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Agronomy Field Research 2008
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Fluid Fertilizer Foundation
Monsanto
Pioneer
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HARVEY COUNTY EXPERIMENT FIELD

Introduction

Research at the Harvey County Experiment Field deals with many aspects of dryland crop production on soils of the Central Loess Plains and central Outwash Plains of central and south central Kansas and is designed to directly benefit agricultural industries in the area. The focus is primarily on wheat, grain sorghum, and soybean, but research is also conducted on alternative crops such as corn and sunflower. Investigations include variety and hybrid performance tests, chemical weed control, reduced tillage/no-tillage systems, crop rotations, cover crops, fertilizer use, planting practices, and disease and insect resistance and control.

Soil Description

The Harvey County Experiment Field consists of two tracts. The headquarters tract (North Unit), 75 acres immediately west of Hesston on Hickory Street, is all Ladysmith silty clay loam with 0-1% slope. The South Unit, 4 mi south and 2 mi west of Hesston, is composed of 142 acres of Ladysmith, Smolan, Detroit, and Irwin silty clay loams as well as Geary and Smolan silt loams. All have a 0-3% slope. Soils on the two tracts are representative of much of Harvey, Marion, McPherson, Dickinson, and Rice counties as well as adjacent areas. These are deep, moderately well to well-drained, upland soils with high fertility and good water-holding capacity. Water runoff is slow to moderate. Permeability of the Ladysmith, Smolan, Detroit, and Irwin series is slow to very slow, whereas permeability of the Geary series is moderate.

2006-2007 Weather Information

Dry conditions in September and early October allowed ample time for wheat planting preparations and choice of planting date. Modest rains returned after planting, providing adequate moisture for prompt and complete emergence and early growth. However, November had no meaningful rainfall, and conditions remained dry until mid-December, when two excellent rains and several smaller showers led to an above-average month for precipitation. Average temperatures were several degrees cooler than normal in October, slightly above normal in November, and about 5.5°F above normal in December.

Except in February, winter precipitation was above normal. The coldest period of the winter occurred between mid-January and mid-February, when single-digit temperatures were recorded on 10 days. Mean temperatures were somewhat below normal in January and February but well above normal in March. Wheat survival was normal.

Rainfall was about an inch below normal in April but close to double the normal in May. June rainfall was below average but impeded wheat harvest somewhat. Mean temperatures were much cooler than normal in April, near normal in May, and somewhat cooler than usual in June. The major event of the wheat growing season occurred on April 7 and 8; during the early morning hours, temperatures dipped below 25°F for a combined total of 14 hours. Wheat was just past the jointing stage, and main stems were seriously injured by the cold temperatures.

Fungal diseases played a significant role in yield reduction of freeze-injured wheat with tillers that matured later than usual. Leaf rust became the dominant disease by mid-May, and leaves began turning yellow at that point.

Mild conditions in March facilitated early corn planting and seedling development. However, the severe freeze in early April decimated emerged corn. Subsequent opportunities for timely corn planting were extremely limited because of prolonged wet weather. Soybean and grain sorghum plantings also were delayed somewhat. The last spring freeze occurred 4 days earlier than normal on April 15.

In July, average temperatures were 2.5°F below normal. Warmer conditions prevailed in August and September with mean temperatures 2.8 and 1.4°F above normal. The hottest temperatures of the summer occurred from August 7 to 15; during this time, 5 days had temperatures at or above 100°F. Although August had 1.13 in. less rainfall than normal, the summer was favorable for all row crops, with better-than-average conditions overall. September also was drier than usual, with only a light rain interfering with corn harvest. October had near-normal total precipitation, but most of it occurred in the first half of the month and ahead of most grain sorghum and soybean harvesting.

Late-planted corn suffered severe lodging in some areas as a result of southwestern corn borer activity. Soybean and grain sorghum generally had no insect or disease problems of significance. Sunflower suffered serious damage from head-clipper weevil and lesser injury from stem weevil.

The first killing frost of the fall occurred 8 days later than normal on October 23. The frost-free season spanned 191 days, 12 days longer than normal. Late arrival of freezing temperatures in the fall benefited late-planted row crops, most of which matured before the advent of cold temperatures.

Table 1. Monthly precipitation totals (in.), Harvey Co. Experiment Field, Hesston, KS[1]

Month	North Unit	South Unit	Normal	Month	North Unit	South Unit	Normal
	2006				2007		
October	1.96	2.09	2.95	March	3.64	3.88	2.71
November	0.17	0.10	1.68	April	3.91	3.92	2.84
December	1.67	1.69	1.01	May	10.51	9.00	4.83
				June	4.21	4.19	4.72
	2007			July	3.88	3.51	3.59
January	1.10	1.06	0.79	August	3.32	2.75	3.88
February	0.38	0.46	1.08	September	0.95	0.92	2.99
Twelve-month total					35.70	33.57	33.07
Departure from 30-year normal at North Unit					2.63	0.50	

[1] Two experiments reported here were conducted at the South Unit: *Effects of Late-Maturing Soybean and Sunn Hemp Summer Cover Crops and Nitrogen Rate in a No-Till Wheat-Grain Sorghum Rotation;* and *Evaluation of Mesotrione (Lumax) for Crop Safety in Grain Sorghum*. All other experiments in this report were conducted at the North Unit.

NO-TILL CROP ROTATION EFFECTS ON WHEAT, CORN, GRAIN SORGHUM, SOYBEAN, AND SUNFLOWER

M.M. Claassen and D.L. Regehr

Summary

A field experiment consisting of 11 no-till crop rotations was initiated in 2001 in central Kansas on Ladysmith silty clay loam. Cropping systems involving winter wheat (W), corn (C), grain sorghum (GS), double-crop grain sorghum ([GS]), soybean (SB), double-crop soybean ([SB]), and sunflower (SF) are as follows: W-C-SB, W-[SB]-C-SB, W-SB-C, W-GS-SB, W-[SB]-GS-SB, W-[GS]-GS-SB, W-GS-SF, W-[SB]-GS-SF, W-[GS]-GS-SF, GS-C-SB, and GS-GS-GS. Data collection to determine cropping system effects began in 2004. In 2007, wheat suffered severe freeze damage in early April. Highest wheat yields occurred in rotations in which wheat followed sunflower and averaged 30.3 bu/a. Wheat following corn and soybean produced 7.4 and 3.2 bu/a less, respectively, than wheat after sunflower, but from 2004-2007, wheat performed best after soybean with a top yield of 58.2 bu/a, producing 7.1 and 11.8 bu/a less following corn and sunflower, respectively. Inclusion of [GS] or [SB] in the rotation had no apparent effect on wheat. Corn averaged 78.4 bu/a without a significant crop rotation effect. Grain sorghum production was greatest in rotations in which grain sorghum followed soybean or wheat, averaging 95.9 and 103.5 bu/a, respectively. Grain sorghum yields were lowest following [GS] or full-season grain sorghum, averaging 77.1 to 77.9 bu/a. Intermediate grain sorghum yields of 90.7 bu/a occurred following [SB]. Double-crop grain sorghum produced 46.9 to 57.2 bu/a without significant rotation effect. Soybean produced the best average yield of 34.7 bu/a in all rotations involving corn and wheat or in the rotation with grain sorghum and wheat without double crops. Soybean yields were 5.3 bu/a less in rotations with grain sorghum and wheat that included [GS] or [SB] and in the GS-C-SB rotation. Double-crop soybean yields ranged from 11.5 to 16.1 bu/a and tended to be slightly higher in W-[SB]-GS-SF than in the other rotations. Sunflower yielded 798 lb/a with no rotation effect.

Introduction

The number of acres devoted to no-till crop production in the United States has risen steadily in recent years, most notably since 2002. According to the Conservation Technology Information Center, no-till was used on 62.4 million acres, nearly 23% of the cropland in 2004. At that time, Kansas ranked seventh in the nation with 4.2 million acres of no-till annual crops, representing 21.2% of planted acres. Anecdotal information suggests that no-till annual crop acreages have continued to increase. Soil and water conservation issues; cost of labor, fuel, and fertilizers; changes in government farm programs; development of glyphosate-tolerant crops; and lower glyphosate herbicide cost all contribute to no-till adoption by growers.

Crop rotation reduces pest control costs, enhances yields, and contributes significantly to successful no-till crop production. Selecting appropriate crop rotations provides adequate diversity of crop types to facilitate realization of these benefits and sufficient water-use intensity to take full advantage of available moisture.

In central and south central Kansas, long-term, no-till research on multiple crop rotations is needed to determine profitability and reliability of these systems. This experiment includes 10 three-year rotations. Nine of these involve wheat, corn or grain sorghum, and soybean or sunflower. One rotation consists entirely of row crops. Continuous grain sorghum serves as a monoculture check treatment. Double-crop soybean and [GS] after wheat are used as intensifying components in five of the rotations. One complete cycle of these rotations was completed in 2003. Official data collection began in 2004.

Procedures

The experiment site was located on a Ladysmith silty clay loam where no-till soybean had been grown in 2000. Lime was applied according to soil test recommendations and incorporated by light tillage in late fall of that year. Detailed soil sampling was done in early April 2001, just before establishment of the cropping systems. Average soil test values at that time included pH 6.2, organic matter 2.7%, available phosphorus (P) 46 lb/a, and exchangeable potassium 586 lb/a.

Eleven crop rotations were selected to reflect adaptation across the region. These involved winter wheat (W), corn (C), grain sorghum (GS), double-crop grain sorghum ([GS]), soybean (SB), double-crop soybean ([SB]), and sunflower (SF) as follows: W-C-SB, W-[SB]-C-SB, W-SB-C, W-GS-SB, W-[SB]-GS-SB, W-[GS]-GS-SB, W-GS-SF, W-[SB]-GS-SF, W-[GS]-GS-SF, GS-C-SB, and GS-GS-GS. The experiment uses a randomized complete block design with four replications of 31 annual treatments representing each crop in each rotation.

Plots to be planted to wheat following corn were sprayed with Roundup Original Max in mid-September 2006 to control late-emerged weeds. Overley wheat was planted into corn, soybean, and sunflower stubble on October 14 in 7.5-in. rows at 90 lb/a with a John Deere 1590 no-till drill with single-disk openers. Wheat was fertilized with 120 lb/a N and 32 lb/a P_2O_5 as preplant broadcast ammonium nitrate and as in-furrow diammonium phosphate at planting. No herbicides were used on wheat in any of the cropping systems. Wheat was harvested on July 9, 2007.

Wheat plots to be planted to corn were sprayed with Roundup Original Max in early July and late September 2006. These and soybean plots to be planted to corn in 2007 were sprayed with Roundup plus 2,4-D_{LVE} in late November. A few days before planting, corn plots were sprayed with Roundup Original Max + Dual II Magnum + very low rates of Clarity and 2,4-D_{LVE}. Subsequently, weeds were controlled with a single postemergence application of Roundup Original Max. A White no-till planter with double-disk openers on 30-in. centers was used to plant Pioneer 35P80 RR with Poncho insecticide at approximately 19,000 seeds/a on May 21, 2007. All corn was fertilized with 30 lb/a N and 30 lb/a P_2O_5, banded 2 in. from the row at planting. Corn after wheat, [SB], and grain sorghum received an additional 95 lb/a N, and corn after soybean received 65 lb/a N as 28-0-0 injected in a band 10 in. on either side of each row on June 9. Corn was harvested on September 21, 2007.

Wheat plots to be planted to grain sorghum were treated the same as corn during the preceding summer through the time that corn was planted. Because of later planting, grain sorghum plots required an additional Roundup application in June. AAtrex 4L was applied soon after grain sorghum planting to complete residual weed control. Sorghum Partners KS 585 with Concep III safener and Cruiser insecticide was planted at approximately 30,000 seeds/a in 30-in. rows with 30 lb/a N and 30 lb/a P_2O_5 banded 2 in. from the row on June 20. Sorghum after wheat, grain sorghum, [GS], and [SB] received an additional 60 lb/a of N, and grain sorghum after soybean received 30 lb/a of N as 28-0-0 injected in a band 10 in. on either side of each row in mid-July. Sorghum was harvested on October 31, 2007.

Double-crop grain sorghum plots received an application of Roundup Weather Max just before planting. Pioneer 87G57 with Concep III safener and Cruiser insecticide was planted on July 11 with the same procedures used for full-season grain sorghum. An additional 30 lb/a N were injected on August 15. Postemergence application of AAtex 4L + COC was made with drop nozzles on August 14. Double-crop grain sorghum was harvested on October 31, 2007.

Wheat and row crop plots to be planted to soybean received the same herbicide applications as corn. Asgrow AG3802 RR soybean was planted at 115,000 seeds/a in 30-in. rows on June 5. During the season, a single application of Roundup Original Max was made on July 9. Soybean was harvested on October 1, 2007.

Double-crop soybean had a preplant application of Roundup Weather Max. Asgrow A3802 RR soybean was planted as a double crop at 115,000 seeds/a in 30-in. rows on July 11. One additional Roundup application was required in late August.

Double-crop soybean was harvested on October 26, 2007.

All sunflower plots were sprayed with Roundup Original Max + Dual II Magnum + very low rates of Clarity and 2,4-D_{LVE} on May 19. A follow-up application of Roundup was made a month later, just ahead of sunflower planting. Triumph s672 sunflower was planted on June 20 at 28,000 seeds/a with 30-30-0 fertilizer banded 2 in. from the row. A 0.33x rate of Dual II Magnum also was applied to strengthen preemergence weed control. An additional 40 lb/a N were sidedress dribble applied on August 18. Sunflower was harvested on October 27, 2007.

Results

Wheat

Wheat stand establishment was excellent in all crop rotations. Early spring prospects were those of a bumper crop. However, hard freezing temperatures on April 7 and 8 nearly resulted in total destruction of wheat in this experiment. Heading occurred in mid-May, and following the freeze, there were no significant differences in wheat maturity among the rotations (Table 2). Similarly, there were no significant differences in plant heights. Plant N concentration tended to be inversely related to grain yield but was not consistent. Wheat after corn averaged 1.94% N, 0.37% and 0.33% N more than after sunflower and soybean, respectively. Unlike the long-term yield trend, highest wheat yields occurred in rotations in which wheat followed sunflower and averaged 30.3 bu/a, likely because wheat was in a less advanced stage when the freeze occurred, resulting in less freeze injury. Double cropping with soybean or grain sorghum in selected rotations did not influence wheat yield. The lowest wheat yield (22.9 bu/a) occurred where wheat followed corn, possibly because of increased incidence of Fusarium head blight (Table 2). When averaged over all rotations for the last 4 years, wheat following soybean had the highest yield, 58.2 bu/a, which was 7.1 and 11.8 bu/a more than wheat after corn and sunflower, respectively. Grain test weights averaged 49.1 lb/bu in wheat after sunflower and soybean and 46.5 lb/bu in wheat after corn. Grain protein levels followed the trends noted for plant N concentration with averages ranging from 11.9% to 12.8% among rotations in which wheat followed soybean or corn. Grain protein in wheat after sunflower was significantly lower (11.4%). In general, antecedent crop effects were much more significant than overall rotation effects in determining wheat performance.

Corn

Corn emerged about 9 days after planting. Final corn populations averaged 18,260 plants/a (Table 3) and were not significantly affected by crop rotation. Corn reached the half-silking stage 60 to 61 days after planting, tending to be slightly later following wheat in rotation but without statistical significance. Leaf N averaged 2.39% with no significant rotation effect. Lodging was greater than usual as a result of southwestern corn borer activity and ranged from 14% to 20% without a consistent relationship to crop rotation. Corn yields averaged 78.4 bu/a without rotation effect. Test weight was highest in corn after grain sorghum (57.2 lb/bu) and lowest in corn after wheat with an average of 55.1 lb/bu. Number of ears/plant averaged 1.03 without a significant effect by crop rotation.

Grain sorghum

Grain sorghum planting was delayed by wet weather. Emergence occurred rapidly at 5 days after planting. Final populations ranged from 23,300 to 26,900 plants/a. Lowest full-season grain sorghum plant counts occurred in GS-GS-GS and W-[GS]-GS-SB, whereas populations differed little across remaining rotations. On average, full-season grain sorghum reached half-bloom stage at 57 days after planting. In W-[GS]-GS-SB, W-[GS]-GS-SF, and GS-GS-GS, half-bloom occurred 2 to 4 days later than the average in other crop rotations. Leaf N levels ranged from 3.12% to 3.69% among rotations, with the highest mean values in grain sorghum after wheat and soybean and lowest mean values in grain sorghum following full-season grain sorghum or [GS].

Grain sorghum production was greatest in rotations in which grain sorghum followed soybean or wheat and ranged from 95.9 to 103.5 bu/a. Grain sorghum yields were lowest in rotations following grain sorghum or [GS], averaging 77.1 to 77.9 bu/a, and intermediate following [SB]. Grain test weight averaged

60.6 lb/bu with minor differences among rotations. Number of heads/plant ranged from 1.31 to 1.93. Lowest head counts tended to occur in rotations in which grain sorghum followed grain sorghum or [GS], and highest head counts occurred in W-GS-SF. Wheat following sunflower in 2006 produced about half the yield of wheat in other rotations. Consequently, grain sorghum following wheat in the sunflower rotation likely benefited from a more favorable soil moisture reserve. Lodging was insignificant.

Double-crop grain sorghum production averaged 52.1 bu/a, about 58% of the full-season crop. Rotation effect on [GS] yield was not significant. Stands averaged 28,100 plants/a without treatment effect. Other variables measured in [GS] tended to be unaffected by crop rotation.

Soybean

Soybean emerged less than a week after planting. Stands were excellent among all rotations (Table 4). Full-season soybean developed plant heights that averaged 31 in., generally reached maturity at 111 days after planting, and produced a respectable mean yield of 32.4 bu/a across all rotations. However, soybean produced the best average yield of 34.7 bu/a in rotations involving corn and wheat or in the rotation with grain sorghum and wheat without double crops. Soybean yields were 5.3 bu/a less in rotations with grain sorghum and wheat that included [GS] or [SB] and in the GS-C-SB rotation. There was no lodging.

Double-crop soybean stands also were excellent. Plant heights averaged 18 in. with no rotation effect. Double-crop soybean reached maturity without treatment effect at 101 days after planting. No lodging occurred. Yields of [SB] ranged from 11.5 to 16.1 bu/a and tended to be slightly higher in W-[SB]-GS-SF than in other rotations.

Sunflower

Sunflower emerged 5 days after planting. Populations averaged 25,200 plants/a. Triumph s672 NuSun short-stature sunflower reached half-bloom stage at 56 days and had an average height of 38 in. Sunflower was severely affected by head-clipper weevils. As a result, yields averaged only 798 lb/a. Lodging averaged 10%. None of these variables were affected by crop rotation.

Table 2. Effects of crop rotation on no-till wheat, Harvey County Experiment Field, Hesston, KS, 2007

Crop	Crop Rotation[1]	Yield[2] 2007	Yield[2] 4-yr	Test Wt	Stand	Heading[3]	Plant ht	Plant N[4]	Grain Protein	Fusarium HB[5]
		------bu/a------		lb/bu	%	date	in.	%	%	%
Wheat	W-C-SB	27.0	57.4	48.5	100	43	29	1.60	11.9	5.0
	W-[SB]-C-SB	27.7	58.9	48.3	100	43	28	1.62	12.1	4.5
	W-SB-C	22.9	51.1	46.5	99	43	29	1.94	12.8	8.5
	W-GS-SB	26.7	59.3	49.9	99	43	28	1.51	12.0	3.5
	W-[SB]-GS-SB	26.7	58.4	48.9	100	43	28	1.67	11.8	5.5
	W-[GS]-GS-SB	27.3	57.0	49.1	100	43	29	1.65	11.6	3.5
	W-GS-SF	29.3	45.9	47.9	100	43	28	1.53	11.7	5.5
	W-[SB]-GS-SF	30.6	47.6	49.6	100	43	28	1.66	11.5	6.0
	W-[GS]-GS-SF	30.9	45.7	50.0	100	43	28	1.52	11.1	6.5
	LSD 0.05	3.0		1.8	NS	NS	NS	0.15	0.68	NS
	LSD 0.10	2.5		1.5	NS	NS	NS	0.13	0.56	NS*
	Preceding crop main effect means:									
	Corn	22.9	51.1	46.5	99	43	29	1.94	12.8	8.5
	Soybean	27.1	58.2	48.9	100	43	28	1.61	11.9	4.4
	Sunflower	30.3	46.4	49.2	100	43	28	1.57	11.4	6.0
	LSD 0.05[6]	1.6		1.1	NS	NS	NS	0.09	0.39	1.8
	LSD 0.10[6]	1.3		0.9	NS	NS	NS	0.08	0.32	1.5

[1] C = corn, GS = grain sorghum, SB = soybean, SF = sunflower, W = wheat, and [ ] = double crop.
[2] Means of four replications adjusted to 12.5% moisture.
[3] Days after March 31 on which 50% heading occurred.
[4] Whole-plant N levels at late boot to early heading.
[5] Percentage of spikelets killed by Fusarium head blight. Observation at soft dough stage, W. Bockus, Pathologist.
* Rotation effect significant at p = 10.7.
[6] Estimate based on the average number of crop sequences involving the same preceding crop = 3.0.

Table 3. Effects of crop rotation on no-till corn and grain sorghum, Harvey County Experiment Field, Hesston, KS, 2007

Crop	Crop Rotation[1]	Yield[2] 2007	Yield[2] 4-Yr	Test Wt	Stand	Maturity[3]	Ears or Heads/ Plant	Lodging	Leaf[4] N
		-----bu/a-----		lb/bu	1000/a	date		%	%
Corn	W-C-SB	79.2	92.5	55.1	18.1	61	1.01	16	2.40
	W-[SB]-C-SB	79.0	92.1	56.5	18.6	60	1.01	18	2.24
	W-SB-C	78.7	88.4	56.7	18.2	60	1.03	14	2.47
	GS-C-SB	76.8	88.3	57.2	18.2	60	1.05	20	2.44
	LSD 0.05	NS		1.2	NS	NS	NS	NS	NS
	LSD 0.10	NS		1.2	NS	NS	NS	NS	NS
Sorghum	W-GS-SB	102.9	102.0	60.7	25.5	57	1.67	1	3.68
	W-[SB]-GS-SB	95.1	97.1	60.6	25.2	57	1.65	2	3.49
	W-[GS]-GS-SB	73.4	87.1	60.1	24.0	60	1.46	0	3.12
	W-GS-SF	104.1	103.7	60.9	25.0	55	1.93	4	3.69
	W-[SB]-GS-SF	86.2	94.0	60.9	25.3	56	1.69	5	3.40
	W-[GS]-GS-SF	82.4	90.1	60.2	25.8	58	1.31	0	3.45
	GS-C-SB	95.9	100.4	60.9	26.9	55	1.49	1	3.52
	GS-GS-GS	77.1	90.9	60.4	23.3	59	1.34	1	3.16
[Sorghum]	W-[GS]-GS-SB	57.2	74.2	55.5	27.9	58	1.21	0	2.74
	W-[GS]-GS-SF	46.9	76.2	54.0	28.2	59	1.14	0	2.67
	LSD 0.05	13.6		1.6	2.7	2.0	0.24	NS	0.33
	LSD 0.10	11.3		1.3	2.2	1.7	0.20	NS	0.27
	Preceding crop main effect means:								
Sorghum	Wheat	103.5	102.9	60.8	25.3	56	1.80	2	3.68
	[Soybean]	90.7	95.6	60.7	25.2	56	1.67	3	3.44
	Soybean	95.9	100.4	60.9	26.9	55	1.49	1	3.52
	[Sorghum]	77.9	88.6	60.1	24.9	59	1.39	0	3.29
	Sorghum	77.1	90.9	60.4	23.3	59	1.34	1	3.16
	LSD 0.05[5]	12.1		0.5	2.0	1.9	0.22	NS	0.28
	LSD 0.10[5]	10.0		0.4	1.7	1.6	0.18	NS	0.23

[1] C = corn, GS = grain sorghum, SB = soybean, SF = sunflower, W = wheat, and [ ] = double crop.
[2] Means of four replications adjusted to 15.5% moisture (corn) or 12.5% moisture (grain sorghum).
[3] Maturity expressed as follows: corn – days from planting to 50% silking, and grain sorghum - number of days from planting to half-bloom.
[4] N level of the ear leaf plus one in corn and of the flag leaf in sorghum.
[5] Estimate based on the average number of crop sequences involving the same preceding crop to full-season grain sorghum = 1.6.

Table 4. Effects of crop rotation on no-till soybean and sunflower, Harvey County Experiment Field, Hesston, KS, 2007

Crop	Crop Rotation[1]	Yield[2] 2007	Yield[2] 4-Yr	Stand[3]	Plant Ht	Maturity[4]	Lodging
		----------bu/a----------			in.	date	%
Soybean	W-C-SB	36.4	42.9	100	31	111	0
	W-[SB]-C-SB	34.5	42.8	100	33	111	0
	W-SB-C	33.8	41.8	100	31	111	0
	W-GS-SB	34.1	41.5	100	29	113	0
	W-[SB]-GS-SB	28.1	40.3	100	30	111	0
	W-[GS]-GS-SB	29.5	40.6	100	29	112	0
	GS-C-SB	30.6	41.4	100	32	111	0
[Soybean]	W-[SB]-C-SB	11.5	17.5	94	17	101	0
	W-[SB]-GS-SB	13.0	16.8	100	18	100	0
	W-[SB]-GS-SF	16.1	20.8	100	19	101	0
	LSD 0.05	5.2		NS	1.8	1.8	NS
	LSD 0.10	4.3		NS	1.5	1.5	NS
	Preceding crop main effect means:						
	Wheat	33.8	41.8	100	31	111	0
	Corn	33.8	42.4	100	32	111	0
	Sorghum	30.6	40.8	100	29	112	0
	LSD 0.05[5]	NS		NS	1.3	NS	NS
	LSD 0.10[5]	NS		NS	1.1	NS	NS
Sunflower	W-GS-SF	801	1686	25.1	37	56	11
	W-[SB]-GS-SF	866	1555	26.1	38	56	8
	W-[GS]-GS-SF	728	1554	24.4	38	57	10
	LSD 0.05	NS		NS	NS	NS	NS
	LSD 0.10	NS		NS	NS	NS	NS

[1] C = corn, GS = grain sorghum, SB = soybean, SF = sunflower, W = wheat, and [ ] = double crop.
[2] Means of four replications adjusted to 13% moisture (soybean) or 10% moisture (sunflower in lb/a).
[3] Stand expressed as a percentage for soybean and as plant population in thousands per acre for sunflower.
[4] Sunflower maturity expressed as number of days from planting to half-bloom.
[5] Estimate based on the average number of crop sequences involving the same preceding crop to full-season soybean = 2.3.

EFFECTS OF LATE-MATURING SOYBEAN AND SUNN HEMP SUMMER COVER CROPS AND NITROGEN RATE IN A NO-TILL WHEAT-GRAIN SORGHUM ROTATION

M.M. Claassen

Summary

Wheat and grain sorghum were grown in three no-till crop rotations, two of which included either a late-maturing Roundup Ready soybean or a sunn hemp cover crop established following wheat harvest. Nitrogen (N) fertilizer was applied to both grain crops at rates of 0, 30, 60, and 90 lb/a. Experiments were conducted on adjacent sites where different phases of the same rotations were established.

On the first site, late-maturing soybean and sunn hemp were grown in the third cycle of the rotations in 2006. These crops produced 1.37 and 2.08 ton/a of above-ground dry matter with 68 and 113 lb/a of potentially available N, respectively. Both legumes tended to increase grain sorghum leaf N concentration and grain yield but more so at low N rates and more consistently in the case of sunn hemp. At 90 lb/a N, sorghum leaf N levels were similar in all rotations. Grain sorghum yield tended to be higher at most N rates following soybean than in the rotation without a cover crop, but differences often were not significant. Conversely, sorghum yields following sunn hemp were consistently highest at each N rate with a top yield of 112.8 bu/a at 90 lb/a N. However, at this N rate, sorghum yields did not differ significantly between the rotation with sunn hemp vs. no cover crop.

On the second site, wheat followed grain sorghum after these cover crops had been grown for the first time in the rotations in 2005. In that season, soybean and sunn hemp produced an average of 2.42 and 4.14 ton/a with corresponding N yields of 103 and138 lb/a, respectively. Wheat suffered severe freeze damage in early April 2007, resulting in yields of only 19 to 22 bu/a in the best treatments. Grain test weights as well as yields were low and not meaningfully affected by residue from cover crops. Wheat plant N was relatively high at zero N fertilizer in all rotations because of low dry matter production but tended to be highest at 90 lb/a N in rotations with cover crops. N content and grain yield were greatest at 90 lb/a N, but yield increase with the last increment of fertilizer was small.

Introduction

Research at the Kansas State University Harvey County Experiment Field over an 8-year period explored the use of hairy vetch as a winter cover crop following wheat in a winter wheat-sorghum rotation. Results of long-term experiments showed that between September and May, hairy vetch can produce a large amount of dry matter with an N content of approximately 100 lb/a. However, using hairy vetch as a cover crop also has significant disadvantages including cost and availability of seed, interference with control of volunteer wheat and winter annual weeds, and the possibility of hairy vetch becoming a weed in wheat after sorghum.

New interest in cover crops has been generated by research in other areas showing the positive effect these crops can have on overall productivity of no-till systems.

In the current experiment, late-maturing soybean and sunn hemp, a tropical legume, were evaluated as summer cover crops for their effect on no-till sorghum grown in the spring after wheat harvest as well as on double-crop, no-till wheat after grain sorghum. In 4 site-years during the period 2002 through 2006, soybean and sunn hemp produced average N yields of 102 and124 lb/a, respectively. Averaged over N rates, soybean and sunn hemp resulted in 4-year average grain sorghum yield increases of 7.3 and 13.5 bu/a, respectively. Residual effects of soybean and sunn hemp on wheat after sorghum averaged over N rates were minor, with 3-year yields averaging 1.6 and 1.7 bu/a, respectively, more than wheat in the rotation without cover crops.

Procedures

Experiments were established on adjacent Geary silt loam sites that had been used for hairy vetch cover crop research in a wheat-sorghum rotation from 1995 to 2001. In accordance with the previous experimental design, soybean and sunn hemp were assigned to plots where vetch had been grown, and remaining plots retained the no cover crop treatment. The existing factorial arrangement of N rates on each cropping system also was retained. In 2007, grain sorghum was grown on Site 1 in the third cycle of the rotations. Wheat was produced on Site 2 at the end of the first cycle of the rotations.

Grain Sorghum

Cover crop planting in the preceding summer was delayed by late seed arrival. Weeds in wheat stubble were controlled with glyphosate application in early July and follow up treatment 1 day before planting. Asgrow AG7601 Roundup Ready soybean and sunn hemp seed were treated with respective rhizobium inoculants and no-till planted in 7.5-in. rows with a JD 1590 drill on August 8, 2006, at 60 lb/a and 10 lb/a, respectively. Both crops emerged approximately 1 week later. Sunn hemp began flowering in early to mid-October. At that time, soybean had little pod development. Cover crops were terminated on October 13 by rolling with a crop roller. Plots were subsequently sprayed with glyphosate to control crop or weed escapes. The first killing frost of the fall occurred 5 days later. Forage yield of each cover crop was determined by harvesting a 3.28 ft^2 area in each plot just before termination. Samples were subsequently analyzed for N content.

Weeds were controlled during the fallow period after cover crops with glyphosate, 2,4-D_{LVE} and Clarity. Pioneer 85G01 grain sorghum treated with Concep III safener and Cruiser insecticide was planted in 30-in. rows at approximately 42,000 seeds/a on June 6, 2007. Atrazine and Dual II Magnum were applied preemergence for residual weed control before and/or shortly after sorghum planting. All plots received 37 lb/a P_2O_5 banded as 0-46-0 at planting. Nitrogen fertilizer treatments were applied as 28-0-0 injected 10 in. from the row on June 11. Grain sorghum was combine harvested on October 3, 2007.

Wheat

Grain sorghum on Site 2 was combine harvested on November 9, 2006. N rates were immediately reapplied as broadcast 34-0-0. Variety Jagger winter wheat was no-till planted in 7.5-in. rows with a JD1590 drill the same day at 90 lb/a with 32 lb/a P_2O_5 fertilizer banded as 0-46-0 in the furrow. Wheat was harvested on July 9, 2007.

Results

Grain Sorghum

During the 5 days preceding cover crop planting in 2006, rainfall totaled 1.02 in. The next rains occurred 2 and 6 days after planting; a total of 1.52 in. was received. Stand establishment of both soybean and sunn hemp was good. Although August rainfall was well above normal, September and October were much drier than usual. Late-maturing soybean reached an average height of 19 in., showed limited pod development, and produced 1.37 ton/a of above-ground dry matter with an N content of 2.50% or 68 lb/a (Table 5). Sunn hemp averaged 53 in. in height and produced 2.08 ton/a with 2.70% N or 113 lb/a of N. Soybean and sunn hemp suppressed volunteer wheat to some extent but failed to give the desired level of late summer control. Volunteer wheat control was similar for both crops, averaging 67%.

The 2007 grain sorghum crop emerged 5 days after planting; final stands averaged 38,700 plants/a. The season brought some drought stress, but only 5 days had temperatures at or above 100°F. Summer was generally favorable for sorghum, with better-than-average conditions overall.

Both cover crop and N rate effects on grain sorghum were significant. Soybean and sunn hemp significantly increased sorghum nutrient concentration by 0.17% and 0.27% N, respectively, at the zero N rate. Where sorghum followed soybean and N fertilizer was applied, leaf N levels were comparable to those of sorghum in rotation without a cover crop. However, in rotations with sunn hemp vs. no cover crop, sorghum leaf N was significantly greater at 30 and 60 lb/a N but not at 90 lb/a N. The main effect of soybean and sunn hemp, averaged across N fertilizer rates, significantly increased sorghum leaf nutrient levels by 0.07% N and 0.17% N, respectively. Leaf N averaged over cropping systems increased significantly with each increment of N fertilizer.

Soybean cover crop tended to increase sorghum yields at all but the highest N rate, but the increase was significant only at the 60 lb/a N rate. Conversely, with sunn hemp in the rotation, sorghum yields increased across all N rates. However, the sunn hemp benefit was not significant at the 90 lb/a N rate. The positive effect of soybean and sunn hemp cover crops was seen in sorghum yield improvements of 4.0 and 12.2 bu/a, respectively, averaged over N rate. Yields averaged over cropping systems increased significantly at all but the 90 lb/a rate of N fertilizer.

Cover crops did not affect grain sorghum plant population or grain test weight and had no meaningful effect on half-bloom date. The number of heads/plant tended to increase slightly with N rate in sorghum rotations with soybean or no cover crop. In sorghum after sunn hemp, the number of heads/plant increased only at the highest N rate.

Wheat

The first cycle of the crop rotations on Site 2 began in 2005, when soybean and sunn hemp produced an average of 2.42 and 4.14 ton/a with corresponding N yields of 103 and138 lb/a, respectively (Table 6). In 2006, averaged across N rate, grain sorghum yielded 96.1 bu/a after soybean and 101.4 bu/a following sunn hemp. The 2007 wheat growing season was overshadowed by severe cold temperatures in early April that resulted in serious damage to the crop. Grain test weights as well as yields were low and not meaningfully affected by residue from cover crops. Similarly, plant heights were not affected by cropping history. Wheat plant N was relatively high at the zero N fertilizer rate in all rotations because of low dry matter production but tended to be highest at 90 lb/a N in rotations with cover crops. Effect of N rate on most wheat variables was significant. Plant height, N content, and grain yield were greatest at 90 lb/a N, but yield increase with the last increment of fertilizer was small. Yields of 19 to 22 bu/a at top N rates were respectable under existing conditions.

Table 5. Effects of soybean and sunn hemp summer cover crops and nitrogen rate on no-till grain sorghum after wheat, Hesston, KS, 2007

Cover Crop[1]	N Rate[2]	Cover Crop Yield Forage	Cover Crop Yield N	Grain Sorghum Grain Yield	Bushel Wt	Stand	Half[4] Bloom	Heads/ Plant	Leaf N[5]
	lb/a	ton/a	lb/a	bu/a	lb	1000s/a	days	no.	%
None	0	---	---	68.8	56.2	38.7	57	0.97	1.75
	30	---	---	85.5	56.9	38.5	56	1.03	2.10
	60	---	---	96.5	56.9	38.3	56	1.07	2.29
	90	---	---	107.1	57.4	39.5	56	1.11	2.54
Soybean	0	1.14	58	77.2	57.0	39.1	56	1.00	1.92
	30	1.38	70	89.5	56.9	38.1	56	1.05	2.10
	60	1.43	71	106.9	56.8	38.0	56	1.10	2.37
	90	1.52	73	100.5	57.2	37.8	56	1.14	2.55
Sunn hemp	0	1.87	112	90.9	56.6	38.9	56	1.04	2.02
	30	2.08	109	97.9	57.1	39.5	56	1.04	2.29
	60	2.41	127	105.4	57.1	40.2	56	1.04	2.43
	90	1.96	103	112.8	56.9	37.7	56	1.27	2.62
LSD .05		0.61	40	11.3	NS	NS	0.6	0.07	0.12
Means:									
Cover Crop									
None		---	---	89.5	56.8	38.8	56	1.05	2.17
Soybean		1.37	68	93.5	57.0	38.2	56	1.07	2.24
Sunn hemp		2.08	113	101.7	56.9	39.1	56	1.10	2.34
LSD .05		0.31	20	5.6	NS	NS	NS	0.04	0.06
N Rate									
0		1.50	85	79.0	56.6	38.9	56	1.00	1.89
30		1.73	89	91.0	56.9	38.7	56	1.04	2.17
60		1.92	99	102.9	56.9	38.8	56	1.07	2.36
90		1.74	88	106.8	57.1	38.3	56	1.17	2.57
LSD .05		NS	NS	6.5	NS	NS	NS	0.04	0.07

[1] Cover crops planted August 8, 2006 and terminated in early fall.
[2] N applied as 28-0-0 injected June 11, 2007.
[3] Oven dry weight and N content for sunn hemp and soybean on October 13, 2006.
[4] Days from planting to half-bloom.
[5] Flag leaf at late boot to early heading.

Table 6. Residual effects of soybean and sunn hemp summer cover crops and nitrogen rate on no-till wheat after grain sorghum, Hesston, KS, 2007

		Cover Crop Yield[3]		Sorghum	Wheat			
Cover Crop[1]	N Rate[2]	Forage	N	Yield 2006	Yield	Bushel Wt	Plant Ht	Plant N[4]
	lb/a	ton/a	lb/a	bu/a	bu/a	lb	in.	%
None	0	---	---	61.1	5.5	44.4	17	1.38
	30	---	---	74.5	12.6	47.0	24	1.02
	60	---	---	100.6	20.5	48.4	27	1.08
	90	---	---	98.3	21.0	46.7	29	1.24
Soybean	0	2.41	101	92.0	5.1	43.9	17	1.31
	30	2.06	85	98.5	14.8	47.2	25	1.09
	60	2.89	125	98.4	19.4	45.8	27	1.17
	90	2.33	100	95.2	21.6	47.1	28	1.48
Sunn hemp	0	3.74	116	95.8	7.0	44.1	18	1.29
	30	4.13	150	102.7	16.0	47.2	25	1.12
	60	4.34	142	109.0	20.5	48.1	28	1.18
	90	4.37	145	98.2	21.5	46.3	29	1.46
LSD .05		0.72	31	9.4	2.2	2.2	2.5	0.14
Means:								
Cover Crop								
None		---	---	83.6	14.9	46.6	24	1.18
Soybean		2.42	103	96.1	15.2	46.0	24	1.26
Sunn hemp		4.14	138	101.4	16.3	46.4	25	1.26
LSD .05		0.36	15	4.7	1.1	NS	NS	0.07
N Rate								
0		3.07	108	83.0	5.9	44.1	17	1.33
30		3.09	118	91.9	14.4	47.1	25	1.08
60		3.61	133	102.7	20.1	47.4	27	1.14
90		3.35	123	97.2	21.4	46.7	29	1.39
LSD .05		NS	NS	5.4	1.3	1.3	1.4	0.08

[1] Cover crops planted on July 9, 2005 and terminated by early fall.
[2] N applied as 28-0-0 injected July 19, 2006 for sorghum and 34-0-0 broadcast on November 9, 2006 for wheat.
[3] Oven dry weight and N content for sunn hemp and soybean on September 26, 2005.
[4] Whole-plant N concentration at early heading.

EFFECTS OF PLANTING DATE, HYBRID MATURITY, AND PLANT POPULATION IN NO-TILL CORN

M.M. Claassen

Summary

Three Pioneer corn hybrids (38H66, 35P80, and 33B49) representing 98-day, 106-day, and 112-day maturities were planted in a soybean rotation under no-till conditions on April 23, May 21, and June 5 and had final populations of 14,000, 18,000, and 22,000 plants/a. A March 13 planting was destroyed by unseasonable cold in early April. Subsequent wet weather resulted in deviation from the remaining targeted early- and mid-April planting dates. Despite planting postponement, relatively low moisture stress during the remainder of the season resulted in reasonably good dryland corn yields for this area. Later plantings were seriously affected by lodging resulting from southwestern corn borer activity. All treatment factors significantly affected corn. Planting date had the largest effect on length of time to reach half-silk stage. Corn planted on May 21 and June 5 reached silking 6 and 14 days faster, respectively, than corn planted on April 23. Corn yields averaged 114 bu/a when planted on April 23 but declined by 23% and 21% with successive plantings in May and early June. Corn hybrid 33B49 produced an average of 102 bu/a, whereas the earlier-maturing 38H66 and 35P80 had 9% and 6%, respectively, lower yields. Maximum yields occurred with the highest plant population (22,000 plants/a). At 18,000 and 14,000 plants/a, yields declined by 3% and 14%, respectively. In 2004, yields were largest with the latest planting date (mid-April), but in 2005 and 2006, highest yields occurred with the earliest planting (mid-March). In 2006, yields were low and not affected by plant population. In 2004 and 2005, maximum yields occurred with latest maturing hybrid and highest plant population. Grain test weight was good in 2007, tended to be best with the April and May plantings, and was not appreciably affected by hybrid or plant population. Number of ears/plant was not greatly influenced by treatment factors but was slightly greater than one ear/plant with the earliest planting, earliest maturing hybrid, and lowest plant population.

Introduction

In central and south central Kansas, dryland corn often does not perform as well as grain sorghum under existing seasonal weather conditions, which usually involve some degree of drought. Nevertheless, corn is preferred as a rotational crop by some producers because earlier growth termination and harvest facilitate planting of double-crop, no-till wheat in rotations. Genetic gains in corn drought tolerance as well as no-till planting practices that conserve soil moisture have encouraged producer interest in growing corn despite increased risk of crop failure.

Planting date, hybrid maturity, and plant population all have a major effect on dryland corn production. Previous research at this location indicated that highest dryland yields occurred at plant populations of 14,000 or 18,000 plants/a. This experiment was initiated in 2004 to determine if drought effects on no-till corn can be minimized by early planting dates, use of hybrids ranging in maturity from 97 to 112 days, and populations of 14,000 to 22,000 plants/a. Actual planting dates were March 18, April 2, and April 15 in 2004; March 14, April 4, and April 16 in 2005; and March 16, March 31, and April, 14 in 2006. Hybrids planted in 2004 and 2005 were Pioneer 38H67, 35P12, and 33B51, which have maturities of 97, 105, and 111 days, respectively. Hybrids planted in 2006 and 2007 were Pioneer 38H66, 35P80, and 33B49, which have maturities of 98, 106, and 112 days, respectively.

Procedures

The experiment was conducted on a Ladysmith silty clay loam site that had been cropped to no-till soybean in 2006. Corn was fertilized with 95 lb/a N and 37 lb/a P_2O_5 as

18-46-0 banded close to the row before planting and as 28-0-0 injected in a band 10 in. on either side of each row just after mid-May. The experiment design was a split-plot with planting date main plots and subplots with factorial combinations of three hybrids and three plant populations in four replications. Pioneer hybrids 38H66, 35P80, and 33B49 representing maturities of 98, 106, and 112 days to black layer, respectively, were no-till planted at approximately 26,000 seeds/a into moist soil on March13, April 23, May 21, and June 5. These hybrids with the Roundup Ready trait represented the same maturities as hybrids without this trait grown in 2004 and 2005. Weeds were controlled with a March 16 application of 1.5 qt/a AAtrex 4L + 1.6 pt/a Dual II Magnum + 1 qt/a Rascal Plus + adjuvants: 1.28 lb/a AMSU + 1 pt/a Superb HC. Subsequently, Weathermax + 1% AMSU was applied postemergence as necessary to complete season-long weed control. Corn was hand thinned to specified populations of 14,000, 18,000, and 22,000 plants/a. Evaluations included maturity, plant height, lodging, ear number, yield, and grain test weight. Plots in the April 23 planting were hand harvested on September 14. Remaining plots were combine harvested on September 27 and 28, 2007. Because of the large amount of lodging, ears not retrieved by the combine were hand gleaned. The associated yield was determined and included in the total yield as well as reported as a percentage yield loss (Table 7).

Results

Rainfall totaled 1.01, 1.27, 4.89, and 1.11 in. during the first 10 days after the respective planting dates. Corn emerged in 13 days after the mid-March planting and in 10 days or less following the remaining planting dates. Cold temperatures reached a low of 19°F on April 7 and 8, destroying an excellent stand of corn from the first planting. Freezing temperatures did not reoccur after mid-April. Subsequent planting dates were delayed by wet weather. Averaged across these planting dates, plant populations before hand thinning averaged 86% to 92% of the planting rate. The summer was favorable for corn, with better-than-average conditions overall. Late-planted corn suffered severe lodging in some areas as a result of southwestern corn borer activity. Length of time to reach half-silk stage increased with early planting and hybrid maturity but, on average, was not affected by plant populations. Later plantings on May 21 and June 5 reached silking 6 and 14 days faster than corn planted on April 23. Average hybrid differences in silking date ranged from 2 to 5 days.

Corn yields were significantly affected by planting date, hybrid, and plant population. Among possible two-way interactions between these treatment variables, the planting date x hybrid effect was significant for all variables except yield, grain moisture, and yield loss from lodging. The planting date x population effect was significant for yield and all other variables except grain moisture, number of days to reach silking stage, and yield loss from lodging. The hybrid x population effect was significant for yield, bushel weight, number of ears per plant, and plant height. Corn yielded an average of 114, 88, and 90 bu/a when planted on April 23, May 21, and June 5, respectively. Average yields for 38H66, 35P80, and 33B49 were 93, 96, and 102 bu/a, respectively. Populations of 14,000, 18,000, and 22,000 plants/a produced average yields of 89, 100, and 103 bu/a, respectively. Yields of all hybrids were maximized by the earliest planting and declined similarly among later planting dates.

Test weight averaged 57.5 lb/bu and was affected by planting date and, to a lesser extent, plant population. April and May plantings resulted in test weights 1.1 lb/bu greater than the June planting. Populations of 18,000 plants/a or less tended to increase test weight slightly. Number of ears/plant ranged from 0.92 to 1.20 among treatments and was highest with the April planting and earliest maturing hybrid at the lowest plant population.

Lodging was minimal with the April planting. However, southwestern corn borer caused major damage in both the May and June plantings, resulting in lodging averages of 37% and 50%. Corresponding yield losses were 16% and 21%.

Table 7. Dryland corn hybrid response to planting date and plant populations, Harvey County Experiment Field, Hesston, KS, 2007

Planting[1] Date	Hybrid[2]	Plant Popu- lation	Yield[3]	Moist	Bu Wt	Ears/ Plant	Days to Silk[4]	Plant Ht	Lodg- ing	Yield Loss
		no./a	bu/a	%	lb/bu			inches	%	%
April 23	38H66	14,000	94.3	12.4	58.1	1.20	62	77	3	---
		18,000	109.6	12.7	57.8	1.03	64	80	4	---
		22,000	112.6	12.3	56.8	0.98	63	77	8	---
	35P80	14,000	102.3	12.6	57.7	1.08	65	86	6	---
		18,000	118.6	12.3	57.6	1.02	66	85	5	---
		22,000	122.1	12.4	56.8	0.96	66	84	11	---
	33B49	14,000	108.2	13.3	58.7	1.09	69	87	4	---
		18,000	126.1	13.4	58.6	1.02	70	89	8	---
		22,000	127.2	13.3	58.8	0.97	70	87	8	---
May 21	38H66	14,000	79.0	13.8	58.1	1.03	58	84	18	9
		18,000	84.5	13.3	58.5	0.99	58	87	36	17
		22,000	95.6	13.2	58.0	0.96	58	88	50	21
	35P80	14,000	76.1	13.6	58.0	1.03	59	87	30	16
		18,000	82.5	13.6	57.9	0.98	60	86	50	21
		22,000	98.8	13.5	57.7	0.97	59	88	54	24
	33B49	14,000	89.6	15.5	57.0	1.01	61	88	22	11
		18,000	94.7	14.4	58.6	1.01	62	87	33	14
		22,000	90.6	14.7	57.2	0.95	62	86	43	12
June 5	38H66	14,000	83.3	13.6	57.5	1.05	50	77	36	20
		18,000	88.0	13.4	57.1	0.99	50	79	52	25
		22,000	88.9	13.5	56.5	0.98	50	77	63	24
	35P80	14,000	73.2	14.0	56.6	0.99	51	87	42	12
		18,000	99.9	14.4	56.7	0.95	52	7	63	32
		22,000	94.4	13.8	57.3	0.92	52	83	70	29
	33B49	14,000	94.1	15.6	55.9	1.01	53	86	25	11
		18,000	94.5	14.7	56.5	0.98	54	87	46	18
		22,000	95.8	14.8	56.8	0.94	54	84	51	15
LSD .05 Means in same DOP			10.7	0.82	0.87	0.05	1.4	3	10	12
LSD .05 Means in different DOP			14.0	0.86	0.90	0.06	1.4	3	11	12

(continued)

Table 7 (cont.). Dryland corn hybrid response to planting date and plant populations, Harvey County Experiment Field, Hesston, KS, 2007

Planting[1] Date	Hybrid[2]	Plant Popu- lation	Yield[3]	Moist	Bu Wt	Ears/ Plant	Days to Silk[4]	Plant Ht	Lodg- ing	Yield Loss
		no./a	bu/a	%	lb/bu			inches	%	%
Interactions										
DOP*Hybrid[5]			NS	NS	0.0001	0.09	0.0001	0.0001	0.002	NS
DOP*Population[6]			0.05	NS	0.03	0.0005	NS	0.04	0.0001	NS
Hybrid*Population[7]			0.03	NS	0.02	0.1	NS	0.05	NS	NS
Main effect means:										
	Planting Date									
	April 23		113.5	12.7	57.9	1.04	66	83	6	---
	May 21		87.9	13.9	57.9	0.99	60	87	37	16
	June 5		90.2	14.2	56.8	0.98	52	83	50	21
	LSD 0.05		9.8	0.37	0.37	0.04	0.4	1.3	6	NS
	Hybrid									
	38H66		92.9	13.1	57.6	1.02	57	81	30	19
	35P80		96.4	13.3	57.3	0.99	59	86	37	22
	33B49		102.3	14.4	57.6	1.00	62	87	27	14
	LSD 0.05		3.6	0.27	NS	0.018	0.5	1.0	3	5
	Plant Population									
	14,000		88.9	13.8	57.5	1.05	59	84	21	13
	18,000		99.8	13.6	57.7	1.00	59	85	33	21
	22,000		102.9	13.5	57.3	0.96	59	84	40	21
	LSD .05		3.6	0.27	0.29	0.018	NS	1.0	3	5

[1] DOP target dates were March 15, April 1, and April 15.
[2] Pioneer brand.
[3] Average of 4 replications adjusted to 56 lb/bu and 15.5% moisture. Yields included machine harvested plus hand gleaned grain from remaining lodged plants in May and June plantings.
[4] Days from planting to 50% silking.
[5] Probability of planting date effect differing with hybrid; NS = not significant.
[6] Probability of planting date effect differing with plant population; NS = not significant.
[7] Probability of hybrid effect differing with plant population; NS = not significant.

EVALUATION OF MESOTRIONE (LUMAX) FOR CROP SAFETY IN GRAIN SORGHUM

M.M. Claassen

Summary

Fourteen herbicide treatments were evaluated in 2007 for grain sorghum tolerance to mesotrione in comparison with the standard, Bicep II Magnum. Treatments included Lumax, Lexar, and Callisto. Lumax and Lexar treatments involved several rates and were applied alone or in combination with atrazine at 15 days before planting, preemergence just after planting, or in split applications with preplant and preemergence timings. Callisto was applied with atrazine postemergence to sorghum at the 5-leaf stage, and results were compared with postemergence Ally XP plus 2,4-D_A. Rainfall within 1 week after the respective early preplant and preemergence applications equaled or exceeded 0.33 in. No visual injury of consequence resulted from soil-applied treatments. Grain sorghum half-bloom stage was delayed slightly by higher rates of Lumax. Callisto plus atrazine and Ally plus 2,4-D_A caused significant grain sorghum injury that dissipated over time. These treatments also resulted in bloom percentages that were 20% to 27% lower than in the untreated check at the mid-August evaluation. Grain sorghum yields and test weights were not significantly affected by herbicide treatments at $p = 0.05$. Weed pressure was very light, and all treatments resulted in excellent control of Palmer amaranth and large crabgrass.

Introduction

Development of triazine- and ALS-resistant pigweeds and kochia in some areas has presented grain sorghum producers with a new weed control challenge. In recent years, Kansas State University (KSU) has been investigating mesotrione for possible use in grain sorghum. Mesotrione is the active ingredient in Callisto, a postemergence herbicide for broadleaf weed control in corn. Lexar and Lumax are premixes labeled for preplant or preemergence application in corn; each contains S-metolachlor, mesotrione, and atrazine, but the two products differ in the concentration of each active ingredient. **Lumax received full Section 3 registration in 2008 and is the only herbicide with mesotrione that is currently labeled for grain sorghum in Kansas**.

Research at the KSU Harvey County Experiment Field and other locations in Kansas initially focused on management of application rates and timing to assess the potential for crop injury in grain sorghum. During a 4-year period beginning in 2003, experiments were conducted at Hesston in which Lumax at 1x and 2x rates was applied at early preplant intervals as well as immediately following planting (Table 9). Significant injury and yield loss occurred at the 2x rate when abundant rainfall occurred after application, particularly when the application occurred close to planting time.

These and other investigations have shown that Lumax can be used successfully in grain sorghum without significant yield loss from injury at a use rate of 2.5 qt/a on medium texture soils if application is made ahead of planting and crop emergence. Current labeling allows for full-rate (2.5 qt/a) application without incorporation at 7 to 21 days before planting. Split applications can be used with early preplant followed by preemergence treatment after planting but before sorghum emerges. The second application can be made at rates of 1 to 1.25 qt/a. In any case, total Lumax application must not exceed 2.5 qt/a.

Procedures

Soybean was grown on the experiment site in 2006. Soil was a Smolan silt loam with pH 6.2 and 2.6% organic matter. Until initial experiment preparations were implemented, the area was managed under no-till conditions. Palmer amaranth and large crabgrass seeds were spread over the site and lightly incorporated with a mulch treader just before the first treatments were applied. In plots with no residual herbicide, Roundup Original Max was applied to control existing weeds prior to planting and preemergence treatment applications.

Grain sorghum was fertilized with 90 lb/a N and 30 lb/a P_2O_5. Pioneer 85G01 with Concep III safener and Cruiser insecticide was planted into marginally moist soil at approximately 40,000 seeds/a in 30-in. rows on June 20, 2007. Seedbed condition was good. All herbicide treatments (Table 8), replicated four times, were broadcast in 15 gal/a of water with Greenleaf TurboDrop TDXL025 venturies in combination with Turbo Tee 11005 nozzles at 30 psi. Preplant applications were made 15 days before planting. Preemergence applications were made shortly after planting. Postemergence treatments followed on July 8, when sorghum was in the 5-leaf stage with a height of 5 to 7 in. Plots were not cultivated. Crop development variables and injury were monitored several times during the growing season. Grain sorghum was harvested on October 5, 2007.

Results

Grain sorghum emerged 5 days after planting. During the first 10 days after preplant herbicide applications, rainfall totaled 1.15 in. with an additional 0.15 in. during the remaining 5 days prior to sorghum planting. Within the first 10 days after preemergence treatments were applied, 1.69 in. of rain fell. Only light rains occurred at 4 days before and 2 to 4 days after postemergence treatment applications. Preplant and preemergence herbicide applications caused no visual injury of consequence. Postemergence Callisto caused significant chlorosis and moderate stunting of sorghum, which dissipated with time. Ally XP plus 2,4-D also caused significant sorghum injury, noted primarily as leaning plants. Both treatments significantly delayed sorghum bloom date.

Despite overseeding with weed seed, weed pressure was very light. All treatments provided excellent control of Palmer amaranth and large crabgrass.

Grain sorghum half-bloom stage was delayed slightly by the higher rates of Lumax but not by Lexar. More notably, compared with the untreated check, bloom percentage on August 17 was 20% lower in plots treated with Callisto and 27% lower in plots treated with Ally plus 2,4-D. However, sorghum yields and test weights were not significantly affected by treatments ($p = 0.05$). Lowest yields occurred with Ally plus 2,4-D, whereas sorghum treated with Callisto produced yields similar to those with Bicep II Magnum as well as the remaining treatments. Lumax and Lexar treatments tended to result in yields numerically greater than yields with Bicep II Magnum.

Table 8. Mesotrione herbicide effect on grain sorghum, Harvey County Experiment Field, Hesston, KS, 2007

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury[3] 7/23	Injury[3] 8/8	Plant ht 8/8	Plant popula-tion/a	Bloom 8/17	Yield	Bu wt
					%	%	in.	1000s	%	bu/a	lb
1 Lumax	3.94 SE	2.5	qt	15 DBP	0	0	35	36.8	44	85	56
2 Lumax	3.94 SE	2.5	qt	15 DBP	0	0	37	36.0	44	80	56
AAtrex	4 SC	1	pt	15 DBP							
3 Lexar	3.7 SE	3	qt	15 DBP	0	0	35	34.8	46	82	56
4 Lumax	3.94 SE	1.5	qt	15 DBP	0	0	36	36.0	42	92	57
Lumax	3.94 SE	1	qt	PRE							
5 Lumax	3.94 SE	1.5	qt	15 DBP	1	0	35	35.8	43	86	56
AAtrex	4 SC	0.5	pt	15 DBP							
Lumax	3.94 SE	1	qt	PRE							
AAtrex	4 SC	0.5	pt	PRE							
6 Lumax	3.94 SE	1.25	qt	15 DBP	0	0	36	35.2	47	90	57
Lumax	3.94 SE	1.25	qt	PRE							
7 Lumax	3.94 SE	1.25	qt	15 DBP	0	0	36	34.8	43	91	56
AAtrex	4 SC	0.5	pt	15 DBP							
Lumax	3.94 SE	1.25	qt	PRE							
AAtrex	4 SC	0.5	pt	PRE							
8 Lumax	3.94 SE	1	qt	15 DBP	1	0	36	36.3	50	96	56
Lumax	3.94 SE	1	qt	PRE							
9 Lumax	3.94 SE	1	qt	15 DBP	0	0	36	36.0	43	84	56
AAtrex	4 SC	0.5	pt	15 DBP							
Lumax	3.94 SE	1	qt	PRE							
AAtrex	4 SC	0.5	pt	PRE							
10 Lexar	3.7 SE	1.5	qt	15 DBP	1	0	37	35.2	45	81	55
Lexar	3.7 SE	1.5	qt	PRE							
11 Lexar	3.7 SE	2	qt	15 DBP	0	0	36	35.4	48	86	56
Lexar	3.7 SE	1	qt	PRE							
12 Lexar	3.7 SE	1.25	qt	15 DBP	0	0	36	35.4	45	94	57
Lexar	3.7 SE	1.25	qt	PRE							
13 Bicep II Magnum	5.5 SC	2.1	qt	PRE	0	0	36	34.7	45	77	57
14 Dual II Magnum	7.6 EC	1	pt	PRE	25	4	34	35.7	33	80	56
Callisto	4 SC	3	fl oz	POST							
AAtrex	4 SC	1	qt	POST							
COC		1	% v/v	POST							
15 Dual II Magnum	7.6 EC	1	pt	PRE	12	5	35	36.5	26	70	56
Ally XP	60 WG	0.05	oz wt	POST							
2,4-D_A	3.8 SL	1	pt	POST							
16 Hand weed					0	0	35	36.4	39	88	56
17 Untreated					0	0	36	34.9	53	78	56
LSD .05					1	2	1.4	NS	9	NS	NS

[1] Mesotrione is the active ingredient in Callisto, a postemergence herbicide for corn. Lexar and Lumax are premixes that are labeled for preplant or preemergence application in corn. Each contains S-metolachlor, mesotrione, and atrazine in somewhat different concentrations. **Of the three products containing mesotrione, only Lumax is currently labeled for grain sorghum in Kansas. Follow label directions when using this product.** COC = crop oil concentrate (Agriliance Prime Oil).
[2] DBP = days before planting; PRE = preemergence on June 20. POST = postemergence on July 8.
[3] Chlorosis, stunting, or leaning plants.

Table 9. Lumax herbicide rate and timing effects on grain sorghum, Harvey County Experiment Field, Hesston, KS, 2003-2006

Year	Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Rainfall[3] 7 DAT	Rainfall[3] 14 DAT	Rainfall[3] 21 DAT	Rainfall[3] Emerg	Injury[4]	Yield
						---------------in.----------------				%	bu/a
2003	1 Lumax	3.94 SE	2.5	qt	20 DBP	0.72	1.16	1.92	2.35	0	76
	2 Lumax	3.94 SE	5	qt	20 DBP					0	77
	3 Bicep Lite II Magnum	6 SC	1.5	qt	20 DBP					0	77
	4 Bicep Lite II Magnum	6 SC	3	qt	20 DBP					0	68
	5 Lumax	3.94 SE	2.5	qt	10 DBP	0.46	1.59	1.59	1.59	0	81
	6 Lumax	3.94 SE	5	qt	10 DBP					0	75
	7 Bicep LiteII Magnum	6 SC	1.5	qt	10 DBP					0	83
	8 Bicep Lite II Magnum	6 SC	3	qt	10 DBP					0	83
	5 Lumax	3.94 SE	2.5	qt	PRE	0.43	0.57	0.57	0.43	0	76
	6 Lumax	3.94 SE	5	qt	PRE					0	79
	7 Bicep Lite II Magnum	6 SC	1.5	qt	PRE					0	78
	8 Bicep Lite II Magnum	6 SC	3	qt	PRE					0	74
	9 Weed Free									0	---
	10 Untreated									0	71
	LSD 0.05										NS
2004	1 Lumax	3.94 SE	2.5	qt	20 DBP	0.18	2.07	3.87	5.18	0	119
	2 Lumax	3.94 SE	5	qt	20 DBP					1	117
	3 Bicep Lite II Magnum	6 SC	1.5	qt	20 DBP					0	117
	4 Bicep Lite II Magnum	6 SC	3	qt	20 DBP					1	116
	5 Lumax	3.94 SE	2.5	qt	10 DBP	1.91	5	5.28	5	0	116
	6 Lumax	3.94 SE	5	qt	10 DBP					5	114
	7 Bicep Lite II Magnum	6 SC	1.5	qt	10 DBP					0	121
	8 Bicep Lite II Magnum	6 SC	3	qt	10 DBP					4	114
	5 Lumax	3.94 SE	2.5	qt	PRE	2.71	2.99	4.72	2.71	4	115
	6 Lumax	3.94 SE	5	qt	PRE					20	105
	7 Bicep Lite II Magnum	6 SC	1.5	qt	PRE					2	115
	8 Bicep Lite II Magnum	6 SC	3	qt	PRE					11	111
	9 Weed Free									0	117
	10 Untreated									0	115
	LSD 0.05									4	9

(continued)

Table 9 (cont.). Lumax herbicide rate and timing effects on grain sorghum, Harvey County Experiment Field, Hesston, KS, 2003-2006

		Product				Rainfall[3]					
Year	Herbicide Treatment[1]	Form	Rate/a	Unit	Timing[2]	7 DAT	14 DAT	21 DAT	Emerg	Injury[4]	Yield
						---------------in.----------------				%	bu/a
2005	1 Lumax	3.94 SE	2.5	qt	20 DBP	2.14	6.35	10.49	10.5	0	103
	2 Lumax	3.94 SE	5	qt	20 DBP					0	91
	3 Bicep Lite II Magnum	6 SC	1.5	qt	20 DBP					0	100
	4 Bicep Lite II Magnum	6 SC	3	qt	20 DBP					0	102
	5 Lumax	3.94 SE	2.5	qt	10 DBP	6.87	8.36	8.36	8.36	0	103
	6 Lumax	3.94 SE	5	qt	10 DBP					0	96
	7 Bicep Lite II Magnum	6 SC	1.5	qt	10 DBP					0	98
	8 Bicep Lite II Magnum	6 SC	3	qt	10 DBP					0	101
	5 Lumax	3.94 SE	2.5	qt	PRE	0.01	1.9	1.9	0.01	1	99
	6 Lumax	3.94 SE	5	qt	PRE					8	100
	7 Bicep Lite II Magnum	6 SC	1.5	qt	PRE					0	98
	8 Bicep Lite II Magnum	6 SC	3	qt	PRE					0	103
	9 Weed Free									0	101
	10 Untreated									0	98
	LSD 0.05									1	7
2006	1 Lumax	3.94 SE	2.5	qt	13 DBP	0.2	1.48	3.82	3.82	3	107
	2 Lumax	3.94 SE	5	qt	13 DBP					34	100
	3 Bicep Lite II Magnum	6 SC	1.5	qt	13 DBP					0	112
	4 Bicep Lite II Magnum	6 SC	3	qt	13 DBP					1	110
	5 Lumax	3.94 SE	2.5	qt	PRE	3.51	3.51	3.51	3.51	21	105
	6 Lumax	3.94 SE	5	qt	PRE					46	88
	7 Bicep Lite II Magnum	6 SC	1.5	qt	PRE					0	108
	8 Bicep Lite II Magnum	6 SC	3	qt	PRE					1	102
	9 Weed Free									0	109
	LSD .05									8	12

[1]Lumax is a premix of 2.68 lb S-metolachlor (Dual II Magnum), 0.268 lb mesotrione (Callisto), and 1 lb atrazine. It is newly labeled (2008) for grain sorghum in Kansas. **Consult Lumax label for rates and timing.**

[2] DBP = days before planting; PRE = preemergence.

3 Rainfall received during 7, 14 and 21 days after treatment application as well as for the period from application to crop emergence.

[4] Chlorosis, stunting, or leaning plants.

HERBICIDES FOR CHEAT CONTROL IN WINTER WHEAT

M.M. Claassen

Summary

Twenty-one herbicide treatments were evaluated for crop tolerance and weed control efficacy in wheat with focus on cheat control as influenced by rate and time of PowerFlex application vs. standards. Moderate populations of cheat developed. All fall treatments with PowerFlex, Maverick, Olympus, and Olympus Flex provided excellent cheat control. Spring application of these herbicides also gave good to excellent cheat control but tended to be somewhat less effective with low rates of PowerFlex and Maverick. In the spring treatment, Maverick performance was significantly improved by application with 28% liquid nitrogen fertilizer. Osprey failed to give satisfactory cheat control at both times of application. Wheat injury from herbicides was minor and considered inconsequential. Yields were low because of severe injury from low temperatures in early April as well as subsequent leaf rust. Herbicide treatments did not affect wheat yields but significantly improved apparent test weight.

Introduction

Winter annual bromes such as cheat may develop significant competition in wheat that is grown without adequate crop rotation. Shallow tillage or no tillage can contribute to the problem. Several herbicides are currently available to growers that offer good crop tolerance and selective control of cheat in wheat. These products differ in their efficacy in controlling other weedy grasses as well as in the rotational restrictions for crops that follow. Pyroxsulam, to be marketed under the brand name PowerFlex, is a new ALS inhibitor without long soil persistence that is expected to be labeled for use in Kansas by the fall of 2008. Research reported here was designed to evaluate this product's cheat control efficacy and crop tolerance when applied at several rates in the fall vs. in the spring.

Procedures

Winter wheat was grown on the experiment site in 2006. Soil was a Ladysmith silty clay loam with pH 6.6 and 2.4% organic matter. Reduced tillage practices were used to maintain the site and prepare the seedbed. Cheat seed was broadcast over the area to enhance uniformity of weed populations prior to the last preplant tillage operation. Wheat was fertilized with 91 lb/a N and 33 lb/a P_2O_5. Variety 2137 was planted into dry soil at 60 lb/a in 8-in. rows on October 6, 2006. Seedbed condition was fair. All herbicide treatments (Table 10), replicated four times, were broadcast in 20 gal/a of water with TeeJet XR8003 nozzles at 18 psi. Fall and spring postemergence treatments were applied on November 22 and March 16, respectively. In the fall, wheat had one to two tillers and a height of 3 in.; cheat had two to three leaves and a height of 1.5 to 2 in. At the time spring applications were made, wheat had multiple tillers and a height of 4 inches. Cheat had multiple tillers with no significant growth in height since fall treatments were applied. Crop injury and weed control were rated several times during the growing season. Wheat was harvested on June 26, 2007.

Results

Rainfall of 0.41 in. was received 4 days after planting. Wheat emerged 8 days later. Additional rains in October totaled 0.89 in. Dry weather prevailed before and after application of fall treatments. Rainfall on the fourth day after spring treatment application totaled 0.83 in. Wheat was just past the jointing stage, and main stems were seriously injured by the cold temperatures on April 7 and 8. Diseases played a significant role in yield reduction of freeze-injured wheat with tillers that matured later than usual. Leaf rust became the dominant disease by mid-May, and leaves began turning yellow at that point.

Moderate populations of cheat developed. Cheat control was excellent with all fall treatments except Osprey, which performed poorly. The high rate of PowerFlex, both rates of Olympus, and Olympus Flex also provided excellent cheat control with spring applications. Fair to good control was achieved with the lowest rates of PowerFlex and Maverick in the spring, whereas Osprey was even less effective than in the fall. There was a numerical tendency for increased cheat control with springtime rate of PowerFlex, but treatment differences were not significant. Spring applications with 50% UAN significantly enhanced cheat control with Maverick but had little or no effect on efficacy of PowerFlex at 3.57 oz/a or Olympus at 0.9 oz/a.

Indigenous populations of bushy wallflower and henbit that developed on the site were light and variable. All fall treatments controlled bushy wallflower and also provided fair to excellent henbit control (data not shown). However, Maverick and the low rate of Olympus were less effective than the other treatments on henbit. Because of freeze injury, efficacy of spring treatments on these broadleaf species could not be determined.

No significant crop injury was observed following fall treatments. Very minor injury in the form of slight stunting or yellowing occurred with several spring treatments, most notably those applied with 50% UAN. Neither crop injury nor cheat control correlated with wheat yield under existing conditions. Wheat yields were comparable among all fall treatments and were not significantly different from the untreated check. Yields also did not differ significantly among spring herbicide treatments, but all tended to be lower than the untreated check as well as fall treatments. Notably, however, among the several spring treatments applied with 50% UAN, yields were as good as or better than with fall treatments.

All herbicide treatments significantly improved apparent wheat test weight by reducing the amount of cheat present in the grain. Osprey, however, was inferior to the other fall treatments in this regard; Osprey was also inferior to Olympus without or with UAN as well as Maverick with UAN in the spring.

Table 10. Cheat control in winter wheat, Harvey County Experiment Field, Hesston, KS, 2007

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 3/23[3]	Cheat Control 03/13	Cheat Control 4/12	Cheat Control 6/14	Yield	Bu wt[4]
					%	%	%	%	bu/a	lb
1 PowerFlex	7.5 WG	2.13	oz wt	Fall	---	92	---	100	15	47.1
NIS		0.5	% v/v							
2 PowerFlex	7.5 WG	2.85	oz wt	Fall	---	94	---	100	14	46.8
NIS		0.5	% v/v							
3 PowerFlex	7.5 WG	3.57	oz wt	Fall	---	96	---	100	17	48.2
NIS		0.5	% v/v							
4 PowerFlex	7.5 WG	3.57	oz wt	Fall	---	95	---	100	15	48.0
Scoil		1	% v/v							
5 Maverick	75 WG	0.67	oz wt	Fall	---	95	---	100	16	48.2
NIS		0.5	% v/v							
6 Olympus	70 WG	0.6	oz wt	Fall	---	98	---	100	16	47.0
NIS		0.5	% v/v							
7 Olympus	70 WG	0.9	oz wt	Fall	---	99	---	100	17	47.7
NIS		0.5	% v/v							
8 Osprey	4.5 WG	4.76	oz wt	Fall	---	36	---	51	16	42.6
Scoil		1	% v/v							
9 Olympus Flex	11.25 WG	3.17	oz wt	Fall	---	98	---	100	16	48.8
NIS		0.5	% v/v							
AMSU		1.52	lb							
10 PowerFlex	7.5 WG	2.13	oz wt	Spring	1	---	23	88	13	46.8
NIS		0.5	% v/v							
11 PowerFlex	7.5 WG	2.85	oz wt	Spring	3	---	33	90	12	47.2
NIS		0.5	% v/v							
12 PowerFlex	7.5 WG	3.57	oz wt	Spring	2	---	24	93	14	47.7
NIS		0.5	% v/v							
13 PowerFlex	7.5 WG	3.57	oz wt	Spring	2	---	29	95	14	48.1
Scoil		1	% v/v							
14 Maverick	75 WG	0.67	oz wt	Spring	1	---	23	87	15	47.7
NIS		0.5	% v/v							
15 Olympus	70 WG	0.6	oz wt	Spring	1	---	29	100	15	49.1
NIS		0.5	% v/v							

(continued)

Table 10 (cont.). Cheat control in winter wheat, Harvey County Experiment Field, Hesston, KS, 2007

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 3/23[3]	Cheat Control 03/13	Cheat Control 4/12	Cheat Control 6/14	Yield	Bu wt[4]
					%	%	%	%	bu/a	lb
16 Olympus	70 WG	0.9	oz wt	Spring	1	---	33	100	14	49.4
NIS		0.5	% v/v							
17 Osprey	4.5 WG	4.76	oz wt	Spring	1	---	24	41	14	44.6
Scoil		1	% v/v							
18 Olympus Flex	11.25 WG	3.17	oz wt	Spring	2	---	31	99	14	47.7
NIS		0.5	% v/v							
AMSU		1.52	lb							
19 PowerFlex	7.5 WG	3.57	oz wt	Spring	6	---	30	99	17	47.8
NIS		0.5	% v/v							
UAN		50	% v/v							
20 Maverick	75 WG	0.67	oz wt	Spring	3	---	23	98	19	50.0
NIS		0.5	% v/v							
UAN		50	% v/v							
21 Olympus	70 WG	0.9	oz wt	Spring	4	---	30	100	16	48.7
NIS		0.5	% v/v							
UAN		50	% v/v							
22 Untreated					0	0	0	0	18	34.0
LSD 0.05					1	5	9	8	3.3	3.6

[1] AMSU = ammonium sulfate. Scoil = methylated vegetable oil adjuvant. NIS = Agral 90 nonionic surfactant. UAN = urea ammonium nitrate, 28%N.
[2] Fall = November 22, 2006; Spring = March 16, 2007.
[3] No visual injury was observed following fall herbicide application.
[4] Apparent grain test weight reflects the presence of cheat in the harvested sample.

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Experiment Field Personnel

William F. Heer, Agronomist-in-Charge
Mike Seyb, Plant Science Technician

SOUTH CENTRAL KANSAS EXPERIMENT FIELD

Hutchinson

Introduction

The South Central Kansas Experiment Field, Hutchinson was established in 1951 on the U.S. Coast Guard Radio Receiving Station southwest of Hutchinson. The first research data were collected with the 1952 harvest. Before this, data for the south central area of Kansas were collected at three locations: Kingman, Wichita/Goddard, and Hutchinson. The current South Central Experiment Field location is approximately 3/4 mi south and east of the old Hutchinson location on the Walter Peirce farm.

Research at the South Central Kansas Experiment Field is designed to help the area's agriculture develop to its full agronomic potential using sound environmental practices. The principal objective is achieved through investigations of fertilizer use, weed and insect control, tillage methods, seeding techniques, cover crops and crop rotations, and variety improvement and selection of hybrids and varieties adapted to the area as well as alternative crops that may be beneficial to the area’s agriculture production. Experiments focus on problems related to production of wheat, grain and forage sorghum, oat, alfalfa, corn, soybean, cotton, rapeseed/canola, and sunflower and soil tilth, water, and fertility. Breeder and foundation seed of wheat, oat, and canola varieties/hybrids are produced to improve seed stocks available to farmers. A large portion of the research program is dedicated to wheat and canola breeding/germplasm development.

In March 2004, the Kansas State University Foundation took possession of approximately 300 acres of land southwest of Partridge, KS. This land was donated to the foundation by George V. Redd and Mabel E. Bargdill for use in developing and improving plants and crops. The acreage is in two parcels; one is approximately 140 acres, lies south of Highway 61 and west of county road Centennial, and is currently in CRP and will remain there until the contract runs out. In December 2007, two wells were drilled on this quarter to provide for future irrigation research. The second parcel, a full quarter, is currently used for foundation wheat and oat production and wheat, canola, grain sorghum, soybean, and cotton fertility combined with various cropping rotations. Both quarters will be worked into the research activities of the South Central Kansas Experiment Field.

Soil Description

A new soil survey was completed for Reno County and has renamed some of the soils on the field. The new survey overlooks some soil types present in the older survey, and we believe the following descriptions of soils on the experiment field are more precise. The South Central Kansas Experiment Field has approximately 120 acres classified as nearly level to gently sloping Clark/Ost loams with calcareous subsoils. This soil requires adequate inputs of phosphate and nitrogen (N) fertilizers for maximum crop production. The Clark soils are well drained and have good water-holding capacity. They are more calcareous at the surface and less clayey in the subsurface than the Ost. The Ost soils are shallower than the Clark, having an average surface layer of only 9 in. Both soils are excellent for wheat and grain sorghum production. Large areas of these soils are found in southwest and southeast Reno County and in western Kingman County. The Clark soils are associated with the Ladysmith and Kaski soils common in Harvey County but are less clayey and contain more calcium carbonate. Approximately 30 acres of Ost Natrustolls Complex with associated alkali slick spots occur on the north edge of the experiment field. This soil requires special management and timely tillage because it puddles when wet and forms a hard crust when dry. A 10-acre depression on the south edge of the Field is a Tabler-Natrustolls Complex (Tabler slick spot complex). This area is unsuitable for cultivated crop production and was seeded to switchgrass in 1983. Small pockets of the Tabler-Natrustolls are found throughout the experiment field.

Soils on the Redd-Bargdill Foundation land are different than those on the South Central Field. The south quarter (CRP) has mostly Shellabarger fine sandy loams with 1-3% slopes. There are also some Farnums on this quarter. The new classification has these soils classified as Nalim loam. The north quarter was previously classified as all Tabler clay loam. However, the new survey classifies the soils as Funmar-Taver loams, Funmar loams, and Tever loams.

Weather Information

The U.S. Department of Commerce National Oceanic and Atmospheric Administration National Weather Service rain gage (Hutchinson 10 S.W. 14-3930-8) collected 37.71 in. of precipitation in 2007, 7.88 in. above the 30-year (most recent) average of 29.83 in. From 1997-2000, precipitation was above average. In 2001, 2003, and 2006, precipitation recorded at the field was below normal. Precipitation for 2002, 2004, and 2005 was 0.946, 3.14, and 2.22 in. above normal, respectively. The 30-year average has been increasing over the past few years. These figures are different from those available through the Kansas State University automated weather station (http://www.oznet.k-state.edu/wdl/) because of the distance between the two rain gages. As with all years, distribution within the year and rainfall intensity are the determining factors in the usefulness of the precipitation. In 2006, only December precipitation was considerably above normal. In 2007, January, March, April, May, June, October, and December had precipitation above the long-term average. This, however, was not a record high for the field. Record-high precipitation occurred in 1978 with a little more than 47 in. of precipitation recorded. A frost-free growing season of 191 days, most of which were in the spring (April 15-October 23, 2007), was recorded. This is 8 days more than the average frost-free season of 183 days (April 19-October 17).

Table 1. Precipitation at the KSU South Central Kansas Experiment Field, Hutchinson, KS (10 S.W. 14-3930-8)

Month	Rainfall (in.)	30-year Avg* (in.)	Month	Rainfall (in.)	30-year Avg (in.)
2006			April	2.87	2.52
September	1.31	2.71	May	10.31	4.03
October	1.49	2.51	June	7.34	4.46
November	0.08	1.29	July	0.85	3.70
December	2.44	0.89	August	1.68	3.34
2007			September	0.65	2.59
January	0.90	0.73	October	2.91	2.47
February	0.48	1.07	November	0.11	1.29
March	5.34	2.66	December	4.26	0.97
			2007 Total	37.71	29.83

* Most recent 30 years.

CROP PERFORMANCE TESTS AT THE SOUTH CENTRAL KANSAS EXPERIMENT FIELD

W.F. Heer and J.E. Lingenfelser

Summary

Performance tests for winter wheat, grain sorghum, alfalfa, canola, sunflower, oat, and spring wheat were conducted at the South Central Kansas Experiment Field. Off-site tests for irrigated corn, soybean, and grain sorghum were also conducted. Results of these tests can be found in the following publications, which are available at your local K-State Research and Extension office or online at http://www.oznet.ksu.edu/library/.

2007 Kansas Performance Tests with Winter Wheat Varieties. KAES Report of Progress 982.
2007 Kansas Performance Tests with Corn Hybrids. KAES Report of Progress 983.
2007 Kansas Performance Tests with Grain Sorghum Hybrids. KAES Report of Progress 986.
2007 Kansas Performance Tests with Soybean Varieties. KAES Report of Progress 987.
2007 Kansas Performance Tests with Alfalfa Varieties. KAES Report of Progress 988.
2007 Kansas Performance Tests with Sunflower Hybrids. KAES Report of Progress 989.
2007 National Winter Canola Variety Trial. KAES Report of Progress 990

EFFECTS OF NITROGEN RATE AND PREVIOUS CROP ON GRAIN YIELD IN CONTINUOUS WHEAT AND ALTERNATIVE CROPPING SYSTEMS IN SOUTH CENTRAL KANSAS

W.F. Heer

Summary

Predominant cropping systems in south central Kansas have been continuous wheat and wheat-grain sorghum-fallow. With continuous wheat, tillage is preformed to control diseases and weeds. In the wheat-sorghum-fallow system, only two crops are produced every 3 years. Other crops (corn, soybean, sunflower, winter cover crops and canola) can be placed in these cropping systems. To determine how winter wheat (and alternative crop) yields are affected by alternative cropping systems, winter wheat was planted in rotations following the alternative crops. Yields were compared with yields of continuous winter wheat under conventional (CT) and no-till (NT) practices. Initially, CT continuous wheat yields were greater then those from the other systems. However, over time, wheat yields following soybean increased, reflecting the effects of reduced weed and disease pressure and increased soil N. However, CT continuous winter wheat seems to out yield NT winter wheat regardless of the previous crop.

Introduction

In south central Kansas, continuous hard red winter wheat and winter wheat-grain sorghum-fallow are the predominate dryland cropping systems. The summer fallow period following sorghum is required because the sorghum crop is harvested in late fall, after the optimum planting date for wheat in this region. Average annual rainfall is only 29 in./year, with 60% to 70% occurring between March and July. Therefore, soil moisture is often not sufficient for optimum wheat growth in the fall. No-till systems often increase soil moisture by increasing infiltration and decreasing evaporation. However, higher grain yields associated with increased soil water in NT have not always been observed. Cropping systems with winter wheat following several alternative crops would provide improved weed control through additional herbicide options, reduce disease incidence by interrupting disease cycles, and allow producers several options under the 1995 Farm Bill. However, the fertilizer N requirement for many crops is often greater under NT than CT. Increased immobilization and denitrification of inorganic soil N and decreased mineralization of organic soil N have been related to the increased N requirements under NT. Therefore, effect of N rates on hard red winter wheat in continuous wheat and in cropping systems involving alternative crops for the area have been evaluated at the South Central Kansas Experiment Field. The continuous winter wheat study was established in 1979 and was restructured to include a tillage factor in 1987. The first of the alternative cropping systems in which wheat follows short-season corn was established in 1986 and modified in 1996 to a wheat-cover crop-grain sorghum rotation. The second alternative cropping system, established in 1990, has winter wheat following soybean. Both cropping systems use NT seeding into the previous crop's residue. All three systems have the same N rate treatments.

Procedures

The research was conducted at the Kansas State University South Central Experiment Field, Hutchinson. Soil was an Ost loam. The sites had been in wheat previous to the starting of the cropping systems. The research was replicated four or five times using a randomized block design with a split plot arrangement. The main plot was crop, and the subplot was six N levels (0, 25, 50, 75, 100, and 125 lb/a). Nitrogen treatments were broadcast applied as NH_4NO_3 before planting. Phosphate was applied in the row at planting. All crops were produced each year of the study. Crops are planted at the normal time for the area. Plots are harvested at maturity to determine grain yield, moisture, and test weight.

Continuous Wheat

These plots were established in 1979 and modified (split into sub-plots) in 1987 to include both CT and NT. The conventional tillage treatments are plowed immediately after harvest then worked with a disk as necessary to control weed growth. Fertilizer rates are applied with a Barber metered screw spreader before the last tillage (field cultivation) on the CT and seeding of the NT plots. Plots are cross seeded in mid-October to winter wheat. Because of a cheat infestation in the 1993 crop, plots were planted to oat in spring of 1994. Fertility rates were maintained, and oat was harvested in July. Winter wheat was planted in mid-October each year since the fall of 1994. New herbicides helped control cheat in NT treatments. In fall of 2005, these plots were seeded to canola and then back to wheat in October 2006. We hoped this would provide some field data on effects of canola on wheat yields in a continuous wheat cropping system. However, an extended freeze the first week of April had a major effect on wheat yields as discussed in the results section.

Wheat after Corn/Grain Sorghum-Fallow

In this cropping system, winter wheat was planted after short-season corn was harvested in late August to early September. This early harvest of short-season corn allows the soil profile water to be recharged (by normal late summer and early fall rains) before planting winter wheat in mid-October. Fertilizer rates are applied with the Barber metered screw spreader in the same manner as for continuous wheat. In 1996, the corn crop in this rotation was dropped and three legumes (winter pea, hairy vetch, and yellow sweet clover) were added as winter cover crops. Thus, the rotation became a wheat-cover crop-grain sorghum-fallow rotation. Cover crops replaced the 25, 75, and 125 lb/a N treatments in the grain sorghum portion of the rotation.

Wheat after Soybean

Winter wheat is planted after soybean is harvested in early to mid-September in this cropping system. As with the continuous wheat plots, these plots are planted to winter wheat in mid-October. Fertilizer rates are applied with the Barber metered screw spreader in the same manner as for continuous wheat. Since 1999, a group III soybean has been used. This delayed harvest from late August to early October. In some years, this eliminates the soil profile water recharge time before wheat planting.

Wheat after Grain Sorghum in Cover Crop/Fallow-Grain Sorghum-Wheat

Winter wheat is planted into grain sorghum stubble harvested the previous fall. Thus, soil profile water has 11 months to recharge before winter wheat is planted in mid-October. Nitrogen fertilizer is applied at a uniform rate of 75 lb/a with the Barber metered screw spreader in the same manner as for continuous wheat. This rotation was terminated after the harvest of each crop in 2006. In the fall of 2006, canola was introduced into this rotation in place of the cover crops. Winter canola did not establish uniformly, so spring canola was seed into these plots to establish canola stubble for the succeeding crop.

Winter wheat is also planted after canola and sunflower to evaluate the effects of these crops on winter wheat yield. Uniform N fertility is used; therefore, this data is not presented. Yields of wheat after these two crops are comparable to yields of wheat after soybean.

Results

The April freeze was the major influence on all wheat yields in 2007 regardless of rotation or N rate. Therefore, it will be hard to use this data to determine any treatment affects in 2007.

Continuous Wheat-Canola 2006

Continuous winter wheat grain yield data from the plots are summarized by tillage and N rate in Table 2. Conditions in 1996 and 1997 were excellent for winter wheat production in spite of the dry fall of 1995 and the late spring freezes in both years. Excellent moisture and temperatures during the grain filling period resulted in decreased grain yield differences between the CT and NT treatments within N rates. Conditions in the springs of 1998 and 1999 were excellent for grain filling in wheat. However, differences in yield between CT and NT wheat were still expressed. In 2000, differences were wider up to the 100 lb/a N rate. At that point, differences were similar to those of previous years. The wet winter and late spring of the 2003-2004 harvest year allowed for excellent tillering, grain fill, and yields (Table 2). In 2005, the dry period in April and May seemed to affect yields in the 0 and 25 lb/a N rate plots. These plots were seeded to canola in the fall of 2005. Canola in the NT plots did not survive. Yield data for the CT plots is presented in Table 2. There was a yield increase for each increase in N rate. However, the increase was not significant above the 50 lb/a rate. All N fertilizer was applied in the fall, and effects of winter kill were more noticeable at lower N rates. An N rate study with canola was established at the Redd Foundation land to more fully evaluate effects of fertility on canola. Wheat planted after canola looked promising until the April freeze. Because of the growth stage at the time of the freeze, the lower N rate and NT treatment had higher yields than the CT and higher N rate treatments (Table 2). The higher yielding treatments were slightly behind the other plots when the freeze hit; thus, they were not affected as severely by the freeze.

Wheat after Soybean

Wheat yields after soybean also reflect differences in N rate. However, when comparing wheat yields from this cropping system with those from seasons in which wheat followed corn, effects of residual N from soybean production in the previous year are evident, particularly for the 0 to 75 lb/a N rates in 1993 and the 0 to 125 lb/a N rate in 1994. Yields in 1995 reflect the added N from the previous soybean crop with yield by N rate increases similar to those of 1994. The 1996 yields with spring wheat reflect the lack of response to N fertilizer in spring wheat. Yields for 1997 and 1998 leveled off after the first four increments of N. As with wheat in the other rotations in 1999, ideal moisture and temperature conditions allowed wheat yields after soybean to express differences in N rate up to the 100 lb/a N rate. In the past, those differences stopped at the 75 lb/a N rate. When compared with continuous wheat yields, rotational wheat is starting to reflect the presence of the third crop (grain sorghum) in the rotation. Wheat yields were lower in 2000 than in 1999. This is attributed to the lack of timely moisture in April and May and the hot days at the end of May. This heat caused plants to mature early and also caused low test weights. There was not as much cheat in 2004 as in 2003; thus, yields were much improved (Table 3). Yields in 2004 through 2006 indicate that wheat is showing a 50 to 75 lb/a N credit from the soybean and rotational effects. The early April freeze had a major effect on wheat yields in 2007. However, the trend for N credits to soybean seems to have continued. As with the continuous wheat cropping system, yields in the 0 and 25 lb/a N rates were less than those in the 50 to 125 lb/a rates, but the differences are not significant. As the rotation continues to cycle, differences at each N rate will probably stabilize after four to five cycles, potentially reducing fertilizer N applications by 25 to 50 lb/a in treatments in which wheat follows soybean.

Wheat after Grain Sorghum/Cover Crop

The first year that wheat was harvested after a cover crop/grain sorghum planting was 1997. From 1997 to 2000, there does not appear to be a definite effect of cover crop (CC) on yield, likely because of the variance in CC growth within a given year. In years like 1998 and 1999, when sufficient moisture and warm winter temperatures produced good CC growth, additional N from the CC appears to carry through to wheat yields. With the fallow period after sorghum in this rotation, the wheat crop has a moisture advantage over wheat after soybean. Cheat was the limiting factor in this rotation in 2003. More aggressive herbicide control of cheat in the cover crops was started, and 2004 yields reflect the control of cheat. Management of grasses in the CC portion of this rotation seems to be the key factor in controlling cheat and increasing yields. This is evident when yields for 2005 and 2006 (Table 4) are compared with either continuous wheat yields or yields from wheat in rotation with soybean. Because of the stage of development at the time of the April freeze, wheat yields in these plots were more adversely affected than plants in other rotations. We think that lack of a third crop taken to maturity has positively influenced yields.

Other Observations

Nitrogen application significantly increased grain N content in all crops. Grain phosphate levels did not seem to be affected by increased N rate.

Loss of the wheat crop after corn can occur in years when fall and winter moisture is limited. This loss has not occurred in continuous winter wheat regardless of tillage or in wheat after soybean. Corn has potential to produce grain in favorable (cool and moist) years and silage in non-favorable (hot and dry) years. In extremely dry summers, extremely low grain sorghum and soybean yields can occur. The major weed problem in the wheat after corn system is grasses. This was expected, and work is being done to determine the best herbicides and time of application to control grasses.

Soybean and Grain Sorghum in the Rotations

Soybean was added to intensify the cropping system in south central Kansas. Soybean, a legume, can add N to the soil. Thus, N rates are not applied when soybean is planted in the plots for the rotation. This provides opportunities for following crops to use the added N and to check yields against yields for the crop in other production systems. Yield data for soybean following grain sorghum in the rotation are given in Table 5. Soybean yields are affected more by the weather for the given year than by the previous crop. This is seen in yields for 2001, 2003, 2005, 2006, and 2007, when summer growing season moisture was limiting. In 2007, a combination of a wet spring that delayed planting and the hot and dry period from July through October affected yields. In 3 of 12 years the research has been conducted, there has been a significant effect of N on soybean yield. In 2 of 3 years that N application rate did affect yield, yield was affected only at lower N rates. This effect is similar to that is seen in a given crop.

Yield data for grain sorghum after wheat in the soybean-wheat-grain sorghum rotation is shown in Table 6. As with soybean, weather is the main factor affecting yield. Addition of a cash crop (soybean), which intensifies the rotation (cropping system), will reduce yield of grain sorghum in the soybean-wheat-grain sorghum vs. wheat-cover crop-grain sorghum rotation (Tables 6 and 7). More uniform yields were obtained in the soybean-wheat-grain sorghum rotation (Table 6) than in the wheat-cover crop-grain sorghum rotation (Table 7). Lack of precipitation in 2005 and 2006 can be seen in grain sorghum yields for 2006. As with soybean, the combination of a wet spring that delayed planting and the hot and dry period from July through October affected yields. There was also major bird infestation that seemed to concentrate on grain sorghum in the soybean-wheat-grain sorghum rotation (it was about 5 to 10 days ahead in maturity when compared with other grain sorghum in the area). In some cases, birds completely stripped the grain off heads in the plots. Grain sorghum yields were reduced in the intensified cropping system (soybean, wheat, and grain sorghum) compared with the less intense rotation (wheat, winter cover crop, grain sorghum).

Other systems studies are a wheat-cover crop (winter pea)-grain sorghum rotation with N rates (detailed below) and a date of planting, date of termination cover crop rotation with small grains (oat)-grain sorghum.

Table 2. Yields by tillage and nitrogen rate in a continuous wheat cropping system, wheat (2001-2005, 2007), canola 2006, KSU South Central Experiment Field, Hutchinson

	2001[1]		2002		2003		2004		2005		2006		2007	
N Rate	CT[2]	NT[2]	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT[3]	CT	NT
lb/a	bu/a													
0	50	11	26	8	54	9	66	27	47	26	10	0	15	14
25	53	26	34	9	56	9	68	41	63	36	19	0	13	16
50	54	35	32	8	57	22	65	40	68	38	26	0	12	14
75	58	36	34	7	57	42	63	37	73	43	28	0	12	14
100	54	34	35	5	56	35	64	43	73	40	31	0	9	13
125	56	36	32	5	57	38	63	31	69	35	31	0	9	16
LSD[4] (0.01)	10	10	6	NS	NS	18	NS	9	14	14	6	0	6	NS

[1] Data for years before 1996 can be found in Field Research 2000, KAES Report of Progress 854. Data from 1996 through 2000 can be found in Agronomy Field Research 2006, KAES Report of Progress 975, page SC-8.
[2] CT = conventional; NT = no-till.
[3] NT canola did not get established.
[4] Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be placed in one being greater than the other.

Table 3. Wheat yields after soybean in a soybean-wheat-grain sorghum rotation with nitrogen rates, KSU South Central Experiment Field, Hutchinson, KS

	Yield[1]						
N Rate	2001	2002[2]	2003	2004	2005	2006	2007
lb/a	bu/a						
0	12	9	31	40	30	29	15
25	16	10	48	46	43	38	21
50	17	9	59	48	49	46	23
75	17	7	65	46	52	46	24
100	20	8	67	43	50	52	23
125	21	8	66	40	48	50	20
LSD[3] (0.01)	7	4	3	5	5	3	3
CV (%)	23	24	4	6	6	5	9

[1] Data for the years 1991 through 2000 can be found in Agronomy Field Research 2006, KAES Report of Progress 975, page SC-9.
[2] Yields severely reduced by hail.
[3] Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be placed in one being greater than the other.

Table 4. Wheat yields after grain sorghum in a wheat-cover crop-grain sorghum rotation with nitrogen rates, KSU South Central Experiment Field, Hutchinson, KS

N Rate	Yield[1]						
	2001	2002[2]	2003	2004	2005	2006	2007
lb/a	- - - - - - - - - -	- - - - - - - - - -	- - - - - -	bu/a	- - - - - -	- - - - - - - - - -	- - - - - - - - - -
0	45	10	9	47	59	38	10
HV[3]	45	10	5	36	63	58	13
50	41	8	4	35	56	61	15
WP[3]	41	9	8	37	60	64	13
100	39	5	5	32	55	58	14
SC[3]	42	6	6	36	55	55	11
LSD[4] (0.01)	5	3	NS	8	6	5	2
CV (%)	6	20	70	12	6	7	10

[1] Data for the years 1997 through 2000 can be found in Agronomy Field Research 2006, KAES Report of Progress 975, page SC-10.
[2] Yields severely reduced by hail.
[3] HV = hairy vetch; WP = winter pea; SC = sweet clover.
[4] Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be placed in one being greater than the other.

Table 5. Soybean yields after grain sorghum in a soybean-wheat-grain sorghum rotation with nitrogen rates, KSU South Central Experiment Field, Hutchinson, KS

N Rate[1]	Yield											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
lb/a		- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	bu/a	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -
0	16	26	22	33	25	7	22	5	53	20	18	15
25	17	29	23	35	21	8	22	6	50	19	18	16
50	18	30	23	36	23	9	22	6	50	18	18	14
75	20	29	24	36	24	8	21	7	51	18	18	15
100	22	31	25	37	21	9	21	7	51	19	18	16
125	20	25	24	34	22	8	22	7	49	19	19	14
LSD[2] (0.01)	3	NS	NS	NS	NS	NS	NS	1.4	NS	NS	1	NS
CV (%)	10	12	6	12	15	13	7	17	6	11	5	11

[1] N rates are not applied to the soybean plots in the rotation.
[2] Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be placed in one being greater than the other.

Table 6. Grain sorghum yields after wheat in a soybean-wheat-grain sorghum rotation with nitrogen rates, KSU South Central Experiment Field, Hutchinson, KS

	Yield											
N Rate	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007[1]
lb/a	bu/a											
0	32	13	57	52	55	15	34	10	86	86	19	---
25	76	29	63	67	56	15	41	10	112	90	18	---
50	93	40	61	82	54	13	43	9	129	97	16	---
75	107	41	60	84	49	9	43	8	136	95	14	---
100	106	65	55	77	50	7	46	8	141	101	12	---
125	101	54	55	82	49	7	47	9	142	95	12	---
LSD[2] (0.01)	8	13	NS	13	NS	NS	8	NS	9	12	4	---
CV (%)	5	18	10	9	10	58	11	24	4	7	18	---

[1] Due to the dry hot conditions in July and August and the excessive amount of bird damage (100% in some plots) these plots were not harvest for yield in 2007.
[2] Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be placed in one being greater than the other.

Table 7. Grain sorghum yields after cover crop in a cover crop-grain sorghum-wheat rotation with nitrogen rates, KSU South Central Experiment Field, Hutchinson, KS

	Yield											
N Rate	1996	1997	1998	1999	2000	2001	2002[1]	2003	2004	2005	2006	2007
lb/a	bu/a											
0	73	26	69	81	68	17	22	21	92	84	20	37
HV[2]	99	36	70	106	54	17	21	16	138	93	21	50
50	111	52	73	109	66	13	25	15	135	90	28	48
WP[2]	93	35	72	95	51	19	23	17	138	101	23	52
100	109	54	67	103	45	12	25	14	136	89	27	52
SC[2]	94	21	72	92	51	19	19	19	94	80	28	53
LSD[3] (0.01)	13	14	NS	21	16	6	NS	5	19	16	6	16
CV (%)	8	22	13	12	16	21	20	22	9	10	19	18

[1] Yields affected by hot dry conditions in July and bird damage.
[2] HV = hairy vetch; WP = winter pea; SC = sweet clover.
[3] Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be placed in one being greater than the other.

EFFECTS OF TERMINATION DATE OF AUSTRIAN WINTER PEA WINTER COVER CROP AND NITROGEN RATES ON GRAIN SORGHUM AND WHEAT YIELDS

W.F. Heer

Summary

Effects of the cover crop most likely were not expressed in the first year (1996) grain sorghum harvest (Table 8 in Agronomy Field Research 2005, KAES Report of Progress 956). Limited growth of the cover crop (winter pea) due to weather conditions produced limited amounts of organic N. Therefore, effects of the cover crop compared with fertilizer N were limited and varied. The 1998 wheat crop was harvested in June. Winter pea plots were then planted and terminated the following spring before planting the 1999 grain sorghum plots. The N rate treatments were applied and grain sorghum was planted on June 11, 1999. Winter wheat was again planted on the plots in October 2000 and harvested in June 2001. Winter pea was planted in September 2001 and terminated in April and May 2002. Grain sorghum was planted in June and harvested in October. During 2003, this area was in sorghum fallow, and plots were fertilized and planted to wheat in October 2003 for harvest in 2004. The winter pea cover crop was planted into wheat stubble in the fall of 2004. These plots were terminated as indicated in Table 8 and planted to grain sorghum in June 2005. Plots were again in sorghum fallow until planted to wheat in the fall of 2006. These plots were harvested in June 2007. As with other wheat plots on the field, the April freeze was the major yield determining factor. Wheat yield data is shown in Table 9.

Introduction

There has been renewed interest in using winter cover crops to conserve soil and water, substitute for commercial fertilizer, and maintain soil quality. One winter cover crop that could be a good candidate for these purposes is winter pea. Winter pea is established in the fall, overwinters, produces sufficient spring foliage, and is returned to the soil before planting a summer annual. Because winter pea is a legume, it can add N to the soil system. Research projects were established at the South Central Experiment Field to evaluate the effect of winter pea and its ability to supply N to the succeeding grain sorghum crop compared with commercial fertilizer N in a winter wheat-winter pea-grain sorghum rotation with two termination dates for the winter pea and four N rates with and without winter pea.

Procedures

The research is being conducted at the KSU South Central Experiment Field, Hutchinson. Soil in the experimental area was an Ost loam. The site had been in wheat before starting the cover crop cropping system. The research used a randomized block design and was replicated four times. Cover crop treatments consisted of fall-planted winter pea with projected termination dates in April and May and no cover crop (fallow). Winter pea is planted into wheat stubble in early September at a rate of 35 lb/a in 10-in. rows with a double disk opener grain drill. Before termination of the cover crop, above ground biomass samples are taken from a 1-m^2 area and used to determine forage yield (winter pea and other), forage N content, and forage phosphate content for the winter pea portion. Four fertilizer treatments (0, 30, 60, and 90 lb/a) are broadcast applied as NH_4NO_3 (34-0-0) before planting grain sorghum. Phosphate is applied at a rate of 40 lb/a P_2O_5 in the row at planting. Grain sorghum plots are harvested to determine grain yield, moisture, test weight, N content, and phosphate content. Sorghum plots are fallowed until the plot area is planted to wheat in the fall of the following year. Fertilizer treatments are also applied before planting wheat.

Results

Winter Wheat

The fall of 2000 was wet and followed a very hot, dry August and September. Thus, wheat planting was delayed. Fall temperatures were warm, which allowed wheat to tiller into late December. January and February had above-normal precipitation. Precipitation and temperature in April, May, and June were slightly below. Wheat yields reflect the presence of the winter pea treatments and reduced grain sorghum yields for the no-pea treatment plots. Test weight of the grain and percentage of N in the seed at harvest were not affected by pea or fertilizer treatment but were affected by rainfall at harvest time. Weed pressure is a concern. The April termination pea plus 90 lb/a N treatment had significantly more weeds than other treatments. Except for this treatment, there were no differences noted for weed pressure. Grain yield data are presented in Table 8. Because of earlier planting for the 2004 crop, wheat should have had a better chance to tiller; but, the wet, cold fall limited growth. Wheat yields were considerably above those of 2002 (Table 8). As with all other wheat plots, yields in 2007 were adversely affected by the April freeze. The 2007 yields are presented in Table 8, but fertility and lack of winter pea presence in the rotation caused differences in stage of growth at the time of the freeze. Plots (treatments) that were further along were affected more, resulting in lower yields in the higher fertility plots.

As this rotation continues and the soil system adjusts, true effects of the winter cover crop in the rotation will be revealed. In dry (normal) years, soil water (precipitation) during the growing season most likely will not be as favorable as it was in 1999, and water use by the cover crop will be the main influence on the yield of the succeeding crop.

Table 8. Winter wheat yield after grain sorghum as affected by nitrogen rate, winter pea cover crop, and termination date in a winter wheat-winter pea cover crop-grain sorghum rotation, KSU South Central Experiment Field, Hutchinson, KS

		Grain								
		Yield			N			P		
Termination Date	N Rate[1]	2001	2004	2007	2001	2004	2007	2001	2004	2007
	lb/a		bu/a		- - - - - - - - - - - - - - -		%		- - - - - - - - - - - - - -	
April[2] N/pea	0	37	58	15	2.32	1.73	2.14	0.38	0.38	0.46
	30	40	56	15	2.43	1.94	2.14	0.36	0.36	0.45
	60	39	51	11	2.30	2.23	2.25	0.38	0.34	0.46
	90	37	44	12	2.24	2.27	2.23	0.38	0.35	0.45
April[2] /pea	0	39	58	14	2.38	1.89	2.18	0.35	0.38	0.48
	30	42	55	13	2.33	1.97	2.26	0.37	0.34	0.47
	60	36	50	8	2.22	2.23	2.28	0.40	0.33	0.47
	90	37	47	8	2.18	2.46	2.40	0.37	0.32	0.47
May[3] N/pea	0	38	57	16	2.30	1.79	2.09	0.37	0.36	0.45
	30	38	53	15	2.32	2.13	2.17	0.37	0.34	0.45
	60	34	46	11	2.42	2.30	2.29	0.35	0.35	0.47
	90	38	44	11	2.24	2.37	2.29	0.35	0.35	0.46
May[3] /pea	0	42	60	14	2.37	1.91	2.14	0.40	0.36	0.47
	30	37	50	10	2.38	2.19	2.28	0.38	0.35	0.47
	60	35	45	6	2.38	2.33	2.35	0.37	0.33	0.46
	90	37	45	6	2.34	2.42	2.40	0.38	0.34	0.46
LSD[4] (0.05)		5	6	4	0.18	0.12	0.14	0.03	0.03	0.01

[1] Nitrogen applied as 34-0-0 before planting winter wheat.
[2] Early April termination.
[3] Early May termination.
[4] Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be in one being greater than the other.

EVALUATION OF WINTER SMALL GRAINS FOR PRODUCTION OF GRAIN AND FORAGE

V.L. Martin and W.F. Heer

Summary

Hard red winter wheat is the predominant small grain cereal in Kansas and is considered best adapted to climatic conditions typical of the state. It is also the predominant winter annual small grain planted for forage (pasture, hay, silage). Other fall-planted small grain cereals such as winter triticale and rye have potential to providing a high quantity of adequate quality forage. Additionally, although the grain does not yet possess a significant market, it is well-suited for feed on a local basis.

The objective of this study is to evaluate forage and grain yield potential of winter triticale, winter barley and rye compared with traditional hard red winter wheat. This study also provides information for producers interested in winter triticale and barley as a potential feed substitute for winter wheat.

Conditions for growth and development during the 2006-2007 crop year were somewhat dry during fall, but conditions were favorable until early April and cooler and wetter then normal during May and June. In spite of the April freeze, forage yields for most entries were acceptable to good. Grain yield and test weight were much lower than expected because of freeze conditions during early April.

Introduction

Hard red winter wheat is the predominant small grain cereal planted in Kansas as a food/feed grain and forage (typically as pasture). Although this crop supplies excellent pasture under adequate weather conditions, other winter small grain cereals are available that possess winter hardiness and drought tolerance comparable to or better than winter wheat (triticale and rye) and better overall forage quality (winter barley). Interest in alternative small grains is increasing for several reasons. Prolonged dry conditions throughout much of Kansas have caused producers to look for more drought tolerant winter small grains for pasture. The increasing cost of feed grains and alfalfa has producers seeking cheaper feed options. Finally, although alternative winter cereals are not new, recent emphasis on breeding for winter hardiness has resulted in newer, better adapted varieties with higher feed value.

Primary interest in winter triticale, winter barley, and rye is as forage, but these crops also have potential as feed and, to a more limited extent, food grains.

The primary objective of this long-term study is to determine the forage and grain yield potential of alternative winter cereals compared with hard red winter wheat.

Procedures

Research was conducted at the Kansas State University South Central Experiment Field, Hutchinson on an Ost loam. The site was planted to grain sorghum in 2004 and planted to soybean as a cover crop in 2005 with the following tillage operations: offset disk - August 1, 2005; moldboard plow - August 19, 2005; tandem disk - September 6, 2005; pre-plant field cultivation - September 21, 2005. Fertilizer was applied as follows: 75 lb/a N as urea and 40 lb/a P_2O_5 broadcast as a mixture of 11-52-0 and 46-0-0 on September 21, 2005 and 75 lb/a N as urea broadcast on January 19, 2006. No postemergence herbicides were applied.

Plots were planted in a randomized complete block design with four replications. Each test was planted twice with one set of plots for forage harvest and one for grain. The test consisted of three hard red winter wheat varieties (Jagger, Overley, and Big Max), one rye (Thundergreen), six winter triticales (336, Thundertall, Thundercale, Thundercale K, Thundercale V, and T-XTRI), and a triticale/rye blend (633 K blend). Jagger and Overley were selected as wheats for comparison because they are common grazing wheats.

Grain plots were 35 ft x 5 ft and consisted of six rows planted 8 in. apart with a plot drill.

For forage plots, plot length was reduced to 20 ft. Seeding rate was 2 bu/a. All plots were planted October 5, 2005. Planting was delayed because of extremely dry soil conditions. Forage yield was determined using a Carter plot forage harvester and a harvest area of 15 ft x 3 ft. Total wet weight was determined and a sub-sample taken to determine forage moisture. Forage yields were determined on a dry weight basis. Forage yields were determined May 15, 2006, when most plots were in the late milk/early dough stage.

Grain yields were determined using a Gleaner E plot combine and a harvest area of 30 ft x 5 ft. Sub-samples were taken to determine grain moisture, and yields were adjusted to 12.5% moisture. Grain harvest was June 26, 2006.

Results

Fall and winter conditions during 2005-2006 were much drier and warmer than normal. This resulted in delayed planting and poor growth through the winter. However, spring was wet and cool, which provided excellent conditions for crop development and resulted in excellent growth. Above-normal precipitation in May and early June allowed normal grain maturation and slightly delayed forage harvest. For the 2006-2007 crop year, an overall mild, wet winter resulted in excellent growth and advanced growth stage by approximately 2 weeks. However, a severe freeze period during the first week of April lasting several days severely damaged all entries. The most severe effects occurred with wheat varieties. Although plants exhibited significant regrowth, the lateness of this growth and the cool, excessively wet conditions in May and June resulted in severe disease pressure, especially for wheat.

Forage yields averaged more than 5 tons/a (Table 9) with a range of 9,700 - 13,700 lb/a dry matter in 2006. Moisture content of wheat varieties was significantly lower than triticale or rye because the wheat varieties were slightly more mature (early dough versus milk stage). In 2007, yields, although lower, still averaged almost 4.5 tons/a dry matter. Wheat forage was affected most negatively by the April freeze.

Grain yields were quite good considering the delayed planting and dry fall/winter conditions, averaging 2,300 lb/a in 2006 and 2007 (Table 10). Yields are reported in lb/a instead of bu/a because of the difference in bushel weights between grains. In 2007, the freeze severely affected grain yields, particularly in wheat, primarily because of extremely heavy leaf disease pressure during grain development. Grain yield was more variable for triticale varieties and most consistent for winter barley.

The 2 years of this study indicate that newer triticale, rye, and barley varieties have the potential to equal or exceed two traditional wheat varieties in forage production. The quantity of grain produced indicates these alternative crops have potential as a feedstuff and are able to withstand late freezes better than wheat.

These trials are continuing in 2008 and have been expanded to include new winter triticale and rye varieties.

Table 9. Winter cereal harvest, forage yield (dry matter) for 2007, 2006 forage yield, and 2-year average forage yield, Hutchinson, KS

Variety	Grain[1]	Harvest Moisture	2007 Forage Yield[2]	2006 Forage Yield[2]	2-year avg. Yield[2]
			- - - - - - - - lb/a - - - - - - - -		
Thundergreen	Rye	0.62	10530	10810	10670
633 K	Blend	0.57	11275	11380	11330
336	WT	0.55	9500	12420	10960
Thundercale	WT	0.59	10400	11480	10940
Thundercale K	WT	0.59	10500	11840	11170
Thundercale V	WT	0.60	11290	11320	11305
Thundertall	WT	0.61	10790	12210	11500
T-XTRI	WT	0.58	8120	13740	10930
Jagger	HRWW	0.45	6480	9720	8100
Overley	HRWW	0.55	7330	11580	9455
Big Max	HRWW	0.51	7890	---	---
P-713	WB	0.53	9090	---	---
P-919	WB	0.50	8930	---	---
Tambar 501	WB	0.58	7980	---	---
Mean		0.56	8720	11650	
LSD[3] (.05)		0.05	1875	2140	

[1] Rye; Blend (of triticales); WT (Winter Triticale); HRWW (Hard Red Winter Wheat); WB (Winter Barley).
[2] Dry matter yield.
[3] Unless two values within a column differ by more than the least significant difference (LSD), there can be little confidence in one being greater than the other.

Table 10. Winter cereal heading date, plant height, grain moisture, test weight, and grain yield 2007, 2006 grain yield and 2-year average, Hutchinson, KS

Variety	Grain[1]	Grain Moisture	Test Weight	2007 Grain Yield[2]	2006 Grain Yield[2]	2-year avg
		%	lb/bu	- - - - - - - - lb/a	- - - - - - - -	
Thundergreen	Rye	9.4	41.5	1250	2590	1920
633 K	Blend	8.2	34.9	943	2120	1531
336	WT	7.9	31.6	585	2390	1488
Thundercale	WT	8.6	34.2	965	2430	1698
Thundercale K	WT	8.1	36.7	1502	2940	2221
Thundercale V	WT	8.4	35.5	1190	2070	1630
Thundertall	WT	7.9	35.7	619	1970	1295
T-XTRI	WT	9.2	43.9	939	1990	1465
Jagger	HRWW	8.5	35.6	252	2310	1281
Overley	HRWW	9.2	33.4	571	2460	1516
Big Max	HRWW	8.1	37.4	563	---	---
P-713	WB	7.6	36.7	1156	---	---
P-919	WB	7.2	34.9	1054	---	---
Tambar 501	WB	7.8	31.8	1251	---	---
Mean		8.3	36.0	917	2330	
LSD[3] (.05)		NS	3.2	257	453	

[1] Rye; Blend (of triticales); WT (Winter Triticale); HRWW (Hard Red Winter Wheat); WB (Winter Barley).
[2] Grain moisture adjusted to 12.5% moisture.
[3] Unless two values within a column differ by more than the least significant difference (LSD), there can be little confidence in one being greater than the other. NS - No significant difference among treatments.

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Experiment Field Personnel

W.B. Gordon, Agronomist-in-Charge
Mike R. Larson, Plant Science Technician
Douglas Stensaas, Assistant Agronomist

IRRIGATION AND NORTH CENTRAL KANSAS EXPERIMENT FIELDS

Introduction

The 1952 Kansas legislature provided a special appropriation to establish the Irrigation Experiment Field to serve expanding irrigation development in north central Kansas. The original 35-acre field was located 9 miles northwest of Concordia. In 1958, the field was relocated to its present site on a 160-acre tract near Scandia in the Kansas-Bostwick Irrigation District. Water is supplied by the Miller canal and stored in Lovewell Reservoir in Jewell County, KS, and Harlan County Reservoir at Republican City, NE. In 2001, a linear sprinkler system was added on a 32-acre tract 2 miles south of the present Irrigation Experiment Field. In 2002, there were 125,000 acres of irrigated cropland in north central Kansas. Current research on the field focuses on managing irrigation water and fertilizer in reduced tillage and crop rotation systems.

The 40-acre North Central Kansas Experiment Field, located 2 miles west of Belleville, was established on its present site in 1942. Research conducted at this field provides information on factors that allow full development and wise use of natural resources in north central Kansas. Current research emphases are fertilizer management for reduced tillage crop production and management systems for dryland, corn, sorghum, and soybean production.

Soil Description

The predominate soil type on both fields is a Crete silt loam. The Crete series consists of deep, well-drained soils that have a loamy surface underlain by a clayey subsoil. These soils developed in loess on nearly level to gently undulating uplands. Crete soils have slow to medium runoff and slow internal drainage and permeability. Natural fertility is high. Available water holding capacity is approximately 0.19 in. of water per inch of soil.

Table 1. Climatic data for the North Central Kansas Experiment Fields, 2007

	Rainfall (in.)			Temperature (°F)		Growth units	
	Scandia 2007	Belleville 2007	Average 30-year	Daily mean 2007	Average mean	2007	Average
April	1.9	2.0	2.3	51	52	220	217
May	6.8	9.8	3.7	67	63	490	421
June	4.0	1.9	4.6	73	73	650	679
July	3.5	3.7	3.4	80	78	802	807
August	2.3	3.5	3.4	82	77	836	780
September	2.4	5.2	3.6	70	68	550	538
Total	20.9	26.1	20.9			3766	3442

MAXIMIZING IRRIGATED SOYBEAN YIELDS IN THE GREAT PLAINS

W.B. Gordon

Summary

In 2004, studies were initiated to seek ways of maximizing soybean yields in the central Great Plains. Treatments included row spacing (30- and 7.5-in. rows), plant population (150,000 and 225,000 plants/a), and seven fertility treatments. Fertility treatments consisted of a low phosphorus (P) application (Kansas State University [KSU] soil test recommendations would consist of 30 lb/a P_2O_5 at this site), low P-low potassium (K), low P-high K, high P-high K, nitrogen (N)-P-K, and an unfertilized check plot. In 2005, a treatment consisting of 5 lb/a manganese (Mn) in addition to N-P-K was added. Phosphorous application rates were 30 or 80 lb/a P_2O_5, and K treatments were 80 or 120 lb/a K_2O. The N-P-K treatment consisted of applying 20 lb/a N, 80 lb/a P_2O_5, and 120 lb/a K_2O. Fertilizer was broadcast in mid-March each year. Soybean was sprinkler irrigated. Planting dates were May 8, 2004, May 10, 2005, and May 10, 2006. Harvest dates were in mid-October each year.

In 2004, neither increasing plant populations nor reducing row spacing from 30 to 7.5 in. increased grain yields. Increasing plant population in narrow rows reduced yield. Soybean yields responded to fertilizer application. Applying 80 lb/a P_2O_5 with 60 lb/a K_2O increased yield 32 bu/a over the unfertilized check plot. Applying additional K or adding N to the mix did not increase yields. Increasing plant population at lower fertility rates decreased yield.

In 2005, soybean yield was not affected by row spacing or plant population nor was yield affected by any interaction of factors. Fertility treatments had a dramatic effect on soybean yield. Applying 80 lb/a P_2O_5 with 60 lb/a K_2O increased yield 33 bu/a over the unfertilized check plot. Applying additional K or N did not result in any yield increase. However, adding Mn to the mix significantly increased yield.

Again in 2006, soybean yield was not affected by row spacing or by plant population. Soybean yield was positively affected only by addition of the first increment of fertilizer (30 lb/a P_2O_5). Yields of plots receiving 30 lb/a P_2O_5 were increased 30 bu/a over the unfertilized check. Unlike the previous two years, adding higher rates of P and K did not result in further yield increases. Also, adding Mn did not improve yield.

Consistent with results in previous years, row spacing and plant population did not affect soybean yields in 2007. Adding 30 lb/a P_2O_5 in combination with 80 lb/a K_2O increased soybean yield nearly 34 bu/a. The greatest yield was achieved by applying a full compliment of nutrients (N, P, K, and Mn). Adding Mn resulted in a yield increase of 4.8 bu/a over the same treatment without Mn.

In high yield environments, soybean yields can be greatly improved by direct fertilization.

Introduction

Analysis of corn yield data from hybrid performance tests in north central Kansas show that corn yields have increased an average of nearly 2.5 bu/a per year. National trends are similar. Soybean yield trends also have been on an upward swing, but the rate of increase is less than 1 bu/a per year. As a result of genetic advances in soybean production, genes imparting herbicide resistance have been incorporated and many advances in disease resistance have occurred. Effective fungicide and insecticide seed treatments are now available for use in soybean. Despite these many advances, soybean yields have not improved as dramatically as corn yields. Fertility issues could be limiting yield improvement. Typically in a corn-soybean rotation, fertilizer is applied only during the corn phase of the rotation. On a per bushel basis, soybean removes nearly twice as much P and almost five times as much K as corn. With greater corn yield, a greater amount of nutrients are removed and fewer nutrients are left over for a following soybean crop. To capitalize on genetic improvements in yield and technical advances in production, levels of plant nutrients must not be limiting. Other production practices such as plant population and row spacing may interact with fertility management to influence crop yields. The objective of this experiment was to develop cropping systems and fertility practices that would maximize yield of irrigated soybean.

Procedures

The experiment was conducted on a Crete silt loam soil at the North Central Kansas Experiment Field located near Scandia, KS. Treatments included soybean planted at two row spacings (30 and 15 in.) and two plant populations (150,000 and 225,000 plants/a). Fertility treatments consisted of a low-P application (KSU soil test recommendations would consist of 30 lb/a P_2O_5 at this site), low P-low K, low P-high K, high P-high K, N-P-K, and an unfertilized check plot. Phosphorous application rates were 30 or 80 lb/a P_2O_5, and K treatments were 80 or 120 lb/a K_2O. The N-P-K treatment consisted of application of 20 lb/a N, 80 lb/a P_2O_5, and 120 lb/a K_2O. A treatment was added in 2006 that included the same rate of N, P, and K plus 5 lb/a Mn. Soil test values for the experimental area were pH, 7.1; Bray-1 P, 12 ppm; and exchangeable K, 250 ppm. The K source was KCl, and the phosphorus source was triple super phosphate. Fertilizer was broadcast in mid-March each year. The previous crop was corn. Each year, corn received 180 lb/a N and 40 lb/a P_2O_5. Whole plant soybean samples were taken at full bloom for nutrient analysis. Plant heights were taken just before harvest. Whole plants were taken from a 3-m length of row at maturity for yield component analysis. Seed weight was determined from seed samples retained at harvest. Soybean variety Asgrow 3305 was planted in mid-May each year. Soybean was sprinkler irrigated and received an average of 8 in. of irrigation water during the growing season.

Results

In no year of the experiment did increasing plant populations or reducing row spacing result in any increase in yield (Table 2). In 2004, increasing plant population in narrow rows actually reduced yield. Averaged over all 4 years of the experiment, row spacing or plant population did not affect yield of soybean nor was there a significant interaction among the three factors in the experiment However, soybean yield did respond to fertilizer application. Adding 30 lb/a P_2O_5 resulted in a yield increase of more than 18 bu/a (Table 3). Applying 80 lb/a P_2O_5 with 60 lb/a K_2O increased yield 34 bu/a over the unfertilized check plot. Applying additional K or adding N to the mix did not increase yields. Adding P and K fertilizer significantly increased soybean tissue nutrient concentration at the full bloom stage of growth. A Mn treatment was added in 2005. In two of the 3 years that this treatment was included in the experiment, applying Mn with N, P, and K resulted in an increase in soybean yield over the same treatment without Mn. Average yield increase was 4.9 bu/a in those two years. Manganese application can fit in a fertility program designed for maximum soybean yield. Adding of fertilizer increased the number of seeds, number of seeds per pod, weight of seeds, and plant height (Table 4). Adding of P and K fertilizer is crucial for maximizing yield of irrigated soybean.

Table 2. Soybean yield as affected by row spacing and plant population (average over fertility treatments), 2004-2007

Row space	150,000 plants/a	255,000 plants/a
	--------------------Yield (bu/a)--------------------	
30 in.	78.2	77.6
7.5 in.	78.4	76.6
LSD (0.05) = NS*		

* not significant at P > 0.05.

Table 3. Fertility effects on soybean yield and whole plant tissue P and K concentration at full bloom (average over row spacing and plant population), 2004-2007

Treatments	Yield (bu/a)	Whole plant P (%)	Whole plant K (%)
Check	50.3	0.222	2.61
Low P	68.8	0.245	2.59
Low P-Low K	77.8	0.248	2.99
Low P-High K	80.4	0.246	3.41
High P-Low K	84.7	0.292	2.97
High P-High K	84.8	0.300	3.39
N-P-K	84.9	0.294	3.42
LSD (0.05)	4.1	0.019	0.13
CV%	4.2	5.1	4.9

Table 4. Fertility effects on soybean yield components and plant height (average over row spacing and plant population), 2004-2007

Treatments	Seed number (no./m^{2})	Seeds per pod (no.)	Seed size (g/100 seed)	Plant height (cm)
Check	4194	1.6	10.9	60.2
Low P	5222	2.2	11.4	69.2
Low P-Low K	6132	2.8	12.3	71.9
Low P-High K	6604	2.9	13.5	72.2
High P-Low K	7098	2.9	13.6	74.3
High P-High K	7113	2.9	13.2	75.2
N-P-K	7101	2.9	13.8	75.9
LSD (0.05)	244	0.9	0.5	2.9
CV%	12.0	8.1	4.3	2.6

NITROGEN MANAGEMENT FOR NO-TILL CORN AND GRAIN SORGHUM PRODUCTION

W.B. Gordon

Summary

An increasing number of producers in the central Great Plains are using no-till production systems because of several advantages including reduced soil erosion, increased soil water use efficiency, and improved soil quality. However, the large amount of residue left on the soil surface can make nitrogen (N) management difficult. Surface applications of urea-containing fertilizers are subject to volatilization losses. Leaching can also be a problem on coarse textured soils when N is applied in one preplant application. Slow-release polymer-coated urea products are beginning to become available for agricultural use. The polymer coating allows urea to be released at a slower rate than uncoated urea. Use of urease inhibitors applied with urea-containing fertilizers can reduce volatilization losses. Recently, a new product (Nutrisphere-N) that is a co-polymer of maleic and itaconic acids has become available and has shown potential in reducing urea-N losses. Two studies were conducted—one with irrigated corn and the other with dryland grain sorghum. The irrigated corn study compared urea (46% N), UAN (28%), a controlled-release polymer-coated urea (ESN), Agrotain, Agrotain Plus, Nutrisphere–N, and ammonium nitrate at three N rates (80, 160, and 240 lb/a). A no-N check plot also was included. The grain sorghum study consisted of untreated urea, ammonium nitrate, ESN, and urea treated with Agrotain or Nutriphere-N. Nitrogen rates were 40, 80, and 120 lb/a N as well as a no-N check. Both studies were conducted on Crete silt loam soils. In both the corn and grain sorghum experiments, treated urea products yielded better than untreated urea and were similar to ammonium nitrate. There were no significant differences in yield of ESN, Agrotain, or Nutrisphere-N. In the corn experiment that included UAN (28%), yield of UAN treated with Agrotain Plus or Nutrisphere-N was greater than that of untreated UAN. If producers wish to broadcast urea-containing fertilizer on the soil surface in no-till production systems, there are several products available that are very effective in limiting N losses and increasing N use efficiency.

Introduction

An increasing number of producers in the Great Plains are using conservation tillage production systems because these systems have several inherent advantages including reduced soil erosion losses, increased soil water use efficiency, and improved soil quality. The large amount of residue left on the soil surface in no-till systems can make N management difficult. Surface application of N fertilizers is a popular practice with producers, but N losses due to volatilization from broadcast urea-containing fertilizers in no-till production systems can be significant. Depending on conditions, losses can be 10% to 20% of the applied N. Nitrogen immobilization can also be a problem when N fertilizers are surface applied in high-residue production systems. Nitrogen leaching can be both an agronomic and environmental problem on course-textured soils. Polymer coated urea, long used in turf fertilization, has the potential to make N management more efficient when surface applied in no-till agricultural systems. The urea granule is coated but allows water to diffuse across the membrane; N release is then controlled by temperature. A polymer-coated urea product is now available for crop use and is marketed under the name, ESN. Use of urease inhibitors applied with urea-containing fertilizers can reduce volatilization losses. In the soil, urea is hydrolyzed relatively quickly by the soil enzyme urease. In numerous studies, Agrotain, a commercially available urease inhibitor, has proven to be effective at reducing N losses due to volatilization. Agrotain Plus is a product that contains both a urease inhibitor and a nitrification inhibitor (DCD). Recently, a new product (Nutrisphere-N) that is a co-polymer of maleic and itaconic acids has become available and has shown potential in reducing urea-N losses. The cation nickel is essential for the action of urease; Nutrisphere-N is thought to sequester or inactivate nickel ions, rendering urease inactive. The objectives of these experiments were to evaluate N efficiency from surface broadcast applications of urea-containing N and to try to reduce N loss and improve efficiency by using products designed to limit N volatilization and loss.

Procedures

Two experiments were conducted at the North Central Kansas Experiment Field on a Crete silt loam soil. An irrigated corn experiment was conducted at Scandia, KS, and a dryland grain sorghum experiment was conducted at Belleville, KS. At the irrigated site, soil pH was 7.0, organic matter was 2.8%, Bray-1 P was 28 ppm, and exchangeable potassium (K) was 240 ppm. The previous crop was corn. Corn hybrid DeKalb DKC60-19 was planted without tillage into corn stubble on April 20, 2006, and April 22, 2007, at the rate of 31,000 seeds/a. Nitrogen was applied on the soil surface immediately after planting. Treatments consisted of controlled released polymer-coated urea (ESN), Nutrisphere-N coated urea, Agrotain coated urea, urea, and ammonium nitrate applied at three rates (80, 160, and 240 lb/a). A no-N check plot was also included. Additional treatments included UAN (28%), Agrotain treated UAN, Agrotain Plus + treated UAN, and Nutrisphere-N treated UAN. The experimental area was adequately irrigated throughout the growing season. Plots were harvested on October 20, 2006.

At the dryland site, soil pH was 6.5, organic matter was 2.5%, Bray-1 P was 38 ppm, and exchangeable K was 450 ppm. The previous crop was corn. Grain sorghum hybrid Pioneer 85G01 was planted at a rate of 62,000 seed/a on May 20, 2006, and June 3, 2007. Nitrogen was broadcast on the soil surface immediately after planting. Treatments consisted of urea, ammonium nitrate, ESN, urea treated with Nutrisphere-N, and Agrotain treated urea applied at 40, 80, and 120 lb/a N.

Results

Grain yield of irrigated corn plots receiving untreated urea were lower than plots receiving urea treated with Agrotain, ESN, or Nutrisphere-N at all levels of applied N (Table 5). Yields achieved with Agrotain, ESN, and Nutrisphere were equal to those of ammonium nitrate. Yield with UAN (28%) was also lower than yields with UAN treated with Agrotain, Agrotain Plus, or Nutrisphere-N. Averaged over N rates, yields achieved with all treated N products were greater than yields with untreated urea or UAN (Table 6). There were no significant differences in yields of Agrotain, Agrotain Plus, ESN, and Nutrisphere. The lower yields with urea and UAN indicate that volatilization of N may have been a significant problem. The dryland grain sorghum study results were similar to results in the irrigated corn experiment. Yield of plots receiving untreated urea was significantly lower than plots receiving urea treated with Agrotain, Nutrisphere-N, or ESN (Table 7). There were no differences in yield of the three products tested.

Results suggest that the efficiency of surface broadcast urea-containing fertilizers in no-till production systems can be improved by use of several products that are effective at reducing N volatilization losses.

Table 5. Effects of N source and rate on corn grain yield, earleaf N, and grain N, Scandia (2-year average)

N Source	N-Rate (lb/a)	Yield (bu/a)	Earleaf N (%)	Grain N (%)
Check	0	152.2	1.72	1.13
Urea	80	152.0	2.30	1.22
	160	169.3	2.65	1.26
	240	183.1	2.68	1.30
ESN	80	171.6	2.89	1.28
	160	186.6	2.95	1.32
	240	196.9	3.05	1.40
Nutrisphere-N	80	165.8	2.89	1.29
	160	187.7	2.94	1.36
	240	196.9	3.06	1.41
Urea + Agrotain	80	171.6	2.91	1.30
	160	179.7	2.96	1.36
	240	196.6	3.04	1.38
UAN (28%)	80	156.6	2.45	1.24
	160	167.0	2.69	1.28
	240	180.8	2.74	1.27
UAN + Agrotain	80	170.5	2.88	1.30
	160	191.2	2.98	1.35
	240	195.8	3.03	1.39
UAN + Agrotain Plus	80	168.2	2.90	1.31
	160	185.4	2.99	1.38
	240	195.8	3.08	1.42
UAN + Nutrisphere-N	80	170.5	2.87	1.30
	160	192.0	3.01	1.38
	240	195.8	3.04	1.41
Ammonium Nitrate	80	173.9	2.86	1.30
	160	187.8	2.96	1.35
	240	195.8	3.05	1.40
Average(not including check)		181.1	2.88	1.33

Table 6. Effects of N source (averaged over rate) on corn grain yield, earleaf-N, and grain-N, Scandia (2-year average)

Treatment	Yield (bu/a)	Earleaf-N (%)	Grain N (%)
Check	152.0	1.72	1.13
Urea	168.1	2.52	1.26
ESN	185.0	2.96	1.33
Nutrisphere-N	183.5	2.96	1.35
Urea + Agrotain	182.6	2.97	1.35
UAN	168.1	2.62	1.26
UAN + Agrotain	185.8	2.96	1.35
UAN + Agrotain Plus	183.1	2.99	1.37
UAN + Nutrisphere-N	186.1	2.97	1.36
Ammonium Nitrate	185.8	2.96	1.35
LSD (0.05)	6.2	0.09	0.04
CV%	6.8	4.5	4.9

Table 7. Effects of N source and rate on grain sorghum yield, Belleville (2-year average)

Treatment	N-Rate (lb/a)	Yield (bu/a)
Check	0	71
Urea	40	108
	80	122
	120	128
ESN	40	120
	80	130
	120	132
Urea + Agrotain	40	116
	80	129
	120	133
Urea + Nutrisphere-N	40	120
	80	133
	120	132
Ammonium Nitrate	40	118
	80	131
	120	133
N-Source Treatment Means		
Urea		119
ESN		127
Agrotain		126
Nutrisphere-N		128
Ammonium Nitrate		127
LSD(0.05)		5
CV%		6

MANGANESE NUTRITION OF GLYPHOSATE-RESISTANT AND CONVENTIONAL SOYBEAN

W.B. Gordon

Summary

Glyphosate can interfere with manganese (Mn) metabolism and adversely affect populations of soil microorganisms responsible for reduction of Mn. This study was conducted to determine if glyphosate-resistant soybean responds differently to applied Mn than conventional soybean and, if so, develop liquid fertilization strategies to prevent or correct deficiencies. Two separate experiments were conducted. In experiment 1, conventional soybean variety KS 4202 and its glyphosate-resistant isoline KS 4202RR were grown on a Crete silt loam soil with a pH of 7.0 at the North Central Kansas Experiment Field, located near Scandia, KS. Granular manganese sulfate was applied at planting in a band beside the row to give rates of 2.5, 5, and 7.5 lb/a Mn. A no-Mn check plot also was included. Soybean was planted without tillage in early May in 2005 and 2006. Experiment 2 consisted of combinations of starter and foliar-applied chelated liquid Mn treatments. Both experiments were sprinkler irrigated. Averaged over the 2-year period in Experiment 1, yield of the conventional soybean variety was 7 bu/a greater than the glyphosate-tolerant isoline when no Mn was applied. Adding Mn improved yield of the glyphosate-resistant variety, but yield of the conventional isoline decreased at the highest Mn rate. Leaf tissue Mn at full bloom in the glyposate-resistant variety was less than half that in the conventional variety when no additional Mn was applied. Foliar-applied liquid Mn also effectively improved yield of glyphosate-resistant soybean. Soybean yield was maximized with a combination of .3 lb/a Mn applied as a starter and another .3 lb/a applied at the 4-leaf stage or foliar application of 0.3 lb/a Mn at the 4-leaf, 8-leaf, and full bloom stage. These two treatments both improved yield 12 bu/a over the untreated check. Full yield benefit was not achieved with starter only application, even at a higher Mn rate.

Introduction

Many farmers have noticed that soybean yields on high pH soil are not as high as expected, even under optimal conditions. In Kansas, average yield seldom exceeds 60 to 65 bu/a, even with adequate rainfall and/or supplemental irrigation water. Applying glyphosate can retard Mn metabolism in the plant and may also have an adverse effect on populations of soil microorganisms responsible for reducing Mn to a plant-available form. Manganese availability is strongly influenced by soil pH. As soil pH increases, plant available Mn decreases. It is unlikely that Mn deficiencies will occur on acid soils. Adding supplemental Mn at the proper time can correct deficiency symptoms and increase soybean yields on soils with pH of 7.0 or above.

In higher plants, photosynthesis in general and photosynthetic O_2 evolution in Photosystem II (Hill Reaction), in particular, are the processes which respond most sensitively to Mn deficiency. Manganese deficiency-induced changes in O_2 evolution are correlated with changes in the ultrastructure of thylakoid membranes (internal chlorophyll-containing membranes of the chloroplast where light absorption and chemical reactions of photosynthesis take place). When Mn deficiency becomes severe, chlorophyll content decreases and ultrastructure of the thylakoids is drastically changed. Manganese acts as a cofactor, activating about 35 different enzymes. Manganese activates several enzymes leading to biosynthesis of aromatic amino acids such as tyrosine and secondary products such as lignin and flavonoids. Flavonoids in root extracts of legumes stimulate *nod* (nodulation) gene expression. Lower concentrations of lignin and flavonoids in Mn deficient tissue are also responsible for decreased disease resistance of Mn-deficient plants. In nodulated legumes such as soybean, which transport N in the form of allantoin and allantoate to the shoot, degradation of these ureides in the leaves and seed coat is catalyzed by an enzyme that has an absolute requirement of Mn. Ureides account for the majority of N transported in zylem sap to aerial portions of soybean. Tissue Mn deficiency and drought stress can increase shoot ureide concentration. Foliar Mn applications have been shown to be effective at prolonging N_2 fixation. Information is needed to determine if field-grown, glyphosate-resistant soybean responds to applied Mn in a different manner than conventional soybean and what fertilization practices can best correct the problem. Currently, there is little information on Mn fertilization of soybean in Kansas.

Objectives of this research were to determine if glyphosate-resistant soybean responds differently to applied Mn than conventional soybean and, if so, develop fertilization strategies to prevent or correct deficiencies, leading to improved yield for soybean producers.

Procedures

Glyphosate-resistant soybean variety KS 4202 RR and its conventional isoline were used in the experiments. The glyphosate-resistant isoline was created by crossing conventional line KS 4202 to a glyphosate-resistant source and then backcrossing the conventional line to the glyphosate-resistant progeny to produce a BC4 population. Each generation was sprayed with glyphosate, and resistant plants were used as male parents to continue the backcrossing. Single plant selections were made in the BC4F2 generation, the BC4F2:3 lines were grown out and sprayed with glyphosate, and the homogeneous lines were bulked to produce the glyphosate-resistant isoline. No molecular markers were used, and no measurement was made to determine if the two varieties were genetically identical except for the gene imparting herbicide resistance. The two varieties were grown on a Crete silt loam soil with sprinkler irrigation. Soil pH in the top 6 in. of soil at the site was 7.0. Manganese fertilizer treatment was preplant banded soil applications of Mn sulfate at rates of 2.5, 5, and 7.5 lb/a. A no-Mn check plot also was included. The experimental design was a randomized complete block with a split plot arrangement. Whole plots were herbicide-resistant and conventional soybean varieties (isolines of KS 4202); split plots were Mn rates and sources. An additional experiment evaluated liquid chelated Mn applied to soybean as a starter at planting and as a foliar treatment at three growth stages (V4, V8, and R2). Manganese was applied to glyphosate-resistant soybean variety KS 4202RR to give a rate of 0.3 lb/a Mn at each application.

Results

In Experiment 1, yield of glyphosate-resistant variety KS 4202 RR was 7 bu/a less than the conventional variety when no Mn was applied (Figure 1). Applying 2.5 lb/a Mn improved yield and equaled yield of the conventional isoline. Yield of the conventional variety was depressed at the high Mn rate. Tissue Mn concentration (uppermost expanded trifoliate at full bloom) in the herbicide resistant variety was less than half that of the conventional variety when no Mn was applied (Figure 2).

In Experiment 2, yield of glyphosate-resistant soybean variety KS 4202 RR was maximized by a combination of Mn applied as a starter 2 in. to the side and 2 in. below the seed at planting at a rate of 0.33 lb/a and a foliar application at the same rate applied at the 4-leaf stage (Table 8). A starter alone application at either 0.3 or 0.6 lb/a Mn did not give results equaling the combination of starter and foliar treatment. Foliar-applied Mn at 0.33 lb/a at the V4, V8, and R2 growth stages gave yields equal to the starter plus one foliar application at the V4 stage. One or two foliar applications were not as effective as the starter plus foliar or the three foliar applications. Higher rates of starter-applied Mn and single foliar applications will be investigated next year to determine if timing is critical or if higher rates applied earlier in the growing season are as effective as lower rates applied more frequently.

The single glyphosate-resistant soybean variety used in this experiment did not accumulate Mn in the same manner as the conventional variety and did respond to Mn application in this high-yield environment.

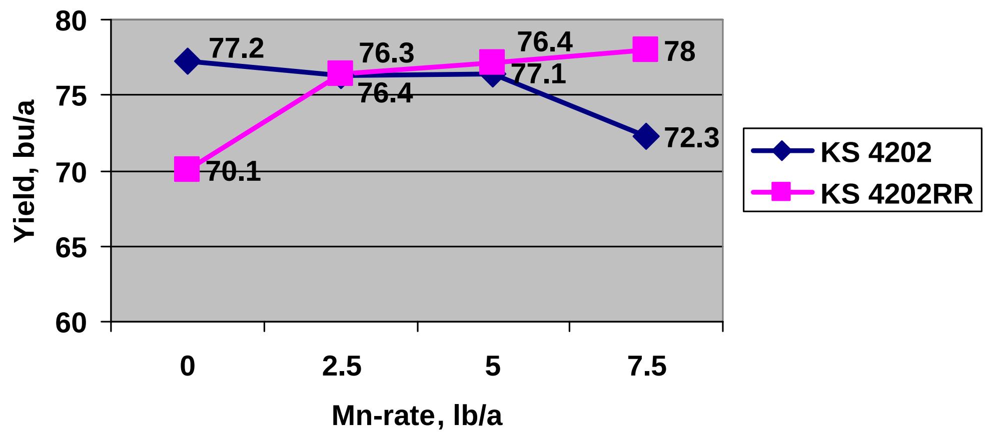

Figure 1. Soybean yield response to applied manganese, 2005-2006

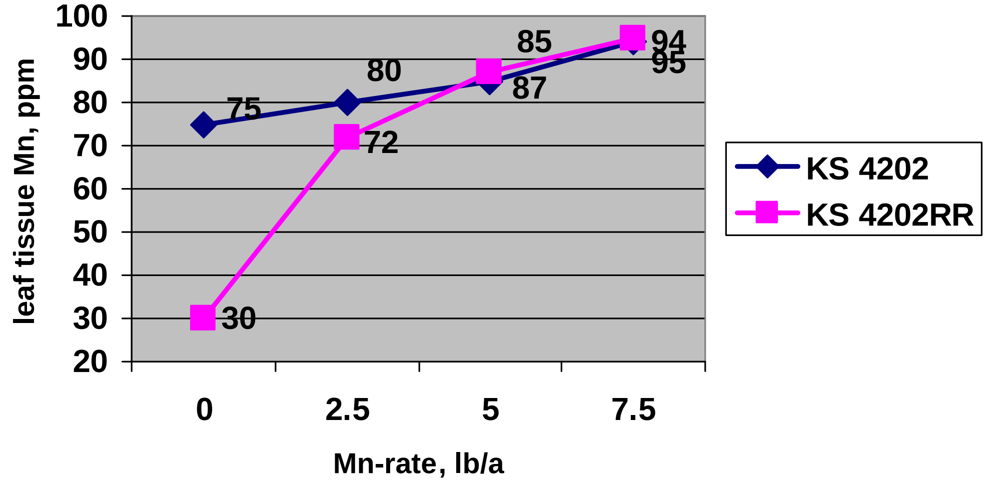

Figure 2. Soybean leaf tissue manganese concentration (uppermost expanded trifoliate at full bloom), 2005-2006

Table 8. Foliar applied manganese effects on soybean yield, 2005-2007

Stage of growth	Yield (bu/a)
Starter (0.33 lb)	65
Starter (0.66 lb)	70
Starter (0.33 lb) + V4 (0.33 lb)	76
V4 (0.33 lb)	67
V4 + V8 (0.33 +0.3 lb)	73
V4 + V8 + R2 (0.33 + 0.33 + 0.33 lb)	76
Untreated Check	64
LSD (0.05)	3

STARTER FERTILIZER APPLICATION METHOD AND COMPOSITION IN REDUCED-TILLAGE CORN PRODUCTION

W.B. Gordon

Summary

Field studies were conducted at the North Central Kansas Experiment Field, located near Scandia, KS, on a Crete silt loam soil. The study consisted of four methods of starter fertilizer application: in-furrow, 2x2, dribble on the soil surface 2 in. to the side of the row, and placed in an 8-in. wide band centered on the row. Liquid starter fertilizer consisted of either 5, 15, 30, 45, or 60 lb/a nitrogen (N) with 15 lb P_2O_5 and 5 lb/a K_2O. A no-starter check also was included. Plant populations were reduced when starter fertilizer was applied in-furrow with the seed. Averaged over starter combinations, corn yield was 36 bu/a lower when starter fertilizer was placed in-furrow than when applied 2x2. Yield with dribble application of starter in a narrow surface band was equal to yield with 2x2 applied starter. Increasing the amount of N in the starter up 30 lb/a consistently increased phosphorus (P) uptake and yield. Using the dicarboxylic copolymer Avail in starters was beneficial for increasing fertilizer P use efficiency and yield.

Introduction

An increasing number of producers in the Great Plains are using conservation tillage production systems because these systems have several inherent advantages including reduced soil erosion losses, increased soil water use efficiency, and improved soil quality. However, the large amount of surface residue present in reduced-tillage systems can reduce seed zone temperatures, which can inhibit root growth and reduce nutrient uptake. Liquid starter fertilizer applications have proven effective in enhancing nutrient uptake, even on soils that are not low in available nutrients. Many producers favor in-furrow or surface starter applications because of the low initial cost of planter-mounted equipment and problems associated with knife and coulter systems in high-residue environments. Crop injury can be severe when fertilizer containing N and P contacts seed. Surface application of starter fertilizer has not been extensively investigated or compared with subsurface applications. In addition, a new class of long-chain, high cation exchange capacity polymer that has the ability to enhance fertilizer phosphate soil availability and uptake by plants has recently become available. This new product is marketed under the name Avail. Objectives of this research were to determine corn response to liquid starter fertilizer combinations using four application methods and evaluate use of Avail in starters.

Procedures

Irrigated, reduced-tillage experiments were conducted at the North Central Kansas Experiment Field on a Crete silt loam soil. Soil test P values were in the upper part of the medium range, soil test K was in the high range, organic matter was 2.5%, and pH was 7.0.

The study consisted of four methods of starter fertilizer application: in-furrow with the seed; 2 in. to the side and 2 in. below the seed (2x2) at planting; dribbled in a narrow band on the soil surface 2 in. to the side of the row at planting; and placed on the soil surface in an 8-in. band centered on the row. Starter fertilizer consisted of combinations of either 5, 15, 30, 45, or 60 lb/a N with 15 lb/a P_2O_5 and 5 lb/a K_2O. Nitrogen as 28% UAN was balanced so all plots received 220 lb/a N regardless of starter treatment. Starter fertilizer combinations were made using liquid 10-34-0, 28% UAN, and KCL. Additional studies compared starter fertilizer with and without the dicarboxylic co-polymer Avail.

Results

When starter fertilizer containing 5 lb/a N and 5 lb/a K_2O was applied in-furrow with the seed, plant population was reduced more than 6,000 plants/a (Table 9). Plant population continued to decrease as N rate increased. Averaged over starter fertilizer rate, corn yield was 36 bu/a lower when starter fertilizer was applied in-furrow with the seed than when applied 2x2 (Table 10). Averaged over the 3 years of the experiment, yield with dribble application of starter fertilizer in a narrow surface band to the side of the row was statistically equal to yield with starter that was placed below the soil surface in the traditional 2x2 band. Applying a surface band is easier and less costly for producers than the 2x2 band. The 8-in. band over the row treatment resulted in yields that were greater than the in-furrow treatment but less than the 2x2 or surface dribble treatments. The fertilizer band was too diffuse to receive the full benefit of a starter fertilizer application. Regardless whether the starter fertilizer was placed 2x2 or dribbled on the soil surface, yields increased with increasing starter N rates up to 30 lb/a. Plant P content also increased with increasing N up to the 30 lb/a N rate (Figure 3).

Resent research results have also verified that adding Avail improves P fertilizer use efficiency. Studies compared a no-starter check with fluid starter containing both N and P with and without Avail. Use of fluid starter increased corn grain yield 19 bu/a over the no-starter check (Figure 4). Adding the polymer Avail to the starter fertilizer further increased yield an additional 9 bu/a. Corn earleaf concentrations at silking were greater in plots receiving the starter plus polymer than in plots receiving no starter or starter alone, indicating that Avail results in an increase in P uptake by plants and, ultimately, greater grain yield (Figure 5).

Table 9. Starter fertilizer placement and composition effects on plant population, 3-year average

Starter (lb/a) $N\text{-}P_2O_5\text{-}K_20$	In-Furrow	2x2	Dribble	Row Band
	----------------------------	plants/a	----------------------------	
5-15-5	25,202	31,266	31,170	31,266
15-15-5	23,142	30,729	31,655	31,552
30-15-5	23,307	31,266	30,492	30,589
45-15-5	21,329	30,976	30,392	30,492
60-15-5	20,371	30,687	30,613	30,298
Average	22,670	30,985	30,864	30,839

Table 10. Starter fertilizer placement and composition effects on corn grain yield, 3-year average

Starter (lb/a) $N\text{-}P_2O_5\text{-}K_20$	In-Furrow	2x2	Dribble	Row Band
	----------------------------	bu/a	----------------------------	
5-15-5	172	194	190	179
15-15-5	177	197	198	180
30-15-5	174	216	212	192
45-15-5	171	215	213	195
60-15-5	163	214	213	201
Average	171	207	205	189

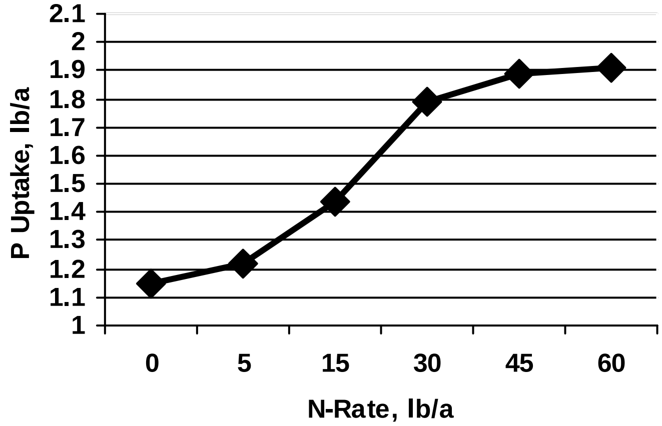

Figure 3. Starter N-rate effects on 6-leaf stage whole plant P uptake (average over starter composition), 3-year average

Figure 4. Starter and Starter + Avail effects on corn grain yield, 3-year average

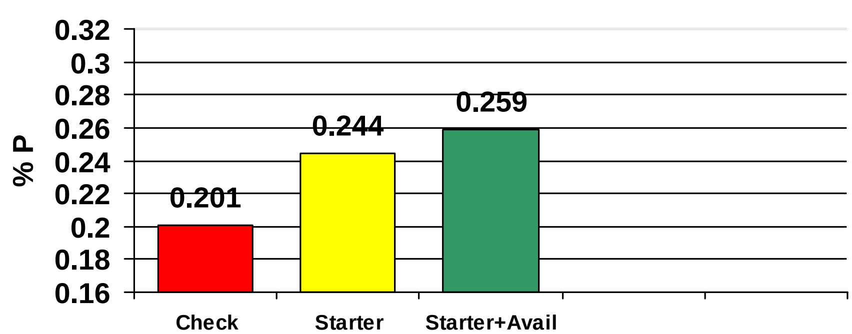

Figure 5. Starter and starter + Avail effects on corn earleaf P concentration, 3 year average

MANAGEMENT SYSTEMS FOR GRAIN SORGHUM PRODUCTION UNDER DRYLAND CONDITIONS

W.B. Gordon

Summary

Experiments were conducted at the North Central Kansas Experiment Fields on a Crete silt loam soil to compare corn and sorghum in both dryland and irrigated environments. The growing season was characterized by above normal rainfall, and yields were excellent. In the dryland experiment, averaged over populations and hybrids, corn yield averaged 153 bu/a and grain sorghum yielded 156 bu/a. The latest-maturing grain sorghum hybrid (DKS 53-11) yielded the greatest, and the earliest-maturing hybrid (DKS 36-00) yielded the least. Longer season sorghums develop more leaves than shorter season sorghums and thus have greater potential for fixing carbon and increasing yield. However, in many years, the fuller season hybrids run short of water in dryland environments and the potential for greater yield is not realized. Rainfall amount and distribution was ideal for grain sorghum production in 2007. The second half of June and first few days of July were dry, which caused some stress in corn, but timely rainfall was received in mid-July and continued in August, and dryland corn yields were significantly above the long-term average. Data from 36 site-years of tests from 1990-2007 in which grain sorghum and corn were grown side by side or nearby in controlled experiments in north central Kansas and south central Nebraska were pooled and analyzed to determine which crop was more profitable under dryland conditions. For producers to net more dollars per acre growing corn than sorghum, corn yield would have to equal or exceed 160 bu/a. If corn yield was less than 160 bu/a, sorghum would be more profitable.

Introduction

Water is the most limiting factor in crop production in the Great Plains. Choice of cropping system may change with limited amounts of available water. Slope of the yield-evapotranspiration (ET) relationship for corn is larger than for most other crops. However, the ET threshold for grain yield is also higher. With grain sorghum, it takes 6 in. of water to produce the first bushel of grain. Corn requires twice as much water to produce the first bushel of grain. Sorghum originated in, is well adapted to, and is primarily grown in semiarid regions of the world. It has long been recognized as being more drought tolerant than other major grain crops and is, therefore, well suited to conditions characterized by 1) insufficient water supply to meet evaporative demand, 2) uneven seasonal distribution of precipitation, and 3) high year-to-year variation in rainfall and surface water supplies. In dryland conditions or with limited amounts of irrigation water, available grain sorghum can be a viable alternative to corn production. The objective of this research was to compare production of grain sorghum and corn production in dryland cropping systems.

Procedures

In 2004-2007 a dryland experiment was conducted at the North Central Kansas Experiment Field on a Crete silt loam soil to compare corn and grain sorghum production in the same environment. The experiment consisted of three corn hybrids (DeKalb DKC 50-20, DeKalb DKC 58-80, and DeKalb DKC 60-19) planted at three plant populations (16,000, 24,000, and 30,000 plants/a) and three grain sorghum hybrids (DeKalb DKS 36-00, DeKalb DKS 42-20, and DeKalb 53-11) planted at 28,000, 36,000, and 44,000 plants/a. Hybrids were selected to represent early, medium, and late maturity groups. Both corn and grain sorghum plots were overplanted and thinned to desired populations. Corn was planted in mid-April each year, and grain sorghum was planted in late May. Both crops were planted without tillage into wheat stubble. In addition, data from 36 site-years of tests from 1990-2007 in which grain sorghum and corn were grown side by side or nearby in controlled experiments were pooled and analyzed to determine which crop was more profitable under dryland conditions.

Results

Averaged over populations and hybrids, during the period 2004-2007, corn yield averaged 121 bu/a and grain sorghum yielded 143 bu/a (Table 11). In 2007, the fullest season grain sorghum hybrid yielded the greatest. Late-season rainfall was good, and warm temperatures continued into October of 2007. Normally, fuller season hybrids have a greater genetic yield advantage over shorter season hybrids, but dry and cool fall conditions sometimes limit yields of fuller season hybrids in north central Kansas. In 2007, summer rainfall was 22% above normal and dryland corn yields were 33% above the long-term average. In spite of the excellent corn yields, grain sorghum yields were equal, and averaged over the period 2004-2007, grain sorghum yielded 22 bu/a more than corn. In 36 site-years of data, grain sorghum had a significant yield advantage of 8 bu/a (Figure 6). Data were then pooled and analyzed to determine which crop was more profitable under dryland conditions. Economic assumptions used in the analysis are shown in Table 12. For the analysis, sorghum is priced at 99.5% of corn. For producers to net more dollars per acre growing corn than sorghum, corn yield would have to equal or exceed 160 bu/a (Figure 7). If corn yield was less than 160 bu/a, sorghum would be more profitable. Grain sorghum yield is more stable than corn in areas where rainfall is variable or irrigation water is limited.

Table 11. Yield of corn and grain sorghum hybrids (averaged over plant populations)

Treatment	Yield, bu/a 2004-2006	Yield, bu/a 2007
Corn Hybrids		
DKC 50-20	104	158
DKC 58-80	108	141
DKC 60-19	102	159
Corn Average	105	153
Sorghum Hybrids		
DKS 36-00	132	142
DKS 42-20	143	159
DKS 53-11	135	166
Sorghum Average	137	156

Table 12. Base assumptions for economic analysis, 2008

Item	Cost
Sorghum cost of production	$248.82/a
Corn cost of production	$294.96/a
Sorghum price	$4.48/bu
Corn price	$4.50/bu
Government payment	$14.17/a

Costs and prices of commodities reflect local conditions.

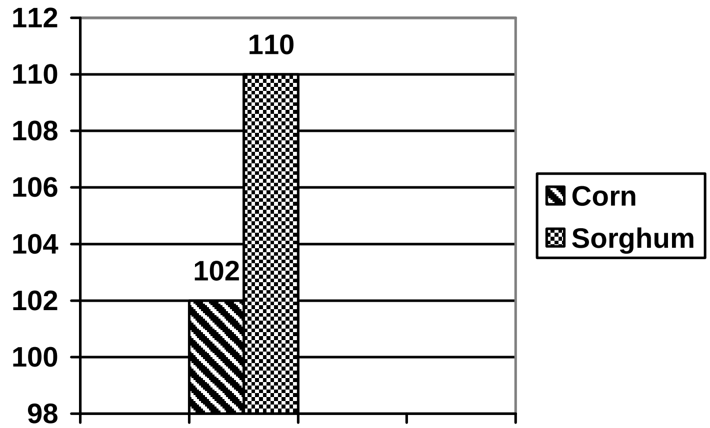

Figure 6. Corn and grain sorghum yields from 36 site years (1990-2007), Belleville, Manhattan, south central Nebraska

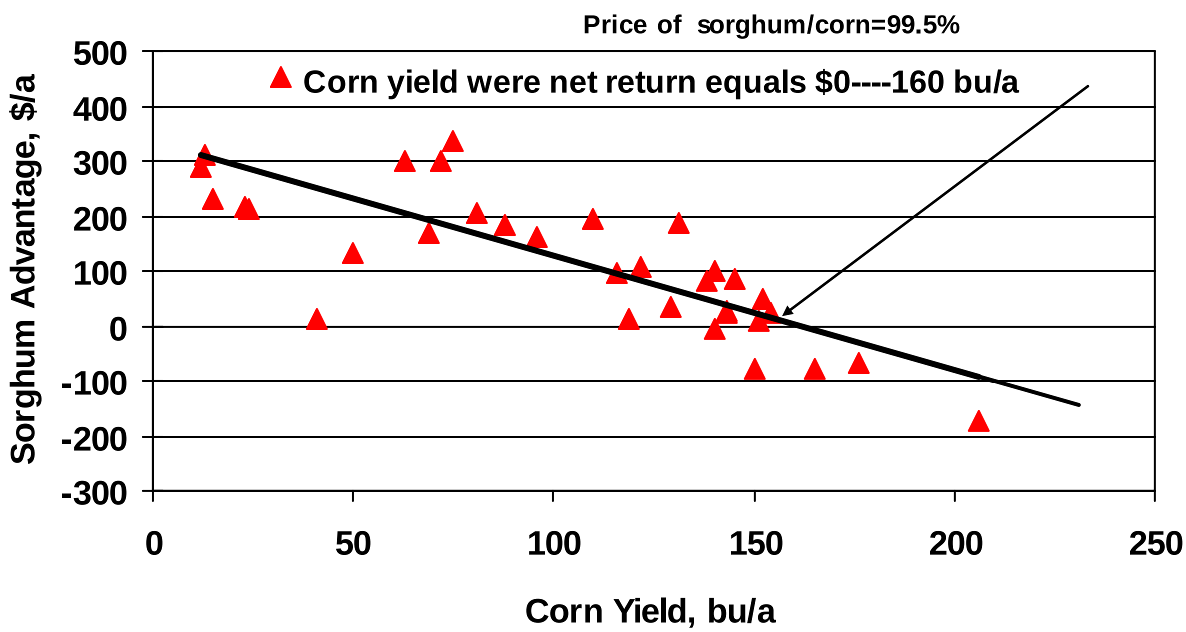

Figure 7. Grain sorghum-corn economic comparison, 2008

CHLORIDE FERTILIZATION FOR WHEAT AND GRAIN SORGHUM

W.B. Gordon

Summary

Research on chloride (Cl) application on wheat has shown significant yield response in Kansas. Chloride affects progression of some diseases by suppressing or slowing infection; however it does not completely eliminate diseases. Chloride responses have been noted even in absence of disease, suggesting that some soils in Kansas may not be able to supply needed amounts of Cl. Soil test calibration experiments have shown that when soil chloride levels (0-24 in.) are below 20 to 30 lb/a, responses to applied chloride are likely. In these experiments with wheat and grain sorghum, Cl consistently increased grain yield.

Introduction

Chloride has been reported to affect plant diseases in wheat and other grains by either suppressing the disease organism or improving overall plant health, allowing the plant to withstand infection. Researchers from across the Great Plains have shown yield increases from Cl application. The objective of these experiments was to evaluate Cl fertilization on wheat and grain sorghum in north central Kansas.

Procedures

In 2004-2007, Cl rates of 10, 20, and 30 lb/a were applied to wheat variety 2145 at the North Central Kansas Experiment Field on a Crete silt loam soil. An unfertilized check plot also was included. The Cl source used was ammonium chloride (6% nitrogen (N) and 16.5% Cl). Nitrogen was balanced on all plots; each plot received 90 lb/a N. Soil test Cl level at the test site was 15 lb/a in the top 24 in. of soil. Chloride was applied broadcast in the spring before jointing stage. In 2007, the same Cl rates were applied to wheat variety Overley. Chloride was applied with or without the fungicide Quilt at 14 oz/a. Fungicide was applied at flag leaf emergence. During 2004-2007, chloride rates (0, 20, and 40 lb/a Cl) and method of application were evaluated on grain sorghum. Application methods included broadcast on the soil surface immediately after planting and as a starter placed 2 in. to the side and 2 in. below the seed at planting. Chloride source was liquid ammonium chloride. Ammonium chloride (NH_4Cl) was added to a starter fertilizer containing 30 lb/a N and 30 lb/a P_2O_5. Plots receiving broadcast NH_4Cl also received the same amount of starter fertilizer but without the NH_4Cl. Nitrogen was balanced; all plots received 150 lb/a N regardless of NH_4Cl treatment. The experiment was conducted in areas where soil test Cl was 14-18 lb/a.

Results

Averaged over the 3-year period, adding 10 lb/a Cl increased grain yield of 2145 wheat 5 bu/a over the unfertilized check (Table 13). Adding higher rates of Cl did not result in any increases in yield. In 2007, adding Cl to Overley wheat increased grain yield 8 bu/a over the unfertilized check (Table 14). When no Cl was applied, fungicide application improved grain yield 5 bu/a more than the no-fungicide check. When 10 lb/a Cl was applied with fungicide, yields were 4 bu greater than with Cl alone. At the two higher Cl rates, fungicide application did not result in a statistically significant yield increase.

Applying Cl increased grain sorghum yield in all 3 years of the experiment (Table 15). Averaged over years and methods of application, adding 20 lb/a Cl increased yield 11 bu/a over the untreated check. Applying Cl at a rate higher than 20 lb/a Cl did not significantly increase grain yield. Applying Cl as a 2x2 starter significantly increased grain yield in only 1 year of the 3-year study. Averaged over years, there was no difference in application method. Results suggest that when soil test Cl levels are below the 20 lb/a level, consistent yield increases can be obtained with application of Cl-containing fertilizer.

Table 13. 2145 wheat yield response to chloride, 2004-2007

Cl rate (lb/a)	2145 wheat yield (bu/a)
0	66
10	71
20	71
30	73
LSD (0.05)	3

Table 14. Overley wheat yield response to chloride and foliar fungicide, 2007

	Overley wheat yield (bu/a)	
Cl rate (lb/a)	No fungicide	Fungicide
0	48	53
10	56	60
20	61	63
30	61	63
LSD (0.05)=4		

Table 15. Grain sorghum yield response to chloride, 2004-2006

Method	Rate	2004	2005	2006	Average
Check	0	120.3	115.2	125.8	120.4
Broadcast	20	127.0	124.2	133.2	128.1
	40	132.8	128.1	136.2	132.4
2x2	20	130.0	131.5	140.5	134.0
	40	131.0	131.3	139.0	133.8
Mean values					
Rate	0	120.3	115.2	125.8	120.4
	20	128.5	127.9	136.9	131.0
	40	131.9	129.7	137.6	133.1
LSD (0.05)		5.2	3.9	4.9	4.8
Method					
Broadcast		129.9	126.2	134.7	130.3
2x2		130.5	131.4	139.7	133.9

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Experiment Field Personnel

Larry D. Maddux, Ph.D., Agronomist-in-Charge
Charles Clark, Plant Science Technician II
William Riley, Plant Science Technician I
David Schooler, Assistant Scientist

EAST CENTRAL

Experiment Field Personnel

Larry D. Maddux, Ph.D., Agronomist-in-Charge
Keith A. Janssen, Ph.D., Soil Management and Conservation Specialist
James M. Kimball, Plant Science Technician II
Mark Horstick, Student
Ryan Schaub, Student

KANSAS RIVER VALLEY EXPERIMENT FIELD

Introduction

The Kansas River Valley Experiment Field was established to study management and effective use of irrigation resources for crop production in the Kansas River Valley. The Paramore Unit consists of 80 acres located 3.5 mi east of Silver Lake on U.S. Highway 24, then 1 mi south of Kiro, and 1.5 mi east on 17th street. The Rossville Unit consists of 80 acres located 1 mi east of Rossville or 4 mi west of Silver Lake on U.S. Highway 24.

Soil Description

Soils on the two fields are predominately in the Eudora series. Small areas of soils in the Sarpy, Kimo, and Wabash series also occur. Except for small areas of Kimo and Wabash soils in low areas, the soils are well drained. Soil texture varies from silt loam to sandy loam, and the soils are subject to wind erosion. Most soils are deep, but texture and surface drainage vary widely.

2007 Weather Information

The frost-free season was 197 and 203 days at the Paramore and Rossville Units, respectively (173 days average). The last spring freeze was on April 9 at both fields (average April 21), and the first fall freeze was October 25 and October 31 for the Paramore and Rossville Units, respectively (average October 11). There were 44 and 38 days above 90°F at the Paramore and Rossville Units. Precipitation was 4 to 10 in. below normal for the growing season (Table 1). Precipitation was below average from November through April. At the Rossville Unit, precipitation was above normal in May and slightly above normal in June. Precipitation in July and August was slightly below normal. Some sudden death syndrome was observed in soybeans, but the disease was not as bad as in previous years. Corn and soybean yields were good at both fields.

Table 1. Precipitation at the Kansas River Valley Experiment Field (in.)

	Rossville Unit		Paramore Unit	
Month	2006-2007	30-year avg.	2006-2007	30-year avg.
	----------in.----------		----------in.----------	
October	2.93	0.95	1.92	0.95
November	0.45	0.89	0.89	1.04
December	1.38	2.42	0.93	2.46
January	0.34	3.18	0.20	3.08
February	1.20	4.88	0.70	4.45
March	3.38	5.46	2.52	5.54
April	3.04	3.67	1.93	3.59
May	8.12	3.44	6.96	3.89
June	5.07	4.64	3.59	3.81
July	2.84	2.97	2.09	3.06
August	1.46	1.90	1.50	1.93
September	1.37	1.24	1.45	1.43
Total	31.58	35.64	24.68	35.23

CORN HERBICIDE PERFORMANCE TEST

Larry Maddux

Summary

This study was conducted at the Rossville Unit. Herbicide applications consisting of five preemergence (PRE), nine two-pass (PRE plus early or mid-postemergence (EP or MP), and one EP were compared. Ratings made on June 25 indicated excellent control of Palmer amaranth (PA) and common sunflower (CS) (greater than 90% control with all treatments). Control of large crabgrass (LC) ranged from 80% to 100%. Ivyleaf morningglory (IM) control ranged from 23% to 88% with eight treatments resulting in greater than 80% control. All treatments resulted in much greater yield than the untreated check; only two treatments yielded lower than the others.

Introduction

Controlling weeds in row crops with chemical weed control and cultivation can reduce weed competition and, in turn, weed yields. Timeliness of application is a major factor in effective weed control. This study compared the effectiveness of 15 herbicide treatments including PRE, EP, and PRE plus EP or PRE plus MP for controlling LC, PA, CS, and IM.

Procedures

The test was conducted on a Eudora silt loam soil previously cropped to soybean at the Rossville Unit. It included five PRE treatments, one EP treatment, nine PRE plus EP or MP, and one untreated check. The test site had a pH of 6.9 and an organic matter content of 1.1%. Hoegemeyer 8778, Herculex, LL RR2 hybrid corn was planted April 30 at 29,600 seeds/a in 30-in. rows. Anhydrous ammonia at 150 lb/a nitrogen (N) was applied preplant, and 120 lb/a of 10-34-0 fertilizer was banded at planting. Herbicides were broadcast in 15 gal/a with 8003XR flat fan nozzles at 17 psi. The experimental design was a randomized complete block with three replications. PRE applications were made April 30. EP treatments were applied May 29 to 4-leaf corn, 1- to 2-in. LC, 2- to 3-in. PA, 1- to 6-in. CS and 1- to 3-in. IM. MP treatments were applied June 4 to 5-leaf corn, 1- to 2-in. LC, 2- to 3-in. PA, 1- to 6-in. CS and 1- to 2-in. IM. Populations of all four weed species were moderate to heavy. However, weed populations were generally fairly light at postemergence time in plots receiving a preemergence treatment. Plots were not cultivated. The reported weed control ratings were made June 25. A total of 0.76 in. of rain was received from May 1 to 3. On May 6, 5.07 in. of rain was received. Plots were irrigated as needed. The test was harvested September 25 using a modified John Deere 3300 plot combine.

Results

Rainfall of 0.76 in. occurred over the 3 days following planting. No crop injury from PRE treatments was observed. Only slight injury was observed with some of the EP and MP treatments (data not reported). Excellent control (greater than 90%) of PA and CS was obtained with all treatments (Table 2). Keystone plus Hornet, Lumax, and Guardsman Max *fb* Status were the only treatments that resulted in less than 90% control of LC. Control of IM ranged from 23% to 88% with eight treatments giving 82% to 88% control. Grain yield was excellent; all treatments had much greater yield than the untreated check. A large variation in yield from plot to plot (LSD (0.05) of 42 bu/a) resulted in few significant differences with two treatments yielding lower than the others.

Table 2. Effects of preemergence and postemergnce herbicides on weed control and grain yield of corn, Kansas River Valley Experimental Field, Rossville, KS, 2007

Treatment	Rate	Application time[1]	Weed control, June 25[2] LC	PA	CS	IM	Grain yield
			------------------	%	------------------		bu/a
Untreated check	---	---	0	0	0	0	59
SureStart *fb*	1.75 pt/a	PRE	93	98	100	48	233
Durango +	24 oz/a	MP					
AMS	2.5 lb/a	MP					
Keystone *fb*	1.4 qt/a	PRE	98	100	100	73	249
Durango +	24 oz/a	MP					
AMS	2.5 lb/a	MP		100			
SureStart +	1.75 pt/a	EP	100		100	85	251
Durango +	24 oz/a	EP					
AMS	2.5 lb/a	EP					
Keystone + Hornet	2.8 qt/a + 3.5 oz/a	PRE	80	100	100	88	234
Lumax	3.0 qt/a	PRE	85	92	92	53	185
Keystone *fb*	2.8 oz/a	PRE	100	100	100	87	250
Hornet +	2.5 oz/a	EP					
Callisto +	0.75 oz/a	EP					
AAtrex Nine-O +	0.28 lb/a	EP					
COC + AMS	1% v/v + 2.5 lb/a	EP					
Keystone *fb*	2.8 qt/a	PRE	95	100	100	88	232
Hornet +	2.5 oz/a	EP					
Impact +	0.19 oz/a	EP					
AAtrex Nine-O +	0.28 lb/a	EP					
MSO + AMS	1% v/v + 2.5 lb/a	EP					
Lexar	3.0 qt/a	PRE	93	97	95	68	230
Lumax + AAtrex 4L	2.5 qt/a + 1.0 qt/a	PRE	93	95	95	23	193
Bicep II Magnum *fb*	2.1 qt/a	PRE	100	98	100	80	245
Callisto +	3.0 oz/a	MP					
COC + AMS	1% v/v + 8.5 lb/a	MP					
Lumax + AAtrex *fb*	1.5 qt/a + .75 qt/a	PRE	98	100	100	82	260
Lumax +	1.0 qt/a	MP					
NIS + AMS	0.25% v/v + 8.5 lb/a	MP					
Degree Xtra + Hornet	2.6 qt/a + 3.2 oz/a	PRE	93	100	90	57	190
Guardsman Max *fb*	2.0 pt/a	PRE	83	100	100	73	249
Status	4 oz/a	MP					
Guardsman Max *fb*	2.0 pt/a	PRE	97	100	100	88	265
Impact +	0.75 oz/a	MP					
AAtrex 4L +	1.0 pt/a	MP					
COC + AMS	1% v/v + 8.5 lb/a	MP					
Define + Aatrex 4L *fb*	1.0 pt/a + 1.0 pt/a	PRE	98	97	95	82	261
Laudis +	3.0 oz/a	MP					
AAtrex 4L +	2.0 pt/a	MP					
COC + AMS	1% v/v + 8.5 lb/a	MP					
LSD (0.05)			11	6	8	31	42

[1] PRE = preemergence (4/30), EP = early postemergence (5/29), MP = mid-postemergence (6/04).
[2] LC = large crabgrass, PA = Palmer amaranth, CS = common sunflower, IM = ivyleaf morningglory.

SOYBEAN HERBICIDE PERFORMANCE TEST

Larry Maddux

Summary

This study was conducted at the Rossville Unit to compare preemergence herbicide treatments followed by glyphosate treatments. Control of large crabgrass (LC) was good to excellent with all but three treatments. All treatments gave excellent control of palmer amaranth (PA). All but one treatment resulted in excellent control of common sunflower (CS). Control of ivyleaf morningglory (IM) ranged from 80% to 90% for all but five treatments, one with 95% control and four with less than 80% control. There were no significant yield differences between treatments, although all yielded higher than the untreated check.

Introduction

Controlling weeds in row crops with chemical weed control and cultivation can reduce weed competition and, in turn, weed yields. Treatments in this study included an untreated check, nine preemergence (PRE) applications followed by glyphosate alone or with a tank mix partner, two treatments of two applications of glyphosate, and one treatment of only one application of glyphosate. Weeds evaluated in this test were LC, PA, CS, and IM.

Procedures

This test was conducted on a Eudora silt loam soil previously cropped to corn. The test site had a pH of 6.9 and an organic matter content of 1.1%. Corn stubble had been disked in the fall. No additional tillage was done prior to planting, and Midland soybean was planted no-till May 22 at 139,000 seeds/a in 30-in. rows with 10-34-0 fertilizer banded at 120 lb/a. Herbicides were broadcast at 15 gal/a with 8003XR flat fan nozzles at 17 psi. A randomized complete block design with three replications per treatment was used. PRE applications were made May 22 and included 22 oz/a Roundup WeatherMax plus ammonium sulfate (AMS) for a burndown. Early postemergence (EP) treatments were applied June 24 to 4-trifoliate soybeans; 1- to 4-in. LC, 3- to 8-in. PA, 4- to 10-in. CS, and 2- to 4-in. IM. Mid-postemergence (MP) treatments were applied July 3 to 5-trifoliate soybeans; 1- to 4-in. LC, 3- to 10-in. PA, 6- to 12-in. CS, and 2- to 5-in. IM. Late postemergence (LP) treatments were applied July 11 to 5- to 6-trifoliate soybeans, 1-in. LC, 4- to 12-in. PA, 6- to 14-in. CS, and 2- to 5-in. IM. All applications of glyphosate received 2.5 lb/a AMS, and the treatments with Flexstar, Fusilade DX, and SelectMax also received crop oil concentrate. Populations of all four weeds were moderate to heavy. Plots were not cultivated. Rainfall of 0.36 in. was received 2 days after PRE applications; an additional 1.51 in. was received within 2 weeks after planting. Plots were irrigated as needed and were harvested October 5 using a modified John Deere 3300 plot combine.

Results

Sufficient rainfall was received 2 days following planting to activate the PRE herbicides. Significant crop injury was observed from the PRE application of Boundary but not from any of the other PRE herbicides (data not shown). The EP application of Flexstar also resulted in some soybean injury.

Table 3 shows weed control ratings made on July 23. Control of PA and CS was excellent for all treatments, except the MP Durango treatment resulted in only 70% control of CS. The LC control was good to excellent with only the Boundary *fb* Touchdown Total and Dual II Magnum *fb* by Flexstar plus Touchdown Total having less than 85% control. Control of IM was mostly in the 80% to 90% control range with three treatments having less than 80% control and one treatment having more than 90% control. All treatments had higher grain yields than the untreated check; there were no significant differences between treatments.

Table 3. Effects of herbicide application on weed control and grain yield of soybean, Kansas River Valley Experiment Field, Rossville, KS, 2007

Treatment[1]	Rate	Application time[2]	Weed control, June 25[3] LC	PA	CS	IM	Grain yield
			------------------%------------------				bu/a
Untreated check	---	---	0	0	0	0	33.8
Sonic *fb*	3.0 oz/a	PRE	100	100	100	88	59.9
Durango	24.0 oz/a	MP					
Valor SX (Gangster V) +	1.5 oz/a	PRE	100	100	100	83	59.6
FirstRate (Gangster FR) *fb*	0.3 oz/a	PRE					
Durango	24.0 oz/a	MP					
Durango DMA *fb*	24.0 oz/a	EP	100	100	100	87	57.9
Durango DMA	24.0 oz/a	LP					
FirstRate *fb*	0.3 pt/a	PRE	100	100	100	88	63.4
Durango	24.0 oz/a	MP					
Durango	24.0 oz/a	MP	85	100	70	77	62.8
Prefix *fb*	2.0 pt/a	PRE	87	100	100	82	56.1
Touchdown Total	24.0 oz/a	EP					
Boundary *fb*	1.5 pt/a	PRE	70	100	100	75	55.5
Touchdown Total	24.0 oz/a	EP					
Touchdown Total	24.0 oz/a	EP	93	100	100	82	66.4
Domain *fb*	10.0 oz/a	PRE	90	98	100	87	66.2
Touchdown Total	24.0 oz.a	EP					
Dual II Magnum *fb*	1.0 pt/a	PRE	78	100	100	78	57.2
Flexstar +	8.0 oz/a	EP					
Touchdown Total	24.0 oz/a	EP					
Touchdown Total *fb*	24.0 oz/a	EP	100	100	100	95	66.3
Touchdown Total	24.0 oz/a	LP					
Dual II Magnum *fb*	1.0 pt/a	PRE	87	100	100	88	61.7
Fusilade DX +	8.0 oz/a	LP					
Touchdown Total	24.0 oz/a	LP					
Dual II Magnum *fb*	1.0 pt/a	PRE	95	100	100	78	63.3
SelectMax +	8.0 oz/a	LP					
Touchdown Total	24.0 oz/a	LP					
LSD (0.05)			13	1	23	23	12.8

[1] Postemergence treatments of glyphosate had ammonium sulfate added at 2.5 lb/a treatments with Flextar, Fusilade DX, and Select MAX had crop oil concentrate.
[2] PRE = preemergence (5/22), EP = early postemergence (6/24), MP = mid-postemergence (7/03), LP = late postemergence (7/11).
[3] LC = large crabgrass, PA = Palmer amaranth, CS = common sunflower, IM = ivyleaf morningglory.

FUNGICIDES ON CORN

Larry Maddux

Summary

Fungicide treatments were applied to corn at the tasseling (VT) growth stage at the Rossville Unit. No significant yield responses were observed in 2007.

Introduction

Fungicides have been shown to increase grain yield of corn in the presence of foliar diseases. Sometimes, increased yields have been observed even when diseases were not obvious. This study was conducted to evaluate the effects of several fungicides on grain yield of soybean.

Procedures

This test was conducted on a Eudora silt loam soil previously cropped to soybean. The test site had a pH of 7.1 and an organic matter content of 2.1%. Soybean stubble was disked and chiseled in the fall and field cultivated in the spring. Anhydrous ammonia was applied at 150 lb/a nitrogen (N). DeKalb DKC 63-74 YG Plus RR2 corn was planted May 1, 2007, at 29,600 seeds/a in 30-in. rows with10-34-0 fertilizer banded at planting. A randomized complete block design with four replications was used. Treatments included an untreated check, check with only nonionic surfactant, Headline at 6 and 9 oz/a, Headline at 4.5 oz/a plus Caramba at 4.5 oz/a, and Headline at 4.5 oz/a plus Trisert at 2 gal/a. Trisert is a 26% N foliar fertilizer solution. Treatments were applied at tasseling (VT) in 20 gal/a. Plots were sprinkler irrigated as needed and harvested on September 21 with a John Deere 3300 plot combine.

Results

Results are shown in Table 4. Corn yields varied among plots, and no significant differences were observed.

Table 4. Effect of fungicides applied at tasseling on corn yields, Kansas River Valley Experiment Field, Rossville, KS, 2007

Fungicide	Rate	2007 yield (bu/a)
Untreated check	---	201
Nonionic surfactant check	---	183
Headline	6 oz/a	186
Headline	9 oz/a	184
Headline + Caramba	4.5 oz/a + 4.5 oz/a	196
Headline + Trisert	6 oz/a + 2 gal/a	211
LSD (0.05)		NS

MACRONUTRIENT FERTILITY ON IRRIGATED CORN IN A CORN/SOYBEAN ROTATION

Larry Maddux

Summary

The effects of nitrogen (N), phosphorus (P), and potassium (K) on a corn-soybean cropping sequence were evaluated from 1983 to 2007 (corn planted in odd years). Corn yield increased with increasing N rates up to 160 lb/a N, P fertilization resulted in corn yield increases 3 of the 13 years of this test, and K fertilization increased corn yield an average of 6 bu/a from 1983 to 1995 with no significant differences observed since.

Introduction

A study was initiated in 1972 at the Topeka Unit to evaluate the effects of N, P, and K on irrigated soybean. In 1983, the study was changed to a corn/soybean rotation with corn planted in odd years. Study objectives are to evaluate effects of N, P, and K applied to a corn crop on grain yields of corn and the following soybean crop and soil test values.

Procedures

The initial soil test in March 1972 on this silt loam soil showed 47 lb/a available P and 312 lb/a exchangeable K in the top 6 in. of the soil profile. Rates of P were 50 and 100 lb/a P_2O_5 (1972 to 1975) and 30 and 60 lb/a P_2O_5 (1976 to 2001) except in 1997 when a starter of 120 lb/a 10-34-0 (12 lb/a N plus 41 lb/a P_2O_5) was applied to all plots (also applied to soybean in 1998). Rates of K were 100 lb/a K_2O (1972 to 1975), 60 lb/a K_2O (1976 to 1995), and 150 lb/a K_2O (1997 to 2001). Rates of N included a factorial arrangement of 0, 40, and 160 lb/a of preplant N (with single treatments of 80 and 240 lb/a N). The 40 lb/a N rate was changed to 120 lb/a N in 1997. Treatments were applied every year to soybeans (1972 to 1982) and every other year (odd years) to corn (1983 to 1995, 1999, and 2001).

Corn hybrids planted were BoJac 603 – 1983; Pioneer 3377 – 1985, 1987, 1989; Jacques 7820 – 1991, 1993; Mycogen 7250 – 1995; DeKalb DKC626 – 1997, 1999; Golden Harvest H2547 – 2001; Pioneer 33R77 – 2003; DeKalb DKC63-81 – 2005; and Asgrow RX785 – 2007. Corn was planted in mid-April. Herbicides were applied preplant and incorporated each year. Plots were cultivated, furrowed, and furrow irrigated as needed through 2001 and sprinkler irrigated with a linear move irrigation system from 2003 to 2007. A plot combine was used to harvest grain.

Results

Average corn yields for the 13-year period from 1983 to 1995 (7 years) and yields for 1997 to 2007 are shown in Table 5. Yields were maximized with 160 lb/a N most years. Fertilization at 240 lb/a N did not significantly increase corn yield. From 1997 to 2007, corn yield with 120 lb/a N was not significantly different from that with 160 lb/a N and ranged from 0 to 8 bu/a less (LSD .05 was 13 to 19 bu/a). A yield response to P fertilization was obtained in 1985 and 1993 (yearly data not shown), but the 7-year average showed no significant difference in yield. No P response was observed in 1997 when starter fertilizer was applied to all plots. A significant yield response to P was obtained in 2003. Fertilization with K resulted in a significant yield increase in 1985, 1989, and 1993 (yearly data not shown), and the 7-year average showed a 6 bu/a yield increase. No significant corn yield response to K fertilization was observed from 1997 to 2007.

Table 5. Effects of nitrogen, phosphorus, and potassium applications on corn yields in a corn-soybean cropping sequence, Topeka, KS

Fertilizer applied[1]			Corn yield						
N	P_2O_5[2]	K_2O	1983 to 1995	1997	1999	2001	2003	2005	2007
------------lb/a------------			----------------------bu/a----------------------						
0	0	0	87	93	88	119	88	92	126
0	0	60/150	86	95	106	123	84	83	101
0	30	0	93	101	115	124	107	114	120
0	30	60/150	86	87	90	115	102	80	108
0	60	0	84	86	76	110	101	102	100
0	60	60/150	92	89	79	115	106	105	104
40/120	0	0	129	200	202	183	174	171	191
40/120	0	60/150	126	181	195	173	167	189	201
40/120	30	0	123	189	188	168	188	179	187
40/120	30	60/150	138	208	181	192	198	200	189
40/120	60	0	117	195	159	183	202	194	194
40/120	60	60/150	132	190	213	182	195	201	194
160	0	0	171	203	171	171	188	196	197
160	0	60/150	177	177	206	168	175	194	206
160	30	0	168	184	189	174	184	174	168
160	30	60/150	181	205	209	190	211	200	184
160	60	0	167	191	199	205	205	203	196
160	60	60/150	178	204	203	198	193	213	201
80	30	60/150	151	187	177	167	178	192	202
240	30	60/150	182	206	219	192	192	205	197
LSD(.05)			15	27	46	26	34	28	26
NITROGEN MEANS									
0			88	92	92	118	98	96	110
40/120			127	194	190	180	187	189	193
160			174	194	196	184	193	197	192
LSD (.05)			8	19	19	13	17	13	13
PHOSPHORUS MEANS									
	0		129	158	161	156	146	154	170
	30		131	162	162	160	165	158	159
	60		128	159	155	166	167	170	165
LSD (.05)			NS	NS	NS	NS	17	NS	NS
POTASSIUM MEANS									
		0	127	160	154	160	160	158	164
		60/150	133	159	165	162	159	163	165
LSD (.05)			6	NS	NS	NS	NS	NS	NS

[1] Fertilizer applied to corn in odd years 1983 to 2007 and to soybean for 11 years prior to 1983 (first number in each pair represents the rate applied to corn from 1983 to 1995).

[2] P treatments were not applied in 1997. Starter fertilizer of 10 gal/a 10-34-0 was applied to all treatments in 1997 and 1998 (corn and soybean) N and K treatments were applied to corn in 1997.

EAST CENTRAL KANSAS EXPERIMENT FIELD

Introduction

The research program at the East Central Kansas Experiment Field is designed to enhance the area's agronomic agriculture. Specific objectives are to 1) identify top performing varieties and hybrids of wheat, corn, grain sorghum, and soybean, 2) determine the amount of tillage necessary for optimum crop production, 3) evaluate weed control practices using chemical, nonchemical, and combination methods, and 4) test fertilizer rates and application methods for crop efficiency and environmental effects.

Soil Description

Soils on the field's 160 acres are Woodson. The terrain is upland and level to gently rolling. The surface soil is a dark gray-brown somewhat poorly drained silt loam to silty clay loam over slowly permeable clay subsoil. The soil is derived from old alluvium. Water intake is slow, averaging less than 0.1 in./hr when saturated. This makes the soil susceptible to water runoff and sheet erosion.

2007 Weather Information

Precipitation during 2007 totaled 45.8 in., which was 9.02 in. above the 35-year average (Table 1). Most of the extra rainfall occurred from one day's rainfall (6.56 in., June 30). Rainfall for June totaled 17.1 in. and exceeded the 35-year average by 11.89 in. Rainfall for July, August, and September was below average. August rainfall was 3.37 in. below average. The coldest days during 2007 occurred in January, February, and December with 13 days in single digits. The overall coldest day was 1.3°F on February 16. There was an exceptionally cold late spring freeze April 7 to 9 with temperatures dropping to 19.5°F. This caused serious freeze damage in wheat, alfalfa, and corn. There were 42 days during the summer of 2007 on which temperatures exceeded 90°F. The hottest 5-day period was August 12 to 16 when temperatures averaged 102˚F. The hottest day was August 14 when the temperature reached 103.5°F. The last freeze in the spring was April 9 (average April 18), and the first killing frost in the fall was November 1 (average October 21). The number of frost-free days was 205, more than the long-term average of 185.

Table 1. Precipitation at the East Central Kansas Experiment Field, Ottawa, KS

Month	2007	35-year avg.	Month	2007	35-year avg.
	----------in.----------			----------in.----------	
January	1.33	1.03	July	1.51	3.37
February	1.73	1.32	August	0.22	3.59
March	1.92	2.49	September	3.02	3.83
April	4.93	3.50	October	4.14	3.43
May	6.92	5.23	November	0.08	2.32
June	17.1	5.21	December	2.90	1.45
Annual Total				45.80	36.78

EVALUATION OF NITROGEN RATES AND STARTER FERTILIZER FOR STRIP-TILL CORN IN EASTERN KANSAS

Keith A. Janssen

Summary

Effects of nitrogen (N) rates and starter fertilizer application on strip-till fertilized corn were evaluated at the East Central Kansas Experiment Field at Ottawa, Kansas, in 2006 and 2007. Under fairly dry growing conditions and following soybean both years, the 80 lb/a N rate optimized corn grain yields at approximately 95 to 110 bu/a. In 2006, starter fertilizer applied at planting increased early-season growth of strip-till fertilized corn compared with applying all of the starter in the strip-till zone but did not increase grain production. In 2007, when planting was delayed, neither early season corn growth nor grain yields were increased by starter fertilizer. Best grain yields were produced both years when all of the starter fertilizer nutrients (i.e., N, phosphorus (P), potassium (K); N-P-K) were included with the rest of the fertilizer in the strip-till zone. More years of testing are needed before reliable N rate recommendations can be made, and final decisions as to whether starter fertilizer is beneficial for strip-till fertilized corn are forthcoming.

Introduction

Corn growers in eastern Kansas might benefit from reducing traditional N rates when growing corn using an under-the-row, strip-till banded fertilization program. The high cost of N fertilizer demands prudent use. Research is needed to determine whether there is any yield benefit from applying starter fertilizer at planting with strip-till under-the-row fertilized corn. Research results can help determine whether strip-till corn producers may be able to lower N rates, refrain from purchasing costly planter fertilizer banding equipment, and not have to apply starter fertilizer at planting.

Procedures

This was the second year for this study. Six N rates and three starter fertilizer scenarios were evaluated for strip-till corn on an upland Woodson silt loam soil at the East Central Kansas Experiment Field. Rates of N compared were 60, 80, 100, 120, 140 and 160 lb/a including a check. Starter fertilizer options evaluated included placement of all of the starter fertilizer 5 in. below the row during the strip-till operation, placement of the starter 2.5 in. to the side and 2.5 in. below the seed row at planting, and as a combination of half of the starter fertilizer applied in the strip-till zone and half at planting. In all cases, 30 lb/a N was included with the P and K starter fertilizers. Research by Barney Gordon at the North Central Experiment Field at Scandia, Kansas, showed that at least a 1:1 ratio of N-P fertilizer mix should be used for best starter P benefits.

The experiment design was a randomized complete block with four replications. Soybean was grown prior to the corn studies each year. For preplant weed control, 1 qt/a atrazine 4L plus 0.66 pint/a 2,4-D LVE plus 1 qt/a COC were applied. Pioneer 35P17 corn was planted April 6, 2006, and May 19, 2007. Planting in 2007 was delayed because of wet weather. Corn was planted at 24,500 seeds/a in 2006 and 26,500 seeds/a in 2007. Preemergence herbicides containing 0.5 qt/a atrazine 4L plus 1.33 pint/a Dual II Magnum were applied the day after planting both years for weed control. Effects of the N rates and starter fertilizer applications on plant establishment were evaluated by counting all plants in the center two rows of each plot. Six whole plants were collected from each plot at the 6-leaf corn growth stage for the purpose of measuring treatment effects on early season growth. Grain yields were measured by machine harvesting and weighing grain from the center two rows of each 10-ft-wide × 40-ft-long plot. Harvest was September 1, 2006, and September 20, 2007.

Results

Moisture available for corn growth was below average in 2006 and 2007. Under these conditions and with corn following soybean, the 80 lb/a N rate was sufficient for maximizing strip-till corn grain yields at approximately 95 to 110 bu/a (Table 2, Figures 2 and 4). In 2006, the application of starter fertilizer placed 2.5 in. to the side and 2.5 in. below the seed row at planting increased early growth of the corn by approximately 60% compared with placement of the starter in the strip-till zone. (Figure 1). The combination application of half the starter fertilizer applied at planting and half applied in the strip-till zone produced intermediate early season plant growth response. However, neither of these starter fertilizer applications increased grain yields. (Figure 2). Highest numerical grain yields were generally produced when all starter fertilizer nutrients (i.e., N-P-K) were included in the strip-till zone. It is hard to say whether this is because of improved late-season nutrient availability or less early season vegetative growth and moisture use. In 2007, when planting was delayed and weather during the early part of the corn growing season was warmer, starter fertilizer had no effect on early season growth or grain yield (Table 2, Figures 3 and 4). More years of testing under different growing conditions are needed before reliable N recommendations can be made and valid advice about benefits of starter fertilizer can be provided. This study will be repeated in 2008.

Table 2. Effects of nitrogen rates and application of starter fertilizer on plant stands, V6 plant dry weights, and grain yields of strip-till corn, East Central Kansas Experiment Field, 2006 and 2007

Fertilizer treatments		Plant populations		V6 dry weights		Grain yields	
Strip-till	Starter 2.5 in. × 2.5 in.	2006	2007	2006	2007	2006	2007
----------N-P_2O_5-K_2O, lb/a----------		× 1000		g/plant		bu/a	
Check 0-0-0		24.3	25.8	2.1	5.3	47	37
60-40-20		24.3	26.0	5.5	9.5	101	89
80-40-20		24.8	25.9	4.2	9.8	109	95
50	30-40-20	24.8	25.9	6.6	9.7	130	90
50-20-10	30-20-10	24.6	25.4	6.4	9.5	101	88
100-40-20		24.3	25.6	4.4	8.3	103	93
120-40-20		24.9	25.6	4.3	9.4	108	99
90	30-40-20	24.8	25.7	7.6	9.2	102	95
90-20-10	30-20-10	24.2	25.6	6.2	9.5	105	102
140-40-20		24.1	25.4	3.9	9.0	109	98
160-40-20		24.1	26.1	4.0	8.9	108	101
130	30-40-20	24.3	25.5	6.8	8.7	100	98
130-20-10	30-20-10	24.0	25.8	5.3	9.2	106	99
LSD (0.05)		NS	NS	1.0	1.4	6	9

April 6, 2006 Planting

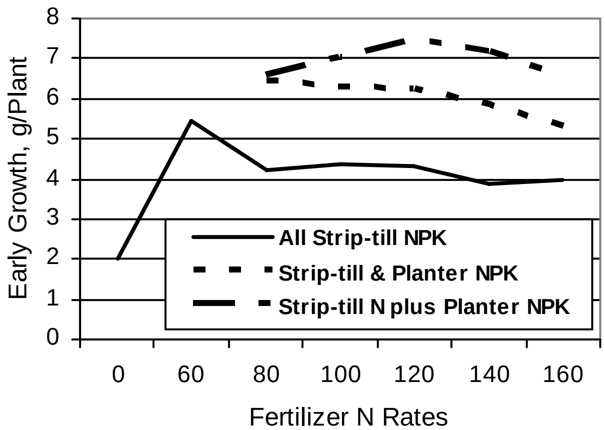

Figure 1. Nitrogen rates and starter NPK fertilizer placement effects on 6-leaf stage growth of strip-till corn

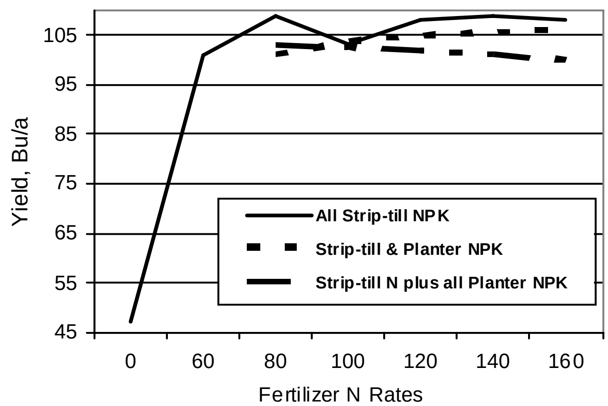

Figure 2. Nitrogen rates and NPK starter fertilizer placement effects on yield of strip-till corn

May 19, 2007 Planting

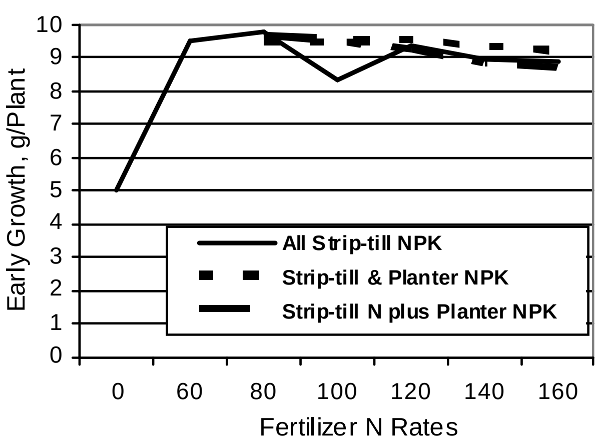

Figure 3. Nitrogen rates and starter NPK fertilizer placement effects on 6-leaf stage growth of strip-till corn

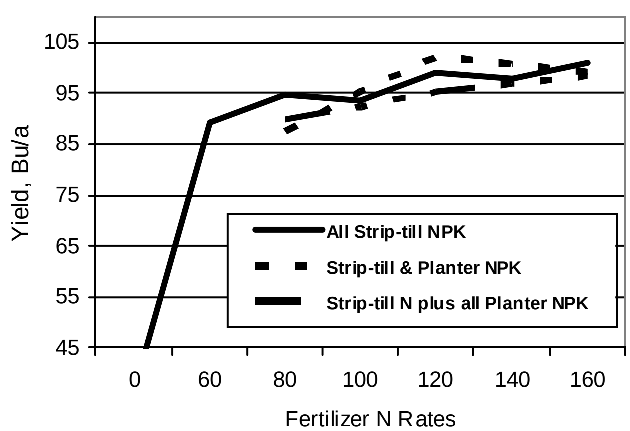

Figure 4. Nitrogen rates and NPK starter fertilizer placement effects on yield of strip-till corn

EVALUATION OF STRIP-TILL AND NO-TILL TILLAGE FERTILIZATION SYSTEMS FOR GROWING GRAIN SORGHUM PLANTED EARLY AND AT THE TRADITIONAL PLANTING TIME IN EASTERN KANSAS

Keith A. Janssen and Gary L. Kilgore

Summary

Field studies were conducted at the East Central Kansas Experiment Field at Ottawa, Kansas, in 2006 and 2007 to evaluate how strip-till performed compared with no-till for growing grain sorghum planted early and at the traditional planting time. Nitrogen (N) rates and effects of starter fertilizer were also studied. None of the experiments showed differences in plant stands with strip-till compared with no-till, but air and soil temperatures when the sorghum was planted early in 2006 were very warm, which could have masked possible strip-till benefits. In 2007, when planting was in June, early season grain sorghum growth and yields were both increased with strip-till compared with no-till. Strip-till increased grain sorghum yields 3 to 6 bu/a on average. Number of days for sorghum to reach half-bloom stage was decreased slightly both years for strip-till compared with no-till. Application of starter fertilizer at planting had no effect on strip-till grain sorghum yields. In both years, 60 to 90 lb/a N optimized grain sorghum yields following soybean in both tillage systems.

Introduction

In Kansas, midsummer heat and drought are significant factors limiting grain sorghum production. Scheduling grain sorghum planting to avoid pollination and grain fill during this period is important. One strategy is to plant grain sorghum early to make better use of spring precipitation, cooler air temperatures, and lower evapotranspiration. Another strategy is to wait, store as much water in the soil profile as possible, plant grain sorghum in mid- to late June, and then rely on stored soil water and fall rains to produce the grain sorghum crop.

Leaving crop residues on the soil surface and not tilling the soil can help retain valuable moisture. However, these practices, combined with planting grain sorghum early, can be challenging. The extra residue can shade the soil and keep no-till field soils cool and wet longer in the spring. This can interfere with timely planting some years, result in poor plant stands, and slow early season grain sorghum growth. Consequently, use of no-till and early planting of grain sorghum has not been widely adopted. Strip-till, on the other hand, is a compromise conservation tillage system. This system includes some tillage, but only where seed rows are to be planted. Row-middles are left untilled and covered with crop residue for soil erosion protection and water conservation. This method of seedbed preparation also enables fertilizers to be precision applied under the row, minimizing the need to applying starter fertilizers at planting.

Objectives of this study were to 1) evaluate strip-till and no-till tillage fertilization systems for growing grain sorghum planted early and at the traditional time, 2) determine N needs for sorghum when using these systems, and 3) determine whether there is any yield benefit from applying starter fertilizer at planting for strip-till fertilized grain sorghum.

Procedures

Field experiments were conducted in 2006 and 2007 at the East Central Kansas Experiment Field on an upland Woodson silt loam soil. Strip-till and no-till tillage systems were compared, and N rates ranging from 0 to 150 lb/a were tested. Also, effects of starter fertilizer placed 2.5 in. to the side and 2.5 in. below the seed row at planting was evaluated for strip-till fertilized sorghum. The sorghum experiments followed no-till soybean both years. For preplant weed control, 1 qt/a atrazine 4L plus 0.66 pint/a 2,4-D LVE plus 1 qt/a COC were applied. Pioneer 84G62 grain sorghum was planted April 14, 2006, (early planting) and May 24, 2006 (traditional planting). In 2007, early planting was not possible because of a prolonged wet spring. Instead, two hybrids (Pioneer 84G62 and 86G08) were planted in early June. Seed drop both years was 69,000 seeds/a. Preemergence herbicides containing 0.5 qt/a atrazine 4L plus 1.33 pint/a Dual II Magnum were applied both years at planting for additional weed control.

Plant stands, early season grain sorghum growth, and grain yields were measured each year. Plant stands were evaluated by counting all plants in the center two rows of each plot. Early season grain sorghum growth was measured by collecting and weighing six plants from each plot at the 5- to 7-leaf growth stage, and grain yields were measured by machine harvesting the center two rows of each 10-ft-wide × 40-ft-long plot. Harvest was September 19, 2006, and October 10, 2007.

Results

Moisture was limiting both years. In 2006, there were no noticeable differences in plant stands between tillage systems for early planted sorghum (data not shown). However, air and soil temperatures at the early planting date in 2006 were unusually warm (80 to 90°F air temperatures and 60 to 70°F 4-in. depth soil temperatures), which could have masked any strip-till benefits. Overall, early season grain sorghum growth and grain yields were unaffected by tillage system in 2006 (Table 3). In 2007, when planting was in June, strip-till increased early season growth and yields compared with no-till (Table 4). Grain yields were increased 3 to 6 bu/a on average. In 2006, days to half bloom ranged from 87 to 94 days after planting for early planted sorghum (July 10 to 17) and later planted sorghum (July 22 to 28), respectively. Number of days to half bloom for the later planted sorghum was only 10 to 12 days later then for the early planted sorghum, even though planting was 39 days later. Strip-till decreased the number of days to half bloom by approximately 1-2 days both years. Starter fertilizer applied at planting did not significantly improve grain yields compared with applying all starter in the strip-till zone either year. In both years, 60 to 90 lb/a N optimized grain sorghum yields. More years of testing are needed before reliable N rate recommendations can be made. Also, more years comparing strip-till and no-till systems at different planting dates are needed before recommendations can be made regarding best tillage systems for planting grain sorghum early and at the traditional planting time. These studies will continue in 2008.

Acknowledgments

Financial support for this research was provided by the Kansas Grain Sorghum Commission.

Table 3. Effects of tillage, planting dates, nitrogen rates, and starter fertilizer placement on early season grain sorghum growth, days to half bloom, and yields of early and traditional planted grain sorghum, East Central Kansas Experiment Field, Ottawa, KS, 2006

Treatment		Planting dates 2006					
		Early planting April 14			Traditional planting May 24		
Tillage	Fertilizer rate and placement	6-leaf dry weight	Half bloom date	Yield	6-leaf dry weight	Half bloom date	Yield
		g	July	bu/a	g	July	bu/a
No-till	0-0-0	5.4	14	74	6.4	28	48
No-till	60-30-10, 2.5 in. × 2.5 in. at planting	6.8	11	106	8.8	24	95
No-till	90-30-10, 2.5 in. × 2.5 in. at planting	6.6	11	92	8.6	24	101
No-till	120-30-10, 2.5 in. × 2.5 in. at planting	5.5	14	94	8.4	24	84
No-till	150-30-10, 2.5 in. × 2.5 in. at planting	6.5	13	96	8.0	25	93
Mean		**6.2**	**13**	**92**	**8.0**	**25**	**84**
Strip-till	0-0-0	4.3	17	73	7.3	26	85
Strip-till	60-30-10, 5 in. below the row	6.0	10	93	9.4	22	107
Strip-till	90-30-10, 5 in. below the row	7.0	12	101	8.7	23	115
Strip-till	120-30-10, 5 in. below the row	6.4	11	95	8.9	22	101
Strip-till	150-30-10, 5 in. below the row	6.7	12	84	8.2	23	108
Mean		**6.1**	**12**	**89**	**8.5**	**23**	**103**
Evaluation of Starter							
Strip-till	90-30-10, 5 in. below the row	7.0	12	101	8.7	23	115
Strip-till	60-15-5 strip-till and 30-15-5 at planting	6.6	12	83	9.2	22	107
Strip-till	120-30-10, 5 in. below the row	6.4	11	95	8.9	22	101
Strip-till	90-15-5 strip-till and 30-15-5 at planting	6.8	11	94	9.0	22	100
LSD (0.05)		1.1	NS	15	1.4	2	22

Table 4. Effects of tillage, hybrids, nitrogen rates, and starter fertilizer placement on early season grain sorghum growth, days to half bloom, and yields of Pioneer 84G62 and 86G08 grain sorghum planted at the traditional planting time, East Central Kansas Experiment Field, Ottawa, KS, 2007

Treatment		Hybrids 2007					
		Pioneer 84G62 Planted June 7			Pioneer 86G08 Planted June 11		
Tillage	Fertilizer rate and placement	5-leaf dry weight	Half bloom date	Yield	7-leaf dry weight	Half bloom date	Yield
		g	Aug.	bu/a	g	Aug.	bu/a
No-till	0-0-0	2.2	14	50	15.7	13	45
No-till	60-30-10, 2.5 in. × 2.5 in. at planting	3.7	11	83	21.1	10	71
No-till	90-30-10, 2.5 in. × 2.5 in. at planting	3.2	10	91	20.0	10	70
No-till	120-30-10, 2.5 in. × 2.5 in. at planting	2.7	11	92	20.7	10	74
No-till	150-30-10, 2.5 in. × 2.5 in. at planting	2.6	11	94	17.9	11	71
Mean		**2.9**	**11**	**82**	**19.1**	**11**	**66**
Strip-till	0-0-0	2.5	14	59	18.3	13	50
Strip-till	60-30-10, 5 in. below the row	4.4	8	94	24.0	9	71
Strip-till	90-30-10, 5 in. below the row	3.7	9	98	23.0	10	75
Strip-till	120-30-10, 5 in. below the row	3.5	9	92	19.8	10	73
Strip-till	150-30-10, 5 in. below the row	3.0	9	95	21.8	9	76
Mean		**3.4**	**10**	**88**	**21.4**	**10**	**69**
Evaluation of Starter							
Strip-till	90-30-10, 5 in. below the row	3.7	9	98	23.0	9	75
Strip-till	60-15-5 strip-till and 30-15-5 at planting	4.2	8	96	22.2	10	75
Strip-till	120-30-10, 5 in. below the row	3.5	9	92	19.8	10	75
Strip-till	90-15-5 strip-till and 30-15-5 at planting	3.4	9	93	23.9	9	76
LSD (0.05)		0.6	1	5	2.7	1	7

PLANTING DATE, HYBRID MATURITY, AND PLANT POPULATION EFFECTS ON CORN

Larry Maddux

Summary

Three planting dates, three corn hybrid maturities, and three plant populations were evaluated in 2006 and 2007 near Ottawa, Kansas. Silking dates were the same for the first two planting dates and about 8 days later for the third. The 105-day hybrid silked 3 days after the 100-day hybrid in both years, and the 113-day hybrid silked 5 and 7 days afterward in 2006 and 2007, respectively. Grain test weight decreased slightly after the April 1 planting date and also decreased as hybrid maturity increased in 2006 but not in 2007. Grain yields were not significantly different ($P < .05$) in 2006, but the highest yield was obtained with the 105-day hybrid planted on March 29. Highest yields were also obtained with the 105-day hybrid planted on April 5 in 2007. No consistent differences between plant populations were observed.

Introduction

During the past few years, corn acreage in east central Kansas has increased. This study was designed to evaluate three planting dates, three plant populations, and three corn hybrids of varying maturities.

Procedures

Three Pioneer corn hybrids of different maturities were planted in 2006 and 2007 on a Woodson silt loam at the East Central Kansas Experiment Field: 38H66 (105 day), 35P80 (110 day), and 33B49 (113 day). Seed was planted at 19,800, 24,200, and 28,600 seeds/a in an effort to obtain final populations of 18,000, 22,000, and 26,000 plants/a. Planting dates of March 15, April 1, and April 15 were attempted. Actual planting dates in 2006 were close, March 13, March 29, and April 13. In 2007, the first planting was made March 19. Unseasonable warm weather resulted in faster emergence than in 2006, and an extreme cold spell on April 7 and 8 resulted in 100% loss of the corn. The second planting date in 2007 was April 5, and the third planting date was delayed by wet weather until May 16. The first planting date was replanted June 7. Fertilizer (120-30-30) was applied with a strip-till applicator prior to planting. Recommended herbicides were applied for weed control. Plots were harvested with a JD 3300 plot combine.

Results

Plant populations obtained were close to the desired populations both years (data not shown). Emergence of corn planted March 13, 2006, was only 3 days before that of corn planted March 29, and these plants reached 50% silking on approximately the same dates (Table 5). Corn planted on the third planting date reached 50% silking about 8 days later. Hybrid 35P80 silked 3 days later than 38H66, and 33B49 reached silking another 2 days later than that. In 2007, corn planted March 19 emerged quickly and was killed by cold weather. The second planting date (April 5) was the only one close to the proper date; the third planting date was delayed by wet weather until May 16, and the first planting date was replanted on June 7. Hybrids planted on the second planting date in 2007 reached 50% silking similar to corn planted on the second planting date in 2006 (planted 5 days later and silked 3 to 5 days later). Corn from the third planting date and the replanted first planting date were silking in mid- to late July under considerable moisture stress. Test weight decreased as planting date was delayed after the April 1 planting date, especially in 2007 with the two later planting dates. In 2006, test weight also tended to decrease as hybrid maturity increased, but this was not observed in 2007. Grain yields were not significantly different ($P < .05$) in 2006, although corn from the March 29 planting date had the highest yield, and corn from the April 13 date had the lowest yield. In 2007, yields were higher from the April 5 planting date and higher than in 2006 but decreased with delayed planting; corn planted June 7 yielded less than half that of corn planted April 5. No significant differences in yields between hybrids or plant populations were observed in 2006. However, populations of 22,000 and 26,000 plants/a tended to yield higher at the early planting date, whereas 18,000 plants/a tended to yield higher at the April 13 planting date. In 2007, PI 35P80 yielded higher than the other two hybrids, and no consistent response to plant population was observed.

Table 5. Planting date, hybrid maturity, and plant population effects on corn, East Central Kansas Experiment Field, Ottawa, KS, 2006 and 2007

Planting Date	Hybrid (Pioneer)	Population	50% Silking 2006	50% Silking 2007	Test weight 2006	Test weight 2007	Yield 2006	Yield 2007
		Plants/a	Days after June 1		lb/bu		bu/a	
3/13/06	38H66	18,000	19	53	58.0	54.3	92	64
6/07/07		22,000	19	54	58.6	53.6	106	62
		26,000	19	54	58.2	52.4	107	58
3/13/06	35P80	18,000	21	56	56.8	54.3	95	66
6/07/07		22,000	21	57	57.2	54.9	96	60
		26,000	22	56	56.8	54.4	93	60
3/13/06	33B49	18,000	23	61	56.7	55.6	93	53
6/07/07		22,000	23	62	57.1	53.7	100	39
		26,000	24	62	57.2	54.9	103	43
3/29/06	38H66	18,000	19	21	58.0	55.5	103	118
4/05/07		22,000	20	21	58.4	56.8	110	111
		26,000	20	21	58.4	56.0	108	119
3/29/06	35P80	18,000	21	25	57.1	55.8	104	130
4/05/07		22,000	22	25	57.9	55.6	108	128
		26,000	22	25	57.5	56.0	100	146
3/29/06	33B49	18,000	23	28	57.4	57.3	103	115
4/05/07		22,000	23	28	57.2	56.3	100	123
		26,000	24	28	57.4	56.6	102	123
4/13/06	38H66	18,000	27	41	55.5	56.7	88	95
5/16/07		22,000	25	42	55.5	55.2	89	101
		26,000	25	42	55.8	55.6	91	92
4/13/06	35P80	18,000	27	44	55.5	55.3	100	111
5/16/07		22,000	28	44	55.6	55.8	93	96
		26,000	29	44	55.4	55.5	95	93
4/13/06	33B49	18,000	32	47	55.2	56.2	92	97
5/16/07		22,000	32	47	54.4	56.1	89	98
		26,000	33	47	54.7	56.6	93	101
Planting date means:								
3/13/06; ***6/07/07***			21	57	57.4	54.2	98	56
3/29/06: 4/05/07			21	25	57.7	56.2	104	124
4/13/06; ***5/16/07***			29	44	55.3	55.9	92	98
	Hybrid Means:							
	38H66		21	39	57.4	55.1	99	91
	35P80		24	42	56.6	55.3	98	99
	33B49		26	46	56.4	55.9	97	88
		Pop. Means:						
		18,000	24	42	56.7	55.7	97	94
		22,000	24	42	56.9	55.3	99	91
		26,000	24	42	56.8	55.3	99	93

FIELD RESEARCH 2008

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