Summary of Results
2004 Field Demonstrations
Maquoketa Watershed Project and
IFLM Manure Phosphorus Management

IOWA STATE UNIVERSITY
University Extension

IFLM Integrated Farm / Livestock Management
DEMONSTRATION PROGRAM

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2004 SUMMARY OF RESULTS

Introduction

During the past year phosphorus (P) issues have increased in importance, especially related to manure application planning. New P application regulations have been implemented leaving producers concerned about having the ability to apply manure at rates adequate to supply the agronomic needs of crops. Field demonstrations conducted in eastern Iowa during the past five years have shown that producers can refine manure application rates to optimize nitrogen (N) and P utilization while reducing the environmental impact of the livestock operations and improving net return from manure application and fertilizer investment.

Nitrogen management continues to be a focal point for cooperators as rising oil prices threaten to significantly increase fertilizer costs in 2005. Field demonstrations have shown that refined N application rates maintain corn yield, improve net return and may lessen N lost to the environment. An added benefit to refined N management may be improved producer eligibility in Conservation Security Program watersheds.

Field demonstration activities spread to new areas of eastern Iowa this season. Corn growers near Tipton conducted N management demonstrations in cooperation with the Cedar County Cooperative. Cooperators in the North Fork Maquoketa watershed in Dubuque and Delaware counties hosted N and tillage management demonstrations. And livestock producers in the Maquoketa watershed in Buchanan, Fayette and Jones counties continued to evaluate swine manure management through multiple rate field demonstrations.

The following summary highlights the nutrient management demonstration efforts of over 70 producers since crop year 2000.

Manure, N and P management on eastern Iowa livestock farms

Livestock manure utilization has become a focus of both livestock and cropping operations across Iowa as regulation of manure application intensifies and eligibility for the Conservation Security Program hinges on efficient nutrient management of commercial and on-farm nutrient sources. Eastern Iowa producers partnered with the Maquoketa Watershed Project and the Hub and Spokes Project to evaluate the effectiveness of both solid and liquid manure applications as efficient crop nutrient sources during the past five crop seasons. Manure nutrient levels, corn yield and end-of-season cornstalk nitrate content were measured to study the performance of manure as a crop nutrient resource.

The producers found that by accounting for nitrogen (N) and phosphorus (P) in the manure from beef, dairy, poultry and swine operations and by reducing commercial N and P applications on fields receiving manure they could significantly increase net return to their cropping operations.

Each manure management demonstration involved manure spreader calibration to accurately determine the amount of manure applied and collection of a representative manure sample for laboratory analysis to quantify the amount of nutrients applied with the manure. Crop available N, P and potassium were calculated for each demonstration using manure application rate, manure nutrient analysis results and nutrient availability factors obtained from ISU Extension publication PM 1811, Managing Manure Nutrients for Crop Production.

MANURE and NITROGEN MANAGEMENT

During crop years 2000-03 Maquoketa watershed livestock producers established twenty small-plot manure management demonstrations. These cooperators utilized primarily solid manure from their dairy, beef, swine and poultry operations, while five of the operations used liquid swine manure. The producers applied the manure at their historic application rate, determined from the spreader calibration. Solid manure was applied in a range from 9 to 26 tons per acre and liquid swine manure was applied at rates between 2,500 and 5,000 gallons per acre.

First-year crop-available N credits from the manure averaged 133 pounds per acre (M) for the 20 demonstrations. The manure N contribution ranged from 29 to 286 pounds per acre. The manure N rate was calculated using adjustment factors of field manure history, N loss from surface application versus manure incorporation and first-year nutrient availability based on the type of manure applied.

At each location two rates of commercial N, 50 and 100 pounds per acre, were randomly applied as replicated treatments in addition to manure. The solid manure was surface applied, usually in the fall, and not incorporated until immediately prior to planting, while liquid manure was incorporated at application. Other field treatments were a check (no manure and no N) and a single application of 100 pounds N per acre to corn following soybean or 150 pounds N per acre to second-year corn (100N*).

When a minimal amount of N, 50 pounds per acre, was applied in addition to manure, corn yield increased from 178 bushels per acre to 186 bushels per acre, shown by the white bars in figure 1. Adding another 50 pounds N per acre to the manure yielded just 1 more bushel per acre.

Average corn income increased $64 per acre when solid manure was the only N fertilizer source compared to the zero check, valuing corn at $2.40 a bushel, shown by the blue line. Return to an application of 100 pounds N per acre was $45 per acre, $19 per acre less than when manure was the sole N source. Net return to added N was maximized at $74 per acre for manure plus 50 pounds N per acre; applying more N did not increase corn yield sufficiently to pay for the extra N.

The end-of-season cornstalk nitrate N (residual N in the corn plant at maturity) was in the optimum range, 1,555 parts per million (ppm), when 50 pounds N per acre supplemented the manure application, shown by the brown bars. When manure was the only N source residual nitrate-N after maturity was slightly less than optimum at 663 ppm.

The optimum range for cornstalk NO_3-N is 700 to 2,000 ppm, indicating a high probability that the appropriate N rate was applied to the

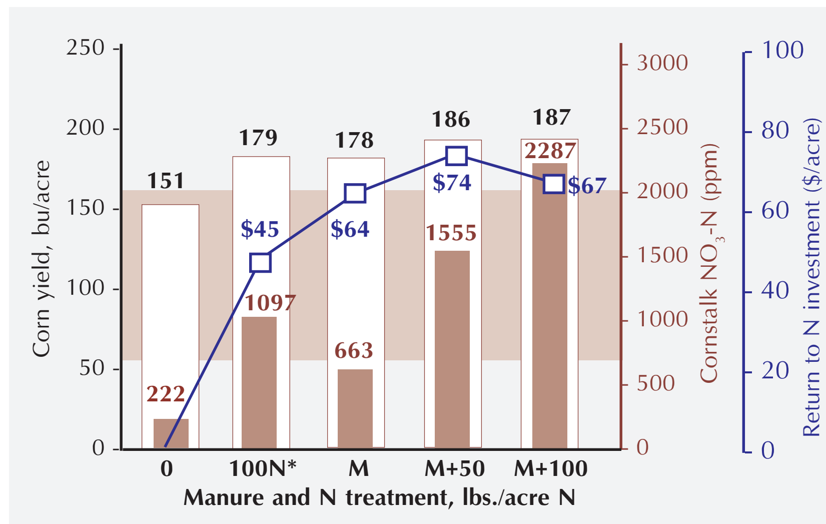


Figure 1. Corn yield, end-of-season cornstalk nitrate-N results and return to N investment from 20 manure demonstrations (corn at $2.40 per bushel and N at $0.20 per pound), 2000-03. Manure N contribution equals 133 pounds N per acre. *See text: either 100 or 150 lbs. N per acre.

crop to provide the most profitable return on the N investment. Analyses higher than 2,000 ppm indicate that the N application rate most likely exceeded the N requirement of the crop. Read more about the end-of-season cornstalk nitrate test on page 16 of this summary.

Each year the demonstration results continue to show that manure is a significant source of crop available N but additional N from commercial fertilizer may be needed to supplement manure applications, especially solid manure, when insufficient amounts of manure are applied or the manure application is not uniform. However, when manure, usually liquid swine manure, is applied uniformly at sufficient rates to supply crop needs added commercial N will not be used efficiently and net income will be reduced.

SWINE MANURE MANAGEMENT

Swine manure can be a very high value by-product of pork production if used efficiently on crop fields needing phosphorus and potassium in addition to nitrogen. Many producers have not maximized the value in manure because they have become accustomed to applying manure at the maximum rates allowed by their manure management plan, which is often based on the county average yield plus ten percent times 1.2 pounds N per planned bushel of corn; with field rotation based solely on crop rotation. However, changes in manure application regulations during 2004 have the livestock producers reassessing their current manure management strategies. New P-based manure application regulations may require some producers to apply manure based on manure P utilization and some producers may not be able to apply manure to some of their fields at all.

Most swine producers or row-crop producers utilizing swine manure may benefit from refined manure management planning based on economics rather than the new regulations. Producers involved with the Hub and Spokes Project and in the Maquoketa watershed have closely evaluated swine manure management through field-scale, multiple-rate demonstrations during the past four years. They found that by applying manure at lower, P-based rates the manure N was used more efficiently and they ultimately could apply manure to more acres and reduce or eliminate commercial fertilizer applications on more of their acres.

At each location, a minimum of three manure rates were used plus a zero check without manure or commercial N. The rates were often based on the producers' prior practice with the additional rates higher and lower than the historical rates. The rates were applied to field-width strips and replicated at least two times in each field. Manure N application rates ranged from 61 to 533 pounds per acre. Figure 2 shows corn yield and cornstalk nitrate-N by manure N application range.

Corn yield was maximized and cornstalk nitrate level optimized at an average rate of 182 pounds manure N per acre. Using a book value of 50

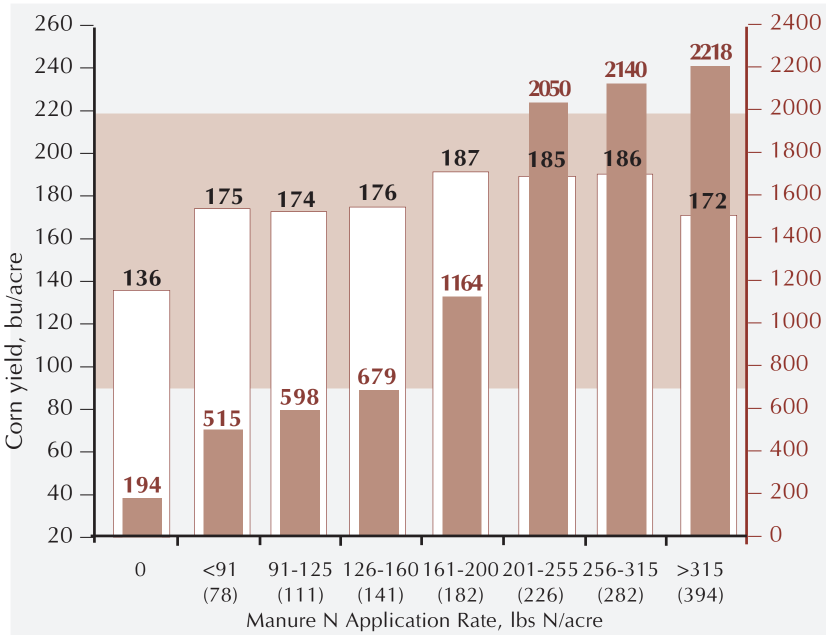


Figure 2. Corn yield and end-of-season cornstalk nitrate-N results from 40 liquid swine manure demonstrations 2002-04. The average manure N rate for each application range is shown in parentheses.

pounds N per 1000 gallons for dry feeder systems, this rate would equate to approximately 3600 gallons per acre. If a wet-dry feeder system was used the application rate could be reduced to 3100 gallons per acre.

Applying manure at higher manure N rates did not result in higher yields, just higher cornstalk nitrate levels. Individual operations may be able to refine their manure application rates even further by collecting stalk samples annually and monitoring cornstalk nitrate levels. Notice in the figure that yield did not increase once cornstalk nitrate was higher than the optimum range. Residual cornstalk nitrate will vary year-to-year depending on environmental conditions and corn yield, so an annual stalk sampling effort in addition to manure sampling will help to optimize each operation's manure management plan performance.

MANURE PHOSPHORUS MANAGEMENT - Liquid swine manure

Phosphorus is a valuable component of manure, but can also be detrimental to the environment if applied in excess and lost through movement as soluble in run-off or potential loss through field tile.

The use of phytase in swine rations can play a big part in reducing P applications in manure. Figure 3 shows corn yield contrasted with estimated manure P applications for each manure N application rate. Manure P applications were calculated using a book value of 42 pounds per 1000 gallons for dry feeder systems without phytase, shown by the blue line. The brown line shows projected manure P when using phytase in the swine feed ration. Phytase in swine rations may reduce manure P excretions by 25 to 40 percent.

The black horizontal dotted line shows the two-year P removal for a corn and soybean rotation yielding 185 and 50 bushels per acre, respectively. New P-based manure regulations will limit P applications to 2 times the crop removal rate for fields with a P Index in the medium category, shown by the red dotted line.

Notice on the graph that the highest yielding manure N rate also provides a two-year crop removal rate of manure P at 107 pounds P_2O_5 per acre, if phytase is used.

More information about how manure applications will be based on the Iowa P Index can be found on page 12 of this summary.

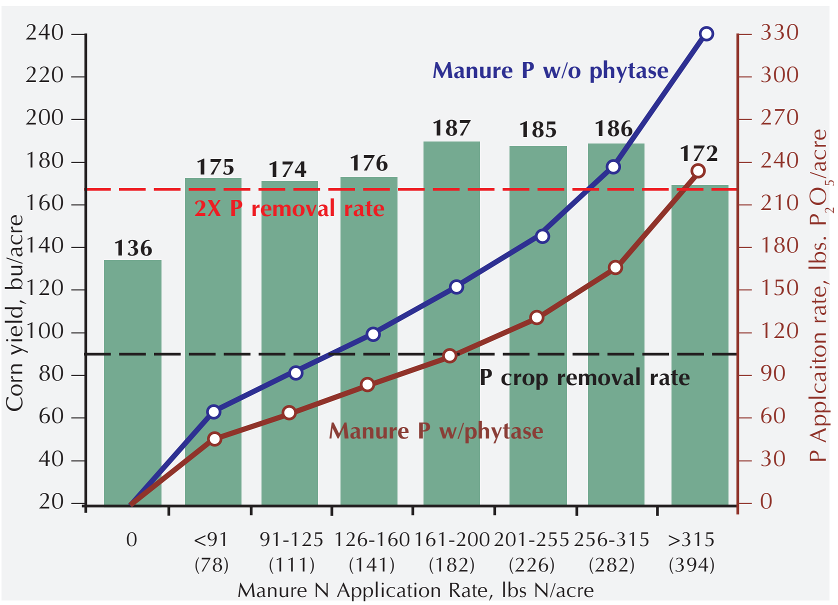


Figure 3. Corn yield and estimated manure P application from 40 liquid swine manure demonstrations 2002-04. The range of calculated manure N is shown, along with the average manure N rate for each range in parentheses.

MANURE PHOSPHORUS MANAGEMENT - Solid and liquid manure

Manure applied to high or very high P soil test fields (more than 20 ppm P) rapidly increased soil P levels but did not increase corn yield when compared to a commercial application of N at 100 pounds per acre receiving no additional P, as shown in figure 3, next page.

Prior to each demonstration a single baseline soil sample was collected from the demonstration site. Average soil P from the 20 demonstration sites was 56 ppm P, shown below as the horizontal brown line. Replicated treatments of manure (M), manure plus 46 P, and 100 pounds N per acre plus zero P, 46 P or the manure P (MP) contribution (139 pounds P per acre) applied as commercial P were usually fall-applied at each location. Following corn maturity, post-season soil samples were collected for each treatment. Fifteen soil cores were collected for each sample.

Average yield varied only three bushels per acre between the five field treatments, not enough to pay for a single crop removal P application. While yield did not vary, soil test values increased from their already very high level for each treatment receiving either commercial or manure P. Manure alone increased soil P, from 56 ppm to 82 ppm, with a single application, shown by the yellow bars.

The P contribution in the liquid swine manure and solid beef, dairy and swine manure were similar on average and increased soil P equally.

When P is valued at $0.23 per pound, the lost value by applying 139 pounds per acre manure P to high or very high P testing fields was nearly $32 per acre because there was no yield benefit from the P application.

To get the most benefit from manure P, target manure applications to low or optimum testing fields further away from livestock operations. After seeing initial demonstration results some Maquoketa Headwaters watershed producers started hauling manure two to three miles, one way, in order to get the most economic benefit from the manure and to reduce the impact excess soil P levels may have on the environment.

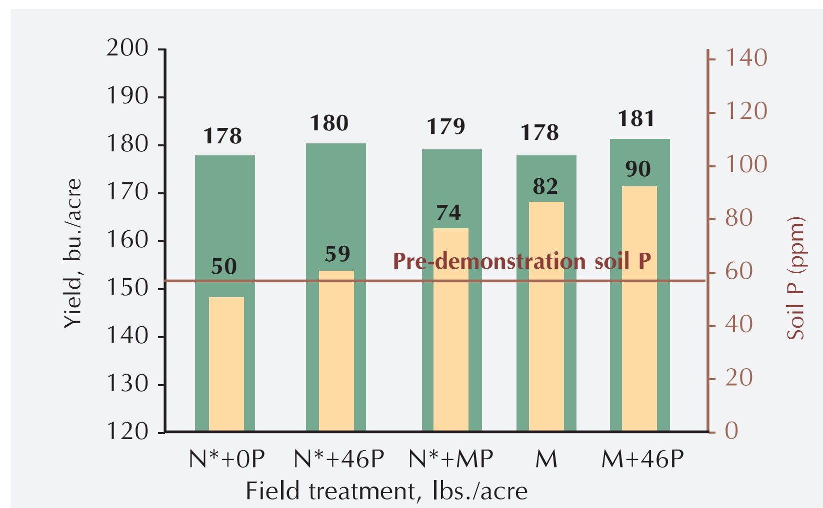


Figure 4. Corn yield and soil phosphorus levels. Pre-demonstration average soil P was 56 ppm indicated by the brown line in the middle of the graph.

Corn following soybeans – phosphorus management

Phosphorus (P) management has certainly increased in importance during the past few cropping seasons, gaining attention from lawmakers, regulators, researchers and now livestock and crop producers. Past practice on many farms called for post-harvest crop removal applications of P and potassium before the next year's corn crop. These applications were considered to be just like making a capital investment in the cropping operation if P wasn't really necessary. Often little regard was given to soil test levels or no soil samples were even collected. However, as operating margins continue to tighten and concerns about the impact of P on the environment escalate it is necessary to know for sure if additional P is needed. The best way to determine if P is needed is to conduct a soil test to measure the crop available P in the soil resource.

Twenty-two producers hosted P management demonstrations to study the impact of P applications on corn yield in a corn/soybean rotation. As part of each demonstration a baseline soil sample was collected to measure the available soil P. Through this process 77 percent of the demonstration sites were found to be testing high, 21 to 30 parts per million (ppm), or very high, greater than 30 ppm for P, with an average P test of 53 ppm. Five of the 22 locations tested 20 ppm or less for soil P.

Iowa State University recommends fertilizing with P when soil tests fall below the high range (less than 21 ppm P), with an option to use a low rate of P in starter fertilizer when P tests are in the high soil test range. Table 4 on page 19 shows research-based P recommendations for corn and soybean production.

Based on an average P soil test of 53 ppm, no yield increase would be expected due to additional P. Cooperators sought to confirm this expectation by implementing replicated, multi-rate demonstrations across multiple fields and years.

The corn-following-soybean demonstrations were fertilized with a single N rate of 120 pounds per acre and received replicated applications of P_2O_5 at zero, 46 (crop removal rate) and 92 pounds per acre (two-year crop removal rate).

At the high and very high testing sites there was no yield response to the one and two-year crop removal rates of added P. Applications of 0, 46 and 92 pounds P per acre resulted in average yields of 195, 194 and 196 bushels per acre, respectively.

There was a yield increase when P was added to optimum and low P (less than 21 ppm) testing sites, as shown by the blue bars in the figure 5.

When corn is valued at $2.40 per bushel and P costs $0.23 per pound, improved yield due to P application, regardless of soil test level, was not sufficient to pay for P fertilizer and application costs, as shown in the lower portion of the figure. When soil tests are in the high and very high range, net return to P was significantly reduced.

Applying phosphorus fertilizers to high P testing soils adversely affects more than just profitability. Recent research conducted at Iowa State University by Antonio Mallarino and others showed that dissolved P loss with surface runoff increased dramatically as soil P test levels increased. This is P that could end up in surface water, possibly enhancing algae blooms and ultimately degrading local water bodies. Measuring soil P levels and utilizing prior P investments by not making new applications should be viewed as the first step to improving crop operating profits and lessening potential environmental impacts from a farming operation.

A second step to P management would be to evaluate the risk of P loss from each field within a farming operation. This can be accomplished by using the Iowa P Index. An explanation of the P Index can be found on the next page of this summary.

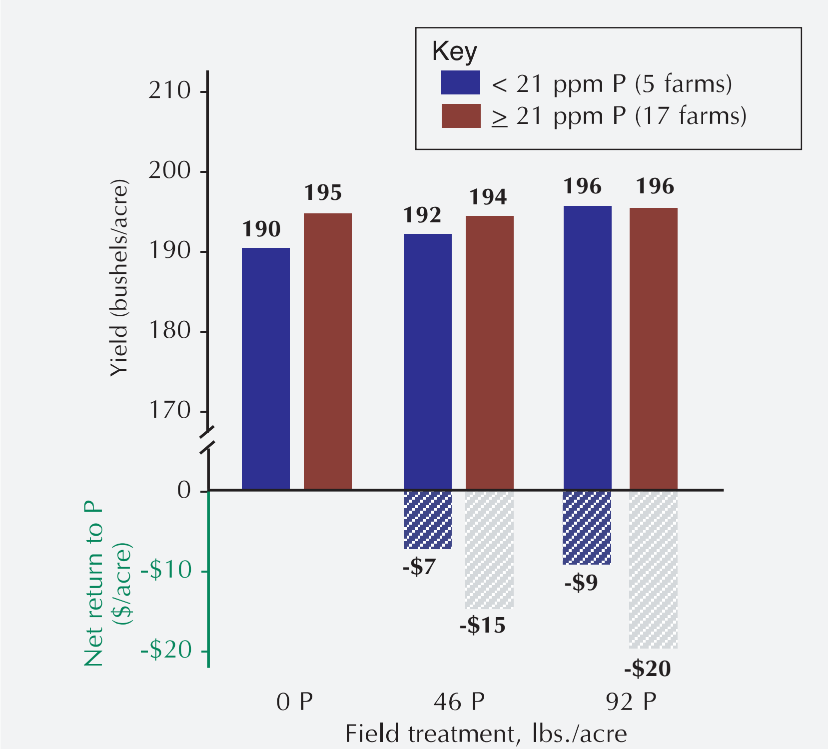


Figure 5. Corn yield (solid bars) and net return to P (hashed bars) for 22 on-farm P management demonstrations, corn following soybeans, 2000-03.

The Iowa Phosphorus Index and manure application planning

The Iowa Phosphorus (P) Index is an assessment and planning tool that is used to assess the potential risk of P movement from agricultural fields to nearby water bodies. The P index was developed by Iowa State University, the National Soil Tilth Lab and the Natural resources Conservation Service (NRCS). The primary components of the P Index are factors considering soil loss (erosion), soil test P, rate and method of P applications, field distance to open water and subsurface drainage. Table 1 shows the Iowa P Index risk categories and associated environmental risks.

Table 1. Iowa P Index.

Risk Category	Environmental Risk
0-1 Very Low	If soil conservation and P management practices are maintained at current levels, P delivery impacts on water quality will be small.
1-2 Low	P delivery to surface water bodies is greater but current management practices keep water quality impaiment low.
2-5 Medium	P delivery is significant and may produce some water quality impairment. Consideration should be given to soil conservation and P management practices so P loss is not increased.
5-15 High	P delivery is likely large and water quality impairment will be large. New soil and water conservation and/or P management practices arenecessary to reduce P loss and water quality degradation.
15+ Very High	P delivery is very high and impacts on water quality are extreme. New soil and water conservation practices plus a P management plan, which may require discontinuing P applications, must be put in place to reduce water quality impairment.

On August 25, 2004 new manure management regulations were put in place requiring manure applications to be planned based on the Iowa P Index. The regulations are effective for new confinement site feeding operations, while existing operations will be phased in during the next 4 years. Table 2 details the application rates allowed for each risk category.

Table 2. Iowa P Index based manure application rates.

Risk Category	Application rate requirements
Very Low (0-1)	Apply manure at or below N based rates.
Low (>1-2)	Apply manure at or below N based rates.
Medium (>2-5)	Manure may be applied at an N-based rate if current or planned soil conservation and phosphorus management practices predict the rating of the field to be 5 or less for the next determination of the P Index However, manure application can't result in P application in excess of 2 times the P removed with crop harvest during the crop rotation.
High (>5-15)	Manure cannot be applied until practices are adopted which reduce the P index to at least the Medium category. However, prior to Dec. 31, 2008, fields with a P Index between 5 and 10 may receive manure a P-based rate if practices will be adopted to reduce the P Index to the Medium category.
Very High (>15)	Manure may not be applied on a field with a rating greater than 15.

Corn following soybeans – Nitrogen management

Recent soybean management challenges have many traditional corn-soybean producers re-thinking their current crop rotation. Continuous corn or a corn-corn-soybean rotation may seem like a better alternative to additional applications of insecticide to combat soybean aphids or fungicide to control Asian soybean rust. However, according to University of Wisconsin research conducted from 1987-2001 corn rotated with soybean yields 17 percent higher, 169 bushels per acre, than a continuous corn system, 140 bushels per acre.

In addition to improved yield, another big financial benefit to rotated corn is that nitrogen (N) applications may be reduced by up to one-third following soybeans than when growing continuous corn. Iowa State University recommends applying 100-150 pounds N per acre for corn following soybeans versus applying 150-200 pounds N per acre for continuous corn.

A corn-soybean rotation may also result in more efficient use of N inputs since N lost through tile lines may be reduced under a corn-soybean rotation when compared to continuous corn. Tile drainage monitoring completed by ISU researchers showed higher nitrate N losses from continuous corn plots when compared to plots where corn is rotated with soybean. Rotated plots lost up to 50 percent less nitrate-N through tiles than continuous corn plots.

Higher corn yields, lower N application rates and potentially less environmental impact from N associated with a corn-soybean rotation has encouraged producers in the Maquoketa watershed and other eastern Iowa watersheds to explore ways to further refine University recommendations. Cooperating producers have used both small-plot demonstrations and larger, field-scale demonstrations to compare several different N rates. Three years of field-scale N demonstrations hosted by 18 eastern Iowa producers produced quite similar results to small-plot N demonstrations conducted by 19 producers in the Maquoketa and Mud Creek watersheds. These corn-following-soybean demonstrations show that N use is optimized when applied at rates between 90 and 120 pounds N per acre.

Field-scale N demonstrations

Cooperating producers applied N treatments pre-plant, at planting or side-dress either as anhydrous ammonia, 28 percent urea ammonium nitrate (UAN) solution or 32 percent UAN solution in large field-width blocks at five N application rates (zero, 60, 90, 120 and 150 pounds N per ace). Treatments were from two to 10 acres in size. Corn yields were measured by using a combine equipped with a global positioning system-enabled

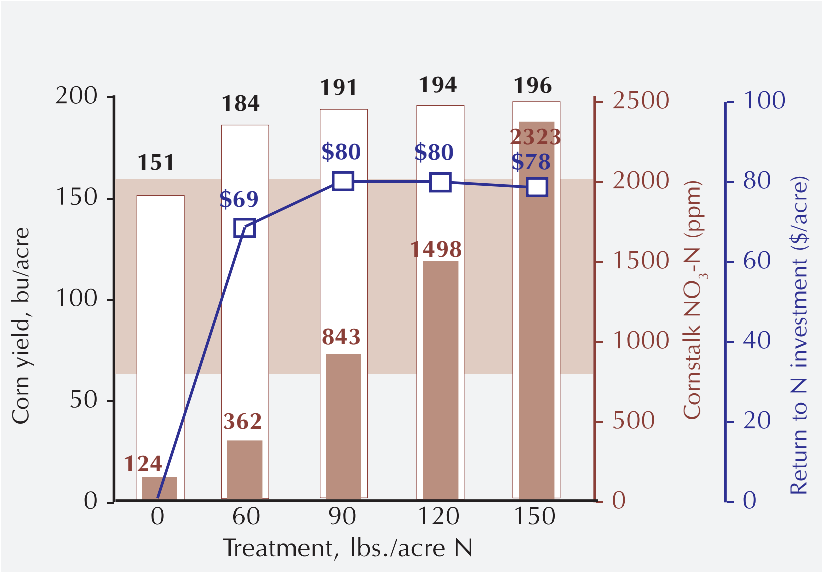


Figure 6. Corn yield, end-of-season cornstalk nitrate-N results and return to N investment from 18 field-scale N rate demonstrations, 2002-2004. The return to N investment is based on corn at $2.40/bushel and N at $0.20/lb.

yield monitor or by weighing each harvested treatment.

Figure 6 shows corn yield, residual nitrate-N and return to N from 18 field-scale N demonstrations. The white bars show the average yield for each of the five N treatments, ranging from 151 to 196 bushels per acre.

Residual nitrate-N in the cornstalks following corn maturity was measured for all N treatments, shown as the brown bars in the graph. To measure the residual nitrate-N in the cornstalks, fifteen 8-inch segments of the lower stalk were collected from each N treatment and sent to a certified laboratory. To learn more about the end-of-season stalk test please turn to page 16.

The zero check and 60 pounds N per acre treatments did not have enough N available to optimize corn production. Both the 90 and 120 pounds N per acre rates were within the optimum range of 700 to 2,000 parts per million (ppm), while the 150 pounds N per acre rate showed excess N remaining in the corn plant after maturity.

The optimum range for cornstalk nitrate-N of 700-2,000 ppm, marked by light-brown rectangles in the background, indicates a high probability that the appropriate N rate was applied to the crop to provide the most profitable return on the N investment.

The average return to dollars spent for N fertilizer, priced at 20 cents per pound and corn at $2.40 per bushel, is shown as the blue line on the graph. The best return to N fertilizer, $80 per acre, was at the 90 and 120 pounds N per acre rates. Application of N at rates higher than 120 pounds N per acre showed a reduction in net return to the N investment.

Small-plot N demonstrations

To implement the smaller N demonstrations, six rates (zero, 30, 60, 90, 120 and 150 pounds N per acre) of N were applied at planting to replicated plots in one-half acre, uniform soil type demonstration sites. Each treatment covers a 15- by 40-foot area and is repeated three times at each location. Ammonium nitrate was used as the N source because of its non-volatile nature. Figure 7 details corn yield, residual nitrate-N and return to N from 19 N management demonstrations. Average yield for the 90, 120 and 150 pounds per acre rates all exceed 190 bushels per acre, shown by white bars. As with the field-scale N demonstrations, end-of-season cornstalk nitrate-N was measured at harvest for all N treatments. The residual nitrate-N is lower at all N rates than in the field-scale study due mostly to the N source being surface-applied rather than incorporated mechanically. However, the resulting trend of higher residual nitrate-N when more N is applied is the same both large and small-plot demonstrations.

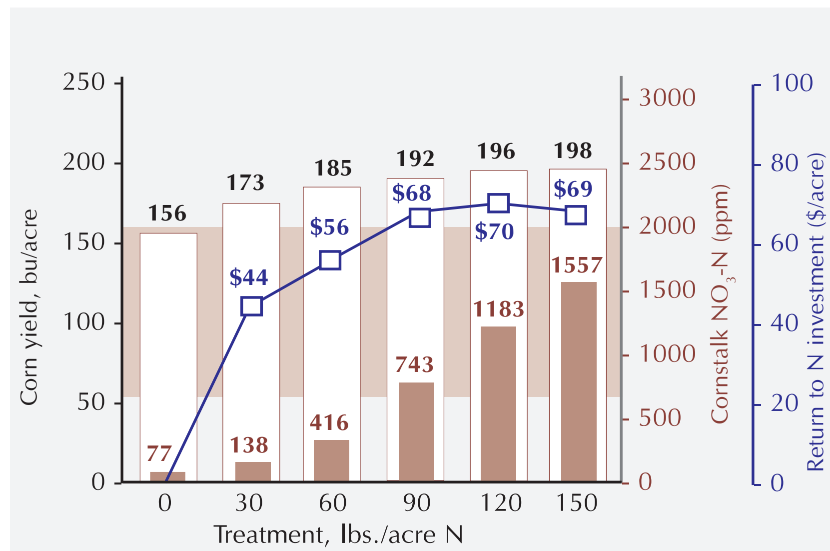


Figure 7. Corn yield, end-of-season cornstalk nitrate-N results and return to N investment from 19 small-plot N rate demonstrations on corn-following-soybeans, 2000-03. (Corn at $2.40/bushel and N at $0.20/lb.)

The end-of-season cornstalk nitrate N test

Cornstalk residual nitrate levels are an indicator of whether or not the nitrogen supply was adequate for corn development. The test measures nitrate concentration in the lower portion of the cornstalk at the end of the growing season.

The basis of the test is that a corn plant suffering from inadequate nitrogen availability removes nitrogen from the lower cornstalk and leaves during grain filling. If the plant has more nitrogen than needed for maximum yields, nitrate accumulates in the lower stalks at the end of the season.

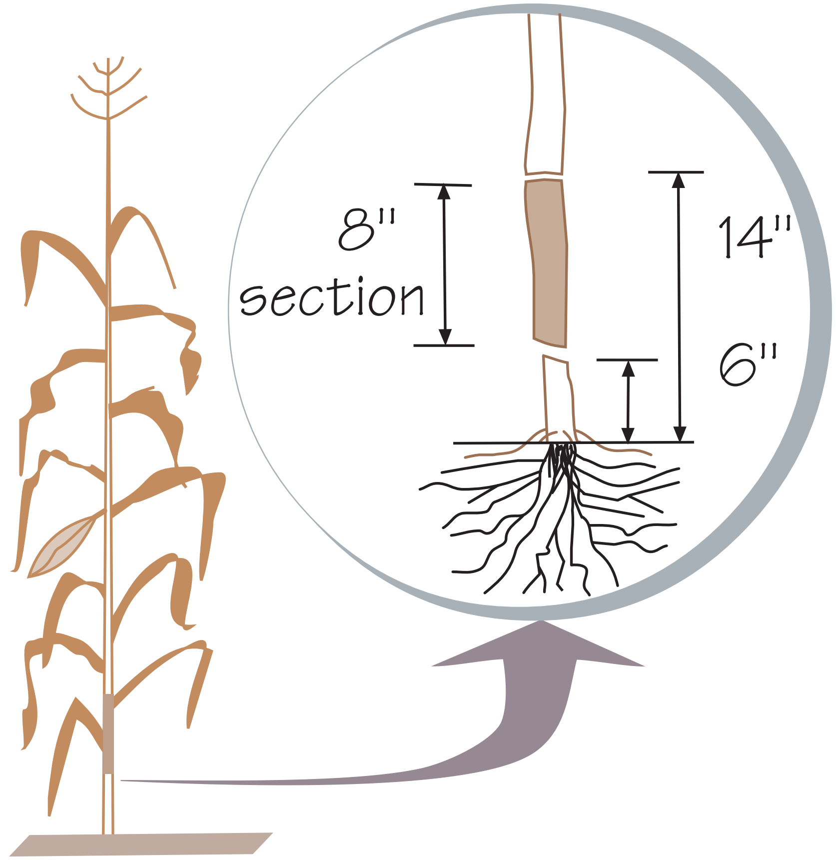
Test results are returned from the testing lab as parts per million nitrate nitrogen. A scale for evaluating your results is shown below.

Producers can use this information to determine whether or not their corn crop had adequate nitrogen late in the growing season. While the cornstalk nitrate N test is a valuable tool to evaluate nitrogen management, drastic changes in nitrogen managment should not be made with just one year's results. Annual sampling can provide trends of residual nitrate levels over time, accounting for seasonal variability, ultimately increasing the confidence in refining nitrogen management.

Try using the end-of-season stalk nitrate test to compare two nitrogen management practices, such as two nitrogen rates or manure versus manure plus some rate of commercial nitrogen.

Table 3. End-of-season cornstalk nitrate test.

	Excessive stalk N (>2000 ppm): N level is in excess of what the crop needed for normal development, grain yield is maximized and additional N would not be used by the crop
2000 ppm	
	Optimal stalk N (700-2000 ppm): N availability close to the rate needed to maximize yield, return to applied N was optimized, additional N would not have increased yield enough to recoup the cost of the additional N
700 ppm	
	Marginal stalk N (250-700 ppm): N level is close to the minimal amount needed, additional N may or may not have increased yield
250 ppm	
	Low stalk N (<250 ppm): additional N would have likely increased yield



Here's how to collect samples:

Cut an 8-inch segment of stalk beginning 6 inches above the soil. Optimum time for sampling is when the corn is between one to three weeks after black layer formation. Remove the leaf sheaves.

Do not sample stalks severely damaged by disease or insects.

Fifteen 8-inch segments make up a single sample. Areas of a field differing in soil types or management history should be sampled separately.

Place the samples in paper (NOT PLASTIC) bags and send to the lab as soon as possible. If it's not possible to send the samples to the lab within one day of removing them from the stalk, place them in the refrigerator — but don't let them freeze.

Contact the Maquoketa Watershed Project staff or your local ISU Extension staff for a list of labs doing the end-of-season cornstalk nitrate nitrogen test.

Online resources for manure, phosphorus and nitrogen management

ISU Extension Maquoketa River Watershed Project
http://extension.agron.iastate.edu/waterquality/projects/maquoketa.html

Iowa Manure Management Action Group (IMMAG)
http://extension.agron.iastate.edu/immag

Iowa DNR Animal Feeding Operations
http://www.iowadnr.com/afo/index

ISU Odor and Nutrient Management Newsletter
http://www.exnet.iastate.edu/Pages/communications/EPC

Iowa State University Agronomy Extension
http://extension.agron.iastate.edu

EPA Animal Feeding Operations (AFO) Virtual Information Center
http://cfpub.epa.gov/npdes/afo/virtualcenter.cfm

Heartland Regional Water Quality Coordination Initiation
http://heartlandwq.iastate.edu

Natural Resources Conservation Service
Conservation Security Program
http://www.ia.nrcs.usda.gov/programs/csp.html

Iowa Department of Agriculture and Land Stewardship
http://www.agriculture.state.ia.us

Iowa Corn Growers Association
http://www.iowacorn.org

Iowa Pork Producers Association
http://www.iowapork.org

Midwest Plan Service
http://www.mwpshq.org

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Phosphorus (P) recommendations for corn and soybean production

Table 4. ISU phosphorus application recommendations.

	P soil test (ppm)[a]				
Soil test category	Very low	Low	Optimum	High	Very high
Bray P, and Mehlich-3 P					
Low subsoil P	0-8	9-15	16-20	21-30	31+
High subsoil P	0-5	6-10	11-15	16-20	21+
Olsen P					
Low subsoil P	0-5	6-10	11-14	15-20	21+
High subsoil P	0-3	4-7	8-11	12-15	16+
Crop	P_2O_5 to apply (lbs/acre)				
Corn	100	75	55	0	0
Soybean	80	60	40	0	0

[a] The recommended amounts of P_2O_5 for the optimum test category are based on nutrient removal for the reported yield. The amounts shown in the table for the optimum soil test category are for 150 bu corn grain per acre or 55 bu soybean per acre which will be used if no yield goals are given on the information sheet.
Recommendations for soils with a corn suitability rating (CSR) of 30 or less will be based on expected crop yield and nutrient removal for soil test categories of optimum or lower.

Thank you to all the field demonstration cooperators. Without their extra efforts this valuable information would not be available.

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The Iowa Corn Growers Association provided support for this project with funds targeted to assist Iowa producers in exploring and refining nutrient management options through coordinated field demonstrations on their own farms.

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