

Drought induced nitrogen and phosphorus carryover credits in corn/soybean rotations in the Upper Mississippi River Basin

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Drought Effects:

- Reduced crop yields
- Reduced nutrient removal/
uptake
- Decreased leaching & runoff
- Potential carryover N & P
Credit



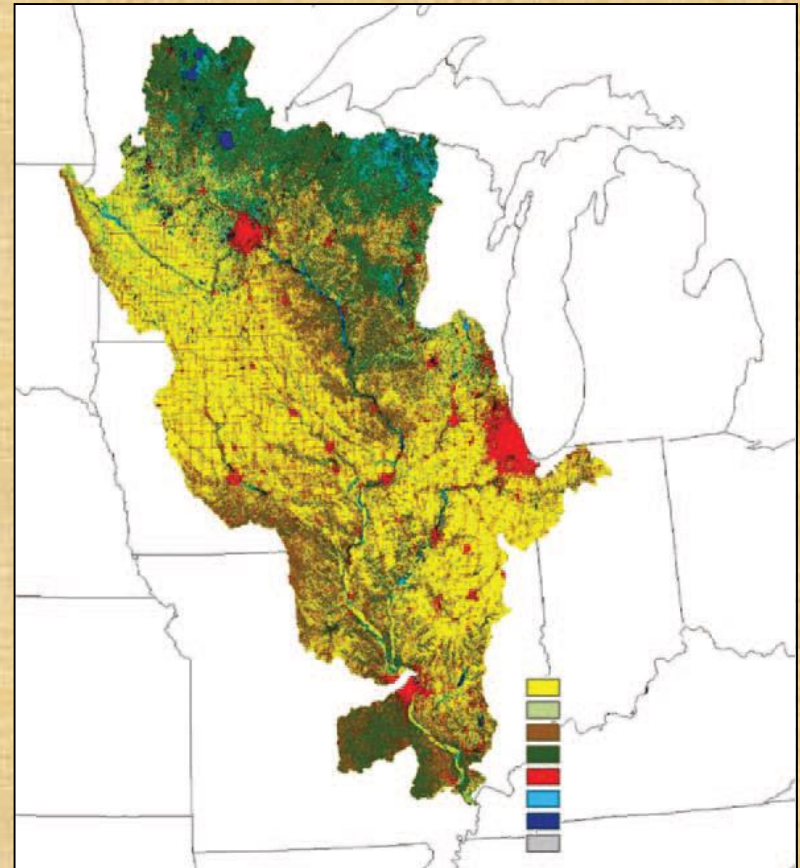
Farmers face many important nutrient management decisions:

- How much of the initially applied N & P is in the soil?
- Is the residual N & P available to the next crop?
- What can I do to prevent loss of the residual N & P
- By how much can I adjust my fertilizer rate
for the next crop

Applied the **APEX Model** to assess potential drought induced N & P carryover Credits on 3,703 farm fields within the Upper Mississippi (UMRB)

UMRB States: Illinois, Iowa, Minnesota, Missouri, Wisconsin, Indiana, Michigan, South Dakota

The river basin measures 4.76 million sq.km, covering about 40% of the US
<http://www.nwrc.usgs.gov/sandt/Misisipi.pdf>



Corn/soybean/wheat croplands.
Source: USDA NRCS (2010).

APEX Model Simulations

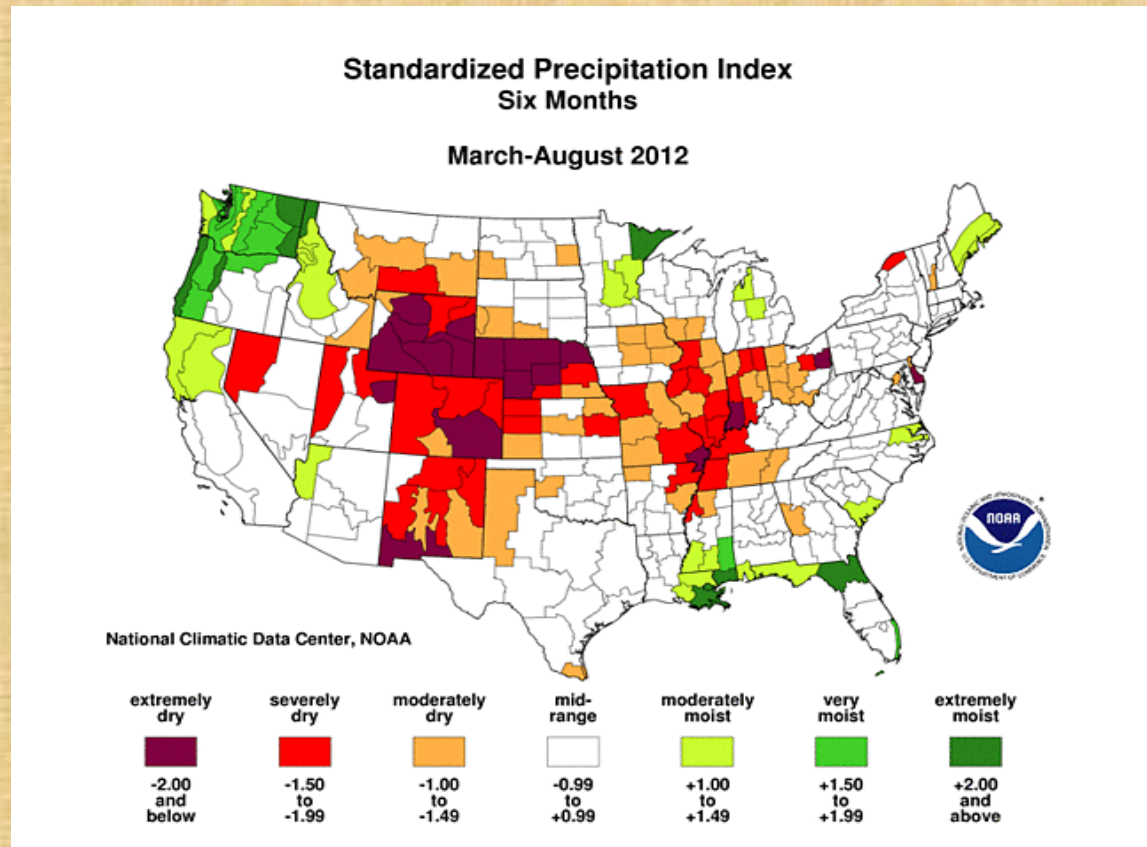
Baseline Management Simulations

- Simulations were based on actual farmer management practices from the 2003 to 2006 CEAP survey results.
- A total of **3,703** farm fields participated
- Each farm was associated with Natural Resources Inventory (NRI) sampling points - distinct management practices
- NRI points have statistical acreage weights whose sum equals the total cultivated area
- Each NRI point was simulated over a 47-yr timescale: 1960 – 2006.

277,177 simulations were conducted for the whole Basin for all crops cultivated

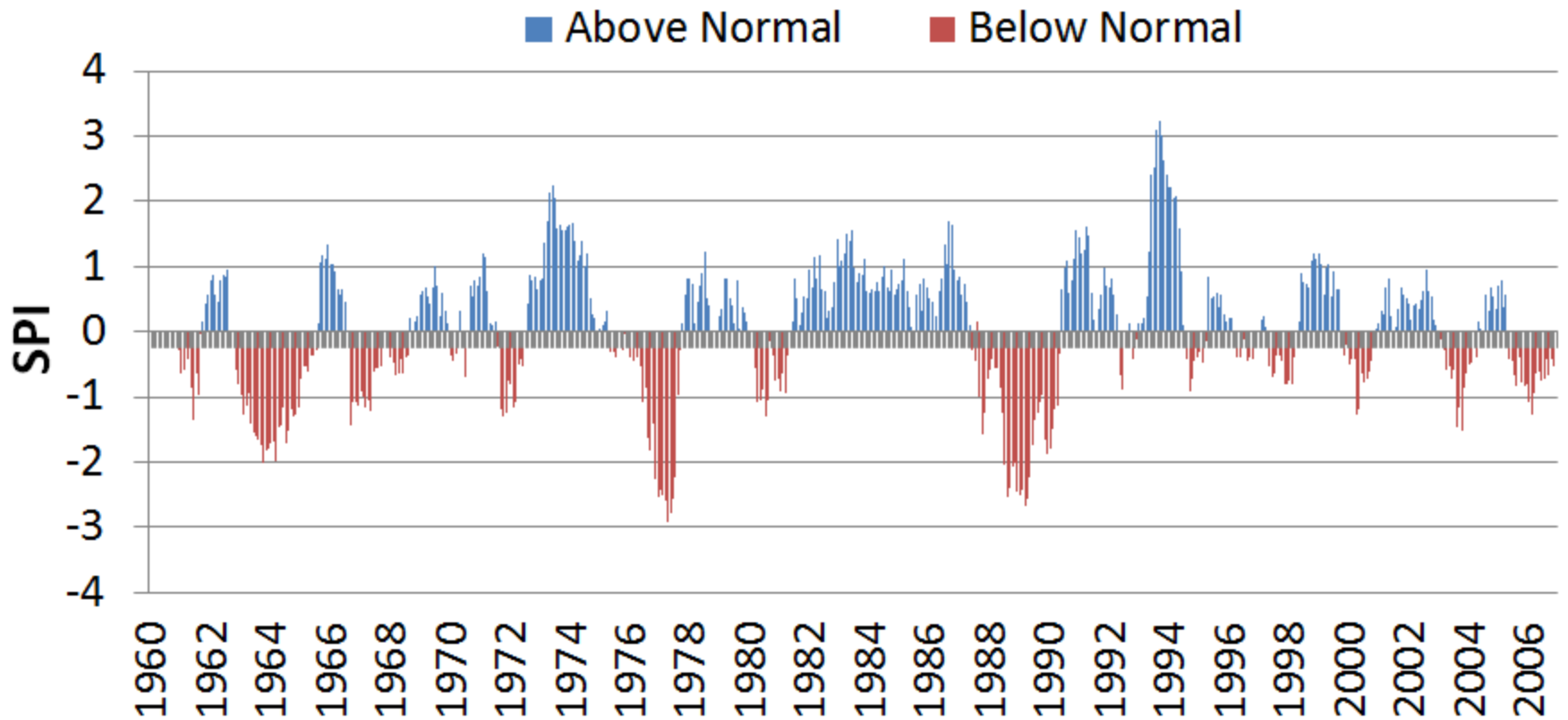
The Standardized Precipitation Index (SPI)

McKee et al. (1993)



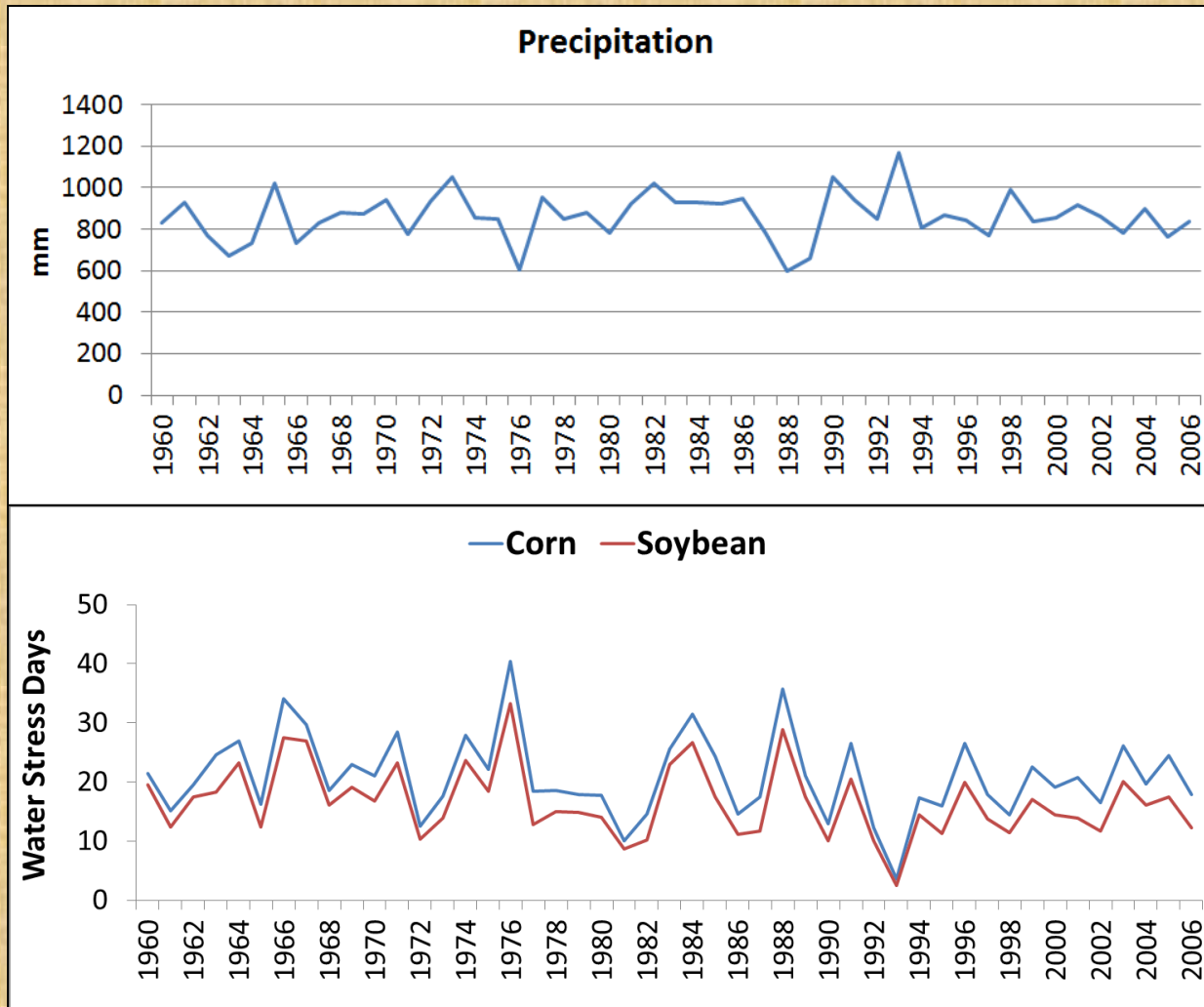
<http://drought.unl.edu/MonitoringTools/DownloadableSPIProgram.aspx>.

UMRB Drought Years



12 Month Timescale

Rainfall Pattern of the UMRB: 1960-2006



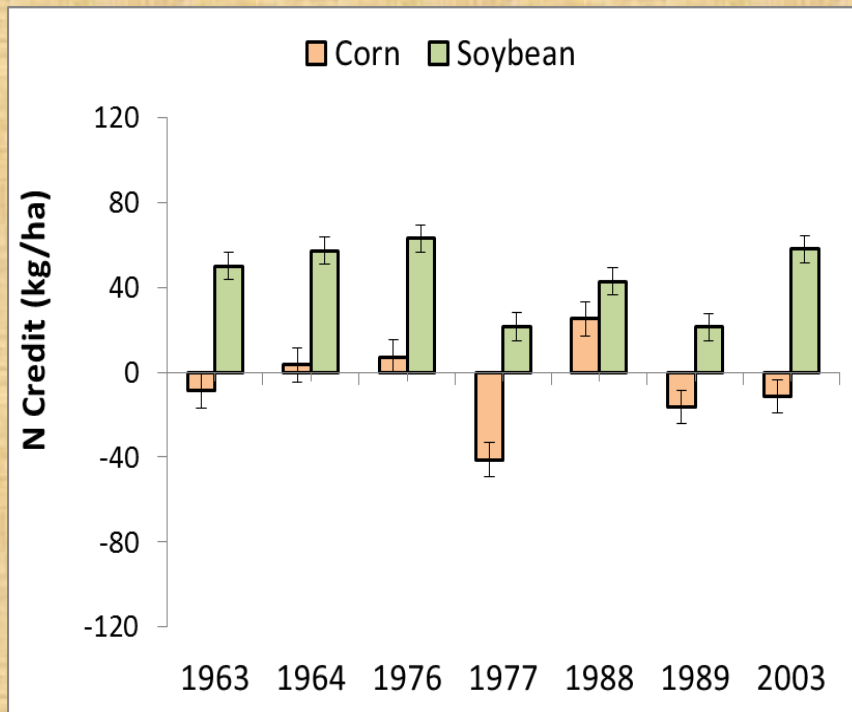
Comparative Simulations/Data Analysis



- Severe to Extremely Dry – $SPI < -1.5$
- Extremely Wet Season – $SPI > 1.5$

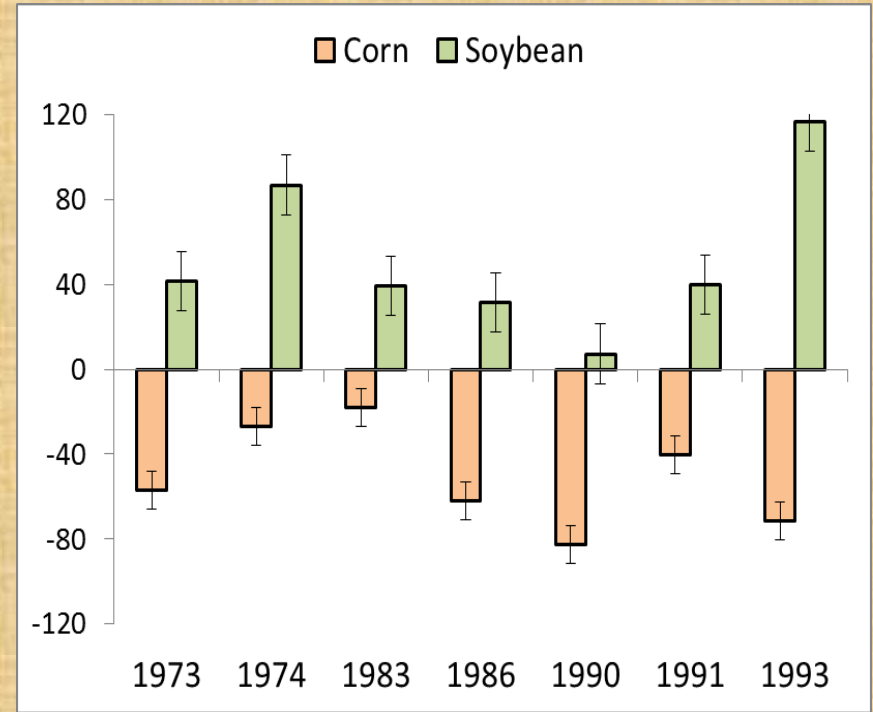
Nitrogen Carryover Credit

Severe to extreme dry years



Corn N Credit range: -41 to 25 kg/ha
Soybean N Credit range: 21 to 63 kg/ha

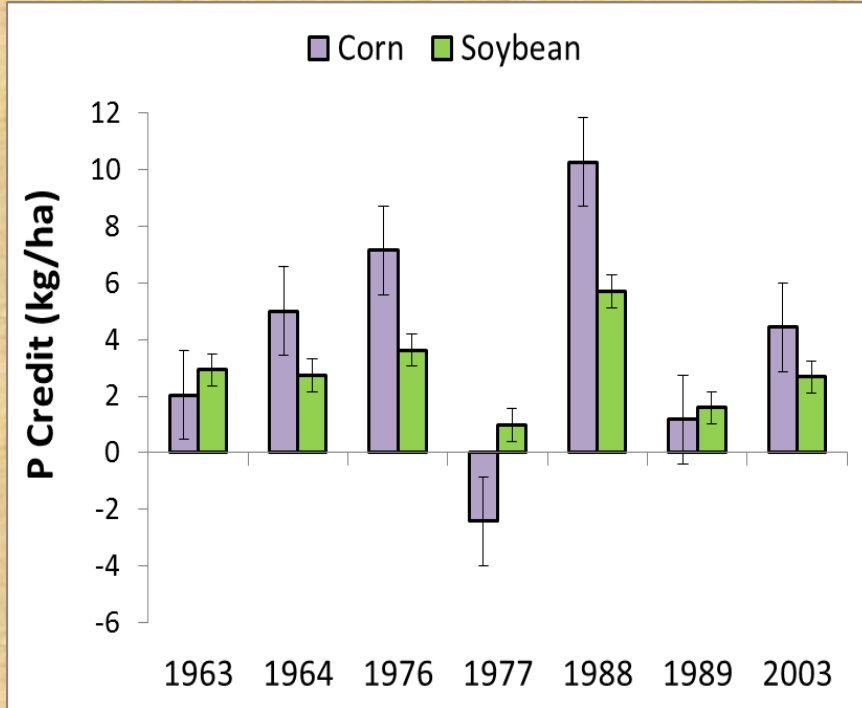
Very wet to extreme wet years



Corn N Credit range: -83 to -18 kg/ha
Soybean N Credit range: 7 to 117 kg/ha

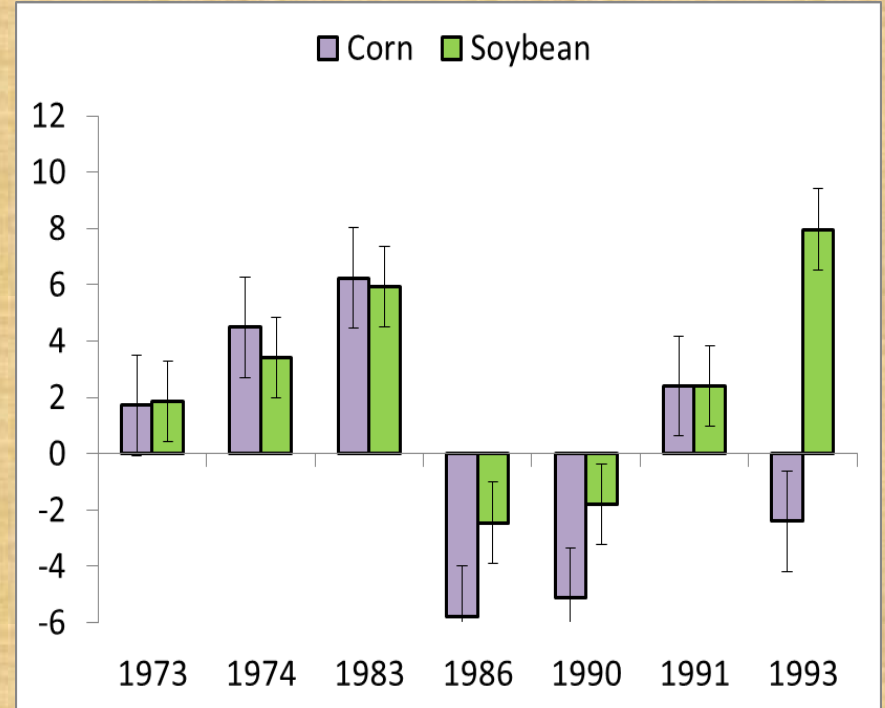
Phosphorus Carryover Credit

Severe to extreme dry years



Corn P Credit range: -2 to 10 kg/ha
Soybean P Credit range 1 to 6 kg/ha

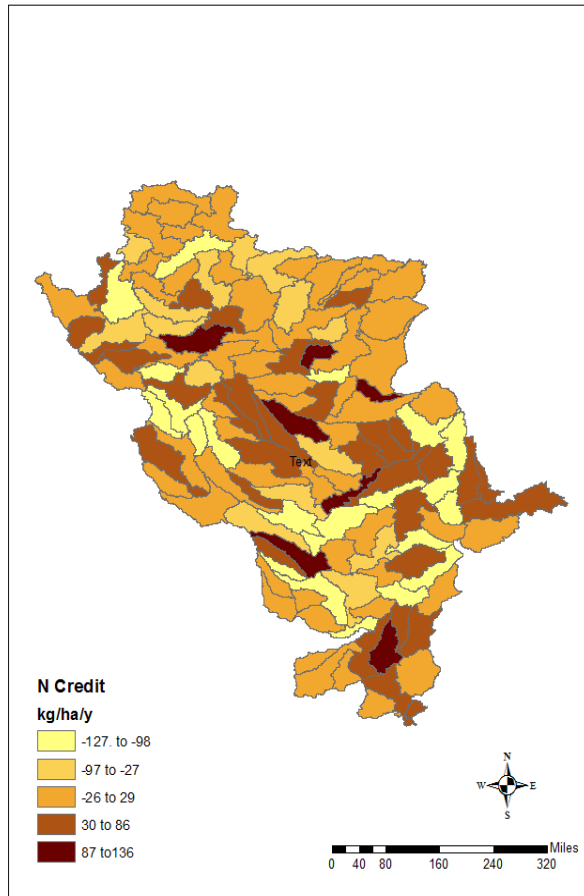
Very wet to extreme wet years



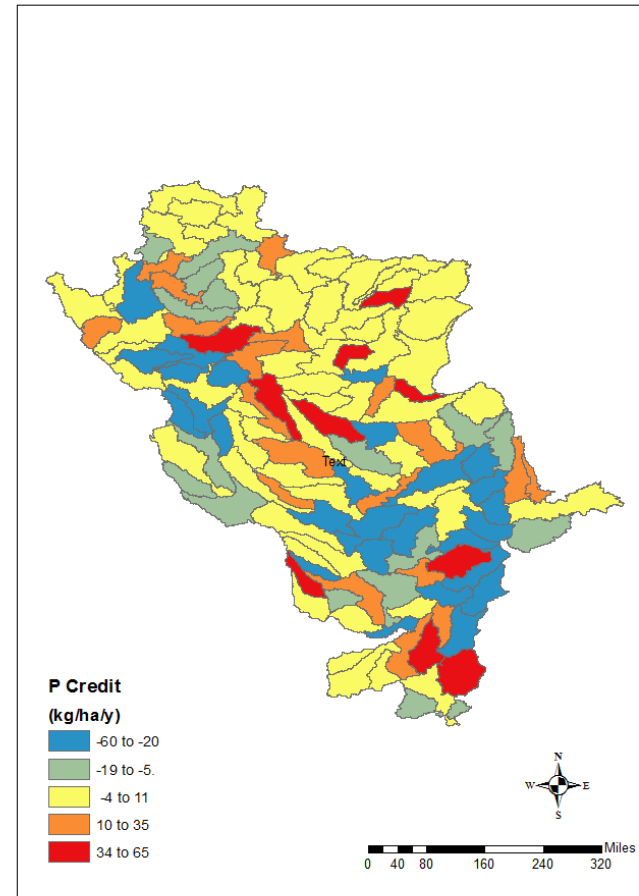
Corn P Credit range: -6 to 6 kg/ha
Soybean P Credit range: -2 to 8 kg/ha

Spatial Distribution of N & P Carryover Credits in the UMRB

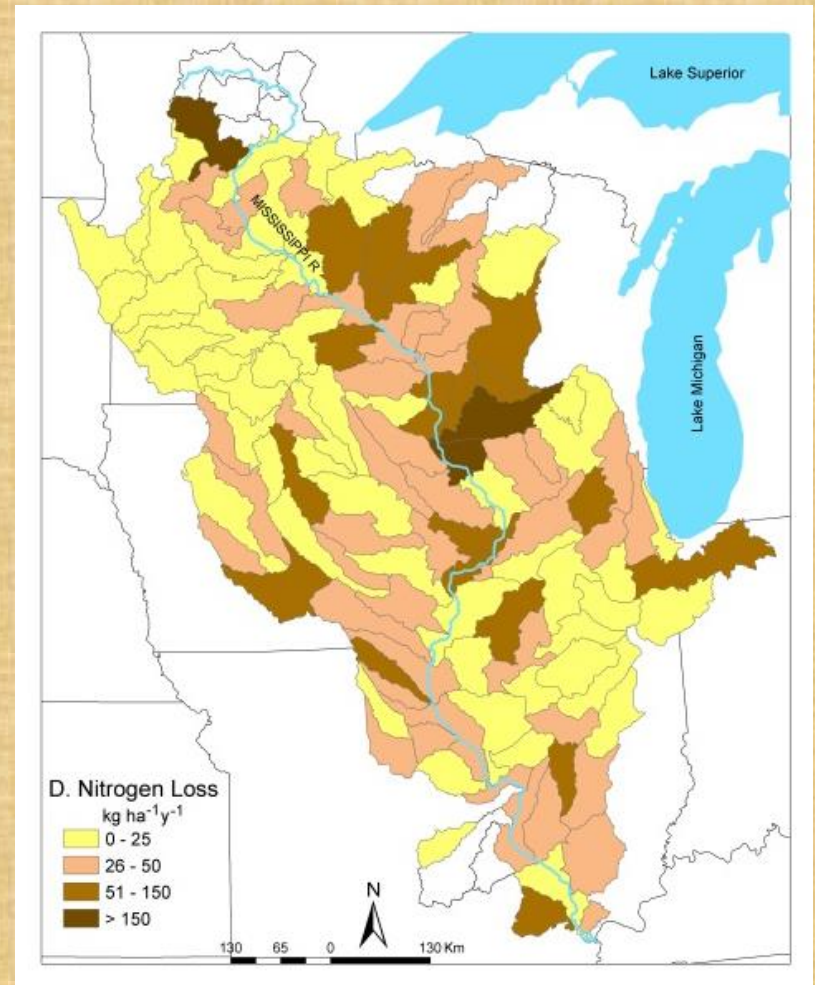
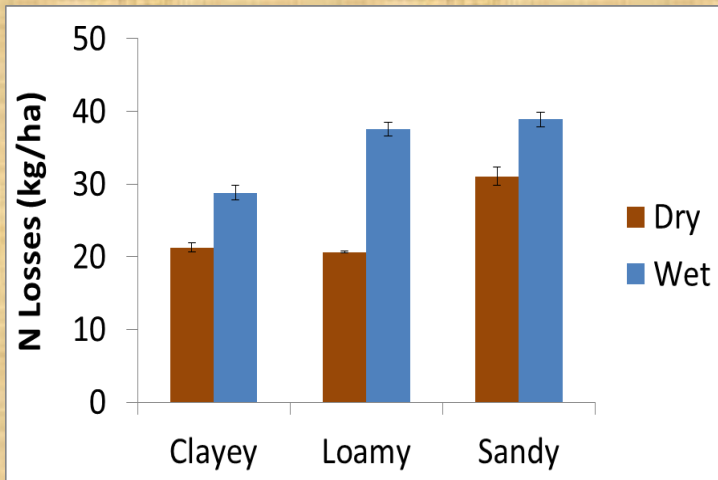
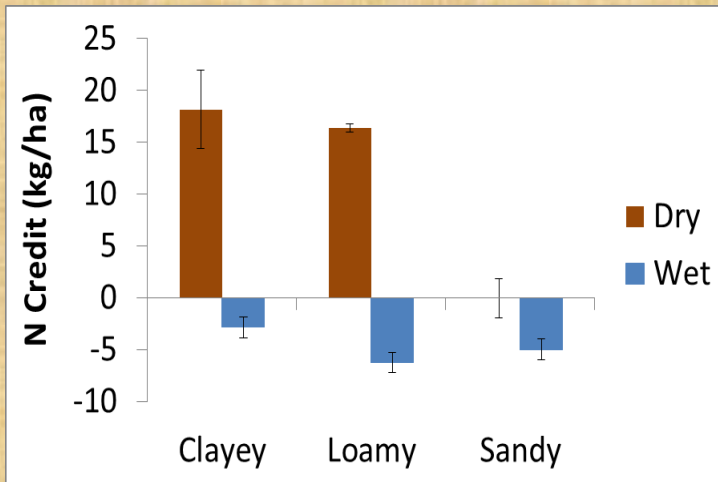
N



P



Site-specific factors affect the size of N & P carryover Credits, e.g. Soil Texture



Some Concluding Remarks

- Farmers should be encouraged to take annual soil nutrient tests as the best tool for assessing the quantity of carryover N & P potentially available to the next crop.
- Planting cover crops after harvest has been shown to improve nutrient retention, minimize nutrient losses, and hence nutrient credits, in particular, residual nitrate.
- Legumes such as soybean potentially increase the size of the N Credit whether under drought or normal growing seasons.
- The size of the N & P Credit can be impacted by management and site-specific factors, such as soil texture.

Thank you
Questions