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


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)  

UMRB Drought Years

12 Month Timescale
Rainfall Pattern of the UMRB: 1960-2006

[Graphs showing precipitation and water stress days for corn and soybean from 1960 to 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
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