

by Drs. W.B. Gordon and D.A. Whitney

# Starters Bump Sorghum Yields 18 Percent

Kansas researchers also find fluid starters applied at right N:P ratio improve early-season growth and hasten maturity.

**Summary:** Use of starter fertilizers has become common in conservation tillage corn, but little attention has been given to starter nutrient ratios for no-tilled grain sorghum. We therefore initiated field research from 1991 through 1993 in North Central Kansas to evaluate the effect of different N:P starter ratios on grain sorghum production. Averaged over three years of the study, starter combinations providing either a 1:1 or 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio shortened the time from emergence to mid-bloom and increased yield by 18 percent over our 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio broadcast check. These yield increases were consistent for the two different planting dates we established. Results demonstrated that early-season growth and yield can be improved with a 1:1 or 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio versus the 1:3 (10 lbs/A of N with 30 lbs/A of phosphate) N:P<sub>2</sub>O<sub>5</sub> ratio commonly used to grow grain sorghum in the central Great Plains.

In conservation tillage environments where below-optimum soil temperatures lower nutrient availability, starter fertilizers can place nutrients within the rooting zone of young seedlings for improved availability. In some experiments that have evaluated crop response to NP starters, improved early growth and increased yield were attributed to the P component of the combination. In others, N has been indicated as the most critical element in soils not low in P. A common practice in the central Great

Plains is to apply starter in an N:P ratio of approximately 1:3 (10-34-0 liquid) at a rate of approximately 100 lbs/A.

Some grain sorghum producers in the central Great Plains prefer to delay planting until mid-June to avoid drought and heat stress during the crop's

reproductive phase of development (July and early August).

However, late planting increases the risk of an early frost occurring before crop maturity. Starters can hasten maturity and avoid late-season low temperature damage.

Month	Year			
	1991	1992	1993	30-yr. avg.
April	3.07	1.57	2.58	2.47
May	3.90	2.18	3.21	4.07
June	3.17	4.73	4.61	4.31
July	0.74	8.63	17.89	3.86
August	1.78	3.64	4.79	3.78
September	0.81	3.22	2.44	3.37
October	0.74	4.95	1.14	2.19
Total	14.21	28.92	36.66	24.05

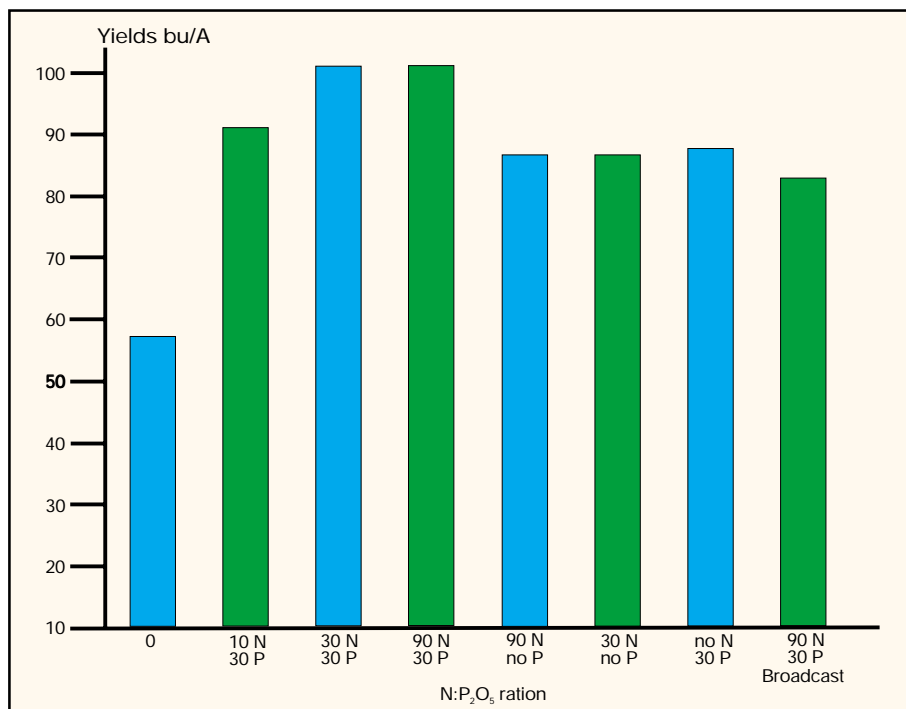


Figure 1. Effect of starter N:P<sub>2</sub>O<sub>5</sub> ratio on grain sorghum yield, Gordon and Whitney, Kansas State University, average. Of 1991-93

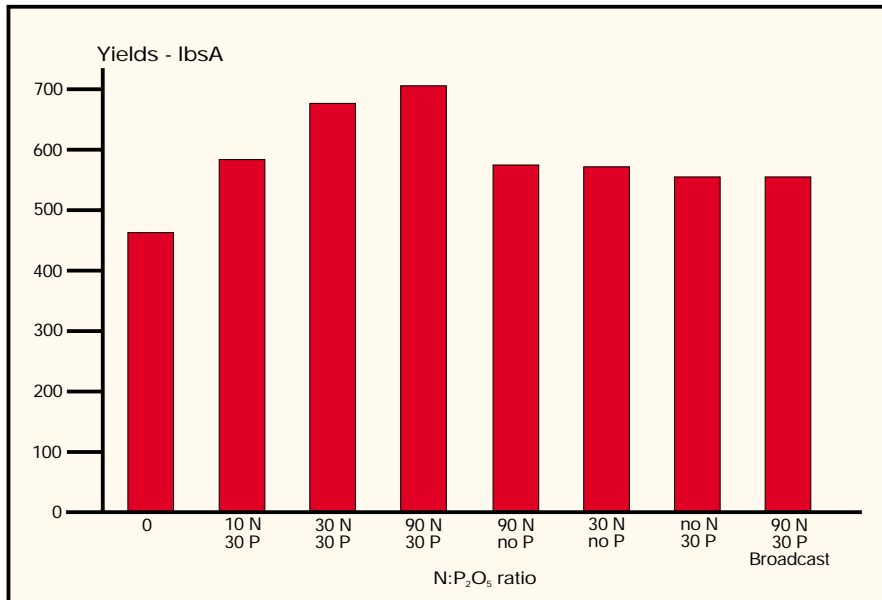


Figure 2. Effect of starter N:P<sub>2</sub>O<sub>5</sub> ratio on 6-leaf stage whole-plant dry weight of sorghum, Gordon and Whitney, Kansas State University, average. Of 1991-93.

Planting early, on the other hand, poses equal risk. The grower's strategy to have sorghum head prior to mid-season heat and drought stress can be lost when cool soils slow crop emergence and growth. Again, starters can be helpful since they improve early-season growth in cool soils.

Our objective in this experiment was to evaluate no-till sorghum response to several NP starter combinations at two planting dates.

#### Effects of N:P ratio

**Yield.** When averaged over three years of our experiment, starter combinations that provided either 30 or 90 lbs/A of N with 30 lbs/A of phosphate (1:1 or 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio) increased yields 18 percent over the 90 lbs/A of N and 30 lbs/A of phosphate broadcast check (Figure 1). In two of the three years, the starter that supplied 10 lbs/A of N and 30 lbs/A of phosphate (1:3 N:P<sub>2</sub>O<sub>5</sub> ratio) also increased yield over the broadcast check treatment. When averaged over three years, however, the 1:1 and 3:1 N:P<sub>2</sub>O<sub>5</sub> ratios both yielded 10 bu/A more than the 1:3 N:P<sub>2</sub>O<sub>5</sub> ratio.

Even under very poor growing conditions (1991), starters at either the 1:1 or 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio increased yields over the broadcast check 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio. In 1991, rainfall was 41 percent of normal (Table 1). Note also only 0.74 inch fell in July. When averaged over all treatments, yields were only 23 bu/A.

Growing conditions turned nearly ideal in 1992, when total rain doubled that of 1991 (Table 1). Even the unfertilized check plot exceeded 100 bu/A. Again, starters at either the 1:1 or 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio improved yields when compared to broadcast check. Note also that in 1993 nearly 18 inches of rain fell in July alone (Table 1).

**Dry matter.** When averaged over three years of the study, only starters with 1:1 or 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio resulted in greater early-season dry matter production (6-leaf stage) than broadcast check (Figure 2). Treatments that supplied starters at 1:1 and 3:1 N:P<sub>2</sub>O<sub>5</sub> ratios increased dry matter production over broadcast check by 18 and 21 percent, respectively.

**P uptake** at the 6-leaf stage followed the same trend as dry matter production. When averaged over three years, the 1:1 and 3:1 N:P<sub>2</sub>O<sub>5</sub> ratios increased P uptake

over broadcast check by 23 and 26 percent, respectively. No other starter treatment resulted in any improvement in P uptake. It has been shown that when P is banded, N also is needed in the band for stimulation of P uptake. In our experiment, starter at the 1:3 N:P<sub>2</sub>O<sub>5</sub> ratio did not appear to provide enough N for maximum stimulation of P uptake. Starter at the 1:1 N:P<sub>2</sub>O<sub>5</sub> ratio was no more effective at increasing P uptake than that at the 3:1 N:P<sub>2</sub>O<sub>5</sub> ratio.

**Leaf concentrations.** In 1992 and 1993, starters at 1:1 and 3:1 N:P<sub>2</sub>O<sub>5</sub> ratios gave greatest leaf tissue P concentrations at heading. Leaf N concentrations were greater with starters applied at these same ratios when compared to broadcast check, but not significantly different from those with other combinations.

**Maturity.** When compared with broadcast check, starters applied at 1:1

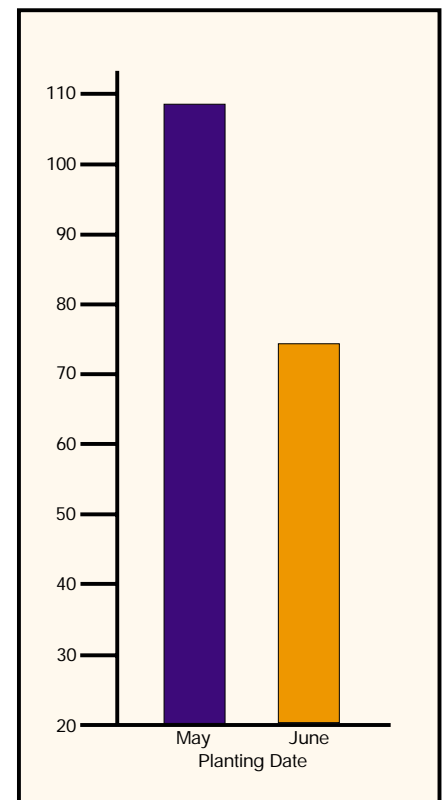


Figure 3. Effect of planting date on grain sorghum yield, Gordon and Whitney, Kansas State University, average. Of 1991-93.

and 3:1 N:P<sub>2</sub>O<sub>5</sub> ratios shortened the period between emergence and mid-bloom by 6 and 7 days, respectively.

### Effects of planting date

*Yield.* No significant planting date x starter fertilizer interaction occurred in any year of the test, indicating that grain sorghum yield response to starter fertilizer is independent of planting date. In other words, starter effects were similar regardless of the time the crop was planted. Yields, however, were lower with the June than the May planting (Figure 3). This was probably due to the effects of lower than optimum temperatures on grain fill.

*Dry matter* production was not affected by planting date.

*P uptake.* When averaged over three years, P uptake at the 6-leaf stage was 19 percent greater for the May planting than for the June planting.

*Leaf concentrations.* Leaf N and P concentrations were not affected by planting date.

### Methodology

*Soil.* Our studies took place near Belleville, Kansas, on a Crete silt loam soil. Soil pH was 6.1; organic matter content was 2.4 percent. Bray-I P and exchangeable K in the surface 6 inches

of soil were 24 (medium-high) and 380 (very high) ppm, respectively.

*Plots.* Experimental design was a split-plot replicated four times. Plots consisted of four rows 42 feet long and 30 inches apart. Whole plots consisted of planting dates (mid-May and late-June). Subplots were combinations of N and P starters (0, 10, 30, or 90 lbs/A of N, with or without 30 lbs/A of phosphate, plus a check (no fertilizer) and broadcast NP treatment.

*Placement.* Starter fertilizer treatments were knife-applied at planting in a band 2 inches to the side and 2 inches below the seed. Immediately after planting, surface broadcast applications were made to all plots, except the unfertilized plots, to bring the total amount of fertilizer applied to 90 lbs/A of N and 30 lbs/A of phosphate

*Fertilizer.* Fertilizer combinations consisted of 28% UAN, ammonium polyphosphate (10-34-0), laboratory grade phosphoric acid (85% H<sub>3</sub>PO<sub>4</sub>), and water. Each combination was mixed separately and diluted so that 40 gal/A of material was applied, regardless of N and P rates.

*Planting.* Pioneer 8699 was planted each year at 50,000 seeds/A using a New Idea 9700 air planter equipped

with Buffalo row cleaning units. At planting, crop residue was cleared from an 8- to 10-inch wide area centered on the old row. No additional tillage occurred. Planting dates were mid-May/late-June in 1991, mid-May/mid-June in 1992, and late-May/late-June in 1993.

*Tissue samplings* were collected at the 6-leaf stage for analysis of dry matter, and N and P concentrations. Leaf samples (leaf below flag leaf) also were collected at bloom stage for analysis of N and P concentrations.

*Harvest* occurred in mid-October of each year. Grain yield was determined by combine harvesting of a 5- by 40-foot area and corrected to 14 percent moisture.

*Weather.* Extreme drought conditions in July and August of 1991 caused delayed and erratic heading as well as plant leaf tissue damage. Because of drought effects, leaf nutrient concentrations, mid-bloom notes, and yield components in 1991 were not reported.

---

*Dr. Gordon is associate professor and Dr Whitney is professor in the Department of Agronomy at Kansas State University. □*