Purdue On-Farm Nitrogen Rate Trial Protocol

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This protocol describes the design and conduct of on-farm, field-scale research trials with the objective of identifying agronomical and economical optimum nitrogen (N) rates for corn production in Indiana. The power in participating in this on-farm research is not simply what you may learn from your plots, but more what you will gain by pooling your response data with those of other cooperators in area of the state. Our ultimate goal with this project is to develop N rate recommendations on a regional, if not soil-specific, basis.

While the protocol is fairly simple, the actual logistics of conducting the trial often require further discussion, so please do not hesitate to contact us with questions.

Nitrogen rate trials for corn following soybean should include five different N rates; approximately 75, 115, 155, 195, and 235 pounds of N per acre. These rates includes any N fertilizer applied prior to or following corn planting (e.g., spring-applied DAP, starter fertilizer, preplant fertilizer, or sidedress fertilizer. The nitrogen in fall- or winter-applied DAP usually disappears (leaching or denitrification) prior to the uptake needs of the following corn crop, so we typically do not count that N as part of the N rates for the trial. We also do not purposefully credit any N from the previous soybean crop as part of our N rate treatments because we are interested in determining optimum nitrogen FERTILIZER rates with these trials.

For corn following corn N rate trials, increase each of the five suggested N rates by 30 lbs/ac because continuous corn usually requires a higher optimum N rate and we want to make sure we "capture" the optimum N rate in the results.

Ideally, growers should calibrate their N applicators prior to the season to ensure that the targeted rates of N will be accurately applied. If you need assistance in determining how to do this, contact Jim Camberato (jcambera@purdue.edu, 765-496-9338).

It is important to recognize that the number of N rates suggested for this trial, as well as the unusually low and high N rate "treatments", is important for accurately defining the yield response curve that then enables us to more accurately calculate optimum N rates for a given trial. Simply comparing your standard N rate with, say, a single rate that is 50 lbs per acre higher or lower does not answer that question. Such a paired comparison is good for demonstration purposes or to convince a grower of the benefit, but does not help define the actual optimum N rate range.

Each treatment plot (strip) should be no less than 500 feet long. Typically, plot length in an on-farm trial is simply the length of the field (minus the end rows). The N rate treatments must be replicated at least twice, but preferably three or four times in the field (Fig. 1). Replication is necessary to enable the mathematical statistical analyses of the plot data.

The sequence of the N rate treatments should be randomized within each replicate to avoid the possibility that one or more N rate treatments would be unfairly favored over others by some unknown factor if they always occurred in the same sequence in the trial. One example could be the effects on the yield of a particular treatment if its position in the field always coincided with that of a systematically arranged drain tile system.

The width of each plot (strip) should be equal to two or more combine header widths to enable harvesting a full header width down the center of each plot yet avoid having to glean partial header widths between plots. Harvesting the center of each treatment plot instead of the entire plot avoids border effects from adjacent plots with different N rates.

The number of rows suitable for each treatment plot should also be compatible with all equipment widths to be used in the field (planter, fertilizer applicators, combines, etc). The table below shows examples of compatible plot sizes for different implement sizes.

If your tractor and/or nitrogen applicator is equipped with auto-steer navigation and variable rate (VR) N application control, we can work with you to design an pre-plant application scheme based on the GPS boundary of the field that will further simplify your application of the various N rates in the trial. If your VR system allows for the use of a prescription N rate map, that would further simplify your logistics of applying the different N rates regardless whether you apply the N rate treatments preplant or sidedress.

Availability of a combine with GPS-equipped yield monitor greatly simplifies your harvest logistics. To ensure accurate yield estimates across the range of N rate treatments, it works well to calibrate the yield monitor using loads harvested from each of the N rate treatments. To facilitate processing of the yield data after harvest, it works well to identify the harvest of each N rate plot as an individual “load”, “task”, or “region” (depending on the type of yield monitor). After harvest, you can simply send the yield file from the yield monitor to Bob Nielsen and he will extract the yield data for further statistical analysis. If you have questions on calibration or working with yield files, talk to Bob Nielsen before harvest.

If a yield monitor is not available, a weigh wagon can be used to measure the grain weight harvested from each plot, but the length of each plot must also be known and recorded. Harvest and record data from each treatment plot separately.

Potential collaborators may ask about potential yield losses expected from the lower N rate treatments in the trial. This is a fair question and, unfortunately, we do not have the financial resources to compensate collaborators for such losses. Based on our field trials to date, growers could expect to lose yield primarily with the two lowest N rate treatments (75 & 115 lbs N for corn after soybean or 105 & 145 lbs N rates for corn after corn) at amounts ranging from 8 to 17%, respectively.

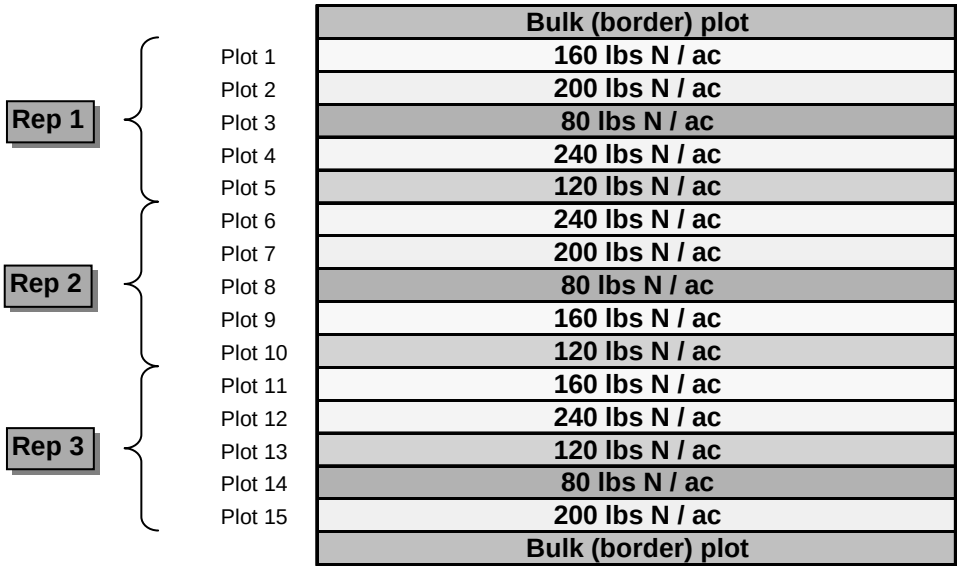
Regardless of the details of the on-farm trial, contact Bob Nielsen or Jim Camberato if you have any interest in participating in this research. We can discuss the specific details for your field and equipment to help you decide whether you will be comfortable and interested in becoming one of our on-farm research collaborators.

Additional copies of this protocol may be downloaded from the Web site devoted to Purdue’s Collaborative On-Farm Research at http://www.agry.purdue.edu/ofr. Results from these trials plus other on-farm projects are also posted at this Web site.

Table 1. Plot width options for different combinations of planter width, N applicator width, and combine header width. Examples are for 30-inch row spacing equipment.

Implement	Example 1	Example 2	Example 3
Planter:	12 row	16	12
Applicator:	12 row	8	12
Combine:	6 row	8	8
Compatible plot size:	12 row	16	24

Example Plot Layout Using One Hybrid and 5 Sidedress N Rates



Total width of field required if 12-row plots = 510 ft

Figure 1. Example of randomized plot layout for a nitrogen trial with 5 N rates, each replicated 3 times for a total of 15 treatment "plots". Each colored rectangle is equal to a treatment "plot" and would equal a compatible plot size listed in Table 1. The sequence of the treatment plots within each replicate can be changed, but each replicate should contain one and only one plot of each N rate treatment. As one might imagine, such a randomized treatment layout is most easily accomplished with sidedress N applications where you have the rows of corn to guide you from one replicate of a treatment to the next. Availability of accurate GPS lightbar navigation systems would allow you to put out preplant N rate treatment strips that should then match up with the planted rows of corn. (Questions? Talk to Nielsen)

Example Nitrogen Rate Plot Layout Combined w/ Two Seeding Rates

		Bulk (border) plot	
Plot 1	Rep 1	**Standard seeding rate**	**120 lbs N**
Plot 2	Rep 1	**Standard seeding rate**	**80 lbs N**
Plot 3	Rep 1	**Standard seeding rate**	**160 lbs N**
Plot 4	Rep 1	**Standard seeding rate**	**240 lbs N**
Plot 5	Rep 1	**Standard seeding rate**	**200 lbs N**
Plot 6	Rep 1	**Std. seed rate + 5,000**	**120 lbs N**
Plot 7	Rep 1	**Std. seed rate + 5,000**	**80 lbs N**
Plot 8	Rep 1	**Std. seed rate + 5,000**	**200 lbs N**
Plot 9	Rep 1	**Std. seed rate + 5,000**	**240 lbs N**
Plot 10	Rep 1	**Std. seed rate + 5,000**	**160 lbs N**
Plot 11	Rep 2	**Std. seed rate + 5,000**	**200 lbs N**
Plot 12	Rep 2	**Std. seed rate + 5,000**	**240 lbs N**
Plot 13	Rep 2	**Std. seed rate + 5,000**	**120 lbs N**
Plot 14	Rep 2	**Std. seed rate + 5,000**	**160 lbs N**
Plot 15	Rep 2	**Std. seed rate + 5,000**	**80 lbs N**
Plot 16	Rep 2	**Standard seeding rate**	**200 lbs N**
Plot 17	Rep 2	**Standard seeding rate**	**240 lbs N**
Plot 18	Rep 2	**Standard seeding rate**	**160 lbs N**
Plot 19	Rep 2	**Standard seeding rate**	**80 lbs N**
Plot 20	Rep 2	**Standard seeding rate**	**120 lbs N**
Plot 21	Rep 3	**Standard seeding rate**	**240 lbs N**
Plot 22	Rep 3	**Standard seeding rate**	**80 lbs N**
Plot 23	Rep 3	**Standard seeding rate**	**200 lbs N**
Plot 24	Rep 3	**Standard seeding rate**	**160 lbs N**
Plot 25	Rep 3	**Standard seeding rate**	**120 lbs N**
Plot 26	Rep 3	**Std. seed rate + 5,000**	**200 lbs N**
Plot 27	Rep 3	**Std. seed rate + 5,000**	**80 lbs N**
Plot 28	Rep 3	**Std. seed rate + 5,000**	**120 lbs N**
Plot 29	Rep 3	**Std. seed rate + 5,000**	**240 lbs N**
Plot 30	Rep 3	**Std. seed rate + 5,000**	**160 lbs N**
Plot 31		**Bulk (border) plot**	

Total width of each "block" of seeding rate if 12-row plots = 150 ft
Total width of field required for this example if 12-row plots are used = 960 ft

Figure 2. Example of randomized plot layout for a nitrogen trial with 5 N rates and 2 seeding rates, each combination replicated 3 times for a total of 30 treatment “plots”. Each N rate rectangle is equal to a treatment “plot” and would equal a compatible plot size listed in Table 1. As one might imagine, such a randomized treatment layout is most easily accomplished with sidedress N applications where you have the rows of corn to guide you from one replicate of a treatment to the next. Availability of accurate GPS lightbar navigation systems would allow you to put out preplant N rate treatment strips that should then match up with the planted rows of corn. (Questions? Talk to Nielsen)

Use this form to record the pertinent information about the trial and return to the appropriate Purdue campus specialist.

The online PDF version[1] allows you to input the information directly.

Purdue On-Farm Research Trials – Corn Plot Information

Name:							
County:							
Soil series:			**Drainage [1]:**				
Most recent soil sample results [2]:	**OM**	**pH**	**P**	**K**	**Ca**	**Mg**	**CEC**
Soil sample date?:			☐ **Lbs per acre or** ☐ **ppm?**				
Previous crop:			**Tillage [3]**				
Individual plot length (ft):			**Individual plot width (ft):**				
Hybrid (Company and brand):							
Planting date:			**Seeding rate:**				
Foliar fungicide? ☐ **Yes** ☐ **No**			**If yes, product and appl'n timing:**				
Harvest date:			**Header width (ft):**				
Yield monitor? ☐ **Yes**	☐ **No**		**If yes, equipped w/ GPS?** ☐ **Yes**		☐ **No**		
Broadcast fertilizer [4]:							
Starter fertilizer [5]:							
Pre-plant nitrogen [6]:							
Sidedress nitrogen [6]:							
Rainfall amount: (Inches per month)	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct.**

[1] Whether tiled or not plus assessment of overall drainage (e.g., poor, good, excellent).
[2] A copy of a recent soil sample for the field if it is available or record on sheet. Soil O.M. is a strong interest.
[3] Tillage method preceding this crop, such as no-till, strip-till, disc, moldboard plow, etc.
[4] Rate, analysis and date of broadcast fertilizer application if any (e.g., DAP).
[5] Rate/gallons, starter fertilizer and placement (2x2, surface band, etc.) if any.
[6] Type (UAN, urea, AA, etc.) and date of application.

Other comments:

[1] Online at http://www.agry.purdue.edu/ext/ofr/protocols.html .