Balanced Fertility Still Pays in Irrigated Corn

By Mike Stewart, Steve Phillips, Terry Kastens, and Dietrich Kastens

Just a few years ago we were asking questions about the value and economics of fertilization (Stewart, 1999). Today we are asking similar questions, but for much different reasons. Not that long ago we were facing depressed crop prices that caused many to question whether cutting fertilizer rates was advisable. However, over the past year or two grain prices have reached dizzying heights, and fertilizer and other input prices have followed. Although circumstances are dramatically different, the questions being asked are similar, viz.: "Should I reduce fertilizer rates in response to the current price environment?" Thus, it is time again for a review of the role of nutrient inputs in crop production systems, particularly irrigated corn in this instance.

Fertilizer N prices have changed dramatically over the past few years (**Figure 1**). As prices have escalated, questions about application rates have followed. Agricultural economists at Kansas State University (KSU) have developed an Excel spreadsheet crop budget tool (Dhuyvetter et al., 2006) where, based on crop and fertilizer prices, optimal (profit maximizing) fertilizer N and irrigation levels can be determined for corn, soybean, wheat, sorghum, sunflower, and alfalfa. This tool is particularly useful to evaluate the relative impact of changes in N price across grain prices.

Figure 2 shows an example for irrigated corn production (250 bu/A yield goal) using default values in the program and varying corn and N fertilizer prices across a wide and relevant range. This evaluation reveals some key points. As crop price increases, the impact of increasing N fertilizer price on optimal rate of application diminishes, as evidenced by the convergence of the lines in **Figure 2** from left to right. In other words, N price does impact optimal rate of application, but that impact is diminished with increased grain price. Indeed, there is little difference in predicted optimal N application rate at \$3.50/bu corn and \$0.25/lb N compared to \$5.50 corn and \$0.75 N…the difference is only 14 lb N/A. Granted, the outlay and risk involved in today's environment is significantly higher than a few years ago, but the most profit producing N rate has not changed much.

The importance of balancing N with other nutrient inputs is often emphasized. One of the best ways to ensure the production of optimal yields and efficient use of N and other fertilizer inputs is through complete and balanced fertilization. Results from a recent high-yield irrigated corn study (Gordon, 2005) in north central Kansas have demonstrated how balance among N, P, K, and S can impact yield (**Figure 3**). Nitrogen was kept at a constant and non-limiting level (300 lb/A) as P, K, and S were added. Notice the "stair-step" effect as a more complete nutrient input program was put into place. Using the response data from this example, and assuming that N cost is \$0.60/lb, P_2O_5 is \$0.90/lb, K_2O is \$0.50/lb, S is \$0.80/lb, and corn price is \$5.50/bu, a very simple analysis of return on fertilizer investment shows that N alone returned \$211/A while the complete treatment (N+P+K+S) returned \$533/A. Thus, even in a relatively recent price scenario, balanced fertility still has the potential to pay handsomely.

The addition of P, K, and S in the previous example obviously impacted how much of the applied N was utilized to produce yield. **Figure 4** shows how improving nutrient balance impacted apparent N fertilizer recovery efficiency. Recovery efficiency for the fertilizer treatments in this example was determined by estimating how much N was taken-up by the crop over the zero N control, assuming N uptake of 1.4 lb N/bu grain produced, then dividing that by 300 (lb N fertilizer applied). While this is a crude estimation, it nevertheless serves a

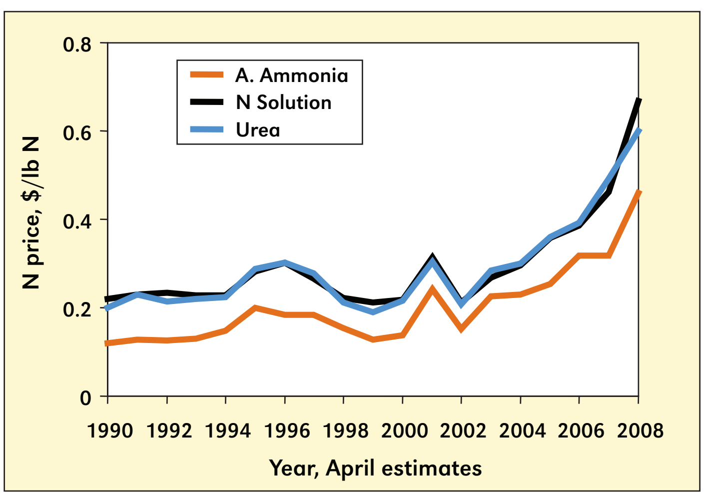

Figure 1. Price per pound of N for major fertilizer materials, April estimates, 1990-2008. (Source: USDA/ERS, 2008.)

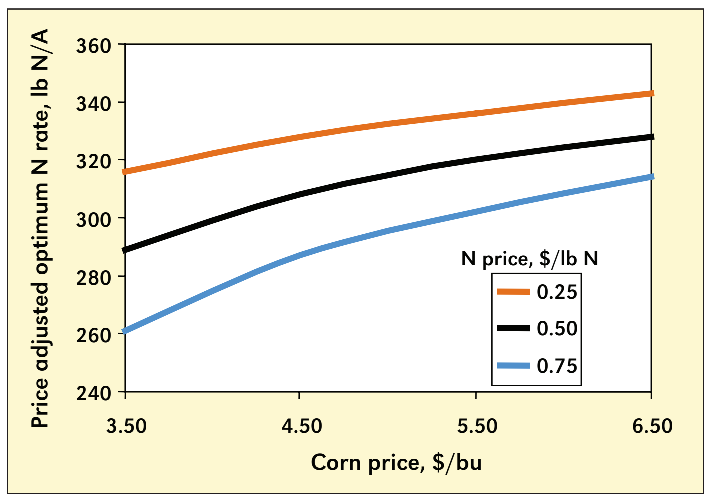

Figure 2. Estimated impact of corn and N fertilizer price on optimal rate of N application for irrigated corn. Assumes 250 bu/A yield goal, 2% organic matter, and 20 lb NO_3-N/A. (Source: derived from Dhuyvetter et al., 2006.)

Abbreviations and notes for this article: N= nitrogen; P = phosphorus; K = potassium; S = sulfur.

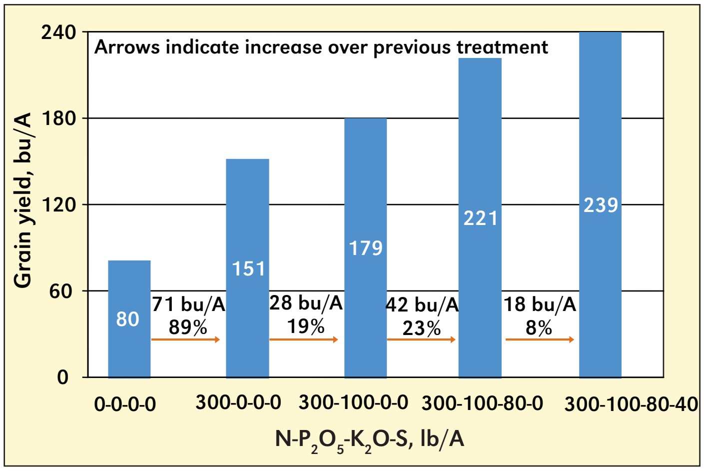

Figure 3. The impact of fertility treatments on irrigated corn yield in north central Kansas, Carr sandy loam, 2-year average (Gordon, 2005).

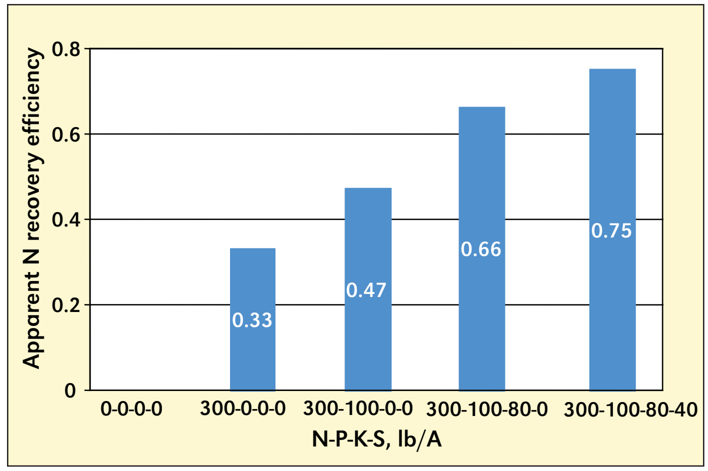

Figure 4. The impact of improving fertility balance on apparent N recovery efficiency in irrigated corn production in north central Kansas; Carr sandy loam, 2-year average, assumes 1.4 lb N uptake per bu (after Gordon, 2005).

purpose. Notice that, compared to N alone, the complete program improved apparent N use efficiency by over two-fold, from 0.33 to 0.75. This is equivalent to more than doubling the "bang for the N buck" by simply attending to other nutrient needs.

The north central Kansas irrigated corn example discussed above is from a single location and is used to demonstrate how crop nutrition can impact production and returns in the current environment. Therefore, one should not necessarily use the fertilizer rates in this example to guide decisions in other production environments. Nutrient application decisions should, as always, be based on information such as realistic yield goals, soil test results, plant analysis, cropping history and nutrient budgets, and experience. Tools such as the previously discussed KSU crop budget calculator can be useful as well. Along with establishing the right rate and balance of nutrients, it is important to consider other fertilizer best management practices that take into account right timing, placement, and source. Furthermore, the adoption of appropriate site-specific management tools is another option that is increasingly feasible as production systems evolve and adapt to meet greater demands and challenges. BC

Dr. Stewart (e-mail: mstewart@ipni.net) is IPNI Southern and Central Great Plains Region Director, located at San Antonio, Texas. Dr. Phillips is IPNI Southeast USA Director, located at Owens Cross Roads, Alabama. Dr. Kastens is Extension Agricultural Economist, Farm Management, at Kansas State University. Dietrich Kastens is a farmer located at Herndon, Kansas.

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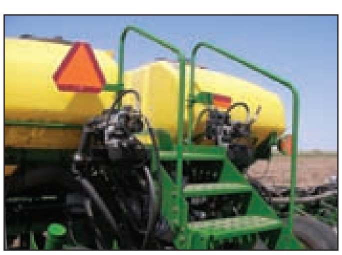
Kastens Inc. Farms in Rawlins County, Kansas, uses a 24-row planter for corn and grain sorghum. Liquid N (32-0-0) and liquid P_2O_5 (10-34-0) are variable-rate applied. Prescription maps are generated in the office and then imported into a controller that accomplishes the rate changes, product application documentation, and section control functions. "We carry 850 gal. of 10-34-0 and 1,300 gal. of 32-0-0 in the field...They are blended into a common product that is delivered through single disk openers set 4 in. off row and 2 in. deep," explains Dietrich Kastens.



On the Kastens Farms' planter, two diaphragm pumps (one for 10-34-0 and one for 32-0-0) are hydraulically controlled.

Two-product variable rate application and section control is handled by AgLeader Insight in the tractor cab.