Corn Response to Starter Fertilizer: Planting Date and Tillage Effects

By L.G. Bundy and P.C. Widen

Corn yields are often increased by starter fertilizer at early planting dates. Data in this study also indicate substantial yield benefits from starter use can occur at late May planting dates, particularly in no-till.

CORN YIELD RESPONSES to row-applied starter fertilizer are frequently reported in northern corn production areas.

These responses are often attributed to the role of starter fertilizer in compensating for the reduced root growth and nutrient availability in cold soils with early planting or in reduced tillage. However, observations from on-farm demonstrations and research trials suggest that the probability of yield response to starter fertilizer is reduced at the higher soil temperatures normally associated with later planting dates, and at high phosphorus (P) and potassium (K) soil test levels.

The economic implications of starter fertilizer use with various planting dates and in tillage systems have not been determined. In fact, corn yields in Wisconsin are usually increased by early planting and use of starter fertilizer, indicating that overall profitability in many production situations can be optimized by their use.

Grain moisture at harvest can also be influenced by planting date. Potential differences in drying costs should be considered in the economic evaluation of starter fertilizer use alternatives. The specific objectives of this evaluation of tillage and planting date effects on corn response to starter fertilizer treatments are listed below.

Objectives

- Determine corn yield response to row-applied starter fertilizer at a range of planting dates.
- Compare response to starter fertilizer in no-till and conventional tillage at each planting date.
- Study the effects of starter fertilizer composition on crop response by evaluating growth, yield, and nutrient uptake obtained with various combinations of nitrogen (N), P, and K.
- Determine economic returns from starter fertilizer use at various planting dates based on yield, fertilizer costs, and grain drying costs associated with various treatment combinations.

Materials and Methods

An experiment designed to evaluate planting date and tillage effects on corn response to starter fertilizer was conducted on the University of Wisconsin Research Station at Arlington from 1989 to 1991. The soil at the experimental site was a Plano silt loam. The site had been in continuous corn for at least 10 years. During this period, fertilizer P and K applications were approximately equal to crop removal.

A split-split plot design, replicated four times, was used with tillage (no-till or moldboard plow) designated as the main plot treatment. Individual plots were four rows (10 ft.) wide and 30 ft. long. In the moldboard plow tillage system, fall

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plowing was used with seedbed preparation by disking shortly before planting. Subplot treatments were four planting dates (late April, early, middle, and late May). A single hybrid, of 95-day relative maturity (Kaltenberg brand 5200), was used at all planting dates each year. Seeding rates were adjusted so that stands could be hand thinned to a uniform density of 24,000 to 26,000 plants/A after emergence in all treatments.

Sub-subplot treatments were four starter fertilizer additions applied at planting in a 2 x 2 placement (10 + 0 + 0, 10 + 25 + 0, 10 + 0 + 25 and 10 + 25 + 25 lb/A of N, P_2O_5 and K_2O, respectively). Ammonium nitrate (34-0-0), triple superphosphate (0-46-0), and potassium chloride (0-0-60) were used as nutrient sources. Prior to the first planting date, anhydrous ammonia was injected to provide 180 lb N/A in all treatments.

Before the first planting each year, soil samples were taken throughout the experimental area to determine initial soil test levels. Surface samples (0-to-6 inch depth) were analyzed for pH, organic matter, available P, and exchangeable K. Average initial soil test values were: pH, 6.4; P, 25 parts per million (ppm); and K, 98 ppm. Weekly plant height measurements were made in all plots until tasseling. A measurement of the percent total residue cover was made early in the growing season. Grain yields were determined by machine harvest of the middle two rows of each plot. A subsample of grain from each plot was retained for moisture measurements.

Results and Discussion

Plant height effects. The effects of starter fertilizer on plant height were most apparent in no-till at late May planting dates. Starter fertilizer had little effect on plant height at the other tillage-planting date combinations. These results show that starter fertilizer promotes more rapid crop growth in late no-till plantings. Plant height during July was consistently increased by starter fertilizer additions in each year. The largest response usually occurred when the starter fertilizer contained both P and K.

Grain yield effects. Starter fertilizer, planting date, and tillage treatments significantly affected grain yields (**Figure 1**). The moldboard plow tillage system grain yields were significantly higher than no-till except in 1991.

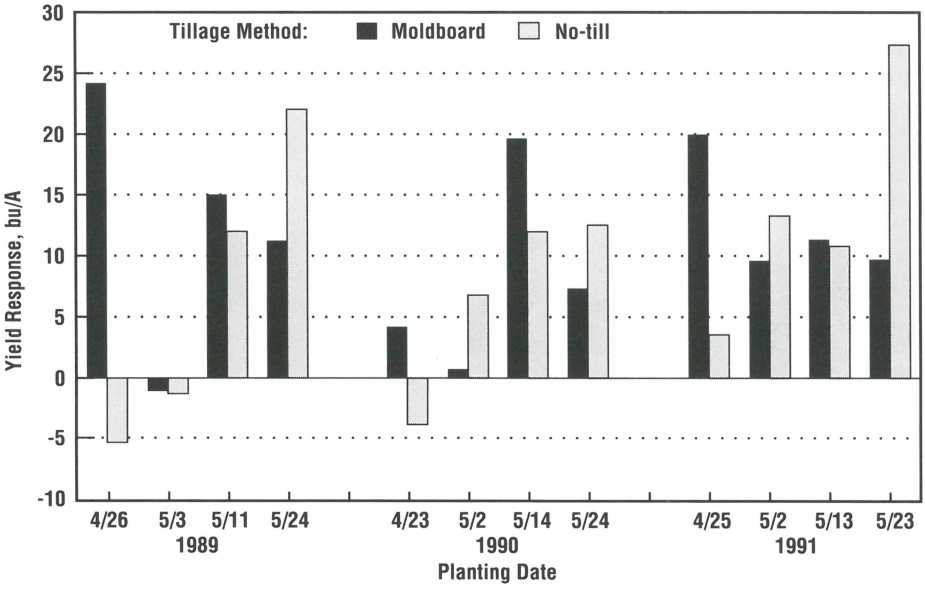


Figure 1. Starter fertilizer, planting date, and tillage treatments significantly affected corn grain yields (Wisconsin).

Planting date had a significant effect on grain yield. In most cases, early planted corn in both tillage systems produced the highest yields. Starter fertilizer treatments containing P and/or K usually increased yields relative to the control (no P or K) treatment. Starter treatments that contained P alone or both P and K usually produced the highest corn yields.

The importance of using a starter fertilizer containing both P and K is apparent from the data. Yields with this treatment were usually higher than with other starter fertilizer additions. These data suggest that, for early plantings in a moldboard plow system, using starter fertilizer that contains both P and K will produce the highest corn yields. It also suggests that yields from corn planted in late May can be significantly increased if starter fertilizer containing both P and K is used. The no-till data are similar to those in the moldboard plow system in that yields can be increased with starter fertilizer at late May planting dates, but higher yields will usually be obtained with earlier planting dates.

Grain yield responses to starter fertilizer in two tillage systems at four planting dates each year were determined by comparing yields in the control with yields where the starter fertilizer contained both P and K. Starter fertilizer increased grain yields in 20 of 24 comparisons. Positive responses to starter fertilizer ranged from 0.6 to 27 bu/A, while negative responses ranged from 1 to 5 bu/A.

Grain moisture effects. Grain moistures were significantly higher at the late-May planting dates in both tillage systems, except in 1990 where the mid-May planting date grain moistures were highest. Higher grain moistures at the later planting dates are due to the shorter growth and development period available to the crop. Starter fertilizer use usually lowered grain moisture relative to the control (no P or K) treatment. Fertilizers containing P alone or both P and K were most effective in reducing grain moisture at harvest. The effect of starter fertilizer on grain moisture is most apparent in the no-till system at the later planting dates, and is likely due to more rapid crop development where starter fertilizer was applied.

Economic analysis of starter fertilizer use. An economic analysis of starter fertilizer use at four planting dates in two tillage systems is shown in **Figure 2**. Returns

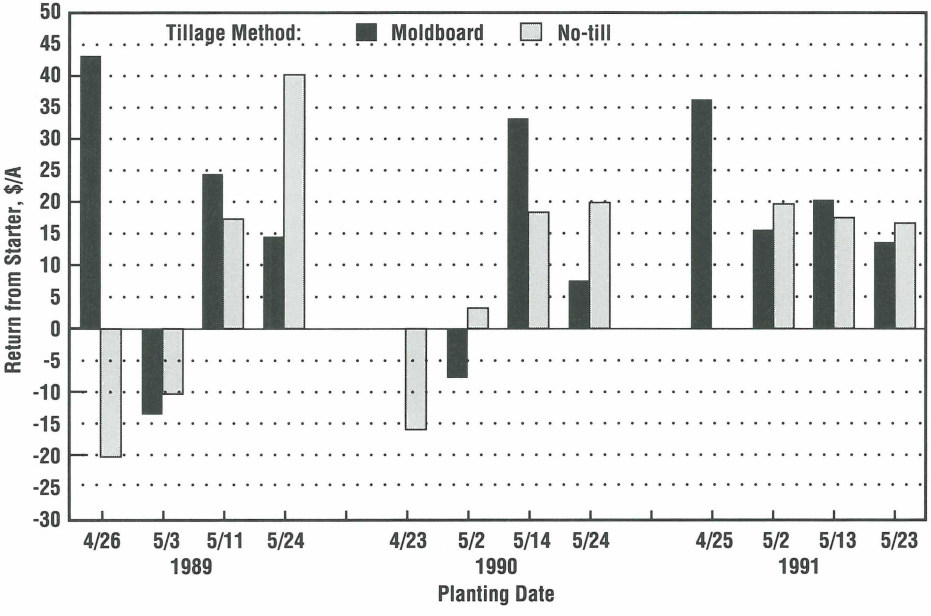
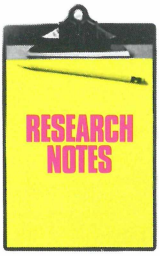


Figure 2. Economic benefits varied among planting dates and tillage systems, but starter fertilizer use was profitable in most comparisons (Wisconsin).

from starter fertilizer use were calculated using a $2.25/bu value for corn and a $10.00/A cost for the starter fertilizer application containing 25 lb/A of both P_2O_5 and K_2O. Grain drying costs were calculated at $0.02/bu for each 1 percent moisture above 15 percent. For each planting date and tillage, net returns with and without starter fertilizer were compared to determine the economic benefits from starter fertilizer use. Although economic benefits varied among planting dates and tillage systems, starter fertilizer use was profitable in 19 of 24 comparisons. Economic benefits from starter fertilizer ranged from $3 to $43 per acre, while losses from starter fertilizer ranged from $8 to $20 per acre.

Summing Up

These findings indicate that starter fertilizer use is likely to be highly profitable across a range of planting dates and tillage systems. ■



Foliar Boron Fertilization of Soybeans

RESEARCHERS from five states met recently in Atlanta to discuss progress on a coordinated project dealing with boron (B) fertilization of soybeans. A common protocol has been developed to examine rates of foliar B application based on earlier studies at the University of Missouri. Participants in this multi-state project include Drs. Dale Blevins and Paul Tracy of the University of Missouri, Bob Hoeft, University of Illinois, Ed Oplinger, University of Wisconsin, Jay Johnson, Ohio State University, and Gary Gascho, University of Georgia.

Studies in 1991 indicated that a rate of 0.25 lb/A foliar B seemed to produce the most consistent yield effects. Results indicated a need to further evaluate differing responses in soybean cultivars, multiple B rates at a single, early application date, and possible examination of a band (soil application) at early trifoliate.

Support for this research is being provided by the Foundation for Agronomic Research and U.S. Borax. ■

Correction for Summer 1991 Issue

AN ERROR appears in a formula shown in **Figure 1** on page 26 of the Summer 1991 issue of *Better Crops With Plant Food,* part of an article titled "Optimum Phosphorus Management for Small Grain Production." The graph itself was correctly presented, but the formula appearing with it had a division sign (/) omitted.

The graph with the correct formula appears at right. For more information on spring wheat response to soil test phosphorus (P) level in the northern Great Plains, contact Dr. Paul Fixen, North-central Director, Potash & Phosphate Institute (PPI), P.O. Box 682, Brookings, SD 57006. ■

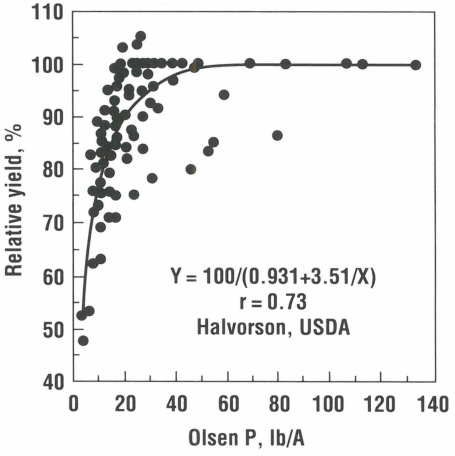


Figure 1. Spring wheat response to soil test P level in the northern Great Plains.