Purdue University Department of Agronomy
Soil Fertility Update

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Carryover Nitrogen - Potential Impact on Wheat Fertilization

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Reduced corn yield resulted in considerably more nitrogen (N) left in the soil after harvest in Indiana. The amount of N leftover depended on grain removal, fertilizer N applied, and release of soil N. Drought-stricken corn grain removes about 0.7 pounds of N per acre. Indiana soils are quite variable in N release ranging from as little as 50 pounds of N per acre to as much as 150 pounds of N per acre. Low organic matter and/or very poorly-drained soils are on the low side of this range while high organic matter and well-drained soils are on the high side. Leftover N can be estimated by subtracting crop removal from fertilizer N applied and a "guesstimate" of soil N released. However, there is a lot of uncertainty in this estimate. Measuring leftover N by soil sampling and laboratory analysis is a much better approach.

Typically in Indiana we do not consider leftover N because winter and spring rainfall remove the N from the crop root zone. Most of the N remaining in the soil at the end of the season is in the highly leachable form of nitrate (NO_3-N). Nitrate has a negative charge and is repelled by soil particles (negative charge as well), so it moves downward with water. Indiana typically receives 18 to 24 inches of rainfall between October and April, which is sufficient to remove most of the NO_3-N from the rootzone of Indiana soils.

The amount of carryover N available for the following wheat crop or next year's corn crop depends on the winter and spring rain as well as the amount of N left in the soil by the previous crop. Rainfall has been plentiful in the southern half of Indiana since last August (15 to 35 inches), but rainfall has been limited in the northeast and northwest (10 to 20 inches and less than 10 inches in some areas). Rainfall totals for the last 90 and 180 days are shown in Fig. 1. Carryover NO_3-N is much more likely in these areas than in southern Indiana.

A wheat crop has more potential than a corn crop to scavenge carryover N. Of course wheat planted in the fall has an advantage in that it will accumulate some N prior to dormancy. Wheat's primary advantage is the established root system that can take up N early in the spring before corn is even planted. Drier soil from wheat crop water use also slows the loss of NO_3-N from the soil.

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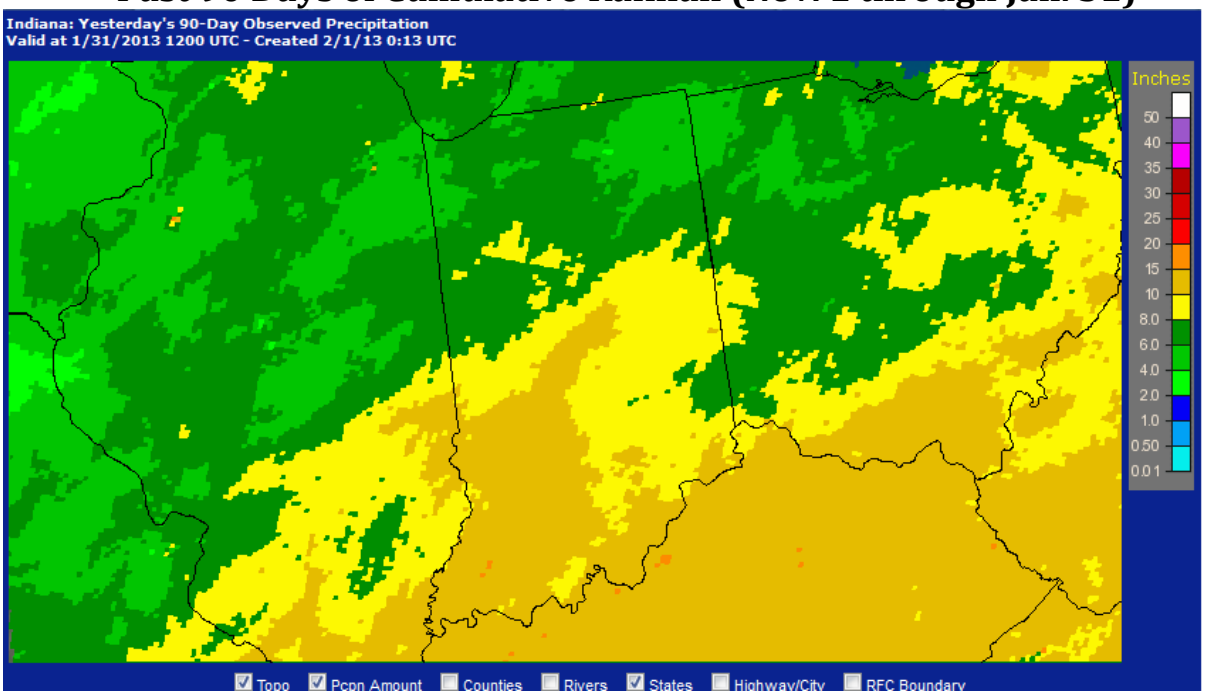
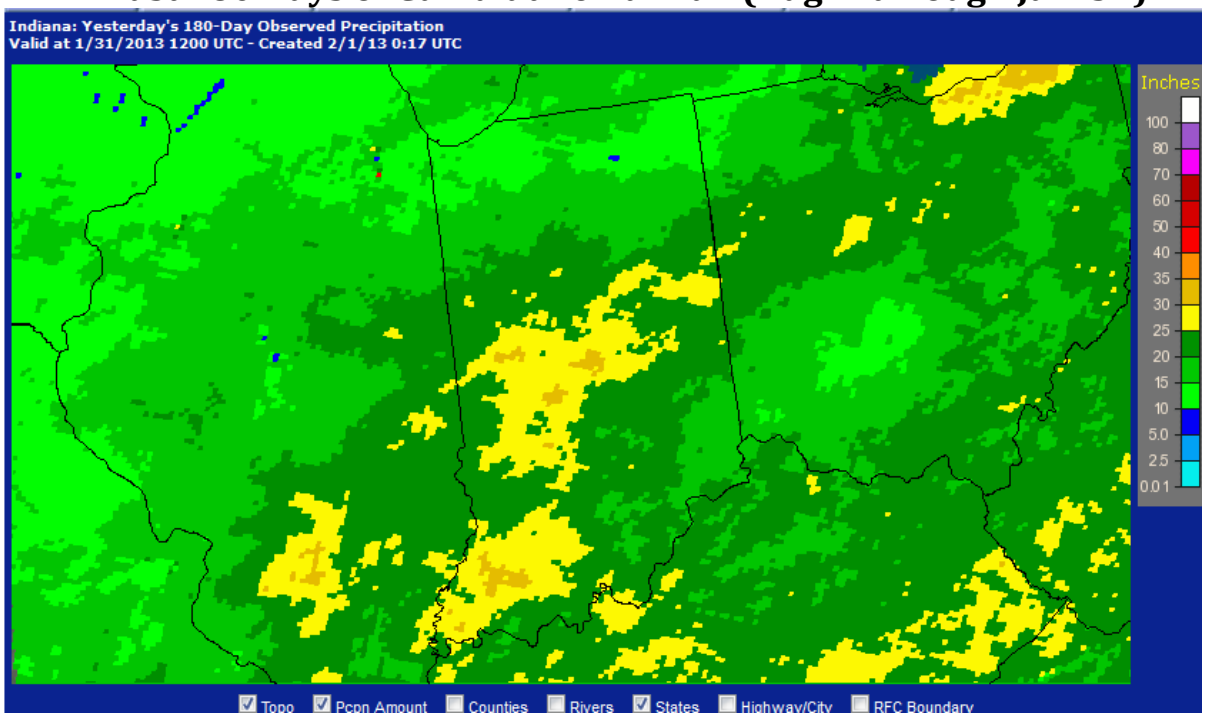
Fig. 1. Cumulative rainfall for Indiana for 90 days (Nov. 1 through Jan. 31) and 180 days (August 1 through Jan. 31). Note: The scale for rainfall in inches is located to the right of each map and differs between time periods. Data sourced from National Weather Service (http://water.weather.gov/precip/).

Past 90 Days of Cumulative Rainfall (Nov. 1 through Jan. 31)



Past 180 Days of Cumulative Rainfall (Aug. 1 through Jan. 31)



The amount of N in the soil at the stem erect stage (Feekes 5 or Zadoks 30) just prior jointing affects how much fertilizer is needed to optimize wheat yield. The University of Kentucky recommends no fertilizer be applied to wheat if the NO_3-N content to a depth of 3 feet exceeds 120 pounds per acre[2], but no other guidelines exist for wheat based on soil NO_3-N.

Since deep soil sampling is laborious the more typical approach to adjusting fertilizer N rates has been to use the young wheat plant as an indicator of soil N supply rather than measuring soil NO_3-N directly. Research at Virginia Tech and Univ. of Kentucky provide guidelines for sampling wheat at Feekes 5 or Zadoks 30 and adjusting fertilization rate based on the N concentration (%N) of the tissue (Fig. 2 and 3). Sampling wheat at the proper growth stage is important because the tissue concentration changes rapidly with growth during this time period. At a given %N level in the tissue there is only a difference of 20 pounds N per acre in the recommendation given by Virginia Tech and Kentucky (Fig. 3). Nitrogen applied at spring green-up should also be subtracted from the recommendations given in Fig. 3.

Bottom line is wheat grown in Indiana may utilize and benefit from more carryover N than usual, especially in the northern area where rainfall to date has been limited. Spring fertilization rates necessary to optimize yield may be lower than what is needed following normal corn crops. The only guidelines for adjusting N fertilization are at Feekes 5 or Zadoks 30, which is an ideal time to fertilize from crop production and N efficiency standpoints. Unfortunately, this timing is risky in wet soils and it is later than many fertilize wheat.

Fig. 2. Tissue Sampling Procedures for Wheat at the Stem Erect Stage (Feekes 5 or Zadoks 30 at right)[2].

- Cut a handful of wheat tissue at 20-30 representative areas in the field – ½" above ground
- Remove soil particles and dead leaf tissue
- Mix thoroughly in a clean container and subsample about three handfuls of tissue and place in a clean paper bag (never plastic)
- Dry or send to the laboratory immediately

Fig. 3. Nitrogen fertilizer recommended at Feekes 5 or Zadoks 30 based on tissue %N for Virginia Tech[2] (left) and for Kentucky[3] (right). Nitrogen applied at spring green-up should also be subtracted from the recommendation.

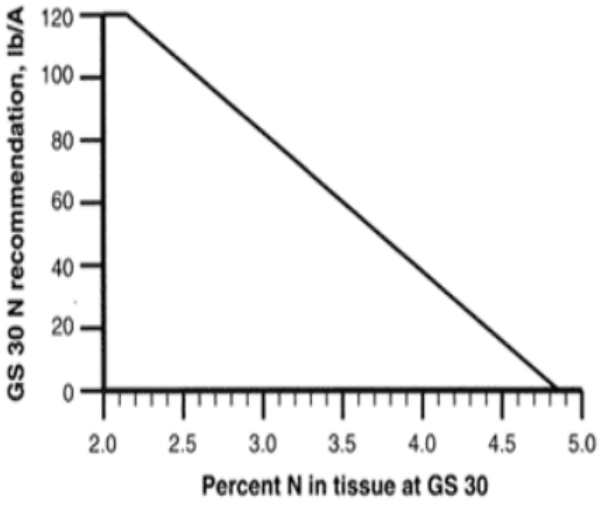


Table 5-1. Guidelines for fertilizer N application using wheat tissue N concentrations at Feekes 5.

Plant N Concentration *(%)*	Recommended Fertilizer N Rate *(lb N/acre)*
2.3	100
2.7	80
3.2	60
3.6	40
4.0	20

Murdock (unpublished data)

References Cited

[2] Wheat tissue testing and spring nitrogen rate determination. Crop and Soil Environmental News, March 2006. Wade Thomason, Extension Grains Specialist and Mark Alley, W.G. Wysor Professor of Agriculture, Dept. of Crop & Soil Environmental Sciences Virginia Tech. http://www.sites.ext.vt.edu/newsletter-archive/cses/2006-03/wheattissuetesting.html

[3] ID-125 A Comprehensive Guide to Wheat Management in Kentucky. Section 5 – Fertilizer Management. Loyd Murdock, John Grove, and Greg Schwab. Dept. of Plant and Soil Sciences. Univ. Kentucky. http://www.ca.uky.edu/agc/pubs/id/id125/id125.htm