Starter Fertilizer Response on High and Very High Testing Soils

By L.G. Bundy and T.W. Andraski

Fertility research often emphasizes that the probability of crop response to added nutrients is minimal at high to very high soil test phosphorus (P) and potassium (K) levels. Such relationships have been established primarily by examining broadcast applications of nutrients. However, starter fertilizers present a different scenario. The placement of nutrients close to the plant makes them positionally available for uptake early in the plant's development. Probably for this reason, responses to starter fertilizer have been observed across a wide range of soil tests, including high to very high levels.

> Research shows that responses to starter fertilizer are possible where application at late planting dates of long-season hybrids appears to hasten maturity and increase yield potential.

This study investigated corn responses to starter fertilizer through replicated on-farm trials conducted at 100 locations in Wisconsin from 1995 through 1997. Ninety-three percent of the soils were in the very high soil test P category, and 73 percent were in the very high soil test K category. A 2x2 placement (2 in. below and 2 in. to the side of the seed) of starter fertilizer was compared to no starter. The average starter rate was 15-26-32 lb nitrogen (N)-P_2O_5-K_2O/A. A few of the sites had additional nutrients...sulfur (S), zinc (Zn), and magnesium (Mg), but yield response differences compared to NPK alone were not apparent. Cooperating farmers paid an average of $14.05/A for starter fertilizer, with costs ranging from $8.17 to $30.00/A.

The effects of starter fertilizer on grain yield, grain moisture, and early-season plant height averaged across sites for individual years and the three-year period are shown in **Table 1**. Starter fertilizer significantly increased yield by an average of about 4 bu/A in each of the three years. Yield response ranged from -10 to +42 bu/A. Using starter fertilizer resulted in significantly lower grain moisture contents (0.1 to 0.3 percent) in two of the three years, indicating

TABLE 1. Effect of starter fertilizer on average corn grain yield, grain moisture, and early-season plant height (approximately eight weeks after planting) from 100 on-farm trials, 1995-1997.

Measurement	Year	Number of observations	Starter fertilizer Without	With
Yield, bu/A	1995	44	127	131**
	1996	31	137	142**
	1997	25	144	147**
	Mean	100	134	138**
Moisture, %	1995	44	22.2	22.1
	1996	31	26.1	25.9†
	1997	25	27.6	27.3†
	Mean	100	24.8	24.6**
Height, in.	1995	44	48.3	50.5**
	1996	25	50.2	52.4**
	1997	20	55.9	57.4*
	Mean	89	50.6	52.6**

**, *, † Indicates significant at the 0.01, 0.05, and 0.10 probability levels, respectively.

accelerated plant growth or development resulting in earlier crop maturity. Early season plant height measurements taken about eight weeks after planting showed a significant effect of starter fertilizer in all years. Average plant heights were about 2 in. greater where starter fertilizer was applied.

Positive economic responses were considered to be those greater than or equal to 4.5 bu/A. This evaluation assumed corn at $2.50/bu and $10/A for starter fertilizer. The percentage of sites which had a positive economic response was 32 percent in 1995, 45 percent in 1996, and 48 percent in 1997. Grain moisture averaged 24.7 percent for sites with a positive economic response and 24.5 percent for those without. Average early-season plant height was similar between the two economic response categories. These results suggest that taller plants associated with the addition of starter fertilizer during the early part of the growing season did not necessarily translate into profitable yield responses.

Several variables were analyzed to determine if they contributed to the starter responses observed. They were soil pH, manure history, P rate in starter fertilizer, soil organic matter, surface residue, subsoil fertility group, soil texture, corn production zone, previous crop, soil test P, N rate in starter fertilizer, tillage, row spacing, K_2O rate in starter fertilizer, year, soil yield potential, planting date, soil test K, and relative corn maturity. Only the effects of soil test K level and corn hybrid relative maturity significantly affected the percentage of responsive sites. An initial analysis determined that relative maturity considered alone did not have a strong relationship to starter response ($r^2 = 0.05$). However, when planting date was also included, the two factors accounted for more of the yield variability. The inclusion of planting date was based on previous research showing this to be an important factor. The effects of planting date (PD) and relative maturity (RM) were combined by adding the planting date in Julian days to the relative maturity, creating a PDRM value. The PDRM value was better correlated to yield response (**Figure 1**). This relationship shows that the probability of a profitable response increases for longer season hybrids planted later (greater PDRM values). Response probabilities were also separated by soil test K level (**Figure 2**). Lower soil test K levels [below 140 parts per million (ppm)] resulted in higher overall probabilities of profitable responses.

Table 2 summarizes the probability of obtaining a positive economic return from starter fertilizer for several corn hybrid RM ratings at various planting dates on soils with very high soil test P and K levels. For example, the probability of a positive economic return from starter for a 90-day corn hybrid would be 10 percent if planted on April 25

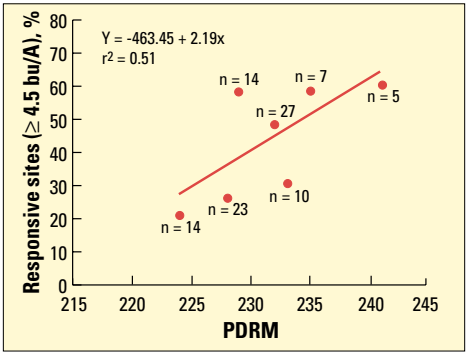

Figure 1. Relationship between planting date in Julian days (PD) plus corn relative maturity (RM) and the percentage of sites with a profitable yield response to starter fertilizer, 1995-97 (n = number of observations in each PDRM grouping).

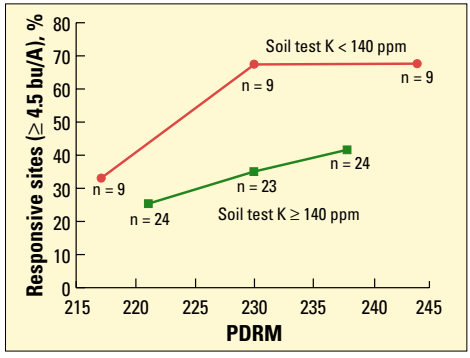

Figure 2. Effect of soil test K level on the relationship between PDRM and the percentage of sites with a profitable yield response to starter fertilizer, 1995-97 (n = number of observations in each PDRM grouping).

Information Agriculture Conference Set for August 7-9, 2001

The popular Information Agriculture Conference series continues with InfoAg 2001 scheduled for August 7, 8 and 9. Organized by PPI/PPIC/FAR, InfoAg 2001 will take place at the Adam's Mark Hotel – Airport, Indianapolis, Indiana.

Dr. Harold F. Reetz, Jr., PPI Midwest Director, is serving as conference planning coordinator. With over 70 hours of presentations and workshops, the program will include updates on machinery, data analysis techniques, yield mapping, remote sensing, variable-rate application, site-specific nutrient management, communications options, simulation tools, and more. As with previous Information Agriculture Conferences, an exhibit area will feature some of the latest in site-specific systems, data management, and communications technology. There will also be a return of the special CyberDealer sessions targeting the business aspects of incorporating site-specific management systems into services of retail supply and consulting businesses.

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TABLE 2. Probability of obtaining a positive economic return from starter fertilizer to corn for several corn relative maturity ratings at various planting dates on soils with very high P and K levels.

	Planting date							
Relative maturity	**4/25**	**5/1**	**5/5**	**5/10**	**5/15**	**5/20**	**5/25**	**5/30**
	probability, %							
90	10	15	20	25	30	35	40	45
95	15	20	25	30	35	40	45	50
100	20	25	30	35	40	45	50	55
105	25	30	35	40	45	50	55	60
110	30	35	40	45	50	55	60	65

and increase to 45 percent if planted on May 30. For a longer-season hybrid, such as 110-day corn, the probability of a positive economic return would be 30 percent if planted on April 25 and increase to 65 percent if planted on May 30.

Corn response to starter fertilizer has traditionally been associated with cool, wet growing conditions. This research indicates that planting date and relative maturity are also important factors. While soil test K appeared important for determining probability of response, soil test P was not. This study demonstrates that responses are possible, and in some cases highly probable, where starter applied at late planting dates of long-season hybrids appears to hasten maturity and result in greater yield potential, even on very high testing soils.

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