IMPLEMENTING ADAPTIVE NUTRIENT MANAGEMENT AS PART OF A 590 PLAN

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Introduction

Adaptive nutrient management is a new feature in the revised NRCS code 590. This paper will explain what adaptive nutrient management is and how to implement it.

The goal of adaptive management is to enable growers to use on-farm data to refine nutrient management strategies to adapt to conditions on their farm. Adaptive management in the context of the 590 standard can be used to 1) document the need for and amount of rescue N applications after excessive rainfall; 2) adjust P and K application rates when documented crop yield levels are greater than ranges provided in UWEX Pub. A2809; or 3) refine any nutrient application rate (primarily N) or management strategy using on-farm research data.

Evaluating and Documenting Nitrogen Loss from Excessive Rainfall

Section V.A.1.i. of the 590 standard allows for supplemental in-season N when N deficiency from excessive rainfall has been documented on each field. Evaluation and documentation of this field situation is not necessarily simple because of the complexity of estimating N loss, determining crop N deficiency, and assessing physiological damage to the crop from water logged soil conditions. Information which should be considered when estimating N loss from excessive rainfall includes: date, rate, and form of N application; amount of time elapsed between prior N application and excessive rainfall; rainfall amount; duration of rainfall event(s); soil water holding capacity; soil aeration/saturation; amount of time the soil was saturated; soil temperature; and appearance of the crop. A few methods that may be considered when evaluating and documenting the need for supplemental N include:

- Laboski, C.A.M. 2016. Evaluating N loss after excessive rainfall. Proc. Wis. Crop Management Conf. 55:00-00 {In press}.
- Schmitt, M.A., G.W. Randall, J.A. Lamb, and G.W. Rehm. 2005. The University of Minnesota Supplemental Fertilizer Nitrogen Worksheet. 43(3). http://www.joe.org/joe/2005june/tt4.php
- Soil nitrate tests have not been calibrated for this purpose. However, experienced agronomists may be able to use soil nitrate tests, especially if soil is sampled at 0-1' and 1-2', along with professional judgment to determine if supplemental N may be needed.
- Plant analysis (tissue testing) may also be used. Keep in mind that hybrids vary in what might be considered a sufficient N concentration and plant analysis is best used when samples are collected from both good and bad areas of a field to compare results.
- Chlorophyll meters (eg. SPAD meters), crop canopy reflectance sensors (e.g., GreenSeeker, OptRx, etc.), or aerial images (regular photography and/or NDVI images) may be used to document N deficiency. Many of these technologies have not been calibrated for Wisconsin. Establishment of high N reference strips early in the growing season is helpful to compare greenness of the crop.
- Nitrogen management models (e.g., Adapt-N, Climate Fieldview Pro, Encirca, N Index, etc.) may also be used. Use with caution: none of these models has been adequately, independently validated for use in Wisconsin.

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The 590 standard states that at least one of the above methods must be used to document N loss from excessive rainfall and if more than 46 lb N/a is applied as a rescue N application, then two methods of evaluation and documentation are required.

Adjusting Phosphorus and Potassium Application Rates

For crops with documented yield levels greater than or less than yield levels provided in A2809, P and K application rates may be adjusted by following the text in Chapter 7 of UWEX Pub. A2809 paying close attention to the section titled "Phosphorus and potassium application rate guidelines". If soil test levels are low or very low determine an appropriate build rate to be added to the rate at optimum by reviewing Table 7.4 for the crop of concern. For example, for corn, soybean, wheat, and alfalfa, 30 lbs P_2O_5/a is added to the rate at optimum soil test levels to arrive at the rate for low testing soils. For very low testing soils, 40 lbs P_2O_5/a is added to the rate at optimum for these crops.

Refining Nutrient Management Through On-farm Research

On-farm research can be used to validate the need for nutrient application rates greater than those outlined in UWEX Pub. A2809 or management practices which may vary from this standard. For a general background and details on conducting on-farm research see the following:

- Glewen, K., and J. Rees. 2013. Grower's Guide to On-Farm Research. University of Nebraska. http://viewer.zmags.com/publication/4efd82ad#/4efd82ad/14
- Lauer, J.G. 2013. On-Farm Testing. University of Wisconsin-Madison, Department of Agronomy. http://corn.agronomy.wisc.edu/Management/L016.aspx
- Nielsen, R.L. A Practical Guide to On-Farm Research. 2010. Purdue University, Department of Agronomy Corny News Network. https://www.agry.purdue.edu/ext/corn/news/timeless/onfarmresearch.pdf
- NRCS Agronomy Technical Note No. 6 Adaptive Nutrient Management, September 2011.

Specific experimental design, data analysis, data collection and documentation criteria required is provided below.

Experimental design

1. Follow the guidance in Lauer, 2013; Nielsen, 2010; or University of Nebraska, 2013 for laying out plots and accounting for field variability.
    a. Plots can be small plots or field strips.
2. When documenting that a different rate of nutrients is more appropriate for farm conditions, a field trial must contain the following:
    a. At least five (5) nutrient application rates including a zero rate where the nutrient of concern is not applied or is applied in starter fertilizer at rates not to exceed 20 lb N/acre, 10 lb P_2O_5/acre, or 10 lb K_2O/acre.
        i. The total amount of nutrient applied (starter + preplant + sidedress + late season + fertigation) is recorded as the nutrient application rate.
    b. Each treatment must be replicated at least three (3) times in the same field.
    c. Treatments should be randomly placed within each replicate.
    d. The study should be collected on at least one (1) field each year.

        i. Field conditions should be similar for comparison purposes. This includes at a minimum tillage, previous crop, and fertilizer/manure application history.
    e. The study should be conducted a minimum of three (3) years.
3. When comparing two or more practices (e.g., source of N fertilizer) not including rate, NRCS Agronomy Technical Note No. 6 Adaptive Nutrient Management, September 2011 suggests five (5) replications at a minimum when two practices are compared and four (4) replications at a minimum when three (3) or more practices are compared.

Data analysis

Data must be statistically analyzed before conclusion can be drawn. When evaluating nutrient application rates, use the Crop Nutrient Response Tool (http://nane.ipni.net/article/NANE-3068) developed by the International Plant Nutrition Institute (IPNI) to calculate the economic optimum nutrient rate. For a comparison of practices, analysis on variance (ANOVA) with Fisher's least significant difference (LSD) is an appropriate statistical analysis. Excel can compute an ANOVA, but not a LSD. Alternatively AgStats (http://pnwsteep.wsu.edu/agstatsweb/) is an online tool that can be used.

Data collection and documentation

Data collected for each on-farm trial will vary based on the objective of the trial. This data can include some or all of the following:

1. Yield, moisture, test weight.
2. Routine soil test levels.
3. Preplant profile nitrate test (PPNT), presidedress nitrate test (PSNT), soil nitrate testing at other times
4. Plant analysis.
5. Manure analysis – required if manure is an objective of the trial.

For all trials document the following site criteria:

1. Year study was conducted.
2. Town and county.
3. Latitude and longitude of field.
4. Soil map unit(s) in the field.
5. Previous crop history for the past 5 years.
6. All nutrients applied for the past five years including source, rate, time, and placement.
7. Hybrid/variety, relative maturity, planting date, seeding rate, row spacing.
8. Tillage and time of tillage.
9. Percentage of surface residue coverage at planting.
10. Is the field tile drained?
11. Is the field irrigated? If so, N content of irrigation water and amount irrigated in season.
12. Weekly precipitation and general commentary about weather with regard to precipitation and temperature during the growing season.
13. Observations on weed, insect, and disease pressure.

Example on-farm trial protocol

An example of an on-farm N rate trial protocol and data collection spreadsheet can be found at http://www.npketc.info/?page_id=289.

Summary

Adaptive nutrient management is designed to allow growers to use on-farm data to refine nutrient management strategies that adapt to conditions on their farm. Adaptive nutrient management can provide for additional flexibility on a farm, but it comes with a responsibility to thoroughly document site conditions, develop appropriate replicated on-farm research trials, statistically analyze data, and properly interpret data. Many producers may find that they need the assistance of extension personnel or crop consultants to adequately conduct adaptive nutrient management.