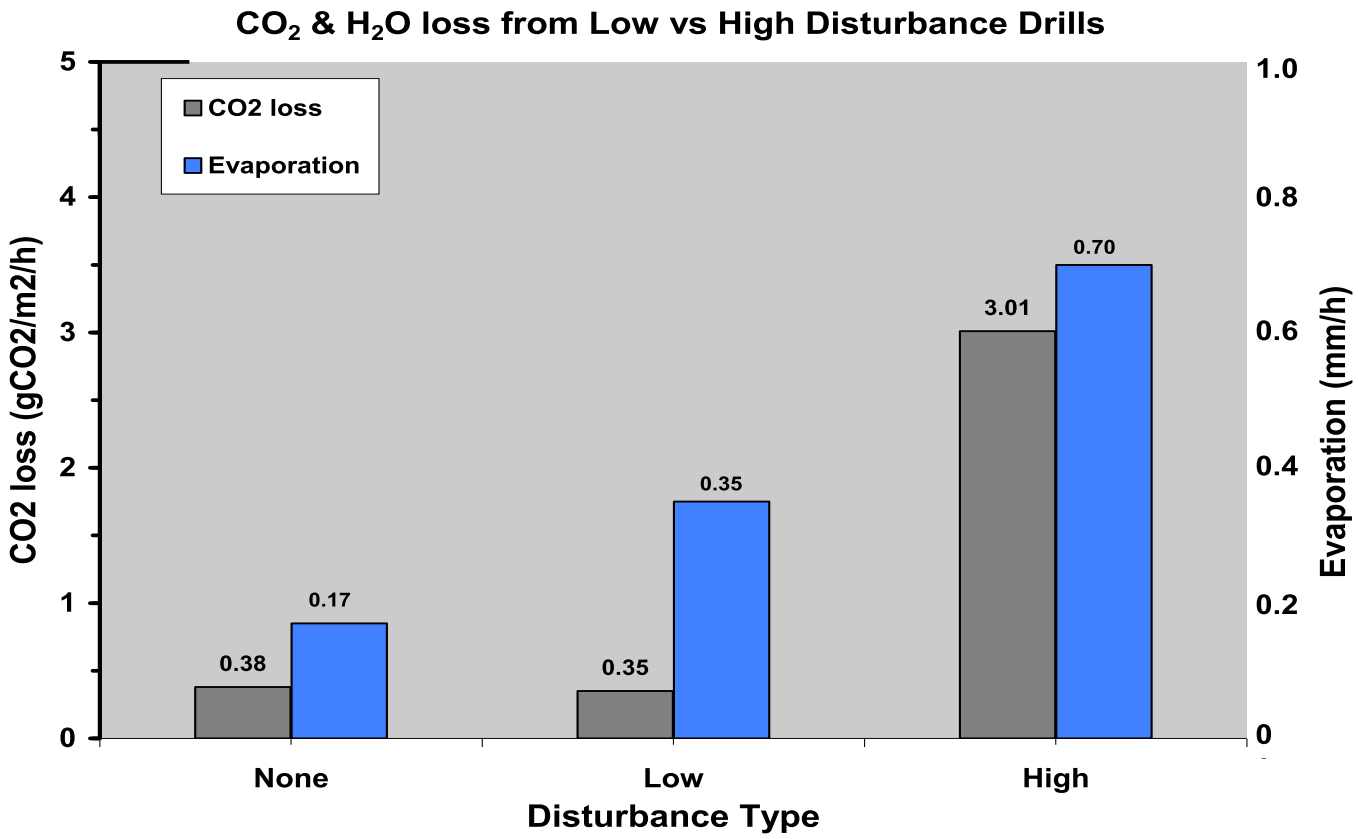
Degrading the soil resource decreases the water holding capacity and infiltration rate

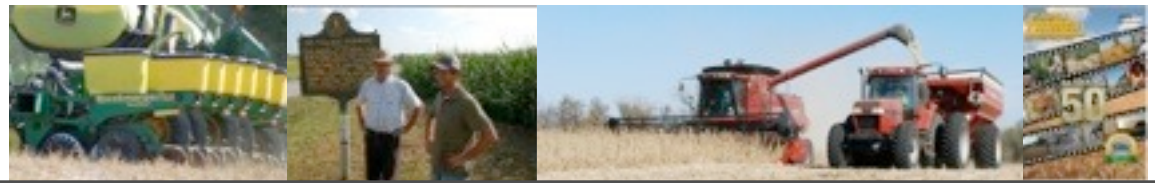
Tillage

- Increases the soil water evaporation rate
- Each tillage operation in the spring uses 0.5 inch of water from the soil

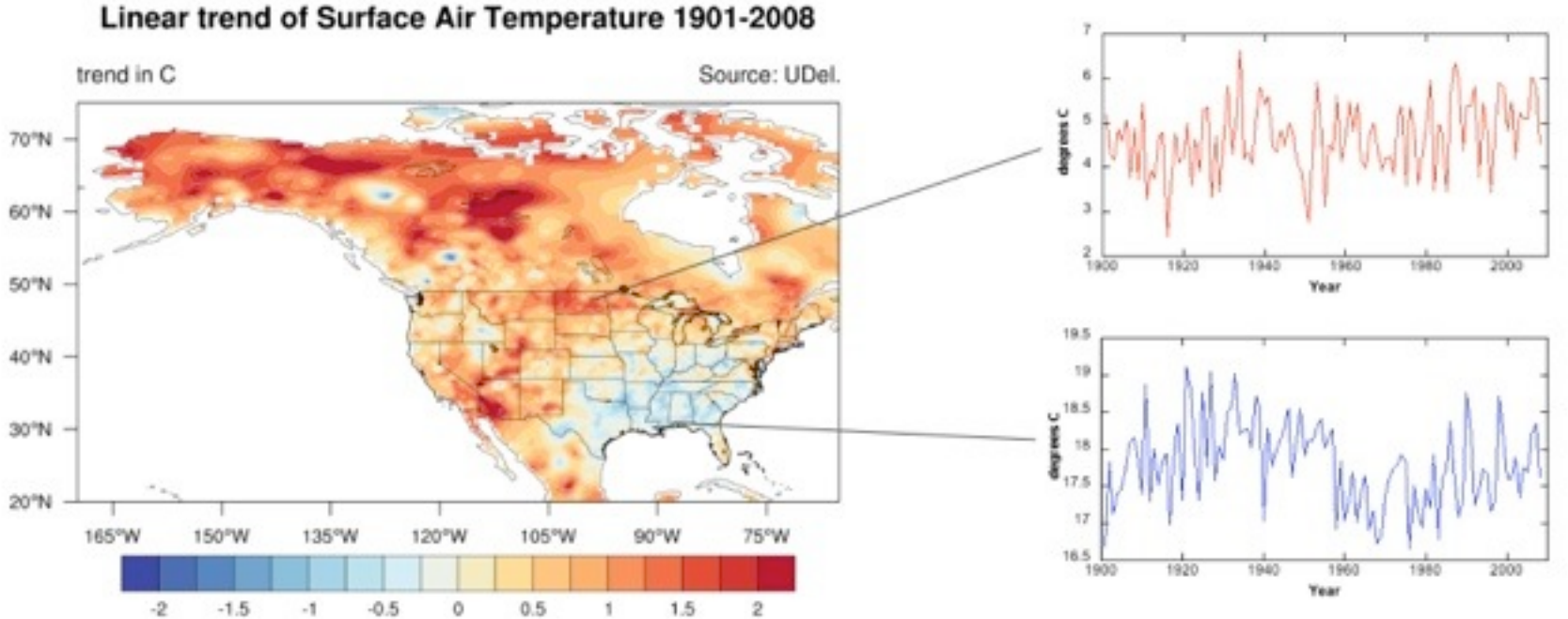


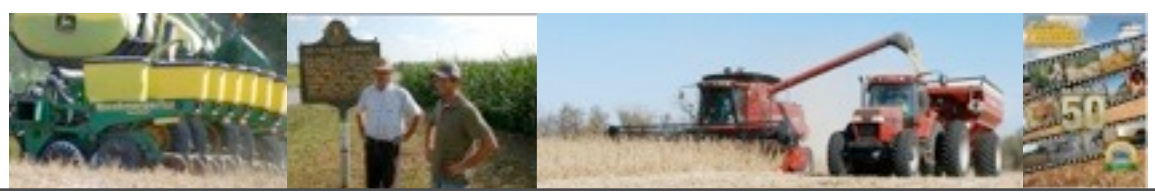
Intense Tillage



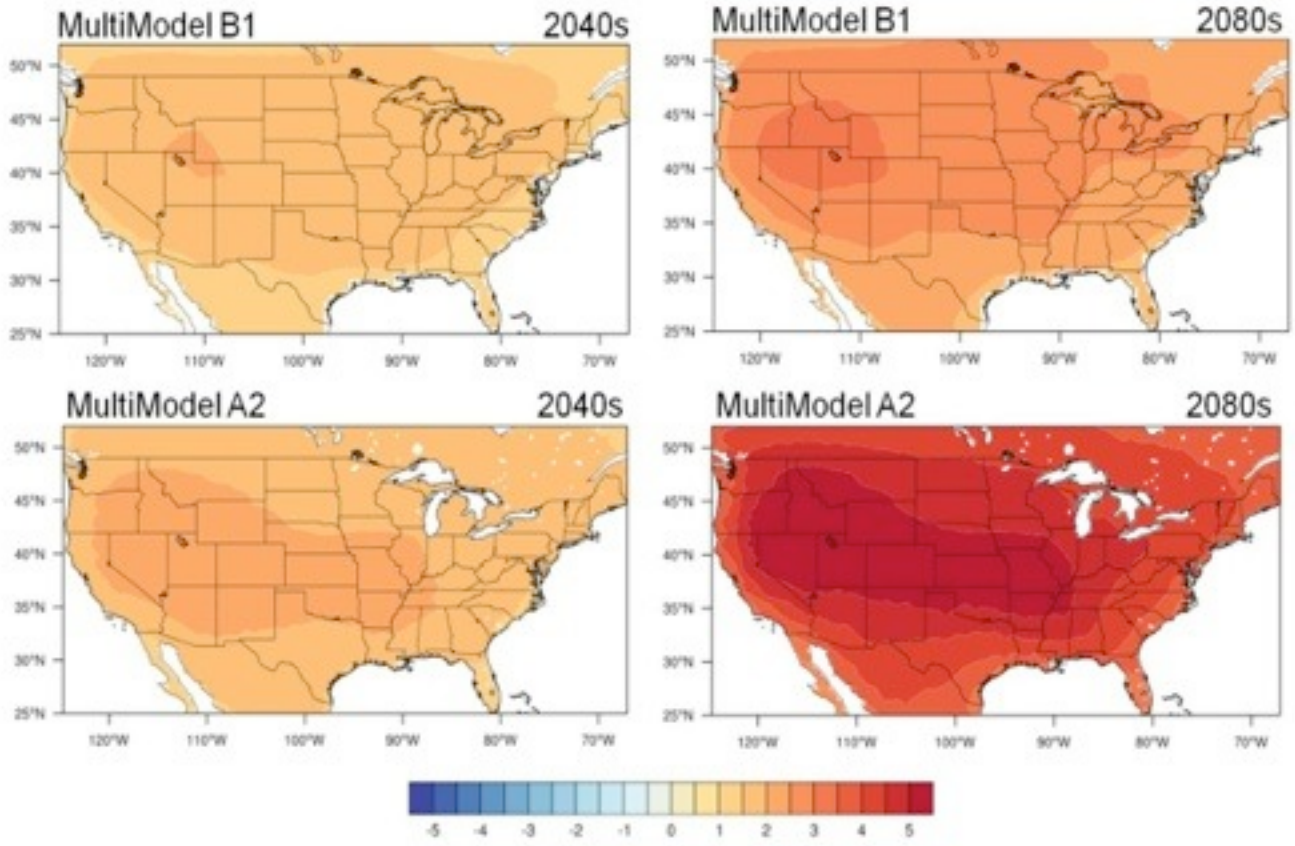


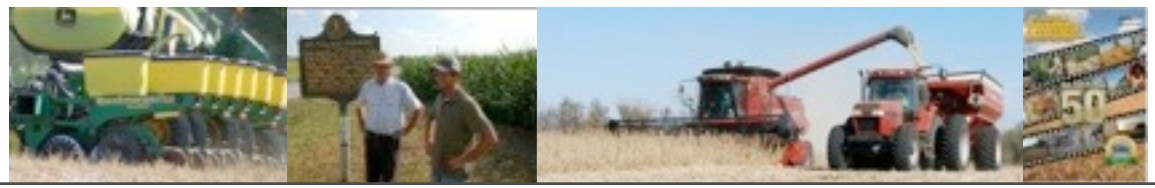
Temperature Changes 20th Century



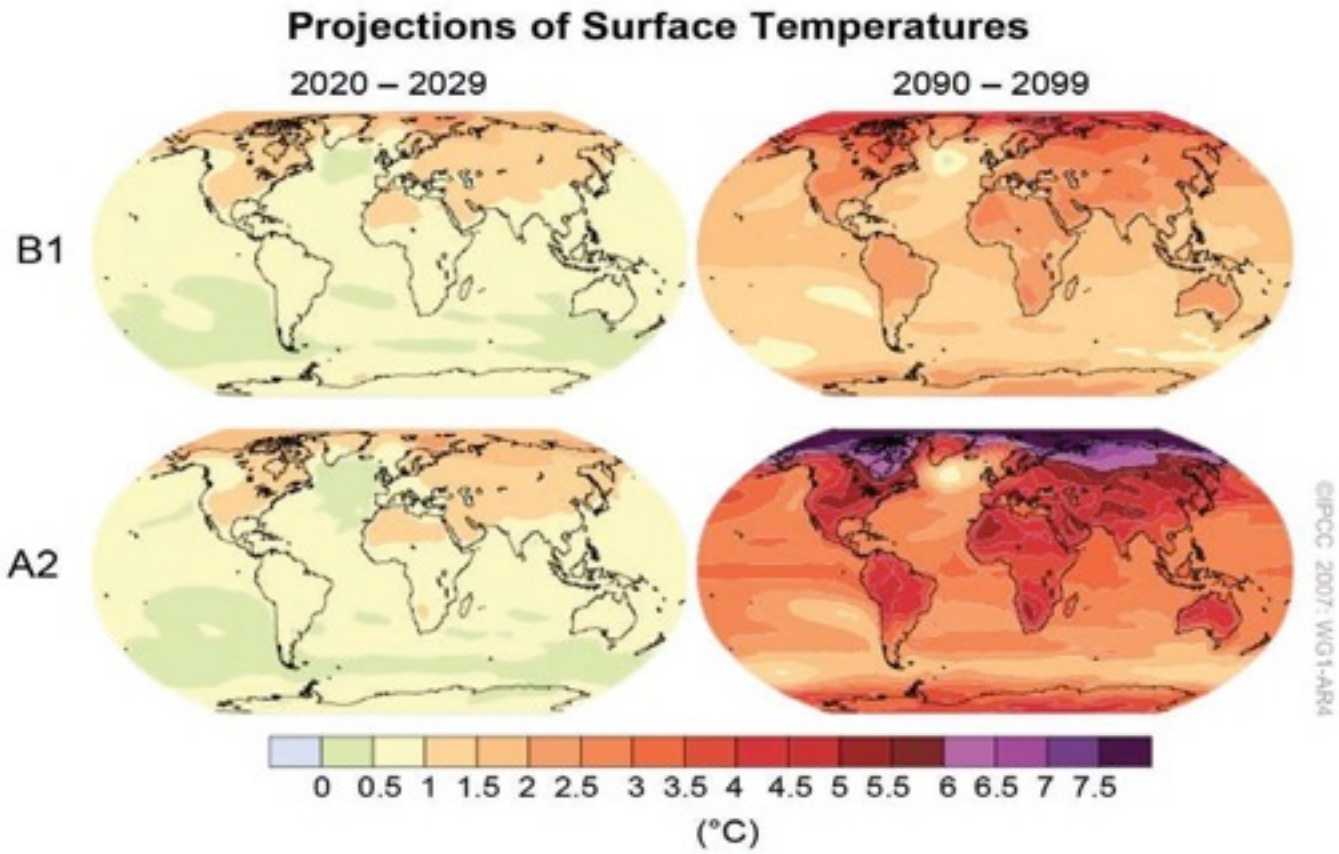


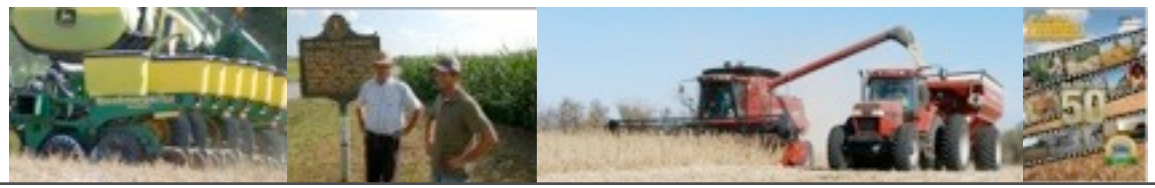
Summer Temperature Change





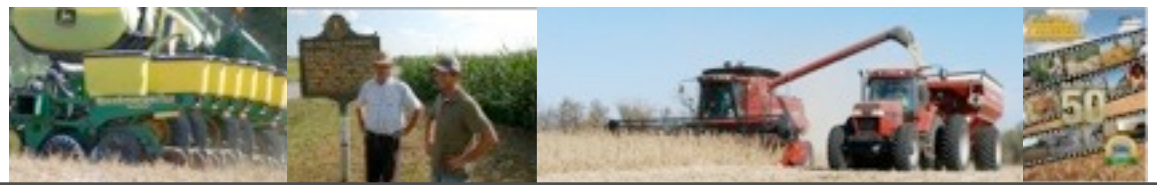
Changing Temperature





Increasing Temperature

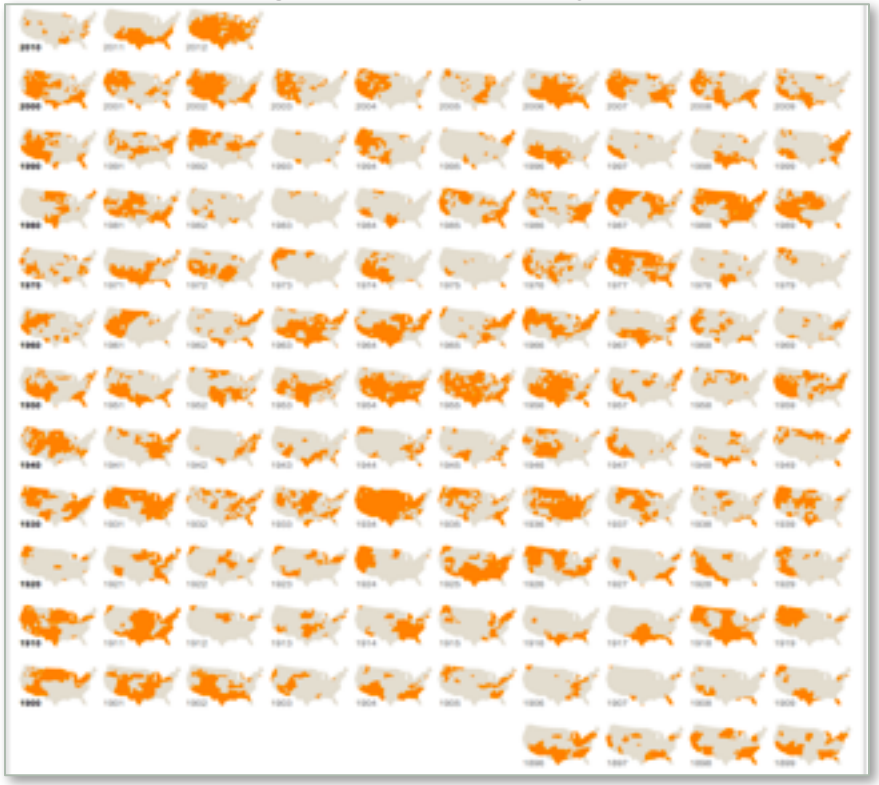
- Increases the crop water demand because ET is a function of vapor pressure deficit
- Crops will undergo water stress more quickly in soils with limited water holding capacity



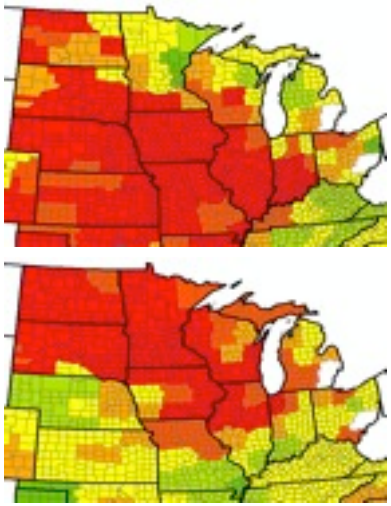
Summer 2012

Palmer Z score – an indicator of short term drought used by NOAA to track soil moisture

Drought index across years

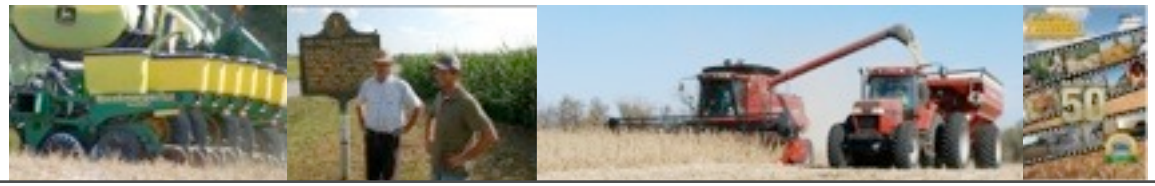


2012 vs. 1988

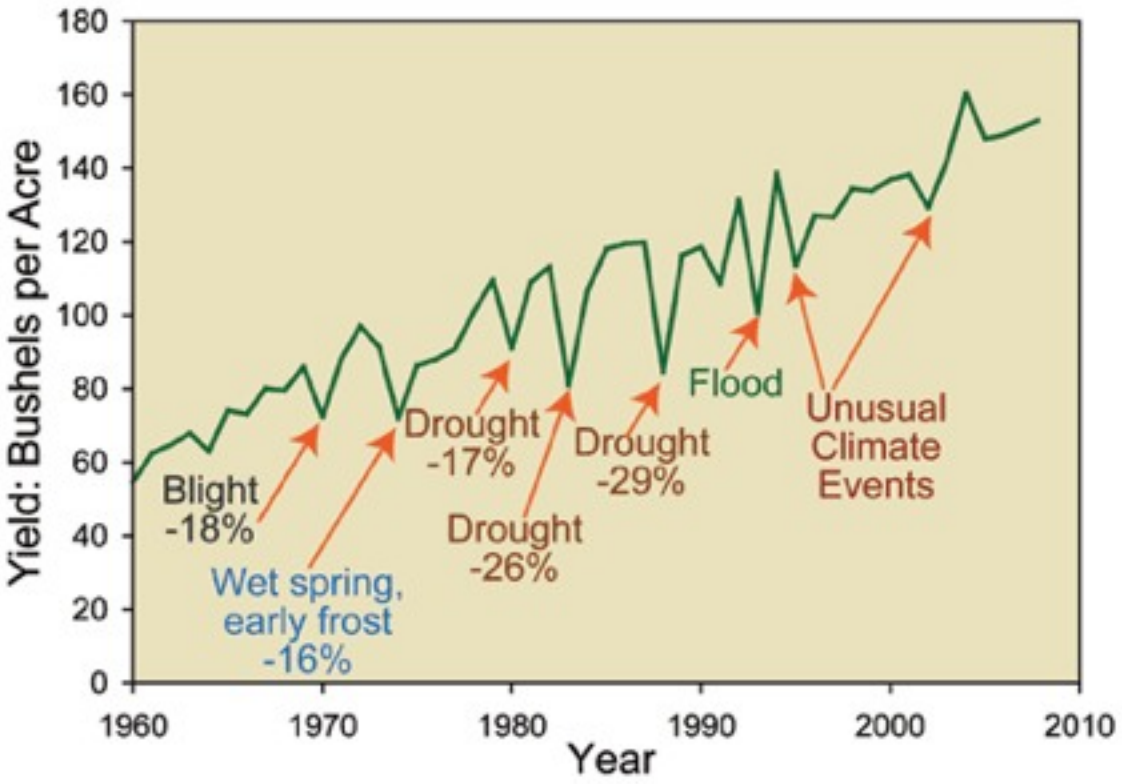


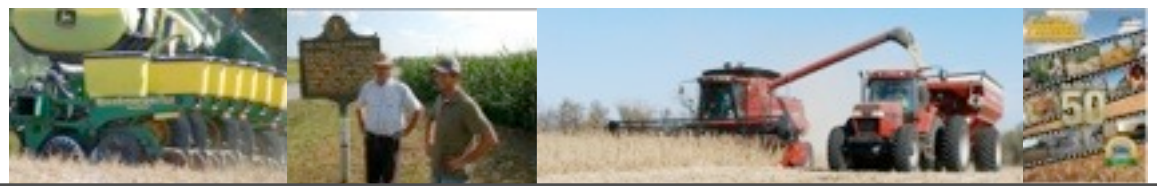
NOAA Palmer Z Index

- Extreme Drought (≤ -2.75)
- Severe Drought (-2.00 to -2.74)
- Moderate Drought (-1.25 to -1.99)
- Mid-Range (-1.24 to 0.99)
- Moderately Moist (+1.00 to +2.49)
- Very Moist (+2.50 to +3.49)
- Extremely Moist (≥ +3.50)



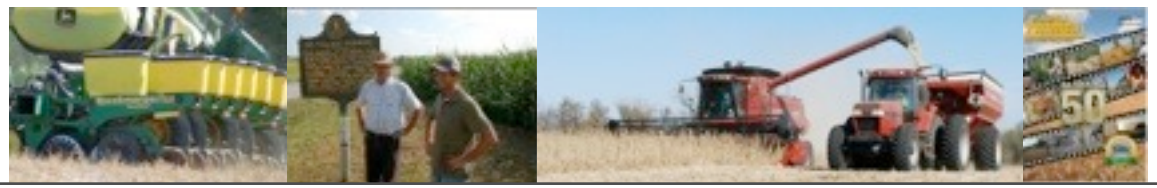
US Corn Yields





Crop Yields 2012

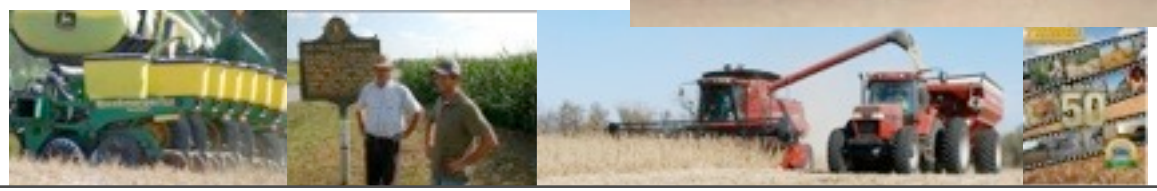
- Better than expected in many places
- Difference was due to soil water availability (good soils vs poor soils)
- Timing was everything, small events helped



Benefits of No-Till

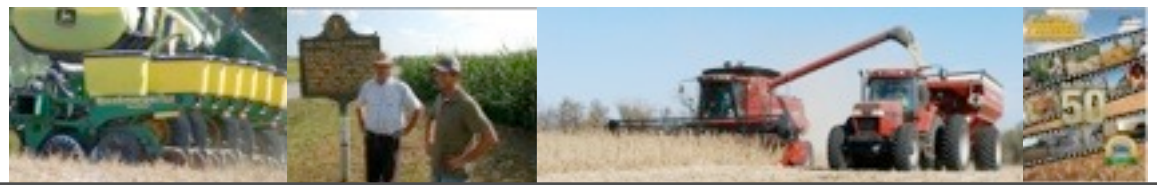
Virtually all the benefits of no till come from the continuous "protective blanket" of crop residue or biomass.

and not from the lack of soil disturbance by tillage.



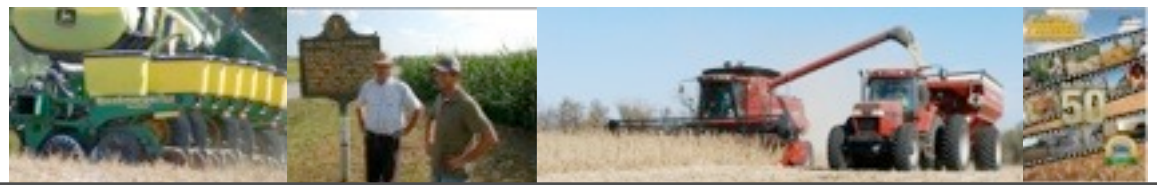
Crop Residue Cover

- Decreases soil water evaporation rate
- Increases the effectiveness of small precipitation events
- Decreases the temperature and soil water extremes to allow both roots and soil biology to function more efficiently



How does No-Till Enhance Water Use Efficiency?

- Short-term
  - Increase and maintain infiltration rates
  - Decrease soil water evaporation rates
- Long-term
  - Increase soil organic matter leading to soil water holding capacity
  - Improved soil environment



Implications

- Increasing variability in precipitation will require we manage the soil to increase water availability to the crop
- Positive effects of no-till are evident in both the short-term and long-term