Starter Fertilizer Application Effects on Reduced and No-Tillage Grain Sorghum Production

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Starter fertilizer containing nitrogen (N) and phosphorus (P) substantially increased grain sorghum yields on a soil testing high in P. The effects of tillage and starter placement methods were also evaluated in this three-year northcentral Kansas study. Starter placement, on average, did not affect yields. Likewise, tillage did not affect the way sorghum responded to starter.

Conservation tillage production systems are being used by an increasing number of producers in the central Great Plains because of several inherent advantages. These include reduction of soil erosion losses, increased soil water use efficiency, and improved soil quality. However, early-season plant growth can be poorer in reduced tillage systems than in conventional systems. The large amount of surface residue present in a no-tillage system can lower seed zone temperatures. Lower than optimum soil temperature can reduce the rate of root growth and P uptake by plants.

Starter fertilizers can be applied to place nutrients within the rooting zone of young seedlings for better availability to hasten maturity and avoid late-season damage by low temperatures. Some experiments that have evaluated crop response to N and P starter fertilizers have demonstrated improved early growth and increased yield and attributed those responses to the P component of the combination. Other studies have indicated that N is the most critical nutrient in the N-P starter on soils not low in P. Many producers do not favor 2x2 (2 in. to the side and 2 in. below the seed) placement of starter fertilizer due to high initial cost of application equipment and problems associated with knife applications in high residue situations. This research was aimed at minimizing fertility problems that arise with reduced tillage systems, thus making conservation tillage more attractive to producers.

Effects of starter fertilizer on grain sorghum development and maturity are illustrated in these photos. Plots receiving 30 lb N/A and 30 lb P_2O_5/A as starter had much larger and more developed seed heads than in no-starter plots.

Methods

The experiment was conducted at the North Central Kansas Experiment Field on a Crete silt loam soil from the spring of 1999 to the fall of 2001. Analysis by the Kansas State University (KSU) Soil Testing Laboratory showed that initial soil pH was 6.2, organic matter was 2.2 percent, Bray P-1 was high [45 parts per million (ppm)], and exchangeable K was 320 ppm (very high) in the top 6 in. of soil. Treatments consisted of two tillage systems (no-tillage and minimum tillage). The minimum tillage treatment received one discing and harrowing operation in the spring three weeks prior to planting. Starter fertilizer was placed either 2x2 or dribbled in a band on the soil surface 2 in. beside the seed at planting. Starter fertilizer treatments consisted of N and P_2O_5 combinations giving 15, 30, or 45 lb N/A with 30 lb P_2O_5/A.

Treatments consisting of either 30 lb N/A or 30 lb P_2O_5/A applied alone and a no starter check also were included. Starter combinations were made using 10-34-0 and 28-0-0. After planting, knife applications of 28-0-0 were made to bring N applied to each plot to a total of 140 lb/A. Grain sorghum (NC + 7R83) was planted at the rate of 60,000 seed/A in mid-May each year of the experiment. At the V6 stage of growth, 20 plants were randomly selected from each plot and analyzed for dry weight and N and P concentration. Starting on September 8, 2001, 10 sorghum heads were randomly selected from each plot, threshed, and grain moisture content measured. Plots were harvested in mid-October each year.

Results

Over the three years of the experiment, tillage had no effect on the way grain sorghum responded to starter fertilizer (**Table 1**). All starter treatments increased grain yield over the no-starter check plots. There was no significant difference in starter placement methods in yield of grain sorghum when averaged over starter fertilizer combinations and years (**Table 2**). However, some individual 2x2-placed starter treatments were superior to dribble applied.

TABLE 1. Tillage effects on grain yield, number of days from emergence to mid-bloom and 6-leaf stage whole plant dry matter (averaged over starter treatment and placement method), Belleville 1999-2001.

Tillage	Yield, bu/A	Days to mid-bloom	6-leaf dry matter, lb/A
Reduced	113	58	906
No-Till	116	59	883
LSD (0.05)	NS*	NS	NS

*NS = not significant at the 5% level of probability.

TABLE 2. Starter fertilizer composition and application method effects on yield of grain sorghum, Belleville, 1999-2001.

Starter, lb/A		Grain yield[1], bu/A	
N	P_2O_5	2x2	Dribble
0	30	104	101
30	0	111	108
15	30	116	111
30	30	127	118
45	30	127	120
Average		117	112
LSD (0.05)		6	

[1]No-starter check = 93 bu/A.

TABLE 3. Starter fertilizer composition and application method effects on number of days from emergence to mid-bloom, Belleville, 1999-2001.

Starter, lb/A		Number of days from emergence to mid-bloom[1]	
N	P_2O_5	2x2	Dribble
0	30	62	62
30	0	58	60
15	30	55	60
30	30	55	57
45	30	54	55
Average		57	59
LSD (0.05)		2	

[1]No-starter check = 65 days.

The highest yields occurred with applications of starter fertilizer containing higher rates of N (30 or 45 lb N/A) in combination with P. The N alone or the P alone treatments

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Example 8. As a rescue treatment, 100 lb K_2O/A was broadcast and then hoed in by hand at growth stage V6 to simulate shallow tillage. The ears in the top row are from the rescue treatment, and the ears below are from the check plot (site 30300).

Planting date: Week of May 8
Harvested population, plants/A: 22,391
Hybrid: DeKalb 477
Soil test K level, ppm: 73
Rate of K applied, lb K_2O/A: 0 (no rescue K applied); 100 (rescue K applied)
K placement: broadcast/hoed (rescue K applied)
K form: 0-0-60 (rescue K applied)
Leaf K concentration, % – ear leaf: 0.51 (no rescue K applied); 0.72 (rescue K applied)
Grain yield, bu/A: 86 (no rescue K applied); 117 (rescue K applied)
Grain yield reduction, bu/A: 31

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did not yield as well as starters that contained both N and P. For example, in the 2x2 starter placement, 30 lb N/A alone increased average yield by 18 bu/A, 30 lb P_2O_5/A by 11 bu/A, while a combination of 30 lb N and 30 lb P_2O_5/A increased yield by 34 bu/A. The yield increase from the N and P combination exceeds the additive effect of each individual nutrient, thus illustrating the importance of nutrient interaction and balanced starter fertility in optimizing grain yield.

The higher N starters were the most efficient in reducing the number of days from emergence to mid-bloom (**Table 3**). When averaged over starter treatment and years, there was no difference between 2x2 applied starter and surface dribbled starter in early season dry matter and days from emergence to mid-bloom. When averaged over tillage treatment and method of application, starter fertilizer containing 30 lb N and 30 lb P_2O_5/A decreased the number of days from emergence to mid-bloom by over 11 days compared to the no-starter check treatment. All starter fertilizer treatments increased V6-stage whole plant dry matter over the no starter check. The starters containing either 30 or 45 lb N/A with 30 lb P_2O_5/A resulted in the greatest V-6 whole plant dry matter accumulation. Grain moisture at harvest was lower in the higher N starters that also included P.

Grain moisture in the 30-30 starter treatment was lower at all sample dates compared to the no-starter check, the P alone treatment or the treatment that included only 15 lb N. Starter containing both N and P had a substantial impact on hastening grain sorghum maturity. BC

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