STARTER FERTILIZER APPLICATION EFFECTS ON REDUCED AND NO-TILLAGE GRAIN SORGHUM PRODUCTION

W.B. Gordon and D.A. Whitney
Department of Agronomy
Kansas State University
Courtland, KS 66939
bgordon@oznet.ksu.edu

Abstract

This experiment was conducted at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Soil test P was in the Ahigh@ range. Treatments consisted of tillage systems and starter fertilizer placement and composition. Tillage systems were no-tillage and minimum tillage (spring disc and harrow treatment). Methods of starter fertilizer application included placement 2 inches to the side and 2 inches below the seed at planting (2x2) and dribbled in a band on the soil surface 2 inches beside the seed row. Liquid starter fertilizer treatments consisted of N and P_2O_5 combinations giving 15, 30, and 45 lb N/acre and 30 lb P_2O_5/acre. Starter treatments containing either 30 lb N or 30 lb P_2O_5/acre applied alone and a no starter check also were included. In both tillage systems, yields were maximized by application of starter fertilizer containing either 30 or 45 lb N/acre with 30 lb P_2O_5/acre. When averaged over years, tillage, and fertilizer composition treatments, 2x2 placed starter fertilizer was not statistically superior to surface dribble application. When averaged over tillage treatment, starter fertilizer containing 30 lb N and 30 lb P_2O_5/a decreased the number of days from emergence to mid-bloom by 10 days compared to the no-starter check treatment. Tillage and method of starter application did not affect sorghum flag leaf tissue nutrient concentration. Tissue P concentration was greater when more N was applied in the starter. Grain moisture at harvest was lower in the higher N starters that also included P. Dribble application of starter fertilizer proved to be a viable alternative to subsurface placement.

Introduction

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 reduce 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 nutrient elements within the rooting zone of young seedlings for better availability which will 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 element in the N-P starter on soils not low in P. Many producers do not favor 2x2 placement of starter fertilizer due to high initial cost of application equipment and problems associated with knife applications in high residue

situations. This research is aimed at minimizing fertility problems that arise with reduced tillage systems thus making conservation tillage more attractive to producers.

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 KSU Soil Testing Lab showed that initial soil pH was 6.2, organic matter was 2.2%, Bray P-1 was 45 ppm and exchangeable K was 320 ppm in the top 6 inches 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 3 weeks prior to planting. Starter fertilizer was placed either 2 in. to the side and 2 in. below the seed at planting (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/acre with 30 lb P_2O_5/acre. Treatments consisting of either 30 lb N/acre or 30 lb P_2O_5/acre applied alone and a no starter check also were included. Starter combinations were made using liquid 10-34-0 and 28% UAN. The P only treatment was made using laboratory grade phosphoric acid. After planting, knife applications of 28% UAN were made to bring N applied to each plot to a total of 140 lb/acre. Grain sorghum (NC+ 7R83) was planted at the rate of 60,000 seed/a in mid-May each year. At the V6 stage of growth, 20 plants were randomly selected from the 1st or 4th row of each plot and analyzed for dry weight and N and P concentration. At first bloom 20 flag leaves/plot were harvested and analyzed for N and P concentration. Starting on September 8, 2001, 10 sorghum heads were randomly selected from the 1st or 4th rows of each plot, thrashed and grain moisture content measured. Plots were machine harvested in early October each year. Yields were corrected to a constant 14% grain moisture content.

Results

Tillage system had no significant effects on any of the measured parameters in the experiment. (Table 1) When averaged over the 3-years of the experiment, sorghum yields with 2x2 applied starter fertilizer were 5 bu/acre greater than when starter was dribbled on the soil surface, but the difference was not statistically significant (Table 2). With both fertilizer placement methods, the greatest yields occurred with applications of starter fertilizer containing either 30 or 45 lb N/acre with 30 lb P_2O_5/acre. All starter treatment increased grain yield over the no-starter check plots. The higher N starters also were the most efficient in reducing the number of days from emergence to mid-bloom (Table 3). The N alone or the P alone treatments did not yield as well as starters that contained both N and P. The treatment containing only 15 lb N/acre with 30 lb P_2O_5/acre also was not as effective as starters containing more N. 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 with 30 lb/a P_2O_5 resulted in the greatest V-6 whole plant dry matter accumulation (Table 4). Grain sorghum flag leaf tissue nutrient concentrations were not affected by tillage or by starter application method (Table 1). Tissue P concentrations increased with increasing amount of N in the starter. 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 (Figure 1).

Table 1. ANOVA Table, P>F

Parameter	Tillage	Placement	Starter
Yield	NS*	NS	0.0001
V6 Dry Weight	NS	NS	0.0001
V6 N	NS	0.0211	0.0001
V6 P	NS	0.0384	0.0001
Flag Leaf N	NS	NS	0.0001
Flag Leaf P	NS	NS	0.0001
Days to Mid-Bloom	NS	NS	0.0001

*NS=not significant at the 0.05 level of probability.

Table 2. Starter fertilizer method of application and composition effects on yield of grain sorghum (average 1999-2001).

Starter, lb/acre		Yield, bu/acre	
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

No starter check=93 bu/acre.

Table 3. Starter fertilizer method of application and composition effects on number of days from emergence to mid-bloom (average 1999-2001).

Starter, lb/acre		Number of days	
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

No starter check=65 days.

Table 4. Starter fertilizer method of application and composition effects on 6-leaf stage whole plant dry weight (average 1999-2001).

Starter, lb/acre		6-Leaf Dry Weight , lb/acre	
N	P_2O_5	2x2	Dribble
0	30	747	712
30	0	805	754
15	0	867	858
30	30	1109	990
45	30	1108	996
Average		927	862

No starter check=534 lb/acre.

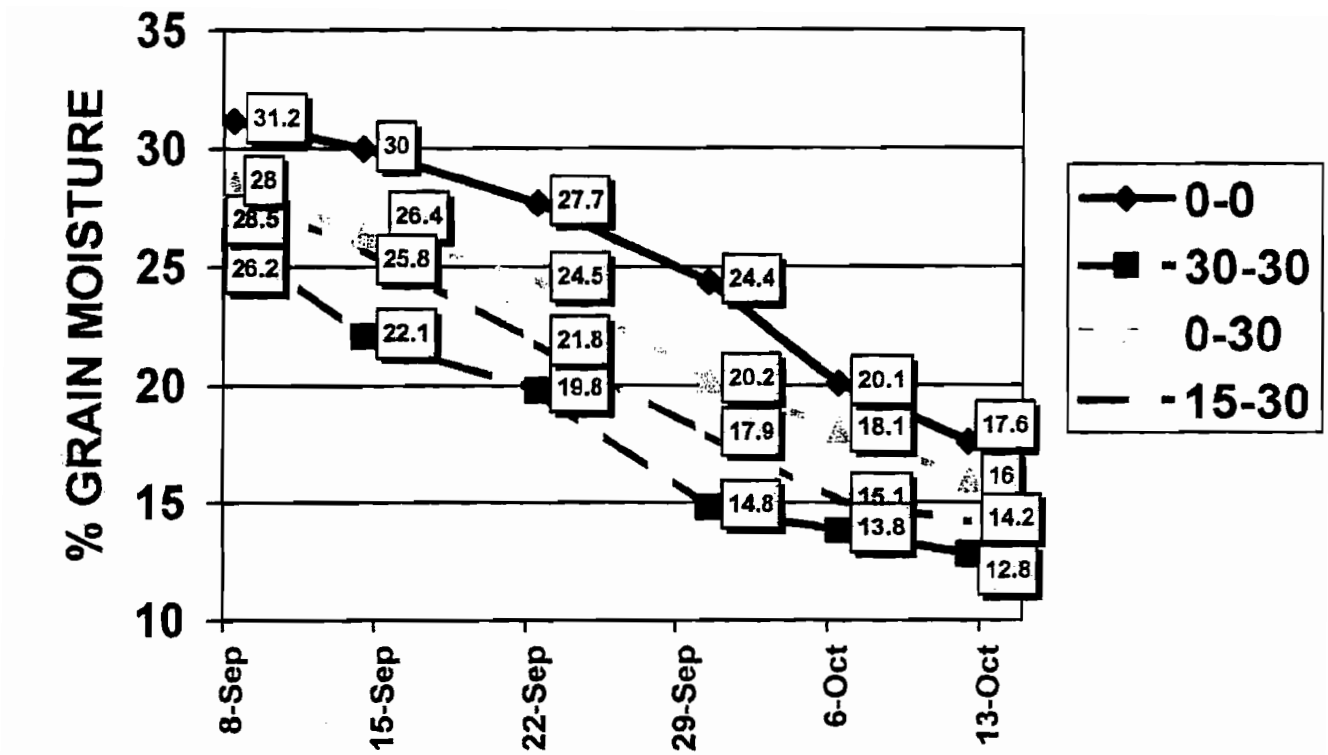

Figure 1. Effect of starter fertilizer composition on grain moisture dry-down for 2x2 placement, Belleville, KS, 2001.

PROCEEDINGS OF THE

THIRTY-SECOND NORTH CENTRAL EXTENSION-INDUSTRY SOIL FERTILITY CONFERENCE

Volume 18

November 20-21, 2002
Holiday Inn University Park
Des Moines, IA

Program Chair:
Larry Bundy
University of Wisconsin
Madison, WI 53706
(608) 263-2889

Published by:
Potash & Phosphate Institute
772 – 22nd Avenue South
Brookings, SD 57006
(605) 692-6280
Web page: www.ppi-ppic.org