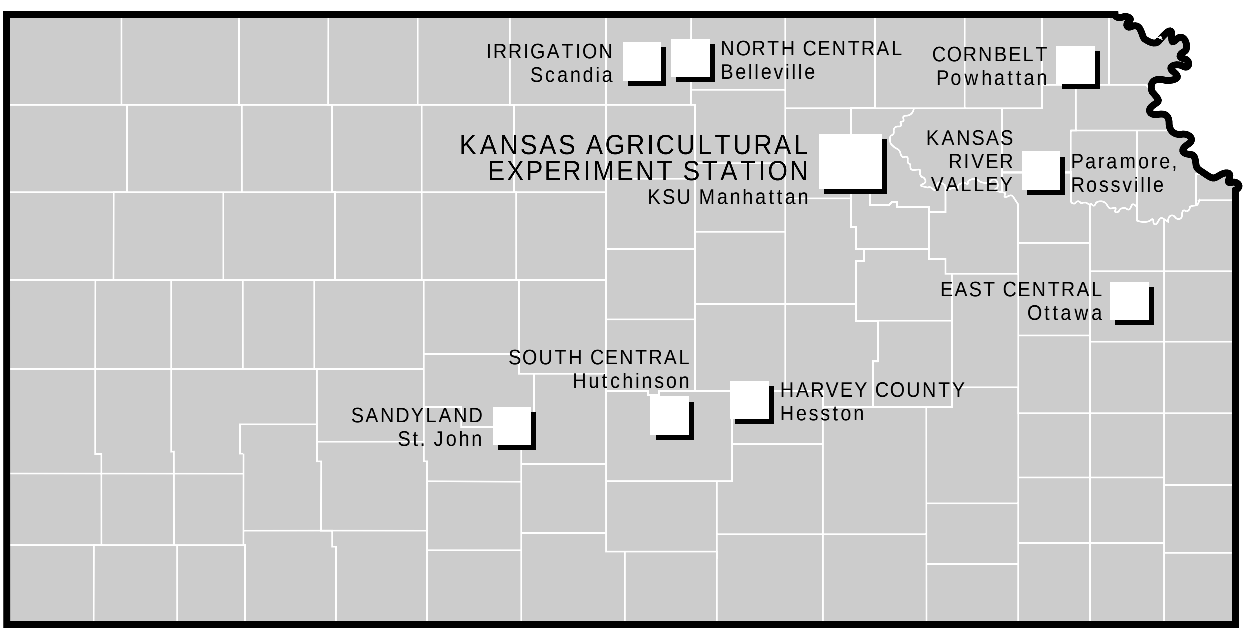
Report of Progress 787
Agricultural Experiment Station, Kansas State University

FIELD RESEARCH 1997



Agronomy and Biological & Agricultural Engineering Experiment Fields

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CORNBELT EXPERIMENT FIELD

Introduction

The Cornbelt Field was established in 1954 through the efforts of local interest groups, Kansas State University, and the state legislature. The objective then was to conduct research on the propagation, culture, and development of small-seeded legumes.

Emphasis since 1960 has been on fertilizer materials (rates, placement, and times of application); row spacings, planting rates, and dates; variety testing; control of weeds and insects; cultural practices, including disease- and insect-resistant varieties; and cropping systems. Foundation seed of oat, wheat, and soybean cultivars is produced to provide a source of quality seed of public varieties.

Soil Description

The soils on the Experiment Field are silty, windblown, Pleistocene sediments called loess (pronounced luss). Grundy silty clay loam, the dominant soil, has a black silty clay loam surface, usually more than 15 inches thick, and a silty clay subsoil. It typically occupies ridge crests and tablelands of western and southeastern Brown County and is extensive in northeastern Jackson, western Atchison, eastern Jefferson, and western Leavenworth counties in Kansas, as well as in western Richardson County, Nebraska. Grundy soil is similar to the Wymore soil of Nemaha and Marshall counties, Kansas and of Pawnee County, Nebraska.

The nearly level slopes have thick surface soil, which thins rapidly as slopes increase. Gradient terraces usually are needed to reduce sheet erosion, which is a serious hazard because the subsoil absorbs water slowly.

1996 Weather Information

A temperature roller coaster occurred during the winter and caused substantial winter kill in the wheat crop. Daytime temperatures remained at 50° for a week and then plummeted to -5° within 24 hours. A slight warmup ensued before temperatures again dropped to -20°, and a soil temperature of -2° was recorded at the 2 inch depth. Rainfall during 1996 was plentiful and well distributed during July and August. The result was excellent yields for all spring-planted crops.

The last killing frost was on April 23 (normal April 25), and the first killing frost was on October 22 (normal October 15). The frost-free period was 9 days longer than the 173-day average.

Table 1. Precipitation at Cornbelt Experiment Field, inches.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
						1996						
0.66	0.45	0.68	1.40	7.69	3.85	5.40	5.54	3.07	2.71	3.14	0.03	34.62
						40-Year Average						
0.79	0.75	2.34	3.05	4.74	5.03	4.51	4.04	4.52	2.80	1.81	1.07	35.45

SOIL pH EFFECT ON SOYBEAN HERBICIDES

Brian H. Marsh

Introduction

Soil pH can have a pronounced effect on herbicide efficacy. This experiment was designed to study the effects of soil pH and application rate of First Rate herbicide on weed control and crop growth and yield. Herbicides with known responses to high and low soil pH were included for comparison.

Procedures

The plot area was established for a 4 by 14 factorial design with lime application in February 1992. Feed grade lime (100% Calcium Carbonate Equivalent) was applied at four rates (0, 0.5, 1.0, and 1.5 times the lime requirement of 12,000 lbs/a) and disk incorporated. Plots were 10 feet by 25 feet. Herbicides were applied on June 22 in 20 gal. water/a and Mulch Master incorporated. All plots received Treflan for grass control except for the untreated check. 'Stressland' soybeans were planted on June 23 in 30 in. rows. Weed control was rated at 4 weeks after planting. Plots were harvested on October 21. Corn (Pioneer 3377) was no-till planted with 8.7 lbs/a of Counter 15G in furrow on April 17, 1996 to evaluated the carryover effects. Corn herbicides (Bullet 4 qts/a, Bladex 1½ lbs/a) were applied with 120 lbs/a (40 gpa) UAN across all plots. Corn growth inhibition ratings were taken 55 days after planting in comparison to corn on the soil pH 6.0, untreated plots. Plots were harvested on October 4.

Results

Average soil pHs from the liming treatments were 5.1, 6.0, 7.1, and 7.6 at planting in 1995. Average yields across all herbicide treatments were 37.0, 42.5, 41.1, and 42.1, respectively, for those pH levels. Yields were significantly lower for the low pH plots. Broadleaf weed pressure was not very heavy; yield from the Treflan only plot was not significantly lower than yields from the other herbicide treatments (Table 2). Grass weed control was excellent for all herbicide treatments across all pH levels. Some reduced control was observed for the low rate of First Rate. Broadleaf weed control was also excellent, except for the Treflan only and lowest rate of First Rate. Weed control was very good at 8 weeks after planted. Ratings at that time had very similar results (data not shown). Some stunting and chlorosis injury were observed for the highest rates of Canopy, Broadstrike, and First Rate. The injury was more pronounced as pH increased. The affected plants were able to recover. Injury ratings were lower at 8 weeks after planting (data not shown), and yields were not affected adversely.

Corn growth in 1996 was affected by soil pH and herbicide carryover (Table 3). Growth across all herbicide treatments was less at soil pH 5.1 than all other soil pH levels. Corn was stunted severely from Canopy carryover at soil pH 7.1 or higher. Registration prohibits its use on soils with soil pH 6.8 or higher. Corn yield was also lower across all herbicide treatments at soil pH 5.1 and at the higher soil pH levels for the Canopy treatments. The 1995 untreated plots had poorer weed control and lower corn yields in 1996. Yields for all other treatments at soil pH 6.0 to 7.6 were not significantly different.

Maintaining soil pH within the desirable range is essential for optimum crop growth and reducing the risk of herbicide injury.

Funded in part by DowElanco

Table 2. Effects of soil pH and application rate on herbicide efficacy (4 weeks after application), crop injury, and soybean yield, 1995.

		Soil pH												Yield
		Broadleaf Control				Grass Control				Growth Reduction				Avg.
Herbicide	Rate	5.1	6.0	7.1	7.6	5.1	6.0	7.1	7.6	5.1	6.0	7.1	7.6	
	oz/a	%				%				%				bu/
First Rate	0.31	98	65	100	100	97	65	99	85	0	0	0	0	42.5
First Rate	0.47	100	100	100	100	99	100	100	100	0	0	0	1	42.2
First Rate	0.63	100	100	100	100	97	100	100	100	0	0	0	3	46.0
First Rate	0.79	100	100	100	100	100	100	100	100	0	2	2	7	42.8
First Rate	0.93	100	100	100	100	100	100	100	100	1	7	3	8	43.7
First Rate	1.25	100	100	100	100	100	100	100	100	7	5	8	15	43.2
Canopy	3.76	95	95	100	100	90	99	100	100	1	5	7	7	41.9
Canopy	7.52	100	100	100	100	100	100	100	100	10	8	17	18	41.5
Scepter	1.25	98	100	100	100	98	100	100	100	7	2	5	3	42.8
Scepter	2.50	100	100	100	100	100	100	100	100	10	5	8	7	38.5
Broadstrike	0.63	98	100	100	100	96	99	100	100	3	7	7	12	41.5
Broadstrike	1.25	100	100	100	100	100	100	100	100	7	15	13	22	45.0
Treflan	15.1	70	60	60	60	94	95	96	96	0	0	0	0	41.1
Untreated		0	0	0	0	0	0	0	0	0	0	0	0	27.6
$LSD_{0.05}$		12				10				5				3.6

Broadleaf weeds (redroot pigweed, velvetleaf, vommon purslane)
Grass weeds (giant foxtail, large crabgrass)
Injury (stunting and chlorosis)
Yield averaged across pH levels

Table 3. Interaction effects of soil pH 1995 soybean herbicides on 1996 corn growth inhibition and grain yield

		Soil pH									
		Growth Inhibition					Yield				
Herbicide	Rate	5.1	6.0	7.1	7.6	Avg.	5.1	6.0	7.1	7.6	Avg.
	oz/a			%					bu/a		
First Rate	0.31	20	2	0	0	6	161	177	176	182	174
First Rate	0.47	20	2	2	4	7	162	178	178	187	176
First Rate	0.63	14	10	0	3	7	152	192	180	197	180
First Rate	0.79	18	0	0	6	6	153	175	169	171	167
First Rate	0.93	22	8	2	8	10	155	181	172	168	169
First Rate	1.25	18	6	6	8	10	137	192	174	170	168
Canopy	3.76	22	20	40	47	32	136	165	139	127	141
Canopy	7.52	24	22	58	64	42	143	179	112	111	136
Scepter	1.25	12	6	6	3	7	132	174	160	155	155
Scepter	2.50	20	4	8	8	10	140	198	176	184	175
Broadstrike	0.63	18	12	2	12	11	126	180	164	160	157
Broadstrike	1.25	14	6	0	4	6	146	176	176	191	172
Treflan	15.1	16	4	2	7	7	156	164	161	168	162
Untreated		12	0	0	0	3	123	139	124	125	128
				11†		6†		28†			14†
Average		18	7	9	12	3†	143	175	161	163	7†

†$LSD_{0.05}$

RUNOFF CONTAMINANTS FROM REDUCED TILLAGE SYSTEMS

Brian H. Marsh

Introduction

Strict guidelines were established regarding atrazine application rate, timing, and exclusion areas to reduce the amount of atrazine entering surface waters within the Delaware River Pesticide Management Area. Because atrazine moves primarily in the solution phase, incorporation was stressed heavily as a method to reduce atrazine concentrations in runoff water.

Many acres devoted to corn production must use no-till to meet conversation compliance requirements. Surface-applied herbicides in no-till are susceptible to movement with runoff water. At times, these two efforts conflict. Although each is addressing a very important concern, best management practices (BMPs) may dictate a compromise. This study evaluated runoff and contaminants from three tillage systems that varied in residue management and placement of chemicals.

Procedures

Three tillage treatments (no-till, 1-pass John Deere Mulch Master, and disk tillage) were used on an entire terrace within the field. These data represent the third year of the study. The terraced areas were between 1½ and 2½ acres.

Disk tillage treatment consisted of disking corn stubble in the fall, disking in the spring, and a field cultivator pass following chemical application. Mulch Master treatment was a single pass with this tillage implement through standing corn stubble following chemical application. Only the planting operation disturbed soil residue in no-till.

Chemicals were applied at the following per acre rates, 1¾ lbs. atrazine, 3 pints Harness (acetochlor), and 2 pints Roundup in 100 lbs. N and 100 lbs. P_2O_5 liquid fertilizer. Fields were planted on April 19. Runoff from each terrace was directed through a flume where water depth was measured with ultrasonic sensors each minute and averaged every 5 minutes. A portion of the runoff was collected and composited. Samples were kept cold until analyzed for atrazine and acetochlor by gas chromatography.

Results

The percent of soil surface covered by residue increased slightly for no-till and Mulch Master treatments from the previous year, and disk tillage values were about the same. Following planting, residue covers for each treatment were:

	1994	1995	1995
no-till	66	69	79
Mulch Master	55	57	65
disk tillage	19	17	21

Chemical application occurred early in the growing season this year. One and three quarters inches of rain fell during several events before any runoff occurred. Five rainfall events of different intensity produced runoff during the sampling duration. Differences in tillage systems were evident this year, because runoff amounts for the no-till system were usually less than those in other treatments that disturbed the soil surface (Figure 1). The bare surface of the disk tillage system was most susceptible to crusting and other factors that limit water infiltration; thus, it had the highest runoff.

Sediment losses were negligible for the no-till and Mulch Master tillage systems throughout the growing season. Two rainfall events produced substantial soil loss in the disk tillage system. Rain during one event was 3.15 inches over several hours and was less rain (0.82 in.) during the other but was very intense, falling in about 15 minutes. The unprotected soil surface of the disk tillage system along with the high runoff amounts resulted in a very high soil loss. Phosphorus losses in the disk tillage system followed the same pattern as soil loss (Figure 2), because most of the phosphorus (90%) moved with the sediment. The total loss was 2½ times greater than that of the other treatments. A larger percentage (94%) of the total moved with the solution phase in the no-till system, where the fertilizer phosphorus remained on the surface and was susceptible to runoff water movement. The Mulch Master system had about half of the phosphorus total in each phase.

In contrast to the low sediment amounts in runoff water from the no-till treatment, very high atrazine concentrations were measured in the first three runoff events. Atrazine concentrations were not different among treatments in the subsequent runoff events. Herbicide concentrations declined with each successive runoff event for all treatments. Incorporation reduced the total amount of atrazine lost by two thirds. The lower runoff amounts from the no-till system narrowed the differences. Atrazine concentrations in runoff water were not different among incorporation methods.

Continual use of disk tillage over the years has led to increased soil erosion for that tillage system (Table 4). Although incorporation can dramatically reduce the atrazine concentration in runoff water, higher runoff amounts can produce more total atrazine leaving the field, as seen in 1995.

Conclusions

Best management practices have been adopted by farmers to address specific concerns. However, one BMP may negatively affect another. Reducing soil erosion and protecting the environment from the same chemical inputs that are necessary for crop production are essential concerns for farmers. Adapting and combining BMPs are imperative for maintaining farm productivity and profitability.

Best management practices that keep water from leaving the field improve crop production and reduce surface water contamination. When tillage is necessary, preserving as much residue on the surface as possible reduces soil loss and water contamination. New generation tillage equipment that can incorporate herbicides and fertilizers through heavy residue and maintain substantial residue amounts on the soil surface can reduce amounts of both sediment and chemical contaminants that leave a field with runoff water.

Table 4. Total soil and atrazine losses with three tillage treatments.

	Soil Loss			Atrazine Loss		
Tillage	1994	1995	1996	1994	1995	1996
		tons/a			ounces/a	
No-till	0.04	0.54	0.02	0.061	0.21	0.45
Disk tillage	0.19	23.1	8.44	0.009	0.31	0.13
Mulch Master	0.09	1.38	0.16	0.008	0.23	0.14

Funded in part by Deere and Company.

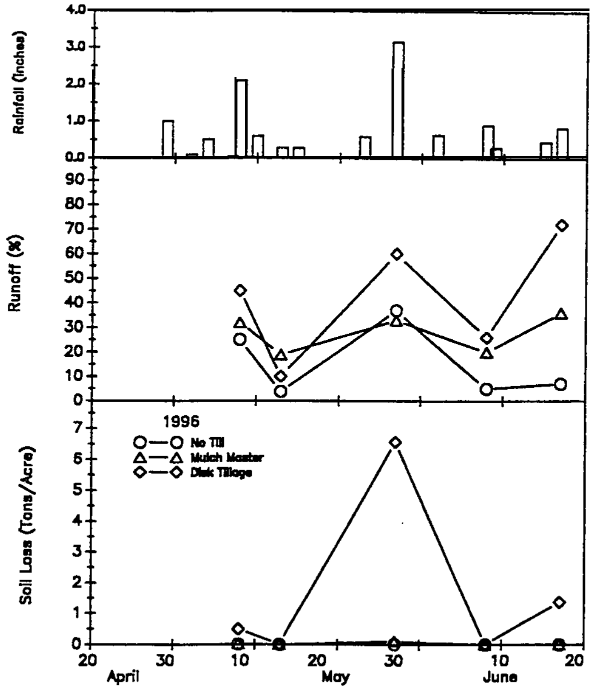


Figure 1. Rainfall, runoff percentage, and soil loss amounts, 1996.

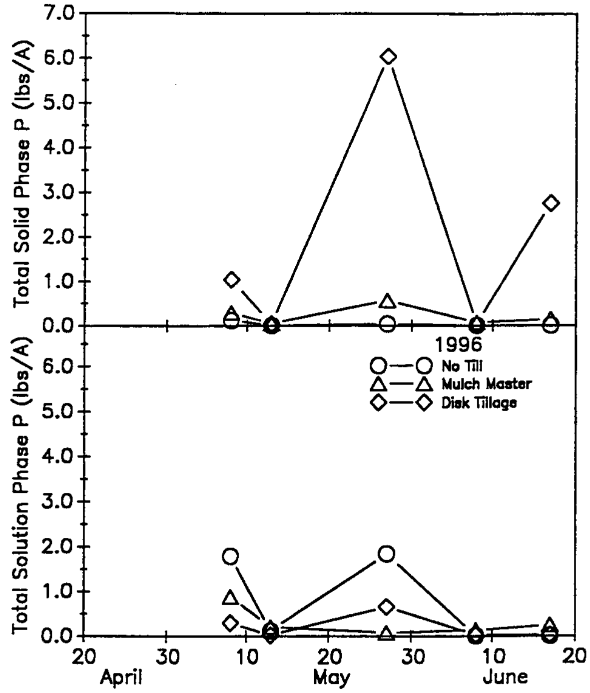


Figure 2. Phosphorus amounts in runoff water, 1996.

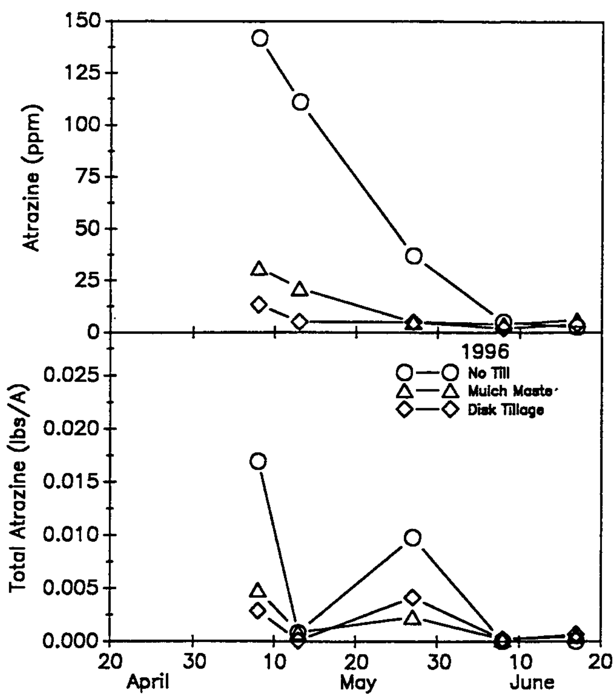


Figure 3. Atrazine concentration and total amount in runoff water, 1996.

POULTRY WASTE AS FERTILIZER

Brian H. Marsh and David A. Whitney

Introduction

Disposal of poultry waste, litter, and dead birds can be a burdensome undertaking, yet waste can be a valuable natural fertilizer source if handled properly. Composition and nutrient value of the waste will vary with the end use of the birds, length of time the manure is stored, and whether or not the litter material is included. Studies have looked at the fertilizer potential of these different litter types. The waste material we used included broiler litter (40%), cage layer manure (30%), alfalfa (15%), and spent hens (15%). The components were mixed, extruded through a 3/16 in. screen, and dried at >210°F for 3 minutes. The material contained 3.3% nitrogen (N) and 2.1% phosphorus (P) and other nutrients needed for plant growth. A study was to determine the potential use of this processed poultry waste as fertilizer.

Procedures

Four rates of poultry waste material (½, 1, 2 and 4 tons/a) and the equivalent amount of N as ammonium nitrate (33, 66, 132, and 264 lbs N/a) were applied on June 10 and incorporated with a field cultivator. Other treatments were 132 lbs N and 190 lbs P_2O_5/a to match the N and P of the 2 ton/a poultry waste treatment and an untreated check. Grain sorghum (NK KS735) was planted at 70,000 seeds/a on June 11. Previous crops grown were soybean in 1994 and grain sorghum in 1995. Soil test results in the surface 6 in. were: pH, 6.3; P, 15 ppm; K, 640 ppm. The P level is at the lower end of the medium group; about 20 lbs P_2O_5/A would be recommended for nonirrigated sorghum in eastern Kansas. The K level was very high, and no K fertilizer would be recommended. Flag leaf samples were collected on August 15. Whole-plant samples were collected and the center 2 rows were harvested on October 18.

Results

Leaf P concentrations were significantly higher where 1 ton or more of poultry waste was applied and with the added P fertilizer. Leaf N concentrations increased with all fertilizer N treatments and with the two higher poultry waste rates. Not all the N from the waste material would have been available for plant growth in the first year. Up to 90% of the N from manure may be available in the first year, but availability drops to about 50% when litter is included. About half the P, most of the K, and various amounts of other nutrients would be available in the first year. Whole-plant N and P contents also increased, and substantial amounts of these nutrients will become available for subsequent crops as the residue decomposes. The most efficient N and P use was from the fertilizer addition of these nutrients.

Grain yield was unresponsive over the check for the N fertilizer-only treatments. The good yield observed in the untreated check was a result of the previous crops, management practices, and yields. The 1995 grain sorghum crop was well fertilized, considering the prior soybean crop in 1994 and the applied N fertilizer (100 lbs N/a) in 1995. Sorghum yields in 1995 were disappointing at an average of 70 bu/a. Considerable soil N would have been available for 1996, and this was reflected in the good yield of the untreated check. Yields from the N and P fertilizer treatment and the poultry waste treatments of 1 ton/a or greater were significantly higher than yield of the untreated check. The 2 ton/a poultry waste treatment had $72.76 worth of fertilizer N and P.

Soil tests showed a significant increase in soil available P from the three highest poultry waste rates and fertilizer P additions. The increase was very dramatic; 20+ ppm for the 4 ton/a waste material rate and fertilizer P addition. No additional P fertilizer would be recommended, and continual application of high waste rates or high P applications would be environmentally unsound. Substantial N remained in the soil in the two higher N-only fertilizer treatments. A large amount of that had moved deeper into the soil. Although this N will still be available for next year's crop production, fertilizer rates must be adjusted to account for the N already present in the soil.

Conclusions

Poultry litter, either raw or processed, can be an effective alternative nutrient source. No deleterious effects were observed at the highest rate applied, but continued application of high manure rates can cause changes in soil chemical properties and negative effects on crop growth. Both nutrient analysis of the manure and soil testing must be performed routinely to assure that application does not exceed recommended rates.

Table 5. Effects of poultry waste on grain sorghum growth and residual soil fertility levels, 1996.

	Flag Leaf		Grain	Whole Plant				Soil		
Material	N	P	Yield	N	P	N	P	N	N	P
								6-12"	0-6"	
Fertilizer	%		bu/a	%		lbs/a		ppm		
0 lbs N/a	2.31	0.338	111	0.76	0.17	94	21	5	10	10
33 lbs N/a	2.80	0.349	116	0.99	0.15	129	19	5	10	9
66 lbs N/a	2.77	0.344	120	0.95	0.15	128	20	6	11	10
132 lbs N/a	2.85	0.332	122	1.00	0.13	137	18	12	14	12
264 lbs N/a	2.99	0.339	117	1.27	0.14	166	18	34	19	11
132 lbs N/a 190 lbs P_2O_5/a	3.01	0.427	130	0.80	0.18	116	26	7	12	30
Poultry Waste										
0.5 T/a	2.61	0.347	118	0.80	0.19	106	24	6	10	12
1.0 T/a	2.48	0.369	132	0.74	0.17	109	25	6	11	17
2.0 T/a	2.80	0.398	145	0.99	0.25	161	40	6	12	20
4.0 T/a	3.00	0.410	147	1.10	0.24	181	40	7	12	33
$LSD_{0.05}$	0.42	0.036	17	0.14	0.02	21	5	6	3	6

Funded in part by Notra Environmental Services

EVALUATION OF CORN HERBICIDES

Brian H. Marsh

Introduction

Selected broadleaf and grass herbicides for corn were evaluated. Several new broadleaf and grass herbicides were compared to other selected herbicide combinations for weed control and phytotoxicity.

Procedures

One hundred twenty pounds of N were applied as anhydrous ammonia on April 11. All treatments were applied in 15 gal. water/a. All treatments listed in Table 6 were applied on April 18. A field cultivator was used on the preplant-incorporated applications. All treatments listed in Table 7 were early postemergence application only. The treatments were sprayed on June 3 and cultivated on June 14. MicroTech was applied on April 18 to all treatments listed in Table 8, which were applied on June 11. An imidazolinone-resistant corn hybrid, ICI 8326IT, was planted at 18,800 seeds/a in 30 in. rows on April 18. Weed control and phytotoxicity were rated on June 28, July 26 and August 5. Grass weeds rated were giant foxtail and large crabgrass. Broadleaves included velvetleaf and redroot pigweed. Plots were harvested with a small plot combine on October 10.

Results

Excellent weed control was obtained for all preplant-incorporated treatments through the growing season (Table 6). No phytotoxicity was observed for any treatments, and grain yields were not significantly different among the herbicide treatments.

Greater variability in weed control occurred in the postemergence only treatments (Table 7). Broadleaf weed control was poor for the Basis/Prowl treatment and grass weed control was marginal for the Accent/Buctril treatment. Timing of the treatments was targeted as early post, the optimum timing for Basis. Lower grain yields were observed in these two treatments because of the less than adequate weed control. The other treatments provided good weed control, which resulted in higher grain yields. The addition of a small amount of atrazine greatly enhanced weed control. No herbicide-related reduction in crop growth was observed.

Excellent weed control was obtained for all post treatments listed in Table 8. No phytotoxicity was observed. The lack of complete broadleaf control with MicroTech only resulted in about a 40 bu/a yield decrease, but yield was more than 100 bu/a better than that with no weed control.

Funded in part by DowElanco and DuPont

Table 6. Effect of preplant corn herbicides on grain yield and weed control, 1996.

Treatment	Rate	Method	Yield	Grass		Broadleaves	
				6/28	7/26	6/28	7/26
			bu/a	% Control			
Broadstrike+Dual	2.2 lb ai	PPI	182	93	92	98	95
Broadstrike+Dual	2.2 lb ai	Pre	185	96	96	99	96
Broadstrike Plus Dual II	0.21 lb ai 2 lb ai	PPI	165	94	85	98	93
Broadstrike Plus Dual II	0.21 lb ai 2 lb ai	Pre	175	97	95	98	97
Bicep II	3.75 lb ai	Pre	192	96	95	97	97
Untreated			43	0	0	0	0
$LSD_{0.05}$			28	6	9	2	2

Table 7. Effect of early postemergence corn herbicides on grain yield and weed control.

Treatment	Rate	Timing	Yield	Grasses		Broadleaves	
				6/28	8/5	6/28	8/5
	ai/a		bu/a	% Control			
Basis	0.25 oz	Post + Cultivation	147	81	88	98	90
Basis Atrazine	0.25 oz 12 oz	Post + Cultivation	166	82	87	98	97
Basis Banvel	0.25 oz 4 oz	Post + Cultivation	146	93	93	94	93
DPX 79406 Atrazine	0.375 oz 12 oz	Post	165	97	88	98	92
Accent Buctril	0.5 oz 4 oz	Post	133	77	83	97	96
Basis Prowl	0.25 oz 1.25 lbs	Post	131	98	83	67	78
Untreated			22	0	0	0	0
$LSD_{0.05}$			27	26	15	8.5	11

Table 8. Effect of postemergence and preplant corn herbicides on corn yield and weed control, 1996.

				Grasses		Broadleaves	
Treatment	Rate	Time	Yield	6/28	7/26	6/28	7/26
			bu/a	% Control			
Scorpion III X-77 UAN	0.25 lb 0.25% v/v 2.5 % v/v	Post	170	98	93	99	96
BroadstrikePlus X-77 UAN	0.25 lb 0.25% v/v 2.5 % v/v	Post	172	98	95	99	96
BroadstrikePlus X-77 UAN	0.50 lb 0.25% v/v 2.5 % v/v	Post	175	97	93	98	94
Broadstrike Plus X-77 UAN	0.25 lb 0.25% v/v 2.5 % v/v	Late Post	164	98	95	95	90
Broadstrike Plus X-77 UAN	0.50 lb 0.25% v/v 2.5 % v/v	Late Post	180	98	95	99	98
Action COC	3 oz 1.25 % v/v	Post	170	93	93	98	97
Exceed COC	1 oz 1.25 % v/v	Post	165	94	93	98	96
Action Banvel COC	3 oz 2 oz 1.25 % v/v	Post	173	97	95	98	96
Exceed Banvel COC	1 oz 2 oz 1.25 % v/v	Post	166	96	92	98	96
Banvel COC	2 oz 1.25 % v/v	Post	162	98	95	78	85
Resolve NIS UAN	5.33 oz 0.2 qt 2 qts	Post	176	99	98	91	98
MicroTech	3 qts	Pre	134	90	85	40	35
Untreated			28	0	0	0	0
$LSD_{0.05}$			18	9	3	10	9

EVALUATION OF SOYBEAN HERBICIDES

Brian H. Marsh

Introduction

Selected preemerge and preplant-incorporated herbicides were evaluated for weed control efficacy and phytotoxicity in soybean.

Procedures

Preplant-incorporated treatments were applied in 15 gal. water/a on June 12 and incorporated with one pass of a field cultivator. KS 3494 soybeans were planted on June 14 at 108,000 seeds per acre in 30 inch rows. Preemergence treatments were applied on June 14, and postemergence treatments were applied on July 2. The soil had a pH of 6.6 and 2.7% organic matter. Plots were 10 ft. and 30 ft. Evaluations for weed control and phytotoxicity were made on July 26 and August 9. Plots were harvested on October 17 with a small plot combine.

Results

Excellent weed control was obtained with all treatments, except for poorer grass control with the lower rate treatment of Authority/Command. The grass weeds were giant foxtail and large crabgrass. Rated broadleaf weeds were redroot pigweed, velvetleaf and common purslane. Thorough weed control is essential for optimum grain yield. The differences in grass control had the dominant effect on grain yield. Yields declined when grass control was 90% or less. Phytotoxicity was not observed from any treatment.

Funded in part by FMC.

Table 9. Effect of soybean herbicides on grain yield and weed control, 1996.

				Grasses		Broadleaves	
Treatment	Rate	Timing	Yield	7/26	8/9	7/26	8/9
			bu/a	% Control			
Authority Command	0.375 lb ai 2 pts	Pre	41	82	97	95	99
Authority Command	0.313 lb ai 1⅓ pts	Pre	37	53	83	75	97

(continued)

Table 9. Effect of soybean herbicides on grain yield and weed control, 1996.

				Grasses		Broadleaves	
Treatment	Rate	Timing	Yield	7/26	8/9	7/26	8/9
			bu/a	% Control			
Authority Sencor Poast Plus	0.313 lb ai 0.1875 lb ai ¼ lb ai	Pre Post	54	97	96	96	96
Authority Sencor Poast Plus	0.375 lb ai 0.225 lb ai ¼ lb ai	Pre Post	54	99	99	98	99
Authority Sencor Dual II	0.313 lb ai 0.1875 lb ai 2 pts	Pre	49	93	97	95	99
Authority F6025 Dual II	0.188 lb ai 0.0375 lb ai 2 pts	Pre	49	95	99	94	99
Authority F6025 Dual II	0.20 lb ai 0.04 lb ai 2 pts	Pre	41	90	98	94	99
Authority F6025 Dual II	0.23 lb ai 0.046 lb ai 2 pts	Pre	43	88	97	95	99
Broadstrike + Dual	2 pts	Pre	38	94	90	94	96
Pursuit Plus	2½ pts	Pre	49	89	97	97	99
First Rate Treflan	⅝ oz 2 pts	PPI	44	77	94	97	99
First Rate Treflan	¾ oz 2 pts	PPI	52	83	97	98	99
Broadstrike + Treflan	2¼ pts	PPI	49	87	97	97	99
Untreated			22	0	0	0	0
$LSD_{0.05}$			8	13	7	14	4

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: (1) to identify the top performing varieties and hybrids of wheat, corn, grain sorghum, soybean and oat; (2) to determine the amount of tillage necessary for optimum crop production; (3) to evaluate weed control practices using chemical, non-chemical, and combination methods; and (4) to test fertilizer rates and placement 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 dark, gray-brown, somewhat poorly drained, silt loam to silty clay loam with a slowly permeable, clay subsoil. The soil is derived from old alluvium. Water intake is slow, averaging less than 0.1 inch per hour when saturated. This makes the soil susceptible to sheet erosion.

1996 Weather Information

Precipitation during 1996 totaled 40.88 inches, which was 3.79 inches above the 28-yr average (Table 1). May was a very wet month with almost one and a half times greater than normal rainfall. June was only slightly below average in moisture, whereas July and August were above average. Overall, moisture availability during the growing season was very favorable.

The length of the 1994 growing season was 20 days longer than average, with 205 frost-free days compared with the 185-day average. The last temperature 32°F or lower in the spring was on April 8 (average, April 18) and the first killing frost in the fall was on October 31 (average, October 21).

Coldest temperatures occurred in December, January, and February; 18 days had readings in the single digits or below. The coldest day all year was February 3, when temperatures ranged from -10° to a high of only 12°.

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

Month	1996	28-yr. avg.	Month	1996	28-yr. avg.
January	1.11	1.06	July	6.27	3.78
February	0.28	1.16	August	5.79	3.67
March	1.04	2.77	September	3.04	3.82
April	3.89	3.59	October	3.53	3.59
May	7.85	5.45	November	2.06	2.51
June	5.05	5.56	December	0.97	1.50
Annual Total				40.88	37.09

PERFORMANCE TRIAL OF DOUBLE-CROPPED SOYBEAN VARIETIES

Keith A. Janssen and Gary L. Kilgore

Summary

Ten soybean varieties were evaluated for double-cropping performance following winter wheat at the East Central Experiment Field, Ottawa during 1996. Maturity groups included III, IV, and V. Growing conditions were better than average with good moisture. Grain yields ranged from 18 to 24 bu/a. Group III and IV maturities had the highest average yields.

Introduction

Double-cropped soybean is a potentially profitable crop after small grain but is risky because of variable moisture at planting, dry summer weather, and possible early frost. Selection of varieties for double-cropped plantings have been based mainly on full-season soybean performance. This study evaluates variety performance under double-cropping conditions. Generally, varieties that make the most use of the double-cropping season, endure heat and moisture stress, set first pods fairly high, and tolerate cool night temperatures do best.

Procedures

Ten soybean varieties were planted on July 18, 1996 in 30-inch row widths following winter wheat. The wheat stubble was burned to facilitate quicker soil drying for planting. The soil was disked once before planting. Soil moisture was good, and emergence was excellent. No herbicide was applied, but the soybeans were cultivated once. Rainfall amounts after planting were: July 2.82 in., August 5.79 in., September 3.04 in. and October 3.53 in. The soybean crop was never visibly stressed for moisture. The first killing frost was on October 31, 1996, a later than average date. Harvest was on December 17, 1996, which was late because of wet field conditions.

Results

Soybean yields ranged from 18 to 24 bu/a with a test average of 22 bu/a (Table 2). This was 2 bu/a lower than the test average for 1995. Plant height varied with variety from 18 to 27 in. and pod height from 1.0 to 5.0 inches. The group V varieties, Manokin and KS5292, were the only entries affected significantly by frost. Group III maturities had the highest average yield (24.0), followed by group IV (22.4 bu/a) and group V (20.8 bu/a). The varieties in the top statistical yield group in 1996 were Midland 8393, Midland 8486, Pioneer 9391, Asgrow 4341, Delange 410, and Flyer.

Table 2. Double-cropped soybean variety performance test, Ottawa, KS.

Variety	Maturity Group	Yield 1996	Yield 2-yr avg	Yield 3-yr avg	1996 Maturity[1] (Freeze on 10-31)	1996 Plant Height	1996 Pod[2] Height
		bu/a @ 13%			month/day	inch	inch
ASGROW 4341	IV	22.5	--	--	10-27	19	1.8
DELANGE 410	IV	22.4	--	--	10-25	20	2.0
FLYER	IV	22.2	25.3	25.7	10-25	19	1.8
HOEGEMEYER 401	IV	18.0	--	--	10-25	18	1.0
KS4694	IV	20.6	--	--	10-28	19	1.8
MANOKIN	V	20.8	21.1	--	froze	27	5.0
MIDLAND 8393	III	24.4	27.4	26.8	10-25	20	2.0
MIDLAND 8486	IV	24.4	27.6	--	10-27	20	2.0
PIONEER 9391	III	23.5	25.5	26.9	10-21	20	2.0
KS5292	V	20.8	21.1	20.0	froze	21	5.0
LSD 0.05		3.6			1.0	2	0.3
CV %		9.7			0.7	6.1	6.5

[1]Maturity is the date on which 95% of the pods have ripened (browned).
[2]Distance from the ground to the bottom of the lowest pod.

EFFECTS OF SUBSOILING ON PERFORMANCE OF CORN AND SOYBEAN

Keith A. Janssen

Summary

Effects of subsoil tillage, chisel plow and no-preplant tillage on corn and soybean yield were compared during 1996. Corn grain yields ranged from 128 to 150 bu/a, with the highest yields from subsoiling and chisel plow. Corn yield in no-till was limited by insufficient nitrogen. Soybean yields ranged from 46 to 48 bu/a and showed no statistically significant differences.

Introduction

Extensive acreage of soils in the east-central and southeast areas of Kansas have naturally occurring, dense, clay subsoils. These slowly permeable subsoils restrict drainage, limit depth of rooting, and limit crop-available moisture. As a result, crop yields are limited by excess soil moisture when conditions are wet and by lack of sufficient available moisture when conditions are dry. Various deep tillage practices have been used to modify these soils to improve early-season seedbed drainage and to increase rooting depth and water availability during the growing season. Some farmers feel that periodic deep soil chiseling or ripping is necessary to loosen these soils and to break up compaction from fertilization, planting, spraying, and harvesting. They also feel that deep tillage benefits earlier planting because of quicker soil dry down in the spring. Some farmers deep till their soils every year, others every other year, and some on a less regular basis. Most of these soils contain significant montmorillonite clay, which expands and contracts with wetting and drying. Also, freeze-and-thaw cycles in most winters loosen these soils to a depth of 6 to 8 inches or more. These naturally occurring shrink-swell processes can alleviate considerable compaction. Consequently, the long-term benefits from subsoiling are being questioned. Another question is, "Are some crops affected more than others by subsoiling?" This study compares various subsoil tillage practices and timings with chisel plow and no preplant tillage for effects on corn and soybean yields.

Procedures

The experiment was started in 1996 at the East Central Experiment Field on a Woodson silt loam soil that has a dense clay subsoil (fine montmorillonitic, thermic Abruptic Argiaquolls) Tillage treatments were no preplant tillage; a straight-shank chisel plowing (5-7 in. depth) every year; and subsoil ripping at 8-10 in. depth every year, every other year, and every 3 years. All tillage plots including the no-till plots were row-crop cultivated once for weed control. Also, all tillage plots except the no-till plots were field cultivated before planting. Because this was the first year for this study, all subsoil frequency treatments showed the same subsoiling effects. Treatments were randomized in two separate blocks, one for corn and one for soybean. Corn (Pioneer 3394) was planted on April 17 in one block, and soybean (KS4694) was planted on June 5 in the other block. These crops will be rotated back and forth each year. Subsoiling and chisel plowing were performed on February 20, 1996. Soil moisture at the time was favorably low. A mixture of 20 gal. 28-0-0 and 15 gal. 7-21-7 liquid fertilizer/a was coulter knifed on April 11 for corn. No fertilizer was applied for soybean. Rainfall amounts after subsoiling were: February 0.28 in., March 1.04 in., April 3.89 in., May 7.85 in. June 5.05 in., July 6.27 in., August 5.79 in., September 3.04 in., and October 3.53 in. The corn and soybean crops were never visibly stressed for moisture.

Results

Corn grain yields ranged from 128 to 150 bu/a, with a test average of 141 bu/a (Table 3.) Subsoiling, 8-10 in. deep produced the numerically highest corn yields (146 bu/a average for the three subsoiling frequency treatments compared with 141 bu/a for the chisel-plow and 128 bu/a for no-till). The yield differences were barely statistically significant. No-till corn yield was limited because of lack of available N. Symptoms of N deficiency were noticeable in no-till. We applied 60 lbs N/a, thinking that the N contribution from the previous soybean crop and N mineralization from the soil would supply all of the N needed for 125 bushel corn. No tillage, which limits N mineralization and high yield, resulted in insufficient N. Our plans are to increase the N rate for corn next year to prevent N deficiency in no-till. Soybean, which fixes it's own nitrogen, ranged in yield from 46 to 49 bu/a, with no statistically significant differences in yield because of the tillage treatments. Availability of moisture during the 1996 crop year was excellent for crop production and probably not very conducive for benefits from subsoiling. The early part of the growing season was drier than normal with no excess seedbed moisture. Also, rainfall during the vegetative and grain fill periods were timely and above average for both the corn and the soybean crops. Consequently, 1996 subsoiling effects may not be representative of the long-term effects. More years of data are needed before any valid conclusions can be drawn about the benefits of subsoiling. This study will be repeated in 1997.

Acknowledgement

Appreciation is expressed to John Wray, Ottawa, KS for providing the subsoiler and the tractor for establishing the subsoil treatments.

Table 3. Subsoiling effects on corn and soybean yields.

	1996 Yield	
Tillage System	Corn	Soybean
	bu/a	
No-till[1]	128	47
Chisel[2]	142	46
Subsoil[3] (every year)	150	47
Subsoil (every other year) 1st year data	141	47
Subsoil (every third year) 1st year data	147	48
LSD.05	ns	ns
LSD.10	12	ns
CV %	6.7	5.3

[1]With one in-season cultivation.
[2]5-7 inch depth.
[3]8-10 inch depth.

PHOSPHORUS LOSSES IN RUNOFF WATER AS AFFECTED BY TILLAGE AND PHOSPHORUS FERTILIZATION[1]

Keith A. Janssen, Gary M. Pierzynski, and Phil L. Barnes

Summary

Phosphorus (P) in runoff from cropland can contribute to nutrient enrichment and eutrophication of surface water bodies. Research was continued during 1996 to determine which tillage systems and which methods of applying P fertilizer will result in the least P losses in runoff water for grain sorghum production under somewhat poorly drained soil conditions in east-central Kansas. The tillage systems evaluated were a chisel-disk-field cultivate, ridge tillage, and no-tillage. Fertilizer treatments were a P check, 50 lb/a P_2O_5 surface broadcast, and 50 lb/a P_2O_5 deep-banded. Runoff from natural rainfall was collected during three periods before and after grain sorghum fertilization and planting. Volume of runoff in 1994 was greatest from the chisel-disk system. In 1995, most runoff occurred with no-till. In 1996, runoff was highest with the ridge-till system. Averaged across all runoff events over 3 years, the volume of runoff was similar for each of the tillage systems, indicating no significant reduction with conservation tillage for this somewhat poorly drained soil. Sediment losses and total P losses in the runoff water followed the pattern chisel-disk > ridge-till > no-till. Soluble P losses were highest with the conservation tillage systems, largely because of surface application of P fertilizer. Losses of soluble P were reduced greatly when the P fertilizer was subsurface-banded. Comparisons of total and soluble P losses with bioavailable P losses showed that substantial algae-useable P in the runoff from this location was in the soluble P form. This could be due to limited sediment losses from minimum slope and low soil erosion potential. No differences in grain yield occurred in 1994 with tillage or P treatments. In 1995 and 1996, deep-banded P produced an average grain sorghum yield 8 bu/a higher than that with broadcast P.

Introduction

Agricultural runoff from cropland can contribute to nutrient enrichment of lakes, streams, and rivers. High levels of phosphorus (P) in runoff water accelerates eutrophication of surface water bodies, producing water that has undesirable odor and taste for drinking and recreation. Excess P in runoff is a problem in the Hillsdale lake watershed in east-central Kansas. Farmers in the watershed are being urged to reduce nonpoint sources of P entering surface water (Big Bull Creek Water Quality Incentive Project). Losses of P from conventionally tilled land are believed to be mainly of P attached to soil, with smaller amounts dissolved in the runoff water. Consequently, soil erosion control practices and use of conservation tillage systems are being encouraged. However, several recent studies have indicated that soluble P concentrations and losses increase with conservation tillage systems because of generally shallower fertilizer incorporation and release of P from unincorporated crop residues. This, coupled with the potential for greater than normal runoff with conservation tillage systems, because of an abundance of slowly permeable soils in the watershed, might mitigate some or all of the sediment P

[1]This research was funded by the Kansas Fertilizer Research Fund and the Kansas Agricultural Experiment Station..

reduction benefits associated with conservation tillage. Consequently, we hypothesized that for somewhat poorly drained soils, best P practices may require both soil erosion control measures and subsurface placement of P fertilizer. The deeper placement would put the fertilizer P below the critical surface-water soil interface and mixing zone (approximately the top 1 inch of soil). Other research has indicated that injecting fertilizer P prevented losses of dissolved and sediment-available P. Deeper P placement also might benefit crop yield because of better positional location for root uptake during dry surface soil conditions.

The objective of this study was to evaluate the effects of different tillage and P fertilization practices on P losses in runoff water for an imperfectly drained soil.

Procedures

The study was conducted at the East Central Kansas Experiment Field, Ottawa, on a 1.0 to 1.5 % slope, somewhat poorly drained, Woodson silt loam soil (fine, montmorillonitic, thermic, Abruptic Argiaquolls). This site represents prime farmland in this region of Kansas. The study was a randomized complete block split-plot design with tillage systems as whole plots and fertilizer treatments as subplots. All treatments were replicated three times. The tillage systems evaluated were chisel-disk-field cultivate (chisel in the fall, disk in the early spring, and field cultivate immediately prior to planting); ridge-till (with ridges formed in the fall), and no-till. These tillage systems were established 5 years prior to the start of this study. Superimposed over these tillage systems were three P fertilizer treatments, a P check with no P fertilizer applied, 50 lb/a P_2O_5 surface broadcast, and 50 lb/a P_2O_5 deep-banded (coulter-knifed) at approximately 4-inch depth on 15-inch centers. This rate of P application was for two crops, grain sorghum and the following year's soybean crop. Every-other-year grain sorghum/soybean rotations are common in the watershed. Bray P-1 soil test P at the start of this study was in the medium to high range. Liquid 7-21-7 fertilizer was the source of P for all P fertilizer applications. Surface broadcast P in the chisel-disk-field cultivate system was incorporated with the field cultivation before planting. All runoff data were collected in the sorghum year of the crop rotation on the previous year's soybean stubble. Runoff from five runoff events in 1994, five event in 1995, and six events in 1996, spanning the period before and after P fertilizer application and grain sorghum planting, were collected. This period is considered most susceptible to erosion and P losses. Runoff water from natural rainfall was collected by delimiting 50 square foot areas (5 ft x 10 ft) with metal frames driven approximately 3 inches deep into the ground in each 10 x 50 ft plot. The runoff from within these frames was directed to a sump and then pumped though a series of dividers (five spitters) to reduce the volume and to obtain a composite sample. The volume of runoff from the splitter outlet in which the sample container had not run over was collected and measured. This volume and the splitter calibration factor for that outlet (which was determine by running a known volume of water through the spitter) were used to determine the total amount of runoff volume. Sediment concentration and losses, total P (perchloric acid digestion of unfiltered runoff samples), and soluble P (filtrate from samples through 45 um filters) concentrations and losses in the runoff water were measured in all years. Beginning in 1995, we also analyzed runoff water for bioavailable P (FeO-strip extractable P). This is a relatively new analytical procedure that has been correlated with algae-useable P. Rainfall amounts and dates on which runoff were collected in 1994 were: 0.70 (5-6-94), 2.05 (6-5-94), 1.30 (7-1-94), 1.60 (7-18-94), and 1.10 inches (8-1-94); in 1995: 0.80 (7-4-95), 1.94 (7-20-95), 1.68

(7-31-95), 0.72 (8-3-95), and 1.10 inches (8-15-95); and in 1996 1.75 (5-26-96), 2.45 (6-06-96), 2.02 (6-16-96), 1.85 (7-04-96), 1.28 (7-08-96), and 2.04 inches (7-22-96). According to long-term rainfall information, rainfall amounts were 20% below average during the 1994 sampling period, 20 % above average during the 1995 sampling period, and 38% above average during the 1996 sampling period. The P fertilizer treatments were applied on 21 June 1994, 11 July 1995, and 21 June 1996. Pioneer 8310 grain sorghum was planted in 1994 and 1995, and Pioneer 8500 grain sorghum in 1996.

Results

For brevity of reporting, all data, except for soluble P data for 1995, will be presented as totals of sampling years or as averages over period of years.

Runoff Volume and Soil Loss

The amount of surface water that ran off varied with rainfall events, tillage systems, and years. Generally, most runoff occurred with the largest and most intense rainfall events. However, moisture and infiltration differences between tillage systems preceding the rainfall events also influenced runoff amounts. When totaled across all 1994 samplings and averaged across all fertilizer treatments, runoff was highest with the chisel-disk and ridge-till systems and lowest with no-till (Figure 1). In 1995, runoff was greatest with no-till and ridge-till and lowest with chisel-disk. This was because tillage in the chisel-disk system dried and loosened the soil prior to rainfall events, which increased infiltration and reduced runoff. In 1996, with above-average rainfall, the ridge-till system had the most runoff. These yearly differences in runoff suggest that rainfall timing, intensities, and amounts, as well as differences in infiltration within the tillage systems preceding the rainfall events, interact to affect runoff. When averaged across all sampling years (16 runoff events), the amount of runoff was 18 % of the total rainfall received for the chisel-disk system, 21 % for the ridge-till system, and 18 % for the no-till system, suggesting no significant decrease in runoff volume with conservation tillage compared to chisel-disk for this imperfectly drained soil. This differs from runoff reductions of up to 50 % and more reported with conservation tillage systems in other studies

Soil losses in the runoff water (Figure 2) generally paralleled runoff amounts, but intensity and timing of individual rainfall events also influenced losses. Overall, soil losses in the runoff water were greatest in 1996, when rainfall and runoff amounts were highest. Sediment losses generally followed the pattern chisel-disk > ridge-till > no-till, suggesting that full-width soil loosing and residue incorporation result in greater soil losses than partial (shaving of the ridge at planting in the ridge-till system) or very limited soil and residue disturbance (coulter at planting in no-till). Averaged across all runoff events and years, soil losses for these pre- and postplant periods were 0.76 ton/a for the chisel-disk system, 0.48 ton/a for the ridge-till system, and 0.25 ton/a for the no-till system. These are roughly 40 and 70 % reductions in soil loss , respectively, for the ridge-till and no-till tillage systems, compared to the chisel-disk system. Although these amounts are for only a part of the crop year, all are below the T (tolerance) level of 4 ton/a for this soil.

Phosphorus Losses

Phosphorus losses were influenced by rainfall events, tillage system, fertilizer practices, and years. In 1995, a statistically significant interaction (0.05 level) between tillage systems and P fertilization practices affected soluble and bioavailable P losses. Consequently, main effects of tillage and fertilizer practices for soluble and bioavailable P losses are presented jointly. Total P losses fertilizer practices for soluble and bioavailable P losses are presented jointly. Total P losses when summed across all runoff events for 1994 (Figure 3) were highest with the ridge-till and chisel-disk systems, and lowest for no-till. These differences generally paralleled soil losses. In 1995, losses of total P were reduced and were higher with no-till and ridge-till compared to chisel-disk. This was because of less runoff volume in the chisel-disk system, resulting in lower soil and total P losses. Total P losses in 1996 were highest with chisel-disc, intermediate for ridge-till, and lowest for no-till. This corresponds again with the amount of soil loss. The effects of the P fertilizer practices on losses of total P were not statistically significant for any year (data not shown). However, some evidence indicated that surface applied P may have been causing some increase in total P losses.

Losses of soluble P were not affected by the tillage and P fertilizer treatments in 1994. In 1995, losses of soluble P varied across tillage systems and interacted with P fertilizer treatments (Table 4). The first event after P application in 1994 resulted in only 0.01 inch of runoff, whereas the first event after P application in 1995 produced 0.40 inches of runoff. Also, in 1994, 0.03 inches of rain fell between P application and first runoff. In 1995, no measurable rainfall occurred between P application and the first runoff. In 1996, two showers (0.07 and 0.24 inches) occurred between P application and the first event, which produced 0.31 inch of runoff. In 1996, as in 1995, both tillage and P fertilizer treatments caused significant differences in soluble and bioavailable P losses, but no significant interaction between tillage systems and fertilizer treatments affected P losses in 1996. Soluble P losses averaged across all years and across all runoff events are shown in Figure 4. In the chisel-disk system, where broadcast P was incorporated by field cultivation before planting, increased losses of soluble P were negligible compared to those with no P fertilizer application. In the ridge-till system, where the broadcast P fertilizer was applied on the soil surface and was covered partially by the shaving of the ridge at planting, losses of soluble P increased moderately compared to no P fertilizer application. In the no-till system, where nearly all of the broadcast P was left exposed on the soil surface, soluble P losses increased nearly sevenfold compared to no P fertilizer applied. Knifed P, on the other hand, had negligible effects on increased soluble P losses compared to no P application in all tillage systems. The 1995 soluble P data (Table 4) also show that the losses of soluble P in runoff for no-till and ridge-till were highest for broadcast P in the first runoff event (7-20-95) after P application and diminished with successive runoff events. Because losses of soluble P and total P in runoff do not indicate exclusively algae-useable P, bioavailable P tests for algae-useable P in runoff water have been developed. Comparisons of the FeO-strip bioavailable P losses (Figure 5) with total P and soluble P losses (Figures 3 and 4) show a strong relationship with soluble P losses. This suggests that for this soil type and landscape, substantial bioavailable P losses were associated with soluble P losses.

Grain Yield

Grain yield in 1994 was not affected by tillage or the P fertilizer treatments. In 1995 and 1996, deep-banded P produced an average grain sorghum yields 8 bu/a higher than that with broadcast P. This should be an incentive for crop poducers to adopt deep-banded P fertilization practices.

Conclusions

These data suggest that on minimum slope, imperfectly drained soils, conservation tillage systems, especially no-till, can reduce soil and sediment forms of P losses but can have quite variable effects on soluble and bioavailable (algae-useable) P losses, depending on how the P fertilizer is applied. If P fertilizer is broadcast and left on the surface of the soil, the chance for losses of soluble P is increased. If the P fertilizer is subsurface applied, then soluble P losses are minimal compared to those with no P fertilizer application. Our work also suggests that switching from full-width tillage systems like chisel-disk-field cultivate to conservation tillage systems must be accompanied by practices that place P fertilizers below the soil surface, or algae useable P (bioavailable P) in runoff actually may increase.

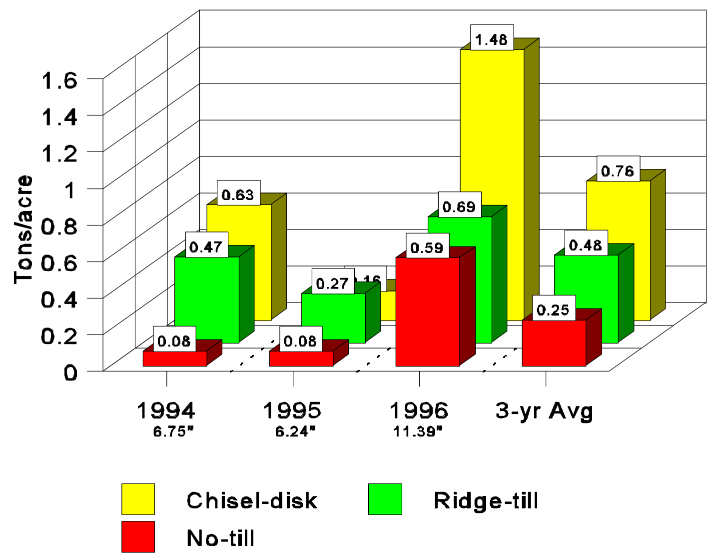


Figure 2. Soil losses as influenced by tillage and rainfall in 3 years, Ottawa, KS.

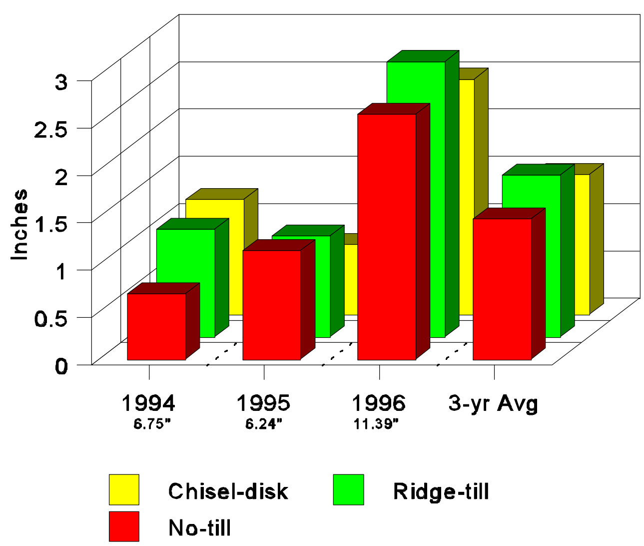


Figure 1. Amount of runoff as influenced by tillage and rainfall in 3 years, Ottawa, KS..

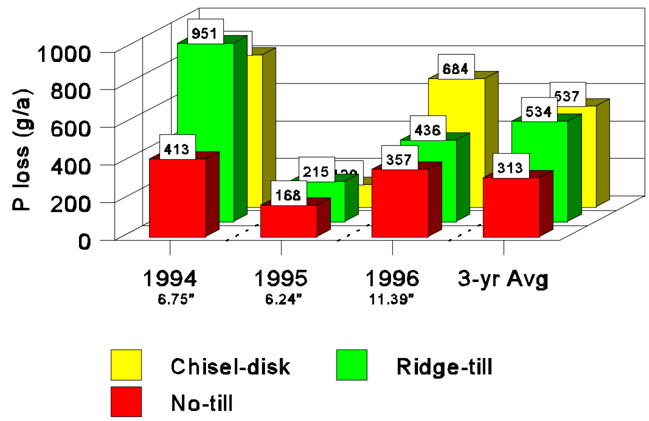


Figure 3. Total P losses as influenced by tillage and rainfall in 3 years, Ottawa, KS.

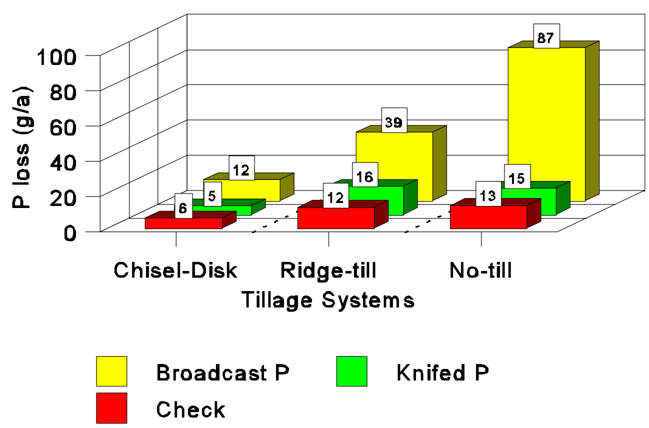


Figure 4. Soluble P losses as influenced by tillage and P rate/placement (3-year average), Ottawa, KS..

Table 4. Soluble P losses in surface water runoff as influenced by tillage and P rate/placement, Ottawa, KS.

		Date of Runoff Water Collection and Rainfall Amount					
		7-4-95	7-20-95	7-31-95	8-3-95	8-15-95	
Tillage System	Fertilizer tmt.	0.80"	1.94"	1.68"	0.72"	1.10"	'95 Total
				g/a			
Chisel-disk, fld. cult.	P Check	0.0	2.9	2.2	1.4	0.4	6.8
Chisel-disk, fld. cult.	50 lb/a P_2O_5 BC	0.0	3.8	4.5	2.5	0.3	11.0
Chisel-disk, fld. cult.	50 lb/a P_2O_5 KN	0.0	1.7	2.3	0.7	0.3	5.1
Ridge-till	P Check	0.4	8.6	4.0	2.3	0.5	15.8
Ridge-till	50 lb/a P_2O_5 BC	0.7	45.7	10.6	8.7	1.7	67.4
Ridge-till	50 lb/a P_2O_5 KN	0.4	7.5	5.4	2.3	0.7	16.3
No-till	P Check	0.4	9.4	2.7	1.3	0.2	14.0
No-till	50 lb/a P_2O_5 BC	1.0	129.5	20.6	57.6	2.1	210.7
No-till	50 lb/a P_2O_5 KN	0.5	10.7	4.6	3.1	0.4	19.2
L.S.D. 0.05		0.8	33.0	5.1	7.7	1.2	33.9

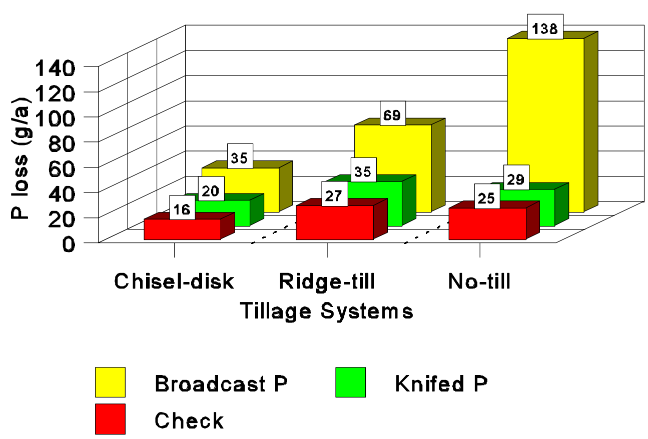


Figure 5. FeO-strip bioavailable P losses as influenced by tillage and P rate/placement (2-year average), Ottawa, KS.

HARVEY COUNTY EXPERIMENT FIELD

Introduction

Research at the Harvey County Experi-ment 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 benefit directly the agricultural industry of the area. Focus is primarily on wheat, grain sorghum, and soybeans, but also includes alternative crops such as corn and oats. Investigations include variety and hybrid performance tests, chemical weed control, tillage methods, fertilizer use, and planting practices, as well as disease and insect resistance and control.

Soil Description

The Harvey County Experiment Field consists of two tracts. The headquarters tract, 75 acres immediately west of Hesston on Hickory St., is all Ladysmith silty clay loam with 0-1% slope. The second tract, located 4 miles south and 2 miles west of Hesston, is comprised of 142 acres of Ladysmith, Smolan, Detroit, and Irwin silty clay loams, as well as Geary and Smolan silt loams. All have 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 run-off 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.

1995-1996 Weather Information

The 1995-1996 growing season will be remembered as one of the harshest on record for winter survival of wheat. Despite dry conditions, stand establishment was nearly normal. However, fall growth was limited by the absence of any meaningful precipitation until mid-December. Dry conditions continued through the winter and early spring, with negligible precipitation from January through April. Several cycles of extreme cold and warm temperatures continued into late March, causing major stand loss in many wheat varieties. Favor-able moisture and temperatures in May and June enabled surviving plants to produce reasonable to excellent wheat yields.

For row crops, above normal rainfall in May followed by wet conditions in early June caused delayed planting. Mid-season rainfall was below normal and resulted in some moisture stress in July. The return of major rainfall events in August was pivotal to the success of row crop production.

The number of days with air temperatures equal to or greater than 99 °F totalled 2, 8, 5, and 3 for May, June, July, and August, respectively. During the July-September period, maximum air temperatures averaged nearly 3 °F below normal, while minimum temperatures were slightly above normal. And, the seasonal total of sorghum Growing Degree Days was slightly above normal. Conditions as a whole were conducive to high row crop yields with little or no lodging. Sorghum and soybeans matured well before the first fall frost on October 18.

Frost occurred last in the spring on April 23 and first in the fall on October 18. This frost-free season of 178 days was about 10 days longer than normal.

Table 1. Monthly precipitation totals,inches - Harvey Co. Experiment Field, Hesston, KS.[1]

Month	N Unit	S Unit	Normal	Month	N Unit	S Unit	Normal
	1995				1996		
October	0.25	0.40	2.55	March	1.59	1.81	2.42
November	0.02	0.01	1.73	April	1.47	2.03	2.71
December	0.94	0.55	1.16	May	6.54	6.13	4.41
				June	3.46	2.98	4.67
	1996			July	1.74	2.58	2.90
January	0.14	0.03	0.67	August	6.22	7.27	3.11
February	0.02	0.01	0.87	September	3.67	3.49	3.63
Twelve-month total					25.81	27.29	30.83
Departure from normal					-4.77	-3.54	

[1] Hairy vetch cover crop experiments as well as weed control investigations in sorghum and soybeans were located at the South Unit. All other experiments reported here were conducted at the North Unit.

GRAIN SORGHUM COLD TOLERANCE

Mark M. Claassen and Paula Bramel-Cox

Introduction

From 1992 to 1994, research with sorghum planting dates at Hesston showed that May planting can increase grain yields significantly when seasonal weather patterns are favorable. Since sorghum typically is planted after spring soil temperatures approach 70 °F, when rapid emergence normally occurs, little information is available about the relative cold tolerance of commercial hybrids. This experiment was initiated to determine how various early and medium maturing hybrids compare in their ability to germinate and grow under cool conditions.

Procedures

Nineteen sorghum hybrids were selected for this study from various sources based on maturity and supplier opinion of cold tolerance characteristics. Wheat was grown on the site in 1995. Reduced tillage practices involved use of a V-blade, mulch treader, and field cultivator. The area was fertilized with 90 lb N/a and 30 lb P_2O_5/a broadcast and incorporated in early April. Temik 15G was applied for insect control in furrow with the seed at planting on April 25 (DOP 1) and June 19 (DOP 2). Sorghum was planted about 1 in. deep at three seeds/ft of 30 in. row, or 52,270 seeds/a. Immediately after planting, the area was sprayed with Ramrod 4L + AAtrex 90 DF at 3.8 or 3.5 + 0.5 lb ai/a for weed control. However, some mechanical weeding was done as necessary to maintain control, primarily escaped grasses. Four of the hybrids with significant lodging in the April planting were hand harvested on August 23. The remaining hybrids in DOP 1 were harvested on September 9. All hybrids in DOP 2 were harvested on October 25.

Results

Soil temperature reached or exceeded 70 °F for 5.5 hours at seed depth on April 26 but returned to a range of 39 to 65 °F throughout the remainder of the month. During the first four days of May, soil warmed to an average of 64 °F, and a daily average of 7 hours at or above 70 °. This period coupled with unseasonably high temperatures on May 7 - 9 caused most sorghum to emerge before mid-May. Following the second date of planting, average daily soil temperatures were mostly above 80 °F.

In DOP 1, sorghum populations on May 11 averaged 35,500 plants/a or 68% of the planting rate. Final populations on May 24 only increased to 38,300 plants/a, i.e, 73% of the number of seed planted. Plant vigor scores on May 24 were slightly higher than on May 11, reflecting warmer temperatures. However, a notably cooler trend followed, which stressed sorghum at the end of the month. NC+ 6B50 consistently had highest plant populations and plant vigor ratings in DOP 1 (Table 2).

DOP 2 sorghum was affected by soil crusting after a hard rain on June 23. At 10 days after this planting, the average population was 33,385 plants/a, i.e., 64% of the planting rate. Only a slight increase of 4% occurred at 20 days after planting. Sorghum hybrids in DOP 2 reached an average maximum population of 34,754 plants/a on July 9. NC+ 6B50, NC+ 5C35 and ICI 5616 had highest stand percentages. These hybrids also had highest plant vigor ratings, which did not differ significantly from six other hybrids.

Early planting increased the average length of time from planting to half-bloom stage by nearly 20 days. Casterline SR 305, Greenbush GB5543-E, and Richardson Sprint E had very large lodging percentages, while most of the remaining hybrids had little or no lodging in DOP 1. No significant lodging occurred in DOP 2.

Sorghum yields averaged 79.1 bu/a for DOP 1 and 98.1 bu/a for DOP 2. Pioneer 8505, Mycogen 1506, and NC+ 6B50 had . the highest yields (87.5 bu/a avg.) in DOP 1 not differing significantly from that of various other hybrids. Those with yields in the top LSD group had an average early vigor score slightly higher than the remaining entries, but early vigor scores did not correlate consistently with yields. Bird damage was minor. In DOP 2, NC+ 6B50 did not attain the top yield group of Pioneer 8500, Pioneer 8505, Mycogen 1506, and ICI 5616, which averaged 119.3 bu/a

Table 2. Early planting effects on grain sorghum, Hesston, KS, 1996.

Sorghum Brand Hybrid	Grain Yield	Test Wt	Plant Vigor	Plant Population May 11	Plant Population May 24	Half Bloom[3]	Plant Ht	Lodg-ing
	bu/a[1]	lb/bu	score[2]	------1000's------		days	in	%
Casterline SR 305	77.7	55.8	3.6	30.2	34.6	71	43	41
DeKalb DK-36	83.2*	58.2	3.0	38.9	43.6	76	42	2
DeKalb DK-38y	73.4	55.5	3.3	29.1	33.0	75	38	1
Delange DSA 117	75.6	57.0	3.0	32.8	34.9	76	37	3
Golden Harvest H-338WC	68.6	57.3	2.9	39.3	42.2	76	39	11
Golden Harvest H-403	71.8	58.8	2.9	36.2	38.6	74	39	5
Greenbush GB5543-E	72.0	57.3	2.9	39.1	40.0	71	46	77
ICI 5616	85.2*	57.8	2.8	39.9	42.5	74	40	3
Mycogen 1482	81.4*	57.8	3.3	28.5	31.7	77	40	0
Mycogen 1506	87.3*	59.1	3.2	29.3	33.0	80	49	0
Mycogen T-E Hardy	78.0	58.6	3.1	36.7	38.1	79	39	0
NC+ 5C35	76.4	55.8	3.2	37.2	41.1	68	38	3
NC+ 6B50	87.0*	57.4	2.5	43.4	46.5	76	42	4
N. King KS-555Y	76.0	58.0	3.0	41.4	42.5	76	41	10
Pioneer 8500	83.1*	58.6	2.8	37.0	38.3	75	44	5
Pioneer 8505	88.2*	59.0	3.0	35.8	38.6	75	43	3
Pioneer 8699	85.6*	57.5	3.5	32.4	37.8	73	41	4
Pioneer 8925	76.4	57.4	3.2	37.8	39.2	66	39	1
Richardson Sprint E	78.5*	57.3	3.0	36.8	39.2	72	47	59
Triumph TR 459	78.8*	58.8	3.3	28.4	30.4	78	39	0
LSD .05	9.7	0.80	0.2	3.8	2.5	0.9	2	9

[1] Average of four replications adjusted to 12.5% moisture.
[2] Rated May 11 on a scale of 1 to 5: 1 is best and 5 is poorest.
[3] Days from planting to 50% bloom.

Table 3. June planting effects on grain sorghum, Hesston, KS, 1996.

Sorghum Brand Hybrid	Grain Yield	Test Wt	Plant Vigor	Plant Population June 29	 July 9	Half Bloom[3]	Plant Ht	Lodg- ing
	bu/a[1]	lb/bu	score[2]	------1000's------		days	in	%
Casterline SR 305	99.8	57.8	2.6	37.1	38.2	49	46	0
DeKalb DK-36	92.7	59.1	2.9	28.1	29.5	55	41	0
DeKalb DK-38y	72.9	57.6	3.0	22.8	25.0	56	39	0
Delange DSA 117	59.6	56.8	2.9	25.0	26.6	53	37	0
Golden Harvest H-338WC	89.9	59.4	2.2	30.2	32.6	57	41	0
Golden Harvest H-403	95.5	59.7	2.2	31.8	32.3	51	40	0
Greenbush GB5543-E ICI	94.9	60.0	2.2	33.3	33.5	51	48	0
5616	116.4*	59.1	1.8	41.9	42.5	58	42	0
Mycogen 1482	100.6	58.8	2.5	31.4	33.4	57	40	0
Mycogen 1506	117.2*	59.4	2.8	26.4	26.8	62	53	0
Mycogen T-E Hardy	99.8	59.7	2.4	37.3	38.8	59	40	0
NC + 5C35	82.5	59.4	1.9	40.0	41.1	50	40	0
NC + 6B50	106.3	59.2	1.6	41.7	41.3	53	43	0
N. King KS-555Y	104.0	59.9	2.5	32.0	33.1	59	43	0
Pioneer 8500	124.6*	60.3	2.2	33.3	34.2	56	44	0
Pioneer 8505	118.8*	60.4	1.9	36.7	38.3	55	43	0
Pioneer 8699	106.1	59.8	2.6	35.0	37.7	50	42	0
Pioneer 8925	61.5	57.4	2.8	35.4	37.2	47	38	3
Richardson Sprint E	108.7	59.5	1.8	34.7	35.5	52	49	0
Triumph TR 459	107.9	59.8	2.5	32.9	36.4	60	42	0
LSD .05	11.3	0.75	0.6	2.8	3.0	1	1	NS

[1] Average of four replications adjusted to 12.5% moisture.
[2] Rated June 29 on a scale of 1 to 5: 1 is best and 5 is poorest.
[3] Days from planting to 50% bloom.

GAUCHO SEED TREATMENT EFFECT ON GRAIN SORGHUM

Mark M. Claassen

Introduction

Chinch bug infestations vary considerably both regionally in south central Kansas as well as locally in proximity to winter wheat fields. Use of a planting-time treatment for chinch bug control usually is not considered viable for early-planted grain sorghum because of insecticide dissipation by the time that chinch bugs migrate from wheat to sorghum. On the other hand, in early sorghum, a planting-time insecticide may be justified because of the potential for wire worm damage associated with slower germination and emergence. For sorghum planted in the conventional range of dates in June, use of a planting time insecticide can be more effective for chinch bug control than postemergence foliar insecticide application when adequate soil moisture is present for insecticide uptake by sorghum. The loss of granular Furadan for sorghum has further reduced the number of insecticide options for sorghum at planting. Research at Hesston was conducted to determine the effect of Gaucho seed-treatment fungicide on plant populations, early plant vigor, and yield of sorghum planted very early as well as at a conventional time in an environment where light chinch bug populations were present.

Procedures

Five sorghum hybrids with Gaucho treated and untreated seed from the same seed lot were planted at early (April 26) and conventional (June 19) dates. A sixth hybrid was added to the June planting. Temik 15 G in furrow at planting also was included as a treatment with two hybrids (Tables 4,5).

The experiment site had been cropped continuously to sorghum. Reduced tillage practices were used for seedbed preparation. Fertilizer and herbicide applications as well as planting rates were the same as those noted for the preceding sorghum cold tolerance experiment. Harvesting was completed September 6 and October 25 for sorghum in the early and conventional planting dates.

Results

In the April planting, there was no consistent effect of Gaucho on early plant populations, plant vigor, or final stands. Also, there was no interaction between hybrids and Gaucho seed treatment. Lodging ranged from 0 to 7%, and had no relationship with treatments. Gaucho was associated with a slight increase in the number of heads/plant as well as an average yield increase of 7 bu/a. Mycogen 1552 and NC+ 271 had largest yield increases of 10.8 and 12.4 bu/a. Temik significantly increased the yield of Pioneer 8500, whereas Gaucho did not. Gaucho had no effect on sorghum test weight.

Hard rainfall 4 days after the June planting caused soil crusting. At 10 days after that planting, Gaucho treated sorghum had an average increase of 6,300 plants/a. Most of this increase was still observed at 20 days after planting. Early plant vigor was slightly greater for Gaucho treated than for untreated sorghum. There was no treatment effect on maturity, heads/plant, or test weight, and no lodging. However, large yield increases in the range of 15 to 21 bu/a occurred with Gaucho treated DeKalb DK-56, Mycogen 1552, and NC+ 271. The average yield increase with Gaucho for all hybrids was 11.7 bu/a.

Table 4. Gaucho and early planting effects on grain sorghum, Hesston, KS, 1996.

Sorghum Brand Hybrid	Insecticide[1]	Grain Yield	Test Wt	Plant Vigor	Plant Population May 11	Plant Population May 22	Half Bloom	Heads/ Plant
		bu/a	lb/bu	score[2]	------1000's/a-----		days[3]	
Cargill 607E	None	56.4	57.4	3.6	29.3	36.1	76	1.3
Cargill 607E	Gaucho	54.8	58.1	3.5	28.0	35.4	75	1.3
DeKalb DK-56	None	65.4	58.0	3.4	24.8	27.9	85	1.4
DeKalb DK-56	Gaucho	71.8	58.1	3.3	25.3	29.4	84	1.3
Mycogen 1552	None	58.4	58.7	3.9	21.9	25.6	83	1.6
Mycogen 1552	Gaucho	69.2	58.7	4.0	21.0	23.7	82	1.9
Mycogen 1506	None	66.8	58.8	3.2	26.7	28.9	80	1.6
Mycogen 1506	Temik	72.5	58.8	3.1	29.0	30.9	79	1.5
Pioneer 8500	None	59.2	58.1	2.8	36.6	38.6	75	1.4
Pioneer 8500	Gaucho	66.0	58.5	3.0	32.2	35.6	74	1.7
Pioneer 8500	Temik	70.5	58.5	2.6	40.0	41.4	74	1.4
NC+ 271	None	58.1	57.5	3.1	33.5	36.4	82	1.1
NC+ 271	Gaucho	70.5	57.6	2.9	32.8	36.1	82	1.2
LSD .05		9.2	0.68	0.3	3.2	3.1	1	0.18
Main effect means[4]:								
Hybrid								
Cargill 607E		55.6	57.7	3.5	28.6	35.7	75	1.3
DeKalb DK-56		68.6	58.1	3.3	25.0	28.6	84	1.4
Mycogen 1552		63.8	58.7	3.9	21.5	24.6	82	1.7
Pioneer 8500		62.6	58.3	2.9	34.4	37.1	74	1.5
NC+ 271		64.3	57.5	3.0	33.1	36.2	82	1.2
LSD .05		7.1	0.6	0.2	2.5	2.4	0.7	0.14
Insecticide								
None		59.5	57.9	3.3	29.2	32.9	80	1.4
Gaucho		66.5	58.2	3.3	27.9	32.0	79	1.5
LSD .05		4.5	NS	NS	NS	NS	0.4	0.09

[1] Seed treated with Gaucho 480 at 8 fl oz/cwt. Temik 15 G applied in furrow at 7 lb/a.
[2] Visual rating May 11 on a scale of 1 to 5: 1 is best and 5 is poorest.
[3] Days from planting to half bloom.
[4] Main effect means compared only for hybrids having same seed lot with and without Gaucho.

Table 5. Gaucho and June planting effects on grain sorghum, Hesston, KS, 1996.

Sorghum Brand Hybrid	Insecticide[1]	Grain Yield	Test Wt	Plant Vigor	Plant Population June 29	Plant Population July 9	Half Bloom	Heads/ Plant
		bu/a	lb/bu	score[2]	------1000's/a-----		days[3]	
Cargill 607E	None	84.2	58.8	2.7	30.6	33.0	60	1.2
Cargill 607E	Gaucho	91.5	58.9	2.5	35.8	37.3	59	1.3
DeKalb DK-56	None	81.2	57.8	2.9	24.6	28.5	68	1.1
DeKalb DK-56	Gaucho	96.8	58.1	2.8	32.8	35.8	68	1.1
Mycogen 1552	None	94.8	59.2	2.7	28.2	30.4	63	1.2
Mycogen 1552	Gaucho	110.1	59.1	2.0	32.7	35.4	63	1.3
Mycogen 1506	None	82.6	58.6	2.4	21.5	22.7	63	1.4
Mycogen 1506	Temik	116.8	59.0	2.4	32.7	35.2	63	1.3
Pioneer 8500	None	102.8	60.2	2.6	29.8	32.2	59	1.4
Pioneer 8500	Gaucho	106.6	60.2	1.7	39.6	40.0	58	1.3
Pioneer 8500	Temik	98.1	60.4	2.0	38.8	40.6	58	1.3
Pioneer 8505	None	101.7	59.8	2.3	34.3	37.0	57	1.2
Pioneer 8505	Gaucho	109.3	60.2	1.6	41.3	42.1	57	1.3
NC+ 271	None	79.4	58.3	2.6	26.0	27.4	64	1.1
NC+ 271	Gaucho	100.3	59.0	2.7	29.2	32.0	64	1.2
LSD .05		10.9	0.65	0.4	4.0	4.2	1.3	0.13
Main effect means[4]:								
Hybrid								
Cargill 607E		87.8	58.8	2.6	33.2	35.2	59	1.2
DeKalb DK-56		89.0	57.9	2.9	28.7	32.1	68	1.1
Mycogen 1552		102.5	59.2	2.4	30.5	32.9	63	1.2
Pioneer 8500		104.7	60.2	2.1	34.7	36.1	58	1.4
Pioneer 8505		105.5	60.0	1.9	37.8	39.5	57	1.2
NC+ 271		89.9	58.7	2.6	27.6	29.7	64	1.2
LSD .05		6.3	0.49	0.3	2.2	2.3	0.95	0.09
Insecticide								
None		90.7	59.0	2.6	28.9	31.4	62	1.2
Gaucho		102.4	59.2	2.2	35.2	37.1	61	1.2
LSD .05		3.6	NS	0.2	1.3	1.3	NS	NS

[1] Seed treated with Gaucho 480 at 8 fl oz/cwt. Temik 15 G applied in furrow at 7 lb/a.
[2] Visual rating June 29 on a scale of 1 to 5: 1 is best and 5 is poorest.
[3] Days from planting to half bloom.
[4] Main effect means compared only for hybrids having same seed lot with and without Gaucho.

EFFECTS OF HAIRY VETCH WINTER COVER CROP TERMINATION DATE AND NITROGEN RATES ON GRAIN SORGHUM[1]

Mark M. Claassen

Introduction

Interest in the use of legume winter cover crops has been rekindled by concerns for soil and water conservation, dependency on commercial fertilizer, and maintenance of soil quality. Hairy vetch is a good candidate for the cover crop role because it can be established in the fall when water use is reduced, it has winterhardiness, and it can fix substantial nitrogen (N). This experiment was conducted to investigate the effect of hairy vetch and N fertilizer rates on the supply of N to the succeeding grain sorghum crop as well as to assess sorghum yield response when the vetch is terminated at different time intervals ahead of sorghum planting.

Procedures

The experiment was established on a Geary silt loam soil on which unfertilized winter wheat was grown in 1995. Detailed soil sampling was done in the fall prior to vetch planting to establishment soil nutrient and moisture status. Additional soil sampling was done at vetch termination and grain sorghum planting as well as at the end of the season.

Reduced tillage practices with a disk and field cultivator were used to control weeds and prepare a seedbed. Hairy vetch plots were roller harrowed and planted at 15 lb/a in 8 in. rows with a grain drill equipped with double-disk openers on September 15, 1995.

Rainfall shortly after planting favored hairy vetch fall stand establishment. Volunteer wheat was controlled by a mid-October application of Fusilade + crop oil concentrate (2 oz ai/a + 1% v/v). Fall, winter, and early spring months were very dry. Consequently, hairy vetch had too little growth to merit termination in early April, the first target date. Subsequent wet weather delayed initial termination by disking until May 20 (DOT 1). Hairy vetch in a second set of plots was terminated in like manner on June 11 (DOT 2), about 5 weeks later than intended.

Vetch forage yield was determined by harvesting a 1 meter^2 area in respective plots on May 16 and June 11. Nitrogen fertilizer was broadcast as ammonium nitrate on specified plots before the last preplant tillage on June 14. Pioneer 8505 grain sorghum treated with Concep III safener and Gaucho insecticide was planted at approximately 42,000 seeds/a on June 14. Weeds were controlled with preemergence application of Microtech + atrazine (2.5 + 0.25 lb ai/a). Grain sorghum was combine harvested on October 27.

Results

Initial soil nitrate N and available P averaged 36 lb/a and 51 lb/a, respectively, with an organic matter level of 2.8%. Hairy vetch provided adequate late fall ground cover

[1]This project was funded partially by a USDA (SARE) grant through the Kansas Rural Center.

(40%) to provide protection from soil erosion (Table 6)

Rainfall in late April and early May allowed hairy vetch to develop considerable growth. At DOT 1, vetch was about 21 in. tall and had reached 20 to 30% bloom stage. It ranged from late bloom to early seed formation stages at DOT 2. Average hairy vetch dry matter yield was just under 2 tons/a at DOT 1 and nearly 2.5 tons/a at DOT 2. The average N content was 2.73% and 2.62%, respectively. Consequently, the average potential amount of N to be mineralized for use by the sorghum crop was 105 to 127 lb/a.

Disking to terminate hairy vetch growth reduced soil moisture at the surface, particularly in DOT 2. Sorghum stands averaged about 8,000 plants/a less in DOT 2 than in DOT 1 or no-vetch plots (Table 7). Whole-plant N content at the 6-leaf stage was highest for sorghum after vetch in DOT 2 and reflected some response to N rate in the absence of a prior vetch cover crop. Leaf N at boot to early heading stage tended to be highest at the highest N rates, but without significance in all cases. Sorghum following vetch required 2 to 4 days longer to reach half bloom than sorghum without a preceding cover crop. Averaged over N rates, sorghum yields were 6 to 12 bu/a lower after vetch than where no cover crop had been grown. This negative effect of hairy vetch was accounted for by adjusting sorghum yields for soil P removal by vetch. Yields tended to increase with N rate in sorghum after vetch, mainly at the 60 lb/a. However, the N rate effect on sorghum with no preceding cover crop was not significant.

Table 6. Initial soil test values, hairy vetch fall ground cover, and hairy vetch yield at spring termination, Hesston, KS, 1996.

Cover Crop/ Termination	N Rate[1]	Initial Soil NO_3-N[2]	Avail. Soil P	Soil Organic Matter	Fall Ground Cover[3]	Hairy Vetch[4] Yield	N	P
	lb/a	lb/a	lb/a	%	%	ton/a	lb/a	lb/a
None	0	50	52	2.9	--	--	--	--
	30	33	55	3.0	--	--	--	--
	60	33	51	2.8	--	--	--	--
	90	34	51	2.7	--	--	--	--
Vetch-May 20	0	33	57	3.1	41	2.03	114	11.98
	30	35	43	2.6	40	1.77	87	.5
	60	39	51	2.9	41	1.95	111	12.9
	90	31	47	2.7	37	1.95	108	11.6
Vetch-June 11	0	35	47	2.7	36	2.22	115	12.7
	30	37	50	2.8	36	2.43	114	12.7
	60	39	49	2.9	42	2.52	135	14.8
	90	40	53	3.0	42	2.62	145	17.6
LSD .05		NS	NS	NS	NS	0.54	33	5.8
Means: Cover Crop/ Termination								
None		37	52	2.8	--	--	--	--
Vetch-May 20		36	50	2.8	40	1.92	105	11.2
Vetch-June 11		36	50	2.8	39	2.45	127	14.4
LSD .05		NS	NS	NS	NS	0.27	17	2.9
N Rate								
0		39	52	2.9	39	2.12	115	12.3
30		35	49	2.8	38	2.10	101	10.6
60		37	50	2.9	41	2.23	123	13.8
90		35	50	2.8	39	2.28	127	14.6
LSD .05		NS	NS	NS	NS	NS	NS	NS

[1] N applied as 34-0-0 June 14, 1996.
[2] Mean nitrate nitrogen (0 - 2'), available P (0-6") and organic matter (0-6") on Sept. 1, 1995, 14 days before hairy vetch planting.
[3] Vetch cover estimated by 6" intersects on one 40' diagonal line transect per plot on November 20, 1995.
[4] Oven dry weight as well as N and P content determined just prior to respective vetch terminations.

Table 7. Effect of hairy vetch termination date and N rate on nutrient uptake, maturity, and yield of grain sorghum, Hesston, KS, 1996.

Cover Crop/ Termination	N Rate[1]	Stand	Plant N[2]	Leaf N[3]	Leaf P[3]	Half Bloom	Grain Yield[5]	Adjusted Grain Yield[6]
	lb/a	1000's/a	%	%	%	days[4]	bu/a	bu/a
None	0	36.6	3.73	2.69	0.334	57	118	115
	30	36.4	4.03	2.79	0.342	56	125	116
	60	35.3	3.83	2.85	0.347	56	121	113
	90	35.2	3.98	2.91	0.357	56	127	120
Vetch-May 20	0	36.5	3.73	2.57	0.316	58	103	103
	30	36.4	3.72	2.67	0.320	59	111	112
	60	35.6	3.79	2.70	0.329	57	118	122
	90	35.9	3.85	2.64	0.319	59	113	114
Vetch-June 11	0	29.7	3.96	2.57	0.311	64	104	107
	30	29.5	3.98	2.59	0.312	63	109	113
	60	28.9	4.10	2.76	0.327	61	123	128
	90	23.6	4.00	2.72	0.330	61	111	119
LSD .05		2.8	0.16	0.19	0.023	3.2	13.1	13.1
Means: Cover Crop/ Termination								
None		35.9	3.89	2.81	0.345	56	123	116
Vetch-May 20		36.1	3.78	2.65	0.321	58	111	113
Vetch-June 11		27.9	4.00	2.66	0.320	62	117	117
LSD .05		1.4	0.08	0.09	0.011	1.6	6.6	NS
N Rate								
0		34.3	3.81	2.61	0.320	59	108	109
30		34.1	3.91	2.68	0.325	59	115	114
60		33.3	3.91	2.77	0.334	58	120	121
90		31.5	3.94	2.76	0.335	59	117	118
LSD .05		2.0	0.09	0.11	0.013	NS	7.6	7.6

[1] N applied as 34-0-0 June 14, 1996.
[2] Whole-plant N content at 6-leaf stage adjusted for variation in initial soil N and P.
[3] Leaf N and P at late boot to early heading stage adjusted for variation in initial soil N and P.
[4] Days from planting to half bloom.
[5] Grain yield adjusted to 12.5% moisture and constant initial soil N and P.
[6] Grain yield adjusted for moisture and vetch soil P removal.

RESIDUAL EFFECT OF HAIRY VETCH WINTER COVER CROP, SPRING TILLAGE, AND N RATE ON NO-TILL WHEAT AFTER GRAIN SORGHUM

Mark M. Claassen

Introduction

Hairy vetch can be used as a winter cover crop to provide protection against soil erosion and contribute nitrogen to succeeding crops. It can be propitiously grown in a wheat-grain sorghum rotation by establishment in the fall after wheat harvest. Termination of the vetch in the spring allows grain sorghum to be planted in a normal June time frame. This experiment was conducted to investigate the residual effect of hairy vetch seeding rate, method of spring termination, and N rate on the supply of N to no-till winter wheat planted shortly after sorhgum harvest as well as to assess wheat yield response.

Procedures

Hairy vetch was established on a Smolan silt loam soil in early October of 1994 following spring oats. A grain drill with double disk openers on 7 in. spacing was used to seed the vetch at 25 and 40 lb/a. Volunteer oats were eliminated by an early November application of Fusilade + crop oil concentrate (2 oz ai/a + 1% v/v). Spring termination of hairy vetch was delayed by cool and wet conditions. Vetch forage yield was determined by harvesting a 1 $meter^2$ area in each plot on June 7. The entire site was then sprayed with Roundup + 2,4-D_{LVE} + Pen-A-Trate II nonionic surfactant (0.375 + 0.71 lb ae/a + 0.5%). Nitrogen fertilizer was broadcast as ammonium nitrate on specified plots prior to tillage (disk, roller harrow) later in June after some soil drying had occurred. Pioneer 8500 grain sorghum treated with Concep II safener and Gaucho insecticide was planted at approximately 30,000 seeds/a on June 27, 1995. Temik 15G insecticide at 7 lb/a was applied in the furrow with the seed at planting. Weeds were controlled with preemergence application of Lasso + atrazine (2.0 + 0.5 lb ai/a). Grain sorghum was combine harvested on October 27.

Wheat cultivar 2163 was no-till planted into sorghum stubble at 75 lb/a on November 6, 1995. No fertilizer was applied. Nutrient status of wheat was determined from whole-plant samples of three tillers from six locations within each plot collected when plants were fully headed.

Results

Mid-October rain enabled vetch to emerge slowly, later that month. Fall growth remained rather limited. However, cool wet conditions allowed hairy vetch to develop considerable spring growth. At the time it was controlled with herbicide, vetch was about 22 in. tall and had reached late bloom stage. Hairy vetch production was not affected by seeding rate. Average hairy vetch dry matter yield was 2.54 tons/a with an average N content of 2.62% (Table 8). Consequently, the average potential amount of N to be mineralized for use by the sorghum crop was 133 lb/a. Despite late June planting and an early fall frost, sorghum yields averaged 84 bu/a. However, there were no significant effects of hairy vetch, tillage, or N rate on yield.

Wheat emergence was delayed by late planting and dry conditions. Little or no tillering occurred until spring. An extremely dry winter as well as cyclical periods of warm and cold temperatures caused considerable wheat stress. However, favorable spring moisture and temperatures allowed late tillering to occur and development of reasonable yields under the circumstances. Residual effect of hairy vetch produced an average wheat yield increase of 6.5 bu/a, with no effect of vetch seeding rate. At the zero level of fertilizer N on the previous sorghum crop, vetch increased wheat yield by 7.9 bu/a. Prior tillage system for grain sorghum had no effect on yield of wheat. Residual effect of 50 lb N/a on sorghum improved wheat production by 2.8 bu/a. Whole-plant analysis showed a significant increase of 0.41% N in wheat that followed sorghum after vetch. Residual no-till and N fertilizer effects on plant N content also were significant, but smaller. Similar trends in treatment effects on grain N levels also occurred. Residual effect of vetch on wheat grain represented an increase of 1% protein.

Table 8. Residual hairy vetch cover crop, tillage and N rate effects on no-till wheat after grain sorghum. Hesston, KS, 1996.

Hairy Vetch Seeding Rate[1]	Tillage System[2]	N Rate[3]	Vetch Yield[4] Forage	Vetch Yield[4] N	Grain Yield	Bushel Wt	Plant N[5]	Grain N
		lb/a	ton/a	lb/a	bu/a	lb	---%---	---%---
0	NT	0	----	----	20.9	56.6	1.21	1.87
0	NT	50	----	----	25.6	56.6	1.19	1.88
0	Disk	0	----	----	21.9	56.5	1.02	1.89
0	Disk	50	----	----	22.9	56.8	1.16	1.91
25	NT	0	2.72	149	28.1	56.3	1.45	2.04
25	NT	50	2.19	121	30.2	56.0	1.80	2.19
25	Disk	0	2.61	133	27.2	56.1	1.32	2.01
25	Disk	50	2.59	144	31.1	55.8	1.47	2.07
40	NT	0	2.63	125	29.4	56.4	1.55	2.08
40	NT	50	2.42	135	30.9	56.1	1.77	2.19
40	Disk	0	2.74	139	27.1	55.9	1.44	1.98
40	Disk	50	2.44	119	30.6	56.0	1.58	2.05
LSD .05			----	---	5.5	0.7	0.22	0.12
Main Effect Means:								
Seeding Rate								
0			----	----	22.8	56.6	1.14	1.89
25			2.53	137	29.2	56.1	1.51	2.08
40			2.55	130	29.5	56.1	1.59	2.07
LSD .05			NS	NS	2.8	0.4	0.11	0.06
Tillage System								
No Till			2.49	133	27.5	56.3	1.49	2.04
Disk			2.59	134	26.8	56.2	1.33	1.98
LSD .05			----	---	NS	NS	0.09	0.05
N Rate								
0			2.68	137	25.8	56.3	1.33	1.98
50			2.41	130	28.6	56.2	1.49	2.05
LSD .05			----	---	2.3	NS	0.09	0.05

[1] Vetch seeded in the fall of 1994.
[2] Seedbed preparation for sorghum planting (spring of 1995).
[3] N rates applied prior to preceding grain sorghum crop only.
[4] Oven-dry weight and N content determined prior to application of specified N rates.
[5] Whole-plant nutrient concentrations of fully headed wheat.

HERBICIDES FOR WEED CONTROL IN GRAIN SORGHUM

Mark M. Claassen

Introduction

Relatively recent development of two sulfonylurea herbicides, Peak and Permit, has presented sorghum growers with an alternative to major dependency on atrazine for broadleaf weed control. This experiment was conducted to evaluate Peak, Permit, and various herbicide combinations for pigweed control and crop safety in sorghum.

Procedures

Spring oats were grown on the experiment site in 1995. The soil was a Geary silt loam with pH 7.0 and 2.3% organic matter. Fertilizer nitrogen was applied at 87 lb/a as 46-0-0 on April 19. Weed seed was broadcast over the area to enhance the uniformity of weed populations. Mycogen 1482 with Concep III safener and Gaucho insecticide seed treatment were planted at approximately 38,100 seeds/a in 30 in. rows on June 14, 1996. Seedbed condition was excellent. All herbicides were broadcast in 20 gal/a of water, with four replications per treatment (Table 9). Preemergence applications were made shortly after planting with XR8003 flat fan nozzles at 18 psi. Postemergence treatments were applied in the same manner on July 2 to 0.5 to 4 in. pigweeds (a few larger plants) and 7 to 12 in. sorghum. Plots were not cultivated. Crop injury and weed control were rated at various times during the growing season. Sorghum was harvested on November 7 with a modified Gleaner E combine equipped with Hesston Headhunters.

Results

More than 1.5 in. of rain fell 9 days after planting. Very dense redroot pigweed populations developed. Palmer amaranth represented about 15% of the pigweed population in untreated check plots. However, Palmer amaranth density was light and variable over the site. Large crabgrass and green foxtail populations also were light.

Significant crop injury occurred with treatments involving Banvel or 2,4-D (Salvo). Typical symptoms were rolled leaves, leaning plants, or general stress. In most cases, there were minimal effects on yields. Permit caused some reduction in sorghum height, but did not appear to reduce yields.

Dual II, Partner, and Ramrod provided excellent preemergence control of green foxtail and large crabgrass, but had little effect on pigweeds. All herbicide treatments for broadleaf weeds provided excellent control of redroot pigweeds, and usually slightly less control of Palmer amaranth. Atrazine + COC as well as Permit at 0.031 lb a.i./a postemergence following Ramrod preemergence were least effective on Palmer amaranth. There were no apparent Peak or Permit rate effects on weed control.

All herbicide treatments improved sorghum yield significantly. Increases ranged from 13 to 70 bu/a. A majority of the treatments resulted in yields not differing significantly from the hand-weeded check. Test weights were high. Significant reduction in test weight was noted primarily with Dual II and Partner alone. There was no lodging.

Table 9. Herbicide effects on weeds and grain sorghum, Hesston, KS, 1996.[1]

Herbicide Treatment[2]	Rate lb ai/a	Timing[3]	Inj. 7/11	Weed Control[4] Rrpw 10/9	Paam 10/9	Grft 10/9	Lacg 10/9	Yield[5]
			%	%	%	%	%	bu/a
1 Dual II	1.5	Pre	0	37	1	100	100	62
2 Bicep II Lite	3.0	Pre	0	100	--	100	99	110
3 Bullet	2.75	Pre	0	98	--	99	100	110
4 Lariat	2.75	Pre	0	100	--	100	100	105
5 Partner	1.50	Pre	0	39	--	100	100	67
6 Ramrod + Atraz	3.0 + 1.0	Pre	0	99	100	99	99	116
7 Guardsman	2.8	Pre	0	100	--	100	100	106
8 Dual II Peak + COC	1.5 0.0178 + 1.0 qt	Pre Post	0	100	94	100	99	113
9 Dual II Peak + COC	1.5 0.0268 + 1.0 qt	Pre Post	0	100	95	99	100	105
10 Dual II Peak + COC	1.5 0.0356 + 1.0 qt	Pre Post	2	100	96	100	100	116
11 Dual II Peak + Atraz + COC	1.5 0.0178 + 0.75 + 1.0 qt	Pre Post	0	100	99	100	100	119
12 Dual II Peak + Banvel + NIS	1.5 0.0178 + 0.25 + 0.25%	Pre Post	25	100	97	99	99	107
13 Ramrod Peak + NIS	3.0 0.0268 + 0.25%	Pre Post	1	100	98	99	99	105
14 Partner Permit + NIS	1.5 0.031 + 0.25%	Pre Post	8	98	96	100	100	112
15 Partner Permit + NIS	1.5 0.047 + 0.25%	Pre Post	9	100	98	100	99	109
16 Partner Permit + NIS	1.5 0.062 + 0.25%	Pre Post	10	99	97	98	100	111
17 Partner Permit + Salvo + NIS	1.5 0.031 + 0.125 + 0.25%	Pre Post	5	100	99	100	100	109
18 Partner Permit + Salvo + NIS	1.5 0.031 + 0.25 + 0.25%	Pre Post	11	100	100	100	100	112
19 Partner Permit + Banvel + NIS	1.5 0.031 + 0.125 + 0.25%	Pre Post	10	100	--	100	99	117
20 Partner Permit + Banvel + NIS	1.5 0.031 + 0.25 + 0.25%	Pre Post	21	100	92	100	99	117

(Continued)

Table 9. Herbicide effects on weeds and grain sorghum, Hesston, KS, 1996.[1]

Herbicide Treatment[2]	Rate lb ai/a	Timing[3]	Inj. 7/11	Weed Control[4] Rrpw 10/9	Paam 10/9	Grft 10/9	Lacg 10/9	Yield[5]
			%	%	%	%	bu/a	lb/bu
21 Partner	1.5	Pre						
Permit + Buctril + NIS	0.031 + 0.125 + 0.25%	Post	5	99	93	100	99	103
22 Partner	1.5	Pre						
Permit + Buctril + NIS	0.031 + 0.25 + 0.25%	Post	4	99	94	100	100	111
23 Partner	1.5	Pre						
Permit + Atraz + COC	0.031 + 0.75 + 1.0 qt	Post	4	100	--	100	100	115
24 Ramrod	3.0	Pre						
Permit + NIS	0.031 + 0.25%	Post	7	99	89	100	98	109
25 Partner	1.5	Pre						
Salvo (2,4-D)	0.5	Post	20	100	--	100	100	110
26 Partner	1.5	Pre						
Banvel	0.25	Post	18	99	--	100	100	110
27 Shotgun	0.81	Post	15	98	--	97	91	98
28 Marksman	0.8	Post	25	98	--	94	92	108
29 Atrazine + COC	1.0 + 1.0 qt	Post	0	97	85	98	95	112
30 Buctril/Atraz	0.94	Post	2	95	94	100	92	107
31 Hand Weed			0	0	0	0	0	119
32 No Herbicide			0	0	0	0	0	49
LSD .05[6]			2	6	6	2	5	12

[1] This research was partially supported by CIBA and Monsanto.

[2] Formulations: AAtrex 90 DF, Banvel 4 SC, Bicep II Lite 4.9 SC, Buctril/Atrazine 3 F, Bullet 4 F, Dual II 7.8 EC, Guardsman 5 SC, Marksman 3.2 F, Lariat 4 EC, Partner 65 DF, Peak 57 WG, Permit 75 DF, Ramrod 4 L, Salvo 5 EC, Shotgun 3.25 F. COC = Farmland Crop Oil Plus crop oil concentrate.
NIS = Pen-A-Trate II nonionic surfactant.

[3] Pre = preemergence to sorghum and weeds on June 14.
Post = postemergence to sorghum 7 to 12" pigweeds 0.5 to 4" on July 2.

[4] Rrpw = redroot pigweed; Paam = palmer amaranth; Grft = green foxtail; and Lacg = large crabgrass.

[5] Adjusted to 12.5% moisture.

[6] Treatments 31 and 32 not included in calculation of LSD's for weed control means.

HERBICIDES FOR WEED CONTROL IN SOYBEANS

Mark M. Claassen

Introduction

Successful soybean production is dependent upon effective weed control. Growers may choose from a number of herbicide options that can accomplish this objective. In recent years number of herbicides available for weed control in soybeans has increased notably. This experiment was conducted to evaluate new herbicides and herbicide combinations for weed control efficacy as well as soybean tolerance.

Procedures

Spring oats were grown on the experiment site in 1995. The soil was a Geary silt loam with pH 7.0 and 2.4% organic matter. Pigweed seed was broadcast prior to the last preplant tillage operation to promote the uniformity of weed populations. Asgrow A4045 STS soybeans were planted at 7 seeds/ft in 30 in. rows on June 17, 1996. Seedbed condition was excellent. All herbicides were broadcast in 20 gal/a of water, with four replications per treatment. Preemergence applications were made shortly after planting with XR8003 flat fan nozzles at 18 psi. Postemergence treatments were applied with the same equipment at 30 psi on July 6 to 0.5 to 4 in. weeds and 4 to 6 in. soybeans. A follow-up application of Poast Plus for grass control was made July 23 in 14 treatments as indicated in Table 10. Plots were not cultivated. Crop injury and weed control were rated at various times during the growing season. Soybeans were harvested on October 11, 1996 with a modified Gleaner E combine and JD row header.

Results

Six days after planting, more than 1.5 in. of rain fell. Redroot pigweed populations were very dense. Palmer amaranth represented an average of approximately 28% of the pigweed population in untreated check plots, with a range of 5% to 50%. Because of variable Palmer amaranth density, control of this specie was estimated in only 50 of 124 plots. Large crabgrass and green foxtail populations were very light.

A number of treatments caused some degree of crop injury. Greatest injury occurred with treatments involving Blazer, Cobra, and Stellar (Cobra + Resource). These herbicides caused varying degrees of leaf necrosis or chlorosis. Stellar also caused wrinkling of leaves. Soybeans treated with Action had less prominent chlorotic or necrotic spots on leaves. Some stunting occurred with Pursuit and Raptor. In most cases, soybeans recovered with little or no effect on yields.

The majority of treatments provided good to excellent control of redroot pigweed and good control of Palmer amaranth. Stellar was somewhat less effective on redroot pigweed at 0.65 or 1.29 oz ai/a, and generally gave poor control of Palmer amaranth. Resource and Action alone were inferior treatments. Pigweed control increased with rate of application of Stellar and Action. Raptor provided excellent control at all rates.

Soybean yields were unusually high and reflected significant increases from herbicides in comparison with the untreated check. Twenty-two treatments had highest yields of 54 to 64 bu/a. Only Resource resulted in a significantly lower yield than the hand weeded check.

Table 10. Herbicide effects on weeds and soybean yield, Hesston, KS, 1996[1].

Herbicide Treatment[2]	Rate oz ai/a	Timing[3]	Inj. 7/13	Weed Control[4] Rrpw 10/9	Paam 10/9	Grft 10/9	Lacg 10/9	Yield
			%	%	%	%	%	bu/a
1 Authority + Classic	2.56 + 0.51	Pre	0	98	96	100	100	53.8
2 Authority + Classic	3.2 + 0.64	Pre	0	100	96	100	100	53.7
3 Authority + Classic	3.66 + 0.73	Pre	0	100	94	100	100	57.1
4 Canopy	4.5	Pre	0	97	100	100	100	57.1
5 Detail	16.4	Pre	0	100	92	100	100	56.3
6 Squadron	14	Pre	0	100	94	100	100	54.5
7 Authority + Classic + Dual II	3.2 + 0.64 + 24	Pre	0	100	100	100	100	55.2
8 Authority + Classic Synchrony STS + COC	2.56 + 0.51 0.21 + 1%	Pre Post	0	100	96	100	100	62.1
9 Pursuit + Blazer + Sunit II + UAN	1.0 + 4.0 + 1.5 pt + 1 qt	Post	34	100	100	100	100	53.7
10 Stellar + COC	0.65 + 0.5%	Post	24	80	26	100	100	48.6
11 Stellar + COC	1.29 + 0.5%	Post	26	86	85	100	100	54.6
12 Stellar + COC	1.94 + 0.5%	Post	26	96	57	100	100	53.7
13 Stellar + Synchrony STS + COC	0.65 + 0.21 + 0.5%	Post	20	100	92	100	100	51.7
14 Stellar + Synchrony STS + COC	1.29 + 0.21 + 0.5%	Post	23	100	--	100	100	55.2
15 Stellar + Synchrony STS + COC	1.94 + 0.21 + 0.5%	Post	25	100	92	100	100	56.4
16 Synchrony STS + COC + UAN	0.21 + 0.5% + 2 qt	Post	0	99	100	100	100	64.0
17 Synchrony STS + Cobra + COC	0.21 + 1.0 + 0.5%	Post	24	100	93	100	100	56.5
18 Resource + COC	0.43 + 0.5%	Post	5	68	20	100	100	37.2
19 Dual II Expert + NIS + UAN	24 1.128 + 0.25% + 2 qt	Pre Post	0	100	92	100	100	55.9
20 Dual II Expert + Action + NIS + UAN	24 0.899 + 0.057 + 0.25% + 2 qt	Pre Post	6	100	94	100	100	58.1

(Continued)

Table 10. Herbicide effects on weeds and soybean yield, Hesston, KS, 1996[1].

Herbicide Treatment[2]	Rate oz ai/a	Timing[3]	Inj. 7/13	Weed Control[4] Rrpw 10/9	Paam 10/9	Grft 10/9	Lacg 10/9	Yield
			--------------------%--------------------					bu/a
21 Dual II Expert + Blazer + NIS	24 0.899 + 6.0 + 0.25%	Pre Post	11	100	92	100	100	59.5
22 Dual II Expert + Pinnacle + NIS	24 0.899 + 0.063 + .25%	Pre Post	0	100	92	100	100	51.4
23 Dual II Expert + Cobra + COC	24 0.899 + 2.0 + 1 pt	Pre Post	28	100	98	100	100	50.2
24 Action + COC	0.057 + 2 qt	Post	12	75	18	100	100	45.7
25 Action + COC	0.071 + 2 qt	Post	15	82	72	100	100	48.4
26 Action + Expert + COC	0.057 + 0.942 + 2 qt	Post	10	99	88	100	100	57.3
27 Action + Pursuit + COC	0.057 + 1.0 + 2 qt	Post	16	100	87	100	100	55.4
28 Raptor + Sun-It II + UAN	0.5 + 1.5 pt + 1 qt	Post	5	100	98	100	100	49.8
29 Raptor + Sun-It II + UAN	0.625 + 1.5 pt + 1 qt	Post	10	100	100	100	100	55.3
30 Raptor + Sun-It II + UAN	0.75 + 1.5 pt + 1 qt	Post	9	100	98	100	100	50.6
31 Pursuit + Sun-It II + UAN	1.0 + 1.5 pt + 2 qt	Post	12	100	100	100	100	57.5
32 Hand Weed			0	100	100	100	100	53.3
33 No Herbicide			0	0	0	0	0	23.2
LSD .05[5]			2	4	16	NS	NS	11.2

[1] This project was partially supported by American Cyanamid, CIBA, and Du Pont.
Note: Action, Expert, and Raptor currently are not labeled for use in soybeans.

[2] Herbicide formulations: Raptor 1 L, Assure II 0.88 EC, Authority 75 DF, Blazer 2 SC, Canopy 75 DF, Action 4.75 WP, Expert 75 WG, Classic 25 DF, Cobra 2 SC, Detail 4.1 SC = Frontier + Scepter, Dual 7.8 EC, Pinnacle 25 DF, Pursuit 70 DG, Resource 0.86 EC, Squadron 2.33 EC, Stellar 3.1 SC = Cobra + Resource, Synchrony STS 42 DF.
COC = Farmland Crop Oil Plus. NIS = Pen-A-Trate II nonionic surfactant.
UAN = 28% urea ammonium nitrate fertilizer.
Treatments 10-18 and 24-26 were followed with postemergent application of Poast Plus + Dash (3 oz ai/a + 1 qt/a) on 7/23/96 for grass control.

[3] Pre = preemergence. EP = early postemergence.

[4] Rrpw = redroot pigweed. Paam = Palmer amaranth. Grft = green foxtail. Lacg = large crabgrass.

[5] Treatments 32 and 33 not included in calculation of LSD's for crop injury and weed control means.

WEED CONTROL IN SOYBEANS WITH ROUNDUP

Mark M. Claassen

Introduction

Roundup has been used widely for nonselective weed control in fallow periods between crops and in no-till production prior to crop emergence. The development of Roundup tolerant soybeans makes it possible to us this herbicide for broad spectrum postemergence weed control during the growing season. Focal issues were rates and timing of Roundup alone, use of a preemergent herbicide ahead of a Roundup application, and a sequential Roundup treatment with subsequent cultivation.

Procedures

Previous crop and site description were the same as those noted for the preceding soybean herbicide experiment. Asgrow AG3001 Roundup Ready soybeans were planted at 7 seeds/ft in 30 in. rows on June 17, 1996. Seedbed condition was excellent. Preemergence applications were made in 20 gal/a of water with XR8003 nozzles at 18 psi. Postemergence treatments were applied in 10 gal/a of water with XR80015 flat fan nozzles at 30 psi. Early postemergence treatments (EP) were applied to 0.5 to 4 in. pigweeds and 4 to 6 in. soybeans. Application of postemergent (P) and late postemergent (LP) treatments occurred when pigweeds had 1 to 12 in. and 1 to 8 in. height, respectively. Corresponding soybean heights were 8 to 11 in. and 24 in.. Treatments 11 and 13 involved cultivation as noted in Table 11. Crop injury and weed control were rated at various times during the growing season. Soybeans were harvested on October 11.

Results

Redroot pigweed populations were very dense. Palmer amaranth represented an average of approximately 33% of the pigweed population in untreated check plots, with a range of 10% to 70%. Similar variation in Palmer amaranth density occurred throughout the site. At the July 13 evaluation, no grasses were evident. Nine days later, only a few grass weeds were present. Final populations of large crabgrass and fall panicum were very light.

None of the Roundup treatments caused any soybean injury. Slight stunting from Pursuit was not reflected in soybean yield. Under very favorable growing conditions, all herbicide treatments provided good to excellent control of redroot pigweed and Palmer amaranth. There was no Roundup rate effect on the level of control. EP treatments performed well in the absence of significant later germination of weeds. Row cultivation gave inferior weed control.

Soybean yields were high and were increased by all herbicide treatments. There were no significant differences among these treatments in their effect on yield. Row cultivation resulted in more than a 10 bu/a yield loss when compared with herbicide treatments.

Table 11. Herbicide effects on weeds and on yield of Roundup Ready soybeans, Hesston, KS, 1996[1].

Herbicide Treatment[2]	Rate lb ai/a[3]	Timing[4]	Injury 7/22	Weed Control[5] Rrpw 9/23	Paam 9/23	Lacg 9/23	Fapa 9/23	Yield
			--------	-------- %	--------	--------	--------	bu/a
1 Roundup Ultra	0.375	EP	0	96	97	100	99	52.0
2 Roundup Ultra + AMSU	0.375 + + 1.7 lb	EP	0	92	93	100	98	47.6
3 Roundup Ultra	0.56	EP	0	95	94	100	99	51.8
4 Roundup Ultra	0.75	EP	0	93	91	99	100	48.6
5 Roundup Ultra	0.375	P	0	96	96	100	100	49.6
6 Roundup Ultra	0.56	P	0	97	96	100	100	55.5
7 Roundup Ultra	0.75	P	0	98	97	100	100	51.2
8 Roundup Ultra	0.56	EP	0					
Roundup Ultra	.375	LP		100	99	100	100	53.3
9 Prowl	1.0	Pre						
Roundup Ultra	0.56	EP	0	97	100	100	100	52.5
10 Lexone	0.38	Pre						
Roundup Ultra	0.56	EP	0	99	99	100	100	47.9
11 Roundup Ultra	0.56	EP	0					
Cultivation		Seq		100	99	100	100	55.2
12 Pursuit + NIS + UAN	0.063 + 0.25% + 1 qt	EP	0	100	93	100	99	54.2
13 Cultivation		P	0					
Cultivation		Seq		79	82	100	100	37.1
14 No Herbicide			0	0	0	0	0	20.9
LSD .05[6]			NS	6.6	NS	NS	NS	10.6
LSD .10[6]				---	8.4	--	--	----

[1] This project was partially supported by Monsanto.

[2] Herbicide formulations: Pursuit 70 DG, Prowl 4 EC, Lexone 75 DF, Roundup Ultra 3 AS (acid equivalent).
AMSU = Ammonium sulfate.
NIS = Pen-A-Trate II nonionic surfactant.
UAN = 28% urea ammonium nitrate fertilizer.

[3] Active ingredient or acid equivalent (Roundup).

[4] Pre = preemergence.
EP = early postemergence.
P = postemergence.
LP = late postemergence.
Seq = sequential.
Row cultivation: 7/13/96 (treatment 13) and 7/29 (treatments 11, 13).

[5] Rrpw = redroot pigweed. Paam = Palmer amaranth. Lacg = large crabgrass. Fapa = fall panicum.

[6] Treatment 14 not included in calculation of LSD's for weed control means.

SPRING OAT VARIETIES

Mark Claassen and Kraig Roozeboom

Introduction

Spring oats can serve a useful roll as a rotational crop when weather or soil conditions prevent implementation of a particular crop sequence. They can also provide a significant grain or forage resource in a diversified crop-livestock operation. Performance tests with oats were conducted here to evaluate yield potential and other agronomic characteristics of varieties currently available.

Procedures

Spring oats were seeded February 23, 1996 at 64 lb/a on two sites with different crop histories. The first site had been cropped to wheat in 1995. Fertilizer (90 lb/a of N and 35 lb/a of P_2O_5) had been incorporated during seedbed preparation in the fall. The second site had been in continuous sorghum. It was fertilized with 90 lb/a of N and 32 lb/a of P_2O_5 on February 21 and 22. Both locations were tilled lightly with a mulch treader just before planting. No herbicide was used. Plots were harvested on July 13.

Results

The seedbed was dry on both sites. The soil was extremely mellow following wheat. At the second site, where oats followed sorghum, soil was somewhat more firm. Emergence occurred during the first 10 days of April.

Dry conditions prevented early germination and possible damage from late freezes in March. Despite below-normal precipitation during the entire growing season, abundant May rainfall made possible relatively good oat yields. Minor Barley yellow dwarf disease occurred late with limited effect.

Table 12. Performance of spring oat varieties following winter wheat, Hesston, KS, 1996.

Cultivar	Yield[1] 1996	Yield[1] 1995	Yield[1] 1994	Test Wt	Maturity[2]	Plant Ht	Lodging	Shattering
	-----------bu/a-----------			lb/bu	days	in	%	%
Armor	89	26	58	28	6	38	74	2
Bates	86	36	73	31	0	36	77	2
Bay	64	--	--	25	13	36	12	0
Belle	61	--	--	28	11	37	10	0
Brawn	114*	49	54	30	2	34	6	0
Dane	64	41	58	26	1	36	26	1
Don	92	42	71	31	1	35	41	2
Gem	85	--	--	28	10	41	18	0
Hazel	82	31	55	29	4	35	6	1

Horicon	76	27	56	27	4	38	29	1
Larry	75	18	74	29	1	35	10	1
Ogle	77	42	65	27	5	37	28	0
Prairie	91	33	58	27	7	37	78	1
Premier	89	24	62	30	6	38	73	2
Starter	78	20	55	29	1	37	18	1
Average	82	32	62	28	5	37	34	1
LSD .05	6	3	4	1	1	1	15	1

[1] Average of four replications adjusted to 12.5% moisture. * = upper LSD group.
[2] Days later than Bates, which reaching 50% heading on May 25.

Table 13. Performance of spring oat varieties following grain sorghum, Hesston, KS, 1996.

Cultivar	Yield[1] 1996	1995	1994	Test Wt	Matur-ity[2]	Plant Ht	Lodg-ing	Shatter-ing
	-----------bu/a-----------			lb/bu	days	in	%	%
Armor	77	--	--	27	6	37	46	1
Bates	83	--	--	31	0	35	85	2
Bay	58	--	--	25	13	36	13	0
Belle	64	--	--	42	10	36	12	0
Brawn	99*	--	--	29	4	32	9	0
Dane	80	--	--	27	1	34	6	1
Don	87	--	--	31	1	34	50	2
Gem	86	--	--	29	10	39	9	0
Hazel	75	--	--	29	4	34	10	2
Horicon	78	--	--	29	5	36	34	0
Larry	77	--	--	29	1	32	13	1
Ogle	80	--	--	27	5	36	23	0
Prairie	79	--	--	26	7	36	74	1
Premier	79	--	--	30	6	36	53	1
Starter	76	--	--	30	1	34	27	1
Average	78	--	--	29	5	35	31	1
LSD .05	7	-	-	NS	1	1	22	1

[1] Average of four replications adjusted to 12.5% moisture. * = upper LSD group.
[2] Days later than Bates, which reaching 50% heading on May 25.

IRRIGATION AND NORTH CENTRAL KANSAS EXPERIMENT FIELDS

Introduction

The 1952 Kansas legislature provided a special appropriation to establish the Irrigation Experiment Field in order to serve the ever-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, Kansas and Harlen County Reservoir at Republican City, Nebraska. A 5-acre site in the Republican River Valley on the Mike Brzon Farm also is utilized for irrigation research. In 1996, there were approximately 125,000 acres of irrigated cropland in north central Kansas. Current research on the field focuses on managing irrigation water and fertilizer in reduced -illage systems and crop rotations.

The 40-acre North Central Kansas Experiment Field, located two miles west of Belleville, was established on its present site in 1942. The field provides information on factors that allow full development and wise use of natural resources in north central Kansas. Current research emphasis is on fertilizer management for reduced-tillage crop production and cropping systems for wheat, soybeans, grain sorghum, and corn.

Soil Description

The predominant soil 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. The 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 inch of water per inch of soil.

1996 Weather Information

The 1996 growing season was characterized by above-normal rainfall in May and July but much below normal rainfall in June (Table 1). Temperatures in June were above normal and actually included some of the highest readings of the summer season. Temperatures in July and August were slightly below normal. Cool temperatures in August and September slowed crop maturation and grain moisture drydown. Crops were mature and not damaged by a late freeze on October 28.

Table 1. Climate data for the Irrigation and North Central Experiment Fields, Scandia and Belleville, KS 1996.

	Rainfall, inches			Temperature, °F			
Month	Scandia 1996	Avg.	Belleville 1996	Daily Mean	Avg. Mean	Growth Units 1996	Growth Units Avg.
April	2.8	2.4	2.1	51	53	251	242
May	5.1	3.7	7.5	63	64	397	427
June	1.0	4.8	0.6	75	74	704	718
July	5.4	3.3	5.7	76	79	772	835
August	3.7	3.3	3.9	74	77	693	748
Sept.	4.1	3.5	4.4	64	67	458	518
Total	22.1	20.9	24.2	67	69	3275	3487

EVALUATION OF AMISORB® FOR CORN AND GRAIN SORGHUM PRODUCTION

W. Barney Gordon

Summary

Amisorb® applied at 2 quarts/a with starter fertilizer (30 lb/a N and 30 lb/a P_2O_5) applied 2 inches to the side and 2 inches below the seed at planting increased early-season growth, nutrient uptake, and yield of irrigated, ridge-tilled corn. Amisorb did not affect growth, nutrient uptake, or yield of dryland grain sorghum.

Introduction

Amisorb (polyaspartate) is a new product offered by Amilar International Company. Literature states that polyaspartate works to artificially increase the area occupied by plant roots, which results in greater availability of mineral nutrients to the plants. These field experiments were designed to evaluate the potential of Amisob to increase nutrient uptake and yield of corn and grain sorghum.

Procedures

The irrigated corn experiment was established on a Crete silt loam soil at the Irrigation Experiment Field, Scandia. The grain sorghum experiment was conducted at the North Central Kansas Experiment Field, Belleville. The corn experiment was ridged-tilled. The grain sorghum experiment was conducted under dryland, no-tilled conditions. Treatments in both experiments consisted of a no starter check, 30 lb/a of N and 30 lb/a P_2O_5, 30 lb/a N and 30 lb/a P_2O_5 plus 1 qt/a Amisorb, and 30 lb/a N and 30 lb P_2O_5 plus 2qt/a Amisorb. The 2 qt rate is recommended by the manufacturer. Starter fertilizer was applied 2 inches to the side and 2 inches below the seed at planting. Liquid ammonium polyphosphate (10-34-0) and urea-ammonium nitrate solution (28% UAN) were used as the starter fertilizer sources. Nitrogen as anhydrous ammonia was knifed immediately after planting to bring all corn plots to a total of 180 lb/a and grain sorghum plots to a total of 120 lb/a. Analysis by the KSU Soil Testing Lab showed that initial pH (April 1996) was 6.5, organic matter was 2.4%, Bray-1 P was 45 ppm, and exchangeable K was 400 ppm in the top 6 inches of soil. The corn hybrid Pioneer 3225 was planted on 22 April, and the grain sorghum hybrid Pioneer 8500 was planted on 6 June.

Results

Growing conditions in 1996 were good, and yields of both corn and grain sorghum were above average. Starter fertilizer increased corn grain yield by 22 bu/a over the no starter check (Table 2) Addition of Amisorb at the 1 qt/a rate did not increase yields or nutrient uptake over the starter-alone treatment. Addition of 2 qt/a Amisorb to the starter fertilizer mix gave increased dry matter production and nutrient uptake at the 6-leaf stage and resulted in a 13 bu/a yield increase over the starter-alone treatment.

Starter fertilizer increased growth and nutrient uptake at the 6-leaf stage and yields of grain sorghum compared to the no starter check (Table 3). The addition of Amisorb to the starter fertilizer mix at either the 1 or 2 qt/a rate did not improve dry matter production, nutrient uptake, or yield of grain sorghum over the starter-alone treatment.

Table 2. Effects of starter fertilizer and Amisorb® on whole-plant dry matter and nutrient uptake at the 6-leaf stage and grain yield of irrigated, ridged-tilled corn, Scandia, KS 1996.

Treatment	Yield	Whole-Plant Dry Weight	6-Leaf Stage N Uptake	P Uptake
	bu/a	lb/a	lb/a	lb/a
No starter	191	229	5.2	0.5
30 lb N, 30 lb P_2O_5/a	213	366	10.0	1.3
30 lb N, 30 lb P_2O_5 + lqt Amisorb/a	213	358	10.0	1.3
30 lb N, 30 lb P_2O_5 + 2 qt Amisorb/a	226	388	10.6	1.6
LSD (0.05)	12	21	0.5	0.2

Table 3. Effects of starter fertilizer and Amisorb® on whole-plant dry matter nutrient uptake at the 6-leaf stage and yield of no-tillage, dryland, grain sorghum, Belleville, KS 1996.

Treatment	Yield	Whole-Plant Dry Weight	6-Leaf Stage N Uptake	P Uptake
	bu/a	lb/a	lb/a	lb/a
No Starter	136	356	7.4	0.8
30 lb N, 30 lb P_2O_5/a	156	508	14.9	1.4
30 lb N, 30 lb P_2O_5+ 1qt Amisorb/a	156	486	14.4	1.3
30 lb N, 30 lb P_2O_5 + 2qt Amisorb/a	155	502	14.6	1.3
LSD (0.05)	11	24	0.6	0.2

STARTER FERTILIZER INTERACTIONS WITH CORN AND GRAIN SORGHUM HYBRIDS

W.Barney Gordon, Dale L. Fjell, and David A. Whitney

Summary

Two studies evaluated starter fertilizer application on corn and grain sorghum hybrids grown in a dryland, no-tillage production system on a soil high in available phosphorus. Treatments consisted of 12 corn or 12 grain sorghum hybrids grown with or without starter fertilizer. Starter fertilizer (30 lb/a N and 30 lb/a P_2O_5) was applied 2 inches to the side and 2 inches below the seed at planting. In both the corn and grain sorghum tests, starter fertilizer improved growth of all hybrids at the 6-leaf stage of growth. Whole-plant uptakes of N and P at the 6-leaf stage also were improved by the use of starter fertilizer. Starter fertilizer improved grain yield of some corn and grain hybrids yields but had no effect of the yield of other hybrids.

Introduction

Maintenance of ground cover from crop residue to control soil erosion has become an important factor in crop production in Kansas. No-tillage systems have been shown to be effective in maintaining crop residues and reducing soil erosion losses. Early-season plant growth and yield can be poorer in no-tillage systems than in conventional systems. The large amount of surface residue maintained with no-tillage systems can reduce seed-zone temperature. Lower than optimum soil temperature can reduce the availability of nutrients. However starter fertilizers can be applied to place nutrients within the rooting zone of young seedlings for better availability. Corn and grain sorghum hybrids can differ in rooting characteristics and availability to extract and use nutrients. These studies evaluate the differential responses of corn and grain sorghum hybrids to starter fertilizer.

Procedures

These field studies were conducted at the North Central Kansas Experiment Field near Belleville on a Crete silt loam soil. Both the corn and grain sorghum tests were initiated in 1995. Analysis by the KSU Soil Testing Lab showed that in the corn experimental area, the initial pH was 6.1, organic matter content was 2.4%, Bray-1 P was 43 ppm, and exchangeable K was 380 ppm in the surface 6 inches of soil. Analysis in the grain sorghum area showed that pH was 6.5, organic matter was 2.5%, Bray-1 P was 45 ppm, and exchangeable K was 420 ppm. Both corn and grain sorghum test sites had been in no-tillage production systems for 3 years prior to the establishment of these studies. The experimental design for both studies was a randomized complete block with a split-plot arrangement. Whole plots were corn and grain sorghum hybrids. The split-plots consisted of starter or no starter fertilizer. Starter fertilizer (30 lb/a N and 30 lb/a P_2O_5/a) was applied 2 inches to the side and 2 inches below the seed at planting. Liquid ammonium polyphosphate (10-34-0) and urea-ammonium nitrate solution (28% UAN) were used as starter fertilizer sources. Nitrogen as anhydrous ammonia was knifed immediately after planting to bring all corn plots to a total of 180 lb/a and grain sorghum plots to a total of 120 lb/a. In 1996, corn was planted on 23 April and grain sorghum was planted on 22 May.

Results

Corn Experiment

Starter fertilizer improved the early growth and nutrient uptake of all corn hybrids tested (Table 4). When averaged over hybrids, dry matter at the 6-leaf stage averaged 181 lbs/a without starter and 340 lb/a with starter.

Dryland corn in central Kansas normally is planted as early in April as possible, so that pollination occurs in June when temperatures are more moderate and moisture conditions are more favorable than in July, when conditions are normally hot and dry. Any practice that promotes earliness often increases yields. Starter fertilizer significantly decreased the number of days from emergence to mid-silk in Pioneer 3489, Pioneer 3346, Pioneer 3394, Cargill 7777, Dekalb 591, Northrup King 6330, and Northrup King 7333 but did not affect maturity in Pioneer 3563, Cargill 6327, Dekalb 626, Dekalb 646, and ICI 8599 (Table 5).

Starter fertilizer increase grain yield of some hybrids but had no effect on the yields of other hybrids (Table 5). The average yield increase for the seven hybrids that responded to starter fertilizer application was 18 bu/a.

Grain Sorghum Study

Starter fertilizer improved the early growth and nutrient uptake of all hybrids tested (Table 6). When averaged over hybrids, dry matter at the 6-leaf stage was 138 lb/a greater with starter than without starter. Starter fertilizer can be quite helpful in improving early-season growth in cool soils. In northern Kansas, an early frost can occur before the crop is mature. Starter fertilizer can hasten maturity and avoid damage from late-season low temperatures. Starter fertilizer significantly reduced the number of days from emergence to mid-bloom in eight of the 12 hybrids tested (Table 7).

Starter fertilizer increased grain yield of some hybrids but had no effect on the yields of other hybrids (Table 7). The average yield increase due to starter fertilizer for the eight hybrids that responded to starter fertilizer was 12 bu/acre.

Table 4. Mean effects of corn hybrid and starter fertilizer on whole-plant dry weight and N and P uptakes at the 6-leaf stage of growth, Belleville, 1996.

Means	Dry Weight	N Uptake	P Uptake
	lb/a	lb/a	lb/a
<u>Hybrid</u>			
Pioneer 3563	249	7.6	0.81
Pioneer 3489	258	8.0	0.98
Pioneer 3346	253	8.1	0.88
Pioneer 3394	285	8.7	0.91
Cargill 6327	275	8.4	0.89
Cargill 7777	290	9.1	0.84
Dekalb 591	241	7.7	0.79
Dekalb 626	270	8.4	0.92
Dekalb 646	236	7.6	0.79
Northrup King 7333	295	8.6	0.96
Northrup King 6330	248	7.8	0.78
ICI 8599	229	7.0	0.77
LSD (0.05)	19	0.5	0.06
<u>Starter</u>			
With	181	10.6	1.18
Without	340	5.6	0.55
LSD(0.05)	26	0.9	0.09

Table 5. Starter fertilizer effects on grain yield and number of days from emergence to mid silk of corn hybrids, Bellville, 1996.

Hybrid	Starter	Yield 1996	Yield 1995-1996	Number of Days to Mid-silk, 1996
		bu/a		
Pioneer 3563	With	136	116	71
	Without	135	115	71
Pioneer 3489	With	147	142	76
	Without	120	119	70
Pioneer 3346	With	170	155	77
	Without	148	132	72
Pioneer 3394	With	179	160	78
	Without	165	142	74
Cargill 6327	With	176	137	76
	Without	175	137	75
Cargill 7777	With	200	177	79
	Without	178	166	73
Dekalb 591	With	163	156	75
	Without	144	135	71
Dekalb 626	With	167	136	76
	Without	167	135	77
Dekalb 646	With	150	137	79
	Without	149	136	79
Northrup King 7333	With	174	141	73
	Without	156	121	78
Northrup King 6330	With	168	156	72
	Without	153	137	75
ICI 8599	With	132	120	75
	Without	132	120	75
Hybrid X Starter LSD(0.05)		6	8	2

Table 6. Mean effects of grain sorghum hybrid and starter fertilizer on whole-plant dry weight and N and P uptakes at the 6-leaf stage of growth, Belleville, 1996.

Means	Dry Weight	N Uptake	P Uptake
	lb/a	lb/a	lb/a
Hybrid			
Pioneer 8699	286	9.2	0.98
Pioneer 8505	289	9.0	1.02
Pioneer 8310	251	8.4	0.96
Dekalb 48	356	11.2	1.29
Dekalb 40Y	354	11.8	1.46
Dekalb 39Y	268	9.1	1.06
Dekalb 51	260	8.5	1.04
Dekalb 55	294	9.1	1.13
Pioneer 8522Y	346	10.9	1.28
Northrup King KS 383Y	295	9.9	1.06
Northrup King KS 524	279	9.4	1.04
Northrup King KS 735	263	8.7	1.03
LSD(0.05)	21	NS*	NS
Starter			
With	364	7.1	0.84
Without	226	12.1	1.39
LSD(0.05)	26	0.8	0.50

*Not significant at the 0.05level of probability.

Table 7. Starter fertilizer effects on grain yield and number of days from emergence to mid-bloom of grain sorghum hybrids, Belleville, 1996.

Hybrid	Starter	Yield, 1996	Yield, 1995-1996	Number of Days to Mid-bloom, 1996
		bu/a		
Pioneer 8699	With	133	110	55
	Without	133	109	56
Pioneer 8505	With	174	138	55
	Without	157	119	59
Pioneer 8310	With	166	122	64
	Without	150	105	67
Dekalb 48	With	170	124	61
	Without	158	109	66
Dekalb 40Y	With	155	121	62
	Without	141	101	68
Dekalb 39Y	With	121	97	60
	Without	121	96	61
Dekalb 51	With	164	127	61
	Without	149	105	66
Dekalb 55	With	179	121	64
	Without	167	105	69
Pioneer 8522Y	With	164	122	62
	Without	153	108	68
Northrup King KS 383Y	With	141	113	60
	Without	140	112	61
Northrup King KS 524	With	150	120	59
	Without	141	107	64
Northrup King KS 735	With	154	116	63
	Without	153	115	64
Hybrid X Starter LSD (0.05)		8	9	2

RESPONSES OF CORN AND GRAIN SORGHUM HYBRIDS TO STARTER FERTILIZER COMBINATIONS

W. Barney Gordon and Gary M. Pierzynski

Summary

In previous research at the North Central Kansas Experiment Field, we found that some corn and grain sorghum hybrids grown under reduced-tillage conditions responded to starter fertilizer containing nitrogen (N) and phosphorus (P), and others did not. Little information is available concerning variability among corn and grain sorghum hybrids in response to starters containing a complete complement of nutrients. These studies evaluated the response of four corn hybrids (Pioneer 3563, Pioneer 3346, Dekalb 591, and Dekalb 646) or four grain sorghum hybrids (Pioneer 8699, Northrup King KS 735, Dekalb 40Y, and Dekalb 48) to starter fertilizer combinations containing N, P, potassium (K), sulfur (S), and zinc (Zn). The corn experiment was conducted on a Carr fine sandy loam soil located in the Republican River Valley near Scandia, KS. The grain sorghum experiment was conducted at the North Central Kansas Experiment Field located near Belleville on a Crete silt loam soil. Starter fertilizer containing N and P increased dry weight at the V-6 stage compared to the no-starter check treatment for all corn hybrids tested. Grain yield of two of the corn hybrids (Pioneer 3563 and Dekalb 646) did not respond to starter fertilizer, regardless of elemental composition. Starter fertilizer containing N and P increased grain yield of Pioneer 3346 and Dekalb 591 by 54 and 50 bu/a, respectively, compared to the no-starter check treatment. The addition of 10 lb/a S to the starter fertilizer mix resulted in an additional increase in V-6 dry weight for all hybrids and grain yield increases for Pioneer 3346 and Dekalb 591. The addition of K and Zn to the starter fertilizer did not result in any additional benefit. Starter fertilizer increased V-6 stage dry matter production in all grain sorghum hybrids tested. Starter fertilizer containing N and P increased grain yield of Dekalb 40Y and Dekalb 48 by 22 and 25 bu/a, respectively. Grain yield of two grain sorghum hybrids (Pioneer 8699 and Northrup King KS 735) did not respond to starter fertilizer. Additions of K, S, and Zn to the starter fertilizer mix did not significantly increase dry matter production or grain yield for any grain sorghum hybrid.

Introduction

Conservation tillage production systems are being used by an increasing number of farmers in the central Great Plains. Early- season growth is often poorer in conservation tillage systems than in conventionally tilled systems. Cool soil temperature at planting time can reduce nutrient uptake of crops. Placing fertilizer in close proximity to the seed at planting time can alleviate the detrimental effects of cool soil temperature on plant growth and development. In previous research at the North Central Kansas Experiment Field, we found that some corn and grain sorghum hybrids respond well to the application of starter fertilizer, whereas other hybrids do not. These experiments were conducted using starters containing only N and P. Little is known about variability among corn and grain sorghum hybrids in response to starters containing a complete complement of nutrients. The objectives of these experiments were to determine the variability in starter fertilizer responsiveness between corn and grain sorghum hybrids grown under reduced- tillage conditions and to ascertain whether that variability is influenced by starter fertilizer composition.

Procedures

The ridge-tilled, furrow-irrigated corn study was conducted on some farmer's fields in the Republican River Valley near Scandia, KS on a Carr sandy loam soil. Analysis by the KSU Soil Testing Lab showed that initial pH was 7.2, organic matter content was 1%, Bray-1 P was 21 ppm, and exchangeable K was 280 ppm in the surface 6 inches of soil. The site had been in ridge-tillage for 4 years prior to establishment of this study. The grain sorghum study was conducted at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Soil test values for this site were: pH 6.5, organic matter content 2.5%, Bray-1 P 44 ppm, and exchangeable K 350 ppm in the top 6 inches of soil. The experimental site had been in no-tillage production for 3 years prior to the establishment of this no-tillage, dryland grain sorghum experiment. Corn hybrids used were: Pioneer 3563, Pioneer 3346, Dekalb 591, and Dekalb 646. Grain sorghum hybrids included in the experiment were: Pioneer 8699, Northrup King KS 735, Dekalb 40Y, and Dekalb 48. The liquid starter fertilizer treatments used in both experiments are given in Table 8. Starter fertilizer was applied 2 inches to the side and 2 inches below the seed at planting. The corn experiment was planted on 23 April at the rate of 30,000 seed/a. The grain sorghum study was planted on 24 May at the rate of 64,000 seed/a. Immediately after planting, N was balanced on all plots to give a total of 200 lb/a in the corn study and 150 lb/a in the grain sorghum study. The N source used in the experiments was urea ammonium nitrate solution (28% UAN), the P source was ammonium polyphosphate (10-34-0), the K source was KCL, the S source was ammonium thiosulfate, and the Zn source was a liquid Zn-NH_3 complex.

Results

Starter fertilizer containing N and P improved dry matter production at the V-6 stage for all hybrids tested compared to the no starter check treatment (Table 9). Additional response was achieved with the addition of S to the starter fertilizer mix. Additions of K and Zn did not result in any additional V-6 stage dry matter production. Two hybrids (Pioneer 3563 and Dekalb 646) did not show any yield response to starter fertilizer (Table 10). This is consistent with results of previous studies using these hybrids. Starter fertilizer containing N and P increased grain yield of Pioneer 3346 and Dekalb 591 by 54 and 50 bu/a, respectively, compared to the no starter check. Addition of S to the starter fertilizer mix resulted in an additional 18 bu/a yield increases for Pioneer 3346 and additional 14 bu/a increase for Dekalb 591 compared to starter fertilizer containing only N and P.

Grain Sorghum Study

Starter fertilizer containing N and P increased dry matter at the V-6 stage for all grain sorghum hybrids tested compared to the no starter check treatment (Table 11). Addition of K, S, or Zn to the starter fertilizer mix did not significantly improve V-6 dry matter production on this medium-textured silt loam soil. Starter fertilizer containing only N and P increased grain yield of Dekalb 40Y and Dekalb 48 by 22 and 25 bu/a, respectively, compared to the no starter check treatment (Table 12). Grain yield of two grain sorghum hybrids (Pioneer 8699 and Northrup King 735) did not respond to starter fertilizer. Additions of K, S, and Zn to the starter fertilizer mix did not significantly further increase grain yield over the increases achieved with N and P alone.

Conclusion

Starter fertilizer improved early-season growth in all hybrids included in the experiment. However, this response did not translate into increased grain yield for all hybrids. Results of this work suggest that responses to starter fertilizer can be very economical for some hybrids even on soils that are not low in available nutrients, particularly when corn and grain sorghum are planted in a high-residue production system.

Table 8. Starter fertilizer treatments.

Treatment	N	P_2O_5	K_2O	S	Zn
			lb/a		
1.	0	0	0	0	0
2.	30	30	0	0	0
3.	30	30	20	0	0
4.	30	30	0	10	0
5.	30	30	0	0	1
6.	30	30	20	10	1

Table 9. Effects of starter fertilizer combinations on V-6 stage whole-plant dry weight of corn hybrids, Scandia, KS, 1996.

Means					V-6 Whole-Plant Dry Weight
					lb/a
Pioneer 3563					355
Pioneer 3346					408
Dekalb 591					393
Dekalb 646					421
LSD(0.05)					26
Starter Combination					
N	P_2O_5	K_2O	S	Zn	
		lb/a			
0	0	0	0	0	152
30	30	0	0	0	409
30	30	20	0	0	406
30	30	0	10	0	500
30	30	0	0	1	402
30	30	20	10	1	501
LSD (0.05)					32

Table 10. Starter fertilizer combinations effects on grain yield of corn hybrids, Scandia, KS.

	Starter Fertilizer Combination					
Hybrid	N	P_2O_5	K_20	S	Zn	Yield
			lb/a			bu/a
Pioneer 3563	0	0	0	0	0	221
	30	30	0	0	0	223
	30	30	20	0	0	222
	30	30	0	10	0	220
	30	30	0	0	1	220
	30	30	20	10	1	221
Pioneer 3346	0	0	0	0	0	153
	30	30	0	0	0	207
	30	30	20	0	0	207
	30	30	0	10	0	225
	30	30	0	0	1	209
	30	30	20	10	1	228
Dekalb 591	0	0	0	0	0	165
	30	30	0	0	0	215
	30	30	20	0	0	213
	30	30	0	10	0	229
	30	30	0	0	1	215
	30	30	20	10	1	229
Dekalb 646	0	0	0	0	0	201
	30	30	0	0	0	204
	30	30	20	0	0	203
	30	30	0	10	0	205
	30	30	0	0	1	207
	30	30	20	10	1	202
LSD(0.05)						9

Table 11. Effects of starter fertilizer combinations on V-6 stage whole-plant dry weight of grain sorghum hybrids, Belleville, KS, 1996.

Means					V-6 Whole-Plant Dry Weight
					lb/a
Hybrid					
Pioneer 8699					770
Northrup King KS 735					783
Dekalb 40Y					780
LSD (0.05)					814
Starter Combination					
N	P_2O_5	K_2O	S	Zn	
		lb/a			
0	0	0	0	0	466
30	30	0	0	0	841
30	30	20	0	0	852
30	30	0	10	0	887
30	30	0	0	1	845
30	30	20	10	1	831
LSD (0.05)					156

*Not significant at the 0.05 level of probability.

Table 12. Effects of starter fertilizer combinations on grain yield of grain sorghum hybrids**,** Belleville, KS, 1996.

	Starter Fertilizer Combination					
Hybrid	N	P_2O_5	K_2O	S	Zn	Yield
			lb/a			bu/a
Pioneer 8699	0	0	0	0	0	130
	30	30	0	0	0	128
	30	30	20	0	0	127
	30	30	0	10	0	130
	30	30	0	0	1	128
	30	30	20	1	1	127
Northrup King KS 735	0	0	0	0	0	126
	30	30	0	0	0	127
	30	30	0	10	0	125
	30	30	0	10	0	125
	30	30	0	0	1	124
	30	30	0	10	1	126
Dekalb 40Y	0	0	0	0	0	111
	30	30	0	0	0	133
	30	30	20	0	0	133
	30	30	0	10	0	131
	30	30	0	0	1	133
	30	30	20	10	1	134
Dekalb 48	0	0	0	0	0	117
	30	30	0	0	0	142
	30	30	20	0	0	144
	30	30	0	10	0	140
	30	30	0	0	1	140
	30	30	30	0	1	140
LSD (0.05)						9

EFFECTS OF POTASSIUM SOURCE, PLACEMENT, AND RATE OF STARTER FERTILIZER ON CORN PRODUCTION

W. Barney Gordon

Summary

Field studies were conducted at the Irrigation Experiment Field near Scandia, Kansas on a Crete silt loam soil. Starter fertilizer (7-21-7) included two sources of potassium (P), sulfate of potassium (SOD) and potassium chloride (KCl). The test also used two starter fertilizer placement methods (in-furrow, with the seed and 2 inches to the side and 2 inches below the seed) and three application rates (50, 100 and 150 lb/a). A no-starter check also was included. Experiments were conducted with both liquid and dry sources of starter fertilizer. Sulfur rates were balanced so that all plots received the same amount, regardless of P source. When liquid starter fertilizer containing KCl was placed in-furrow, grain yield, plant stand, and whole-plant dry matter and K uptake at the 6-leaf stage were reduced. Grain yields were reduced by 29 bu/a when liquid starter fertilizer containing KCl was placed in-furrow compared to placing fertilizer 2 inches to the side and 2 inches below the seed. Results were similar when dry fertilizer sources were used. No yield loss occurred when starter fertilizer containing SOP was placed in-furrow. When averaged over all factors, liquid starter fertilizer containing SOP resulted in yields that were 14 bu/a greater than yields with starter fertilizer containing KCl. Dry fertilizer containing SOP resulted in yields 17 bu/a greater than those with KCl. The use of 7-21-7 starter fertilizer at the 50 lb/a rate increased yields by 22 bu/a (average of both liquid and dry sources) over the no starter check treatment. Further increases in the 7-21-7 starter fertilizer rate did not result in any yield increase.

Procedures

This irrigated field test was conducted at the Irrigation Experiment Field near Belleville on a Crete silt loam soil. Analysis by the Soil Testing Lab showed that, in the experimental area, the initial pH was 6.4, organic matter content was 2.4%, Bray-1 P was 43 ppm, and exchangeable K was 380 ppm in the top 6 inches of soil. The experimental design was a randomized complete block with three factors. The test consisted of starter fertilizer containing two potassium (K) sources applied either in-furrow or 2 inches to the side and 2 inches below the seed at three different rates. The two sources were sulfate of potassium (SOP) and potassium chloride (KCl). A liquid 7-21-7 fertilizer was made using ammonium polyphosphate (10-34-0) and either SOP or KCl. A solid 7-21-7 fertilizer was made using ammonium nitrate, triple super phosphate, and either SOP or KCl. The 7-21-7 fertilizer was applied at 50, 100, and 150 lb/a. A no-starter check treatment was also included. Sulfur was balanced so that all plots received the same amount. Nitrogen was balanced on all plots to give a total of 180 lb/a. The corn hybrid Dekalb 626 was planted on 24 April at the rate of 30,000 seed/a. Stand counts were taken 3 weeks after planting. Whole-plant samples (10 plants per plot) were taken at the 6-leaf stage and analyzed for dry matter content and elemental concentration. Plots were harvested on 20 October.

Results

When liquid starter fertilizer (7-21-7) containing KCl was placed in contact with the seed, plant stands were reduced by over 6,800 plants/a compared to fertilizer placed 2 inches to the side and 2 inches below the seed (Table 13). Whole-plant dry matter and K uptake at the 6-leaf stage also were reduced by placing starter fertilizer containing KCl in-furrow. Grain yields were reduced by 29 bu/a by placing KCl containing fertilizer in-furrow compared to 2 x 2 placement. Stand and yield losses occurred regardless of rate of 7-21-7 fertilizer. When SOP was used as the K source in the liquid starter fertilizer, no significant stand or yield loss occurred with either placement method. When averaged over all factors, yields were 14 bu/a greater when SOP was used in the liquid starter fertilizer than when KCl was used. Use of 7-21-7 liquid starter fertilizer at the 50 lb/a rate increased yields by 22 bu/a over the no starter check. Further increases in rate of starter fertilizer did not result in any significant yield increase. Results were similar when dry starter fertilizer was used (Table 14).

Table 13. Effects of potassium source (sulfate of potassium or potassium chloride), placement (in-furrow or 2x2), and rate of liquid starter fertilizer (7-21-7) on grain yield, stand establishment, and whole-plant dry weight and K uptake at the 6-leaf stage, 1996.

Source and Rate	Placement	Yield	Population	6-Leaf Stage Dry Matter	Whole-Plant K Uptake
		bu/a	plants/a	lb/a	
SOP	In-Furrow	209	28520	496	25
	2x2	212	29844	527	27
KCl	In-Furrow	183	21792	375	20
	2x2	212	28650	535	27
LSD(0.05)		10	842	21	3
Source Means					
SOP		211	29182	511	26
KCl		197	25221	455	23
LSD(0.05)		8	805	16	2
	Placement Means				
	In-Furrow	196	25156	436	22
	2x2	212	29247	531	27
	LSD(0.05)	9	808	15	2

(continued)

Table 13. Effects of potassium source (sulfate of potassium or potassium chloride), placement (in-furrow or 2x2), and rate of liquid starter fertilizer (7-21-7) on grain yield, stand establishment, and whole-plant dry weight and K uptake at the 6-leaf stage, 1996.

Source and Rate	Placement	Yield	Population	6-Leaf Stage Dry Matter	Whole-Plant K Uptake
		bu/a	plants/a	lb/a	
Rate Means, lb/a					
No starter check*		182	28920	264	13
50		204	28210	487	25
100		205	28019	508	26
150		204	25375	454	23
LSD(0.05)		NS**	967	NS	NS

*No starter check was not included in statistical analysis.
**Not significant at the 0.05 level of probability.

Table 14. Effects of potassium source (sulfate of potassium or potassium chloride) , placement (in-furrow or 2x2), and rate of dry starter fertilizer (7-21-7) on grain yield, stand establishment, and whole-plant dry weight and K uptake at the 6-leaf stage, 1996.

Source and Rate	Placement	Yield	Population	6-Leaf Stage Dry Matter	Whole-Plant K Uptake
		bu/a	plants/a	lb/a	
SOP	In-Furrow	211	29650	509	28
	2x2	212	29844	521	28
KCl	In-Furrow	180	21292	362	19
	2x2	211	29622	522	27
LSD(0.05)		11	850	26	3
Source Means					
SOP		212	29182	511	26
KCl		195	25221	455	23
LSD(0.05)		8	805	16	2

(continued)

Table 14. Effects of potassium source (sulfate of potassium or potassium chloride) , placement (in-furrow or 2x2), and rate of dry starter fertilizer (7-21-7) on grain yield, stand establishment, and whole-plant dry weight and K uptake at the 6-leaf stage, 1996.

Source and Rate	Placement	Yield	Population	6-Leaf Stage Dry Matter	Whole-Plant K Uptake
		bu/a	plants/a	lb/a	
	Placement Means				
	In-Furrow	196	25156	436	22
	2x2	212	29247	531	27
	LSD(0.05)	9	808	15	2
Rate Means, lb/a					
No Starter Check*		180	28994	274	14
50		203	28810	489	26
100		206	28756	501	26
150		201	24897	474	24
LSD(0.05)		NS**	955	NS	NS

* No starter check was not included in statistical analysis.
**Not significant at the 0.05 level of probability.

INFLUENCE OF ROW SPACING AND PLANT POPULATION ON CORN PRODUCTION

W. Barney Gordon, Dale L. Fjell, Scott A. Staggenborg, and Victor C. Martin

Summary

Studies were initiated in 1996 to investigate the effects of row spacing and population on corn grain yields. Two sites (one dryland and one irrigated) were located in Republic County and one irrigated test was located at the Sandyland Experiment Field near St. John. The test consisted of three row spacings (30, 20, and 15 inches) at all locations and four plant populations (20,000, 26,000, 32,000, and 36000 plants/a) at the two Republic County locations. The St. John location included three populations (20,000, 26,000, and 32,000 plants/a). A significant row space by population interaction was detected at both Republic County locations. In both the dryland and irrigated locations in Republic County yields were higher in 15-inch rows at the high population (36,000 plants/a) than at the other two row spacings. Yields at the lower populations were similar in all three of the row spacings. Row spacing did not affect yields at St. John. Yields were affected by population alone.

Introduction

Early in the century, corn was grown in rows spaced about 40 inches apart to accommodate horse-drawn equipment and later mechanized equipment and post-emergent cultivation practices. The development of effective chemical herbicides and narrow row equipment has given producers the option of reducing row spacing. With the development of corn headers for combines capable of harvesting 15- to 20-inch rows, interest in narrow-row corn spacing (less than 30 inches) is being renewed among producers in many regions. Recently published information on narrow-row spacings for corn production is limited. Most narrow-row experiments have been conducted in the upper Midwest region and have compared only two row spacings (the conventional 30 inch to one narrow row spacing). Information on narrow row spacing effects on corn yield under western cornbelt conditions is needed. This research compares conventional 30-inch rows to 15- and 20-inch rows at four plant populations ranging from 20,000 to 36,000 plants/a.

Procedure

Experiments were conducted at the North Central Kansas Experiment Field near Belleville, the Richard Larson Farm at Scandia (both sites were located in Republic County), and the Sandyland Experiment Field located at St. John. The soil at Belleville is a Crete silt loam and that at the Larson Farm is a Carr fine sandy loam. The soil at St. John is a Pratt loamy fine sand. The Belleville site was dryland. The Larson Farm and St. John locations were both center-pivot irrigated. Row spacings at all three locations were 30, 20, and 15 inches. Populations at the two Republic County sites were 20,000, 26,000, 32,000, and 36,000 plants/a. Populations at St. John ranged from 20,000 to 32,000 plants/a. A John Deere 71-unit planter was used to plant the plots. Plots consisted of four 30-inch, six 20-inch, or eight 15-inch rows. Plots were overplanted and hand thinned to the desired populations. Planting dates were 24 April, 26 April, and 16 May at Belleville, Scandia, and St. John, respectively. The hybrid Pioneer 3394 was planted at all locations. Plots were harvested by hand and shelled.

Results

At both the Republic County sites, yields were similar in all row spacings at the lower populations (Tables 15 and 16). At the 36,000 plant/a level, yields were significantly greater in the 15-inch row system. At the Belleville location (Table 15), yields at the 36,000 plant/acre level were 119, 123, and 135 bu/a in the 30-, 20-, and 15-inch row systems, respectively. At the Richard Larson Farm, results were similar (Table 16). At 36,000 plants/a, the 15-inch row system outyielded the 30-inch system by 22 bu/a. Yields in the 30- and 20-inch row systems were similar at all population levels. In both these row spacings, yields continued to increase with increasing plant populations up to the 32,000 plant/a level. The very dry weather in June and early July may have limited potential ear size in the developing corn plants and resulted in a positive response to higher than normal plant populations. In the 15-inch row system, yields continued to increase up to the 36,000 plant/a level. At St. John, row spacing did not significantly affect yields (Table 17). A 32 bu/a yield increase resulted from increasing plant population from 20,000 to 26,000 plants/a.

The results of this experiment indicate that, at least under some conditions, yields can be improved significantly by narrowing row spacing to 15 inches, provided populations are large enough.

Table 15. Effects of row spacing and plant population on corn grain yield, Belleville, 1996.

Row Spacing	Population	Yield
	plants/a	bu/a
30 inch	20000	96
	26,000	105
	32,000	115
	36,000	119
20 inch	20,000	91
	26,000	103
	32,000	116
	36,000	123
15 inch	20,000	95
	26,000	104
	32,000	120
	36,000	135
Row Spacing x Population LSD(0.05)		9

Table 16. Effects of row spacing and plant population on corn grain yield, Larson Farm, Scandia, 1996.

Row Spacing	Population	Yield
	plants/a	bu/a
30 inch	20000	121
	26,000	145
	32,000	163
	36,000	167
20 inch	20,000	136
	26,000	144
	32,000	164
	36,000	164
15 inch	20,000	140
	26,000	152
	32,000	163
	36,000	189
Row Spacing x Population LSD(0.05)		13

Table 17. Effects of row spacing and plant population on corn grain yield, Sandyland Experiment Field, St. John, 1996.

Row Spacing	Population	Yield
	plants/a	bu/a
30 inch	20000	164
	26,000	190
	32,000	186
20 inch	20,000	165
	26,000	209
	32,000	183
15 inch	20,000	164
	26,000	190
	32,000	200
Row Spacing x Population LSD(0.05)		NS*
Row Spacing Means		
30 inch		180
20 inch		186
15 inch		185
LSD(0.05)		NS
	Population Means	
	20,000	164
	26,000	196
	32,000	190
	LSD(0.05)	9

*Not significant at the 0.05 level of probability.

EFFECTS OF CROPPING SYSTEM AND NITROGEN FERTILIZATION ON NO-TILLAGE PRODUCTION OF GRAIN SORGHUM

W. Barney Gordon, David A. Whitney, Dale L. Fjell, and Kevin Dhuyvetter

Summary

When averaged over N rates, 1982-1995 yields were 23 bu/a greater in sorghum rotated with soybeans than in continuous sorghum. When no N was applied, rotated sorghum yielded 32 bu/a greater than continuous sorghum. In the continuous system, grain sorghum yield continued to increase with increasing N rate up to the 90 lb/a rate. In the soybean rotation, yields increased with increasing N rate only up to the 60 lb/a rate. Optimal N rate was not very sensitive to changes in N or sorghum prices. When averaged over N rate, grain sorghum rotated with soybeans reached mid-bloom 7 days sooner than continuous grain sorghum. Two knife-applied N sources (anhydrous ammonia and 28% UAN) were evaluated during the years 1982-1989. No grain sorghum yield differences resulted from N source. The 15-year soybean yield average was 35 bu/a. Soybean yields were not affected by N applied to the previous sorghum crop. When averaged over the period 1982-1995, annual returns over variable costs were $32.15, $75.88, and $83.92/a for continuous sorghum, rotated grain sorghum, and rotated soybeans, respectively. Soil nitrate-N levels (samples taken in April before fertilization) were greater in rotated sorghum than in continuous sorghum at the 0 N rate but nearly the same at the 90 lb/a rate. In 1996, four additional N rates (120, 150, 180, and 210 lb/a) were added to the experiment. Yields were greater in the rotated system than in continuous sorghum at all levels of applied N. Yields in the continuous system continued to increase with increasing N rate up to the 90 lb/a level. Yields in the rotated system were maximized with application of 60 lb/a N.

Introduction

Crop rotations were necessary to maintain soil productivity before the advent of chemical fertilizers. Biological fixation of atmospheric nitrogen (N) is a major source of N for plants in natural systems. Biological fixation through legume-*Rhizobium* associations are utilized extensively in agricultural systems. Using a legume in a crop rotation system can reduce the N requirement for the following non-legume crop. Other benefits of legume rotations include: breaking disease and insect cycles, helping weed control programs, and decreasing the toxic effects of crop residues. This study evaluates N rates for continuous grain sorghum and grain sorghum grown in annual rotation with soybeans in a no-tillage production system.

Procedures

This study was established in 1980 at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Data are reported starting in 1982. Treatments included cropping system (continuous grain sorghum and grain sorghum grown in annual rotation with soybeans) and N rates (0, 30, 60 and 90 lb/a). In 1992-1989, the two N sources anhydrous ammonia and urea-ammonium nitrate solution (28% UAN) were evaluated. Both N sources were knife-applied approximately 4 inches below the soil surface in the middles of rows from the previous year's crop. After 1989, anhydrous ammonia was used as the sole N source. In each year, N was knife-applied 7-14 days prior to planting. Grain sorghum or soybeans were planted into old rows without tillage in mid-May to early June. Grain sorghum was seeded at the rate of 60,000 seed/a and soybeans were planted at the rate of 10 seed/ft. Soil samples were taken incrementally to a depth of 24 inches in April of 1992, 1993, and 1994, before any N was applied. Soybean yields were not affected by N applied to the previous sorghum crop and, therefore, are averaged over N rate. In 1996, four additional N rates (120, 150, 180, and 210 lb/a) were added to the experiment in order to further define N response.

Results

In the continuous grain sorghum system, grain yields (average 1982-1995) continued to increase with increasing N rate up to the 90 lb/a (Table 18). Sorghum yields in the rotated system were maximized with an application of 60 lb/a. When no N was applied, rotated sorghum yielded 32 bu/a greater than continuous sorghum. When four additional N rates were added in 1996, sorghum yields were greater in the rotated cropping system than in the continuous system at all levels of N (Table 19). Over the 15-year period, soybean yields averaged 35 bu/a and were not affected by N applied to the previous sorghum crop (Table 20). Two knife-applied N sources, anhydrous ammonia and 28% UAN, were evaluated from 1982-1989. When averaged over cropping system and N rate, yields were 60 and 59 bu/a for anhydrous ammonia and UAN, respectively. For the no N check, the number of days from emergence to mid-bloom was 8 days shorter in the rotated system than in the continuous system (Table 18). Even at the 90 lb/a N rate, time to mid-bloom was 8 days shorter than in the continuous system. Soil nitrate-N levels in the top 24 inches of the soil profile (samples taken in April before fertilization) were greater in rotated sorghum than in continuous sorghum at the 0 N rate but nearly the same at the 90 lb/a rate (Figure 1). Economic analysis showed that annual returns over variable costs were $32.15, $75.88, and 83.92/acre, for continuous sorghum, rotated sorghum, and rotated soybean, respectively (Figure 2). Returns from rotation were significantly greater than returns from continuous sorghum. Optimal N rate was not very sensitive to changes in N or sorghum price (Figure 3).

Table 18. Effects of cropping system and nitrogen rate on grain sorghum yields and number of days from emergence to mid-bloom, Belleville.

N Rate	Cropping System	Grain Yield 1982-1995	Days to Mid-Bloom 1992-1995
lb/a		bu/a	
0	Continuous	43	64
	Rotated	75	56
30	Continuous	59	61
	Rotated	84	55
60	Continuous	70	59
	Rotated	92	5

Table 18. Effects of cropping system and nitrogen rate on grain sorghum yields and number of days from emergence to mid-bloom, Belleville.

N Rate	Cropping System	Grain Yield 1982-1995	Days to Mid-Bloom 1992-1995
lb/a		bu/a	
	(continued)		
90	Continuous	80	58
	Rotated	92	53
<u>System Means</u>			
	Continuous	63	61
	Rotated	86	54
<u>N Rate Means</u>			
0		59	60
30		72	58
60		81	56
90		86	56
LSD (0.05)	Cropping System x N Rate	9	1

Table 19. Effects of cropping system and nitrogen rate on grain sorghum yields, 1996.

N Rate	Cropping System	Grain Yield
lb/a		bu/a
0	Continuous	92
	Rotated	120
30	Continuous	110
	Rotated	137
60	Continuous	131
	Rotated	164

(continued)

Table 19. Effects of cropping system and nitrogen rate on grain sorghum yields, 1996.

N Rate	Cropping System	Grain Yield
lb/a		bu/a
90	Continuous	143
	Rotated	163
120	Continuous	148
	Rotated	162
150	Continuous	148
	Rotated	162
180	Continuous	148
	Rotated	162
210	Continuous	148
	Rotated	162
System Means		
	Continuous	134
	Rotated	154
N Rate Means		
0		106
30		124
60		148
90		153
120		155
150		155
180		155
210		155
Cropping System x N Rate LSD (0.05)		8

Table 20. Yields of soybean grown in rotation with grain sorghum, Belleville, 1982-1996.

Year	Yield
	bu/a
1982	38
1983	15
1984	20
1985	28
1986	48
1987	48
1988	18
1989	25
1990	30
1991	12
1992	58
1993	56
1994	32
1995	41
1996	61
Average	35

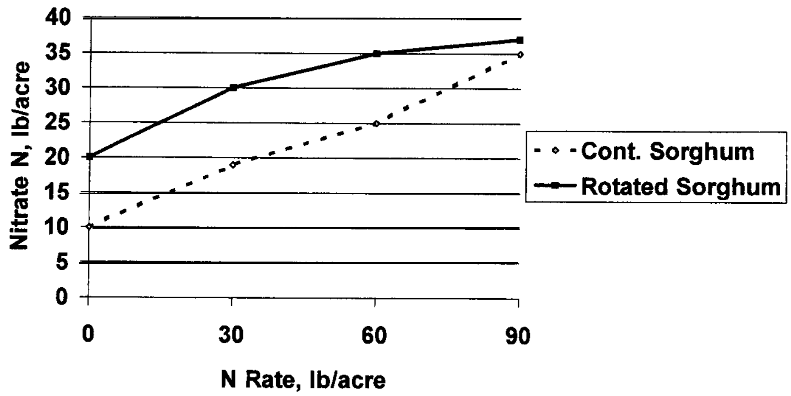


Figure 1. Soil nitrate N at 0-24 inches before fertilizer application, continuous versus rotated sorghum, April 1992-1994.

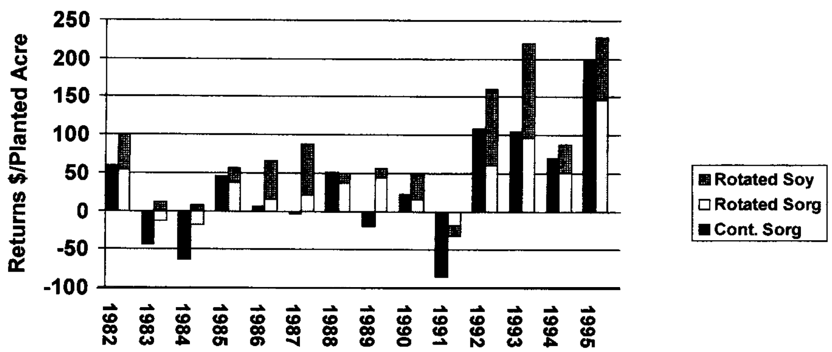


Figure 2. Economic returns over variable costs for three cropping systems.

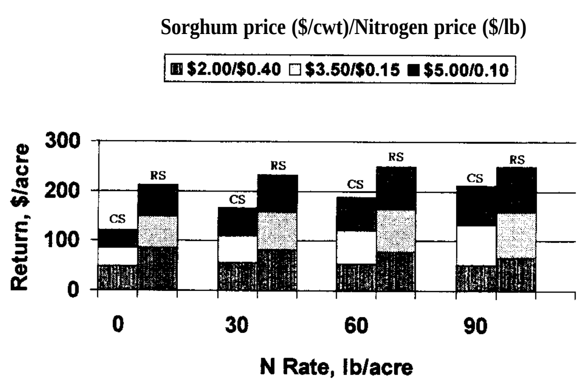


Figure 3. Returns over nitrogen cost for continuous (CS) versus rotated sorghum (RS).

EFFECTS OF PLANTING DATE AND HYBRID MATURITY ON DRYLAND GRAIN SORGHUM PRODUCTION

W. Barney Gordon and Dale L. Fjell

Summary

In 1996, grain yields were equal for the 30 May and the 15 June planting dates. Yields were lower at both earlier and later planting dates. When averaged over the 3 years of the study, late May plantings gave the greatest grain yields. The number of heads/plant (indication of tillering ability) generally declined as planting date progressed later into the growing season. Kernel weights were greatest at the 16 May planting date and least at the 30 June planting date. Numbers of seed/head were equal at the 30 May and 15 June planting dates. With all hybrids, the number of growth units from emergence to black layer declined as planting date was pushed later into the growing season.

Introduction

Some grain sorghum producers in north-central Kansas prefer to delay planting until mid-June so that the critical reproductive phase of crop development avoids drought and heat stress in July and early August. Temperature and soil water status during the heading period are regarded as prime factors in determining planting date. Late planting increases the risk of an early frost occurring before the crop is mature. Planting early so that grain sorghum will head prior to mid-season heat and drought stress may be hindered by sorghum's slow emergence and growth in cool soils. However, early planting allows the crop to mature before a frost. This test was initiated to investigate the effects of planting date and hybrid maturity on yield, yield components, and growth unit accumulation of grain sorghum.

Procedures

This experiment was conducted at Scandia, Kansas on a Crete silt loam soil under dryland conditions. Fertilization consisted of 100 lb/a N and 30 lb/a P_2O_5. Planting dates in 1996 were 16 May, 31 May, 15 June, and 30 June. Hybrids evaluated were Pioneer 8699, Pioneer 8500, Pioneer 8505, and Pioneer 8310. Planting rate was 60,000 seed/a. Final plant population averaged 49,475 plants/a and was not affected by planting date. Plots were harvested on 21 October. Notes were taken on mid-bloom (point at which 50% of the plants in a plot were in some stage of bloom) and black layer (physiological maturity). The formula used to calculate growth units is as follows: add maximum daily high temperature and minimum daily temperature, divide by 2, then subtract the base temperature of 33.8 ^{0}F. Plant height and head counts were recorded at harvest time. Seed samples were retained to determine 1000 seed weight. Grain yields were adjusted to 14 % moisture content.

Results

When averaged over hybrid, 1996 yields were equal at the 31 May and 15 June planting dates (Table 21). Earlier or later plantings resulted in yield reductions. When averaged over the 3 years of the experiment, yields were greatest at the late May planting. Tillering (number of heads/plant) was greatest at the earliest planting date and declined as planting date progressed later in the season. Pioneer 8699 showed the greatest ability to tiller. Numbers of seed/head were constant over the late-May and mid-June planting dates. Earlier or later plantings resulted in fewer seed/head. Kernel weights were greatest at the mid-May planting date and lowest at the late-June planting date. For all hybrids, total number of growth units from emergence to black layer declined as planting date was pushed later into the summer (Table 22). The number of growth units from mid-bloom to black layer was constant, regardless of maturity group of the hybrid.

Table 21. Effects of planting date and hybrid maturity group on grain yield, yield components, and plant height of grain sorghum, Scandia, 1996.

Planting Date	Hybrid	Yield 1996	Yield 1994-1996	Heads/ Plant	Seed/ Head	1000-Kernel Weight	Height
		bu/a				grams	inches
Mid-May	Pioneer 8699	126	117	1.3	1947	27.3	38.7
	Pioneer 8500	138	125	1.2	2260	27.4	43.0
	Pioneer 8505	133	129	1.1	2382	25.9	42.0
	Pioneer 8310	151	137	1.1	2641	27.0	46.0
Late-May	Pioneer 8699	148	140	1.2	2810	23.7	38.7
	Pioneer 8500	159	143	1.0	2783	26.6	40.7
	Pioneer 8505	147	136	1.1	2695	25.0	40.0
	Pioneer 8310	162	140	1.1	2896	27.1	45.3
Mid-June	Pioneer 8699	138	125	1.2	2676	24.0	40.7
	Pioneer 8500	150	122	1.1	2817	25.6	45.0
	Pioneer 8505	151	125	1.1	2737	26.7	45.3
	Pioneer 8310	169	123	1.0	2982	28.3	50.7
Late-June	Pioneer 8699	129	99	1.1	2430	25.3	39.0
	Pioneer 8500	128	96	1.0	2355	26.9	47.3
	Pioneer 8505	130	91	1.0	2565	26.1	45.7
	Pioneer 8310	122	78	1.0	2683	24.7	50.0
Planting Means							
Mid-May		137	127	1.2	2307	26.9	42.4
Late-May		154	140	1.1	2796	25.6	41.2

(continued)

Table 21. Effects of planting date and hybrid maturity group on grain yield, yield components, and plant height of grain sorghum, Scandia, 1996.

Planting Date	Hybrid	Yield 1996	Yield 1994-1996	Heads/ Plant	Seed/ Head	1000-Kernel Weight	Height
		bu/a				grams	inches
Mid-June		152	124	1.1	2803	26.1	45.4
Late-June		127	91	1.0	2508	25.8	45.5
Hybrid Means							
	Pioneer 8699	135	120	1.2	2466	25.1	39.3
	Pioneer 8500	143	121	1.1	2554	26.6	44.0
	Pioneer 8505	140	120	1.1	2595	25.9	43.2
	Pioneer 8310	151	120	1.1	2801	26.8	48.0
	Planting Date x Hybrid LSD(0.05)	8	10	0.05	168	0.2	3
CV%		5.4		3.6	6.1	4.2	3.2

Table 22. Effects of planting date and hybrid maturity group on growth unit accumulation of grain sorghum, 1996

Planting Date	Hybrid	Emergence to Mid-Bloom	Emergence to Black Layer	Mid-Bloom to Black Layer
			Number of Growth Units	
May 16	Pioneer 8699	2384	3859	1475
	Pioneer 8500	2619	4054	1435
	Pioneer 8505	2557	3992	1435
	Pioneer 8310	2670	4134	1464
May 31	Pioneer 8699	2316	3819	1503
	Pioneer 8500	2523	3990	1467
	Pioneer 8505	2458	3929	1471
	Pioneer 8310	2629	3936	1307

Table 22. Effects of planting date and hybrid maturity group on growth unit accumulation of grain sorghum, 1996

Planting Date	Hybrid	Emergence to Mid-Bloom	Emergence to Black Layer	Mid-Bloom to Black Layer
			Number of Growth Units	
June 15	Pioneer 8699	2528	3820	1292
	Pioneer 8500	2667	3910	1243
	Pioneer 8505	2613	3878	1265
	Pioneer 8310	2738	4020	1282
		(continued)		
June 30	Pioneer 8699	2158	3463	1305
	Pioneer 8500	2364	3657	1293
	Pioneer 8505	2289	3638	1349
	Pioneer 8310	2429	3664	1235
Planting Means				
May 16		2558	4010	1452
May 31		2482	3919	1437
June 15		2636	3907	1271
June 30		2310	3605	1296
Hybrid Means				
	Pioneer 8699	2345	3740	1394
	Pioneer 8500	2543	3903	1360
	Pioneer 8505	2479	3859	1380
	Pioneer 8310	2617	3939	1322
ANOVA (P>F)				
Planting Date (PD)		0.0001	0.001	0.007
Hybrid (H)		0.0001	0.0001	0.0009
PD x H		0.0002	0.04	0.05

EFFECTS OF PLANTING DATE AND SEEDING RATE ON GRAIN YIELDS OF TWO WINTER WHEATS GROWN IN NORTHCENTRAL KANSAS

Scott A. Staggenborg and W. Barney Gordon

Summary

Wheat planting dates vary from producer to producer in northcentral Kansas. Increased double cropping of wheat after a summer crop has resulted in large number of acres being planted in mid to late October. This study was designed to assess the performance of the two newest wheat varieties from Kansas State University, Jagger and 2137, at several planting rates and planting dates in northcentral Kansas. As expected, seeding rates from 30 to 120 lbs of seed/a affected only final stand. As planting was delayed in 1995, heads/a and yield decreased because of a dry winter. As a result of several warm periods followed by extreme cold in February and March of 1996, Jagger dormancy was damaged during this period. Jagger yields were 20 bu/a lower than yields of 2137. Spring tillers accounted for a large portion of Jagger's yield. This resulted in lower test weights than 2137, because the grain from the late tillers developed during hotter temperatures in late June. These results illustrate the importance of planting winter wheat in northcentral Kansas so that adequate fall growth can be achieved. Such growth aids the plant in winter survival and spring regrowth.

Introduction

Kansas State University recently released two winter wheat varieties. In 1994, Jagger was released to selected growers for seed increase. Jagger is an early maturing wheat that has some of the highest ratings for leaf disease resistance. 2137, a variety that was part of the donation in 1990 from Pioneer Hi-Breds' wheat breeding program, was released for seed increase in 1995. 2137 is a medium-early maturing variety released to replace 2163. It improvements over 2163 include yield, test weight, and disease resistance.

Wheat planting dates and seeding rates are two topics that most producers are eager to discuss at public meetings and private gatherings. Planting date selection for wheat in northcentral Kansas is often a balancing act between early planting to achieve better stands and fall growth and late planting to reduce the effects of Hessian fly, cheat, and take-all root rot. Double-cropping wheat after a summer row crop has increased the number of wheat acres being planted in mid to late October.

Wheat seeding rates for wheat vary less than planting dates. A survey of wheat producers in northeast Kansas would certainly result in a range of seeding rates from 60 to 120 lbs, with an average in the 70-75 lb range. Most producers are aware of and follow the recommendation to increase seeding rates as planting date is delayed to compensate for reduced tiller production under cooler temperatures.

The release of two new wheat varieties as well as the on-going debate over planting dates and planting rates were the underlying motivations for this study. The objectives of this study were to evaluate the performance of Jagger and 2137 at three planting dates and four seeding rates in northcentral Kansas.

Procedures

This study was initiated in the fall of 1995 at the Northcentral Kansas Experiment Field at Belleville, KS. Treatments consisted of two varieties, Jagger and 2137; four seeding rates, 30, 60, 90, and 120 lbs/a; and three planting dates, September 26, October 9, and October 23, 1995. A factorial arrangement of treatments in a randomized complete block design with three replications was used. All plots were 300 ft^2 in size.

Seedling emergence counts were taken approximately 3 weeks after planting for the first two planting dates. Stand counts were taken for the third planting date on 22 February, 1996. Established stands were determined by counting the number of plants emerged in 3 feet of row from three randomly selected locations in each plot.

Approximately 1 month before harvest (4 June, 1996), head counts were taken to assess each variety's ability to tiller at this range of planting dates and seeding rates. The numbers of heads in 1 foot of row were determined at three randomly selected locations in each plot.

Grain yield, test weight, and moisture were determined on July 12, 1996. Yields were adjusted to a constant moisture of 12.5%.

Results

Seedling Emergence

Final emerged plant numbers were affected by variety and seeding rate (Table 1). Across all dates and seeding rates, final stands of Jagger were 250,000 plants/a lower than those of 2137. Differences in seedling emergence levels between the two varieties were the results of seed quality. The 2137 seed planted contained a great many shriveled kernels, which resulted in more seeds/lb. Because the seeding rates were based on lbs/a, not seeds/a, more seeds were planted in the 2137 plots than in the Jagger plots.

As expected, seedling emergence levels declined as seeding rates declined. The stand established at each seeding rate was different than those achieved at the other three seeding rates.

Although planting date did not affect established stands, we should note that stands were determined on different dates, with those for the first two dates counted in October. Soil moisture on the third planting date was not adequate to sustain seedling emergence. Winter snow fall (November-January) was adequate to achieve emergence, and stand counts were delayed until late February.

Head number

Head numbers determined prior to harvest were affected by variety and planting date (Table 1). Across all planting dates and seeding rates, Jagger produced 800,000 fewer heads/a than 2137. This varietal difference was the result of differences in seed size, varietal maturity, and tillering ability. As discussed previously, the smaller seed size of the 2137 resulted in more seed/a being planted in each plot. Not only were fewer seed/a planted and subsequently fewer plants/a established for Jagger, but its earliness resulted in early spring green up during several warm periods in February and March. These warm periods were followed by extreme cold periods that resulted not only in loss of top growth but also stand reduction from those plants with weak root and crown systems. Because 2137 is a medium-maturing variety, it did not break dormancy during the warm periods in February or early March.

Date of planting effects illustrate the importance of good fall growth for survival of spring cold periods. As planting was delayed, soil moisture became more limiting, resulting in less vigorous seedlings. The weaker seedlings had weaker root and crown systems as well as less carbohydrate accumulation in the fall. During the cold periods in the spring, accumulated carbohydrates were necessary for the plants to remain winter hardy and to survive the cold periods. Carbohydrate reserves are also necessary for regrowth if existing top growth is removed by cold temperatures. As planting date was delayed, all of these components necessary for plant survival during the spring cold spells were diminished by cool and dry conditions in the fall and early winter.

The varietal differences in heads/a could have been larger than the data indicate. The spring cold periods resulted in considerable stand losses in the last two plantings of Jagger. However, Jagger's above-average ability to tiller and the favorable growing conditions in May enabled it to produce spring tillers, thus increasing heads/a at harvest.

Yield

As expected, the effect of varieties and planting date on heads/a resulted in similar effects on grain yields. Heads/a were highly correlated (r=0.94) to grain yield (data not shown).

Grain yields from Jagger were approximately 20 bu/a lower than those from 2137. As planting was delayed, grain yields decreased with extreme variation. The range in grain yields was from a high of 88 to a low of 1 bu/a.

Test Weight

Variety and planting date (variety x planting date interaction) were the only factors that affected test weight. In general, test weight declined from the first planting date to the last planting date, with Jagger having lower overall test weight than 2137 (Table 1).

In both varieties, test weight decreased as planting was delayed. It is reasonable to believe that as a result of the cool, dry fall conditions, wheat planted at later dates produced fewer tillers in the fall and relied more on spring-produced tillers. Those tillers developed later than the main stem head and any fall tillers as a result of being initiated later. Heads from the main stem and fall-produced tillers filled grain during late May and early June. This period was cool and wet, favorable conditions for grain development in wheat. Heads on later maturing tillers filled grain during late June and even early July under higher temperatures than those experienced by the earlier tillers during grain fill. Filling grain under higher temperatures can result in lower grain weights.

Varietal differences in test weight as planting date was delayed can then be explained by the proportion of early and late tillers that each relied upon to produce yield. The highest test weight was achieved by the early planted 2137. Test weights were lower at the other two planting dates than at the first planting date. As indicated earlier, 2137 planted later probably had fewer fall-produced tillers because of the cool, dry conditions experienced during its early growth period and, therefore, relied more on spring-produced tillers to produce yield and had lighter grain overall.

Jagger's test weights followed a similar trend, except that weights were higher for the first two planting dates than the last planting date. Test weights of Jagger for the first two planting dates were similar to the test weights of the last two dates in 2137. Jagger having overall lower test weights than 2137 is obviously the result of more loss of stand in Jagger during the spring cold spells and, thus, more reliance on spring-produced tillers to produce yield. The decline in test weight from the first planting date to the last in Jagger was obviously the result of a higher proportion of the grain coming from spring tillers.

Conclusions

Date of planting affected heads/a at harvest and subsequent grain yield. The greatest heads/a and highest grain yields across both varieties resulted from the early planting date. The results from this study do not recommend one seeding rate above the other. Based on these results, producers should continue at the current planting rates. However, they should be aware of the recommendation that as date of planting is delayed, seeding rates should be increased to compensate for decreased tiller and top growth.

These results from 1 year indicate that medium to medium-early maturing wheat varieties or those that are daylength sensitive and avoid early spring green up are best adapted to northcentral Kansas. Planting early maturing varieties that can green up early in the spring is risky. If early maturing varieties such as Jagger are to be planted in this region, they need to be planted under conditions that allow them to develop an adequate root and crown system as well as accumulate adequate carbohydrate reserves before winter. They may have to contend with several warm/cold cycles during February and March, which can reduce stands and grain yields.

Table 1. Established stand, head count at harvest, grain yield, and test weight for two wheat varieties planted at three planting dates and four seeding rates in 1995 at Belleville, KS.

	Established Stand		Head Count		Yield		Test Weight	
Seeding Rate	Jagger	2137	Jagger	2137	Jagger	2137	Jagger	2137
	plants/a		heads/a		bu/a		lb/bu	
30	431.1	694.4	1242.9	2190.3	29.9	52.3	50.7	54.0
60	637.6	882.8	1588.7	2307.7	36.4	53.2	52.6	53.9
90	1200.3	1412.0	1713.7	2366.4	36.6	58.6	51.7	54.5
120	1440.3	1729.5	1939.9	2756.9	37.8	57.5	52.0	54.6
LSD(.10)	NS		NS		NS		NS	
Planting Date								
Sept 26[1]	869.3	1119.0	2806.2	4019.1	53.1	78.1	53.6	55.6
Oct 9[1]	1097.7	1242.9	1817.9	2305.8	42.0	52.2	53.4	53.9
Oct 23[2]	815.1	1177.1	239.8	891.0	10.4	35.9	48.3	53.3
LSD (.10)	NS		NS		NS		1.3	

Table 1. Established stand, head count at harvest, grain yield, and test weight for two wheat varieties planted at three planting dates and four seeding rates in 1995 at Belleville, KS.

Variety	Established Stand	Head Count	Yield	Test Weight
	plants/a	heads/a	bu/a	lb/bu
Jagger	927.3	1621.3	35.2	51.7
2137	1179.7	2405.3	55.4	54.2
LSD (.10)	131.6	339.4	6.6	--
Seeding Rate (lb/a)				
30	562.7	1716.6	41.1	52.3
60	760.2	1948.2	44.8	53.1
90	1306.2	2040.0	47.6	53.2
120	1584.9	2348.4	47.7	53.3
LSD (.10)	186.1	NS	NS	NS
Planting Date				
Sept 26[1]	994.1	3412.7	65.6	54.5
Oct 9[1]	1170.3	2061.8	47.1	53.6
Oct 23[2]	996.1	565.4	23.1	50.8
LSD (.10)	NS	415.7	7.1	--

1 Counts taken on October 15, October 27 and February 22, 1996.

2 Counts taken on June 4, 1996.

KANSAS RIVER VALLEY EXPERIMENT FIELD

Introduction

The Kansas River Valley Experiment Field was established to study how to effectively manage and use irrigation resources for crop production in the Kansas River Valley. The Topeka Unit consists of 80 acres located 3.5 miles east of Silver Lake on US 24, then 1 mile south of Kiro, and 1.5 miles east on 17th street. The Rossville Unit consists of 80 acres located 1 mile east of Rossville or 4 miles west of Silver Lake on US 24.

Soils 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. The soils are well drained, except for small areas of Kimo and Wabash soils in low areas. 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.

1996 Weather Information

In 1996, the frost free season was equal to the 183-day average. The last 32^0 F frost in the spring was on April 31 (average, April 20), and the first in the fall was on October 29 (average, October 20). Precipitation was below normal through April, above normal in May, below normal in June and July, and above normal in August (Table 1). The precipitation totals for October, 1995 through September, 1996 was over 10 inches below normal for both fields. However, with irrigation, corn and soybean yields were excellent.

Table 1. Precipitation at the Kansas River Valley Experiment Field, 1995-1996.

Month	Rossville		Topeka	
	1995-1996	Avg.	1995-1996	Avg.
	Inches		inches	
Oct.	0.30	0.95	0.30	0.95
Nov.	0.53	0.89	0.53	1.04
Dec.	0.31	2.42	0.31	2.46
Jan.	0.58	3.18	0.15	3.08
Feb.	0.13	4.88	0.22	4.45
Mar.	1.26	5.46	0.88	5.54
Apr.	1.11	3.67	0.74	3.59
May	4.63	3.44	5.42	3.89
June	3.30	4.64	2.09	3.81
July	2.89	2.97	2.29	3.06
Aug.	6.42	1.90	5.10	1.93
Sep.	3.59	1.24	2.30	1.43
Total	25.15	35.64	20.33	35.23

CORN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux and Philip L. Barnes

Introduction

Weed competition can limit crop yields. Chemical weed control and cultivation have been used to control weeds in row crops. In 1996, the corn herbicide test was divided into two tests, a preemergence test (PRE) and a postemergence test (POST). These studies included several of the newer herbicides for use on corn. The major weeds in these two tests were large crabgrass, Palmer amaranth, and common sunflower.

Procedures

The PRE test was conducted on a Eudora silt loam soil previously cropped to soybeans with a pH of 6.8 and an organic matter content of 1.5 percent and the POST test was conducted on a Sarpy fine sandy loam with a pH of 7.1 and an organic matter content of 1.0. Pioneer Brand 3162 and Asgrow RX747T were planted on April 22 and 23 on the PRE and POST tests, respectively, at 26,200 seeds/a in 30-inch rows. Anhydrous ammonia at 150 lbs N/a was applied preplant and 10-34-0 fertilizer was banded at 110 lbs/a at planting. The herbicides were applied on the PRE test on April 23 and on the POST test as follows: preemergent (PRE) - May 1; early postemergent (EEP) - May 29; postemergent (EP) June 4; and mid-postemergence (MP) - June 10. Only the EEP plots were cultivated 7 days after treatment. Ratings for crop injury were made on May 20 and June 25 on the PRE test and on June 18 and June 27 for the POST test. Ratings for weed control were made on May 20 and June 25 for the PRE test and on June 18, June 27 and July 10 for the POST test. The first significant rainfall after PRE herbicide application was April 28 for the PRE test and May 4 for the POST test. Plots were harvested on October 2 using a modified Gleaner E combine.

Results and Discussion

In the PRE test, very little corn injury was observed at 28 days after treatment (DAT) (Table 2). Control of large crabgrass (Lacg) was very good with all treatments. Axiom gave the least, and unacceptable control of Palmer amaranth (Paam). Applications of Surpass 100 at 2.64 qt/a and Balance at 2.0 oz/a also resulted in poor control of Paam, although Surpass 100 at 2.40 and Balance at 1.5 and 2.5 oz/a gave excellent control. Axiom also gave very low and unacceptable control of common sunflower (Cosf). Balance applied alone or in combination with Dual II or Surpass was also weak on Cosf. The addition of 1.11 lb/a atrazine 90 DF to Balance was sufficient to improve control of Cosf to 100%. The grain yield of corn was closely correlated to the weed control ratings, especially that of Cosf. Weed control deteriorated somewhat later in the season, but 1 timely cultivation would probably have maintained the 28 DAT weed control ratings.

A total of 30 herbicide treatments were evaluated in the POST test: 3 very early postemergence + a cultivation 7 DAT (EEP); 21 early postemergence (EP); 5 mid-postemergence (MP); and 1 preemergence is (PRE) + EP (Table 3). Lacg infestation in this test was heavy and only the EP treatment of Lightning + Sun-it II + UAN resulted in more than 90% control. Control ratings greater than 80% were obtained with the EP and MP treatments of Lightning + NIS + UAN; Lightning + Sun-it II + UAN, MP; and Prowl + Atrazine + COC, EP. Control of Paam was good with only 3 treatments having less than 80% control (Lightning + NIS + UAN, EP; Exceed + Accent + NIS, EP; and Basis + Banvel + COC + UAN, EEP). The control of Cosf was also very good with all treatments except 3 having 90% or greater control. Exceed + Accent + NIS, EP and Resource + Buctril, EP gave about 70% control while Resource + Accent + COC only gave 33% control. As in the PRE test, control deteriorated with most treatments after the 28 DAT ratings and a cultivation would have helped. Corn grain yields were lower in this test, and were somewhat variable because of soil variability.

Table 2. Effect of preemergent herbicides on corn injury, weed control and grain yield, Rossville, 1996.

Treatment	Rate	Appl Time	Corn Inj. 28 DAT	Weed Control, 28 DAT[1] Lacg	Paam	Cosf	Grain Yield
	prod./a		%		%		bu/a
Untreated check			0	53	17	33	59
Surpass 100	2.40 qt	PRE	0	100	98	97	113
Surpass 100	2.64 qt	PRE	0	92	73	97	138
Dual II +	2.05 pt	PRE	0	97	97	98	160
Atrazine 90 DF	1.5 lb						
Dual Magnum	1.35 pt	PRE	0	98	98	98	169
Atrazine 90 DF	1.5 lb						
Surpass +	1.5 pt	PRE	0	98	100	95	157
Atrazine 90 DF	1.5 lb						
Harness +	1.75 pt	PRE	0	98	98	98	154
Atrazine 90 DF	1.5 lb						
Frontier +	18 oz	PRE	0	100	100	97	140
Atrazine 90 DF	1.5 lb						
Axiom +	16 oz	PRE	2	95	93	100	126
Atrazine 90 DF	1.5 lb						
Axiom	16 oz	PRE	0	97	58	33	38
Bullet	3.5 qt	PRE	2	92	100	97	130
Balance	1.5 oz	PRE	0	98	97	62	126
Balance	2.0 oz	PRE	0	92	77	73	95
Balance	2.5 oz	PRE	0	97	100	65	125
Balance +	2.0 oz	PRE	2	93	97	72	120
Surpass	1.25 pt						
Balance +	2.0 oz	PRE	0	100	98	63	90
Dual II	1.28 pt						
Balance +	2.0 oz	PRE	0	98	100	100	167
Atrazine 90 DF	1.11 lb						
Balance +	2.0 oz	PRE	13	97	98	92	146
Dual II +	1.03 pt						
Atrazine 90 DF	1.11 lb						
Balance +	2.0 oz	PRE	0	98	100	100	163
Dual II +	1.03 pt						
Atrazine 90 DF	1.67 lb						
Balance +	2.0 oz	PRE	0	97	100	100	181
Atrazine 90 DF	1.67 lb						
Balance +	2.0 oz	PRE	0	98	97	78	124
Dual II	1.54 pt						
Balance +	2.0 oz	PRE	0	98	97	72	67
Surpass	1.5 pt						
Bicep II	2.4 qt/a	PRE	0	95	83	100	141
LSD(.05)			16	17	24	39	57

[1] Lacg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower (5/20/96).

Table 3. Effects of postemergent herbicides on corn injury, weed control, and grain yield, Rossville, 1996.

Treatment[1]	Rate	Appl Time[2]	Corn Injury 7DAT	Corn Injury 14DAT	Weed Control, 28DAT[3] Lacg	Weed Control, 28DAT[3] Paam	Weed Control, 28DAT[3] Cosf	Grain Yield
	prod./a		%			%		bu/a
Untreated check			0	0	0	33	23	28
Resolve +	5.3 oz	EP	2	0	78	92	100	137
Accent +	0.33 oz	EP						
NIS+	0.25 %	EP						
UAN	1 qt	EP						
Resolve +	5.3 oz	MP	0	0	73	92	100	130
Accent +	0.33 oz	Mp						
NIS+	0.25 %	MP						
UAN	1 qt	MP						
Lightning +	1.28 oz	EP	0	0	82	78	98	116
NIS+	0.25 %	EP						
UAN	1 qt	EP						
Lightning +	1.28 oz	MP	0	0	83	94	92	124
NIS+	0.25 %	MP						
UAN	1 qt	MP						
Lightning +	1.28 oz	EP	2	0	92	87	100	128
Sun-it II +	1.5 pt	EP	0					
UAN	1 qt	EP	0					
Lightning +	1.28 oz	MP	0	0	85	92	98	114
Sun-it II +	1.5 pt	MP	0					
UAN	1 qt	MP	0					
Exceed +	1.0 oz	EP	0	0	50	78	67	111
Accent +	0.5 oz	EP	0					
NIS	0.25 %	EP	0					
Exceed +	1.0 oz	MP	0	0	57	95	100	115
Accent +	0.5 oz	MP	0					
NIS	0.25 %	MP	0					
Dual II +	1.5 pt	PRE	0	2	13	98	100	109
Exceed +	1.0 oz	EP	0					
COC	2.0 pt	EP	0					
Dual II +	1.5 pt	PRE	0	3	10	100	100	114
Exceed +	1.0 oz	EP	0					
NIS+	2.0 pt	EP	0					

(continued)

Table 3. Effects of postemergent herbicides on corn injury, weed control, and grain yield, Rossville, 1996.

		Appl	Corn Injury		Weed Control, 28DAT[3]			Grain
Treatment[1]	Rate	Time[2]	7DAT	14DAT	Lacg	Paam	Cosf	Yield
	prod./a		%			%		bu/a
Banvel	4 oz	EP	0					
Dual II +	1.5 pt	PRE	0	3	20	100	100	94
Exceed +	1.0 oz	EP	0					
NIS+	2.0 pt	EP	0					
Buctril	4 oz	EP	0					
Dual II +	1.5 pt	PRE	0	0	37	100	100	97
Exceed +	1.0 oz	EP	0					
NIS+	2.0 pt	EP	0					
Action	1.2 oz	EP	0					
Dual II +	1.5 pt	PRE	0	0	57	98	100	76
Buctri/Atrazine	1.0 qt	EP	0					
Resource +	4 oz	EP	0	5	48	100	33	92
Accent +	0.67 oz	EP						
COC	1.0 pt	EP						
Resource +	4 oz	EP	0	2	13	95	100	79
Beacon +	0.38 oz	EP	0					
COC	1.0 pt	EP	0					
Resource +	4 oz	EP	0	2	7	100	100	85
Clarity	8 oz	EP	0					
Resource +	4 oz	EP	0	0	20	95	100	123
Accent +	0.33 oz	EP	0					
Beacon +	0.38 oz	EP	0					
COC	1.0 pt	EP	0					
Resource +	4 oz	EP	0	3	10	98	72	85
Buctril	0.5 pt	EP	0					
Basis[4] +	0.33 oz	EEP	0	0	70	92	100	142
COC +	1%	EEP	0					
UAN	2 qt	EEP	0					
Basis[4] +	0.33 oz	EEP	0	0	73	98	100	132
Atrazine +	13.3 oz	EEP	0					
COC +	1%	EEP	0					
UAN	2 qt	EEP	0					
Basis[4] +	0.33 oz	EEP	0	0	67	77	100	113

(continued)

Table 3. Effects of postemergent herbicides on corn injury, weed control, and grain yield, Rossville, 1996.

Treatment[1]	Rate	Appl Time[2]	Corn Injury		Weed Control, 28DAT[3]			Grain Yield
			7DAT	14DAT	Lacg	Paam	Cosf	
	prod./a		%			%		bu/a
Banvel +	4.0 oz	EEP	0					
COC +	1 %	EEP	0					
UAN	2 qt	EEP	0					
Basis Gold	14 oz	EP	0	0	68	100	97	125
COC +	1%	EP	0					
UAN	2 qt	EP	0					
Accent +	0.67 oz	EP	0	0	60	93	98	146
Buctril +	16 oz	EP	0					
NIS+	1 %	EP	0					
UAN	2 qt	EP	0					
Frontier +	20 oz	PRE	0	0	47	98	100	113
Marksman	3.5 pt	EP	0					
Prowl	3.0 pt	EP	0	0	83	100	100	113
Atrazine +	1.5 qt	EP	0					
COC	1.0 pt	EP	0					
Prowl +	3.0 pt	EP	0	0	23	100	100	101
Exceed +	1.0 oz	EP	0					
NIS	0.25 %	EP	0					
Prowl +	3.0 pt	EP	0	0	65	97	100	109
Accent +	0.33 oz	EP	0					
NIS	0.25 %	EP	0					
Prowl +	3.0 pt	EP	0	2	42	42	100	71
Beacon +	0.38 oz	EP						
NIS	0.25 %	EP						
LSD(.0.5)			NS	3	29	25	24	42

[1] COC = crop oil concentrate; UAN = 28-0-0 fertilizer; NIS = nonionic surfactant.
[2] PRE = preemergence; EEP = very early postemergence; EP = early postemergence; MP = mid-postemergence.
[3] Lacg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower; DAT = days after treatment application.
[4] Plus 1 cultivation 10-14 days after treatment.

SOYBEAN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux and Philip L. Barnes

Introduction

Chemical weed control and cultivation have been commonly used to control weeds in row crops. Weeds can seriously depress soybean yields. In 1996, this study was divided into a preplant, incorporated and preemergence (PPI/PRE) test and a postemergence (POST) test. These studies evaluated herbicides and herbicide combinations for weed control in soybeans. The major weeds in these tests were large crabgrass, Palmer amaranth, common sunflower, and eastern black nightshade.

Procedures

The PPI/PRE test was conducted on a Sarpy fine sandy loam soil with a pH of 6.8 and organic matter content of 1.1 percent, and the POST test was conducted on an Eudora silt loam soil with a pH of 7.1 and organic matter content of 1.0 percent, both previously cropped to corn. Sherman soybeans were planted on May 16 at 144,000 seeds per acre in 30-inch rows. Fertilizer (10-34-0) was banded at 120 lbs/a at planting. The herbicides in both tests were applied as follows: PPI - May 16; PRE - May 18; early postemergent (EP) - June 11; and mid-postemergent (MP) - June 18. The plots were not cultivated. Ratings for crop injury were made on June 12 for the PPI/PRE test and on June 18 and June 27 for the POST test. Significant rainfalls after the PPI and PRE treatments were May 23 (0.19 inch) and May 29 (1.27 inch). Some plots were not harvested because of high infestations of sunflower, but the plots that could be harvested were harvested October 18 using a modified Gleaner E plot combine.

Results and Discussion

The 22 treatements evaluated in the 1996 PPI/PRE test included 8 preplant, incorporated (PPI), 12 preemergence (PRE), and 1 early postemergence (EP) treatments and 1 untreated check (Table 4). The only soybean injury observed was with the EP treatment of Pursuit + Blazer. However, the soybeans grew out of this injury quite well.

Control of all four weeds (large crabgrass - Lacg; Palmer amaranth - Paam, common sunflower - Cosf; and eastern black nightshade - Ebns) was better with most of the 8 PPI treatments than with most of the 12 PRE treatments (Table 4). Lacg control at 28 DAT (data not shown) was 93% or better with all PPI treatments but had deteriorated to 68 - 88% control by 56 DAT. However, the PRE treatments had Lacg control ratings of only 40 - 68%. As with Lacg control, control of Paam and Cosf was 90% or better at 28 DAT with all treatments except Authority + Command and Authority + Lexone + Dual II. At 56 DAT, Authority + Classic, Pre, and Squadron, Tri-Scept, Detail, and Steel CP, PPI, were the only treatments maintaining 90% or better control of Paam. Only the PRE treatments of Broadstrike + Dual II, Authority + Command, and Authority + Lexone + Dual II resulted in Cosf control less than 87%. Ebns control was 80% or greater with all treatments. Grain yields were most closely related to sunflower control. However, yields were lower than normal, probably because of the presence of soybean cyst nematode in the field.

In the POST test, 16 PPI/PRE + EP and 24 EP treatments were evaluated (Table 5). Greater than 90% control of Lacg was obtained with Treflan, PPI + FirstRate + Pinnacle, EP; Treflan, PPI + FirstRate + Blazer, EP; Prowl, PRE + Pursuit DG, EP; Prowl, PRE + Pursuit DG + Pinnacle, EP; Prowl, PRE + Pursuit DG + Status, EP; Prowl, PRE + Raptor + Status, EP; Prowl, PRE + Sceptor OT, EP; Reflex + Fusion, EP; Twister, EP; Stellar, EP; Stellar + Basagran, EP; Stellar + Classic, EP; and Stellar + Scepter, EP. All treatments except Stellar, EP; Stellar + Basagran, EP, and Basagran, EP resulted in greater than 90% control of Paam. Control of Paam with these three treatments was less than 70%. Control of Cosf was excellent with all treatments except Dual II, PRE + Expert + Blazer, EP which gave 80% control. All treatments except 5 gave 87% or greater control of eastern black nightshade (Ebns). Of these 5 treatments, Flexstar + Fusion, EP gave 78% control; Dual II, PRE + Expert + Action, EP, 68%;Treflan, PPI + FirstRate + Pinnacle, EP, 60%; Concert SP + Assure II, EP, 53%; and Dual II, PRE + Expert + Pinnacle, EP, 52%. Soybean grain yields were probably influenced as much by soybean cyst nematode as by weed control as some plots with good weed control did not have good grain yields.

Table 4. Effect of preemergence and preplant, incorporated herbicides on soybean injury, weed control, and grain yield, Rossville, 1996.

Treatment	Rate	Appl Time	Soybean Inj. 28 DAT	Weed Control, 56 DAT Lacg	Paam	Cosf	Ebns	Grain Yield
	prod./a		%	%				bu/a
Untreated check			0	0	0	0	0	20
Broadstrike +	2.0 pt	PPI	0	73	82	90	95	31
Treflan	3.0 pt	PPI	0	73	93	98	100	37
Squadron	2.33 pt	PPI	0	82	98	100	90	35
Tri-Scept	1.0 qt	PPI	0	68	95	98	98	41
Detail	3.0 pt	PPI	0	88	93	100	100	40
Steel CP	1.0 qt	PPI	0	83	82	97	80	50
Treflan +	0.6 oz	PPI						
FirstRate	1.0 qt	PPI	0	85	80	100	83	31
Treflan +	0.75 oz	PPI						
FirstRate	1.0 qt	PPI	0	72	80	95	90	33
Broadstrike + Dual	1.0 qt	PRE	0	50	72	82	80	16
Broadstrike + Dual	1.5 pt	PRE	0	68	62	88	98	26
Dual II +	0.6 oz	PRE						
FirstRate	1.5 pt	PRE	0	65	78	98	100	43
Dual II +	0.75 oz	PRE						
FirstRate	3.41 oz	PRE	0	53	82	87	93	16
Authority +	2.04 oz	PRE						
Classic	4.27 oz	PRE	0	60	93	93	87	30
Authority +	2.56 oz	PRE						
Classic	4.88 oz	PRE	0	62	88	100	85	37
Authority +	2.92 oz	PRE						
Classic	6.0 oz	PRE	0	53	80	88	83	15
Canopy	4.27 oz	PRE	0	52	88	88	80	17
Authority +	2.56 oz	PRE						
Classic +	1.5 pt	PRE						
Dual II	1.0 lb	PRE	0	47	88	100	83	19
Lorox DF +	2.56 oz	PRE						
Classic	6.67 oz	PRE	0	57	70	67	97	16
Authority +	1.67 pt	PRE						
Command	8.0 oz	PRE	0	47	53	68	93	14
Authority +	1.67 pt	PRE						
Command	6.67 oz	PRE	0	40	47	63	92	7
Authority +	0.25 lb	PRE						
Lexone DF +	1.5 pt	PRE						
Dual II	4.0 oz	EP	20	92	98	100	100	35
Pursuit +	1.5 pt	EP						
Sun-it +	1.0 qt	EP						
UAN +	1.0 pt	EP						
Blazer								
LSD(.05)			0	14	21	13	20	18

[1] Lacg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower.

Table 5. Effect of postemergent herbicides on soybean injury, weed control, and grain yield, Rossville, 1996.

		Appl	Soybean Injury		Weed Control, 28 DAT[1]				Grain
Treatment[2]	Rate	Time	7DAT	14DAT	Lacg	Paam	Cosf	Ebns	Yield
	prod./a		%			%			bu/a
Untreated check			0	2	30	43	73	57	21
Treflan +	1.0 qt	PPI	3	2	88	90	100	87	56
Firstrate +	0.30 oz	EP							
NIS + UAN	.12% +2.5 %	EP							
Treflan +	1.0 qt	PPI	8	5	95	98	100	60	45
Firstrate +	0.30 oz	EP							
Pinnacle +	0.016 lb	EP							
NIS + UAN	.12% +2.5 %	EP							
Treflan +	1.0 qt	PPI	13	7	92	93	100	97	51
Firstrate +	0.30 oz	EP							
Blazer +	1.0 pt	EP							
NIS + UAN	.12% +2.5 %	EP							
Dual II +	1.5 pt	PRE	5	5	77	97	100	90	44
Expert +	1.5 oz	EP							
NIS + UAN	.25% + 2.5%	EP							
Dual II +	1.5 pt	PRE	7	7	73	98	100	68	48
Expert +	1.2 oz	EP							
Action +	1.2 oz	EP							
NIS + UAN	.25% + 2.5%	EP							
Dual II +	1.5 pt	PRE	12	5	75	90	80	100	45
Expert +	1.2 oz	EP							
Blazer +	1.5 pt	EP							
NIS	.25%	EP							
Dual II +	1.5 pt	PRE	8	7	72	97	100	52	33
Expert +	1.2 oz	EP							
Pinnacle +	0.016 lb	EP							
NIS	.25%	EP							
Dual II +	1.5 pt	PRE	13	7	73	98	100	100	40
Expert +	1.2 oz	EP							
Cobra +	0.5 pt	EP							
COC	.25%	EP							
Prowl +	3 pt	PRE	5	5	100	95	100	100	47
Pursuit DG +	1.44 oz	EP							
Sun-it II + UAN	1.5 pt + 1 qt	EP							

Table 5. Continued.

Treatment[2]	Rate	Appl Time	Soybean Injury 7DAT	Soybean Injury 14DAT	Weed Control, 28 DAT[1] Lacg	Paam	Cosf	Ebns	Grain Yield
	product/a		%		%				bu/a
Prowl +	3 pt	PRE	13	7	98	100	100	100	31
Pursuit DG +	1.44 oz	EP							
Status +	10 oz	EP							
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Raptor +	4.0 oz	EP	7	5	85	100	100	100	42
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Raptor +	4.0 oz	EP	13	5	80	98	100	100	28
Status	10 oz	EP							
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Prowl +	3.0 pt	PRE	5	5	88	97	100	100	15
Raptor +	4.0 oz	EP							
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Prowl +	3.0 pt	PRE	18	8	88	100	100	100	44
Raptor +	4.0 oz	EP							
Status +	10 oz	EP							
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Raptor +	5.0 oz	EP	7	5	87	93	100	100	41
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Raptor +	5.0 oz	EP	13	8	82	98	100	100	26
Status	10 oz	EP							
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Prowl +	3.0 pt	PRE	7	5	88	100	100	100	54
Raptor +	5.0 oz	EP							
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Prowl +	3.0 pt	PRE	15	10	92	100	100	100	50
Raptor +	5.0 oz	EP							
Status +	10 oz	EP							
Sun-it II + UAN	1.5 pt + 1 qt	EP							
Prowl +	3.0 pt	PRE	5	5	100	100	100	100	44
Pursuit DG +	1.44 oz	EP							
Pinnacle +	0.125 oz	EP							
NIS + UAN	.25% + 1 qt	EP							
Galaxy +	2.0 pt	EP	17	5	70	93	100	100	13
Poast Plus +	24 oz	EP							
COC + UAN	1 qt + 2 qt	EP							
Concert SP +	0.5 oz	EP	8	7	67	96	100	53	21
Assure II +	8 oz	EP							
NIS + UAN	.25% + 2qt	EP							
Prowl +	2.5 pt	PRE	5	5	92	100	100	100	37
Scepter OT +	1.0 pt	EP							
NIS	.25%	EP							
Scepter +	1.4 oz	EP	10	5	73	90	100	100	43
Resource +	4.0 oz	EP							
COC	1.0 pt	EP							
Scepter OT +	2.0 pt	EP	10	7	75	100	100	100	33
NIS	.25%	EP							

Table 5. Continued.

Treatment[2]	Rate	Appl Time	Soybean Injury 7DAT	Soybean Injury 14DAT	Weed Control, 28 DAT[1] Lacg	Paam	Cosf	Ebns	Grain Yield
	prod./a		%		%				bu/a
Flexstar HL +	17 oz	EP	15	7	82	98	100	78	41
Fusion +	8 oz	EP							
Sun-it II + UAN	1% + 1%	EP							
Flexstar HL +	17 oz	EP	13	5	78	95	100	100	37
Fusion +	10 oz	EP							
Sun-it II + UAN	1% + 1%	EP							
Reflex +	16 oz	EP	13	5	90	97	100	100	45
Fusion +	8 oz	EP							
Sun-it II + UAN	1% + 1%	EP							
Reflex +	16 oz	EP	10	5	95	100	100	100	44
Fusion +	10 oz	EP							
Sun-it II + UAN	1% + 1%	EP							
Twister +	28.6 oz	EP	15	5	93	100	100	100	39
Sun-it II + UAN	1% + 1%	EP							
Twister +	35.9 oz	EP	13	5	97	100	100	100	38
Sun-it II + UAN	1% + 1%	EP							
Stellar[3] +	5.0 oz	EP	18	8	97	67	100	100	32
COC + UAN	0.5% + 2 qt	EP							
Stellar[3] +	7.0 oz	EP	18	5	98	68	100	100	16
COC + UAN	0.5% + 2 qt	EP							
Stellar[3] +	5.0 oz	EP	17	5	98	62	100	100	33
Basagran +	16 oz	EP							
COC + UAN	0.5% + 2 qt	EP							
Stellar[3] +	7.0 oz	EP	18	8	100	65	97	100	16
Basagran +	16 oz	EP							
COC + UAN	0.5% + 2 qt	EP							
Basagran[3] +	16 oz	EP	12	7	100	67	100	100	24
COC + UAN	0.5% + 2 qt	EP							
Stellar[3] +	5.0 oz	EP	18	10	95	100	100	90	30
Classic +	0.5 oz	EP							
COC + UAN	0.5% + 2 qt	EP							
Stellar[3] +	7.0 oz	EP	15	8	93	97	100	98	37
Classic +	0.5 oz	EP							
COC + UAN	0.5% + 2 qt	EP							
Stellar[3] +	5.0 oz	EP	17	7	92	100	100	100	32
Scepter +	1.40 oz	EP							
COC + UAN	0.5% + 2 qt	EP							
Stellar[3] +	7.0 oz	EP	18	8	92	98	100	100	37
Scepter +	1.40 oz	EP							
COC + UAN	0.5% + 2 qt	EP							
Scepter[3] +	1.40 oz	EP	10	5	87	97	100	100	47
COC + UAN	0.5% + 2 qt	EP							
LSD(.05)				4	12	14	10	27	23

[1] Lacg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower; Ebns = eastern black nightshade.

[2] COC = crop oil concentrate; UAN = 28-0-0 fertilizer; NIS = nonionic surfactant.

[3] Plus Select, 8 oz/a + COC, 1 pt/a, 7 DAT.

WHITE FOOD-CORN PERFORMANCE TEST

Larry D. Maddux and Philip L. Barnes

Introduction

This test is one of the 13 locations of a regional fee test coordinated by Dr. L. L. Darrah with USDA-ARS at the University of Missouri. The 1996 test included 43 white hybrids, one white hybrid check and three yellow hybrid checks submitted by 17 commercial seed producers. Nineteen white hybrids were new to the test in 1996.

Procedures

Anhydrous ammonia at 150 lbs N/a was applied on April 2. Atrazine at 1.5 lb/a plus Dual at 1.5 pt/a were incorporated with a field cultivator on April 16. The hybrids were planted April 16 at 29,000 seeds/acre in 30-inch rows on a silt loam soil following a previous crop of soybeans. Fertilizer (10-34-0) at 120 lb/a was banded at planting. The test was furrowed for irrigation June 12 and harvested on September 18 with a Gleaner E plot combine.

Results and Discussion

Yields in this test averaged 199 bu/a, with a range from 160 to 230 bu/a and an LSD(.05) of 20 bu/a (Table 5). The yellow check B73xMo17 yielded 207 bu/a and the other two yellow checks (Pioneer Brand 3245 and 3394) yielded 219 and 193 bu/a, respectively. Irrigated corn yields were good this year. The yellow corn performance test (in another field at the Rossville Unit) had an average yield of 192 bu/a with a range from 166 to 216 bu/a.

Conclusions

The average yield of the 47 hybrids in the test was 199 bu/a, with a range from 160 to 230 bu/a. The LSD(.05) was 20 bu/a (two hybrids must differ in yield by 20 bu/a to be considered significantly different in yielding ability 95% of the time).

Table 6. Grain yield, stand, root and stalk lodging, ear height, moisture content, and days from planting to half-silk of the white food-corn hybrids, Topeka, 1996.

Brand	Hybrid	Yield	Stand	Root Lodged	Stalk Lodged	Ear Height	Half Silk	Mois-ture
		bu/a	%	%	%	inches	days	%
Asgrow	XP9465W	206.4	97.2	0.0	0.0	47.3	80.0	23.9
DeKalb Genetics	DK703W	190.7	95.4	1.0	0.0	45.7	80.7	22.9
DeKalb Genetics	DK631W	159.6	89.8	0.0	0.0	36.7	75.7	20.6
DeKalb Genetics	EXP564W	219.3	94.0	0.0	0.0	52.0	80.3	21.9
DeKalb Genetics	EXP664W	196.5	97.2	0.0	1.0	47.3	80.0	22.5
Genetic Resources	GRI95203	182.8	92.6	1.5	2.4	55.3	81.0	22.8
Genetic Resources	GRI96515	202.2	92.6	0.0	1.9	49.0	80.3	22.2
ICI Seeds	8317W	197.3	97.2	0.0	0.0	50.3	79.7	22.2
ICI Seeds	8320W	189.0	94.0	1.0	0.0	48.0	82.7	22.1
IFSI	90-1	202.6	97.2	0.0	0.5	52.3	82.0	22.8

Table 6. Grain yield, stand, root and stalk lodging, ear height, moisture content, and days from planting to half-silk of the white food-corn hybrids, Topeka, 1996.

Brand	Hybrid	Yield	Stand	Root Lodged	Stalk Lodged	Ear Height	Half Silk	Mois-ture
		bu/a	%	%	%	inches	days	%
IFSI	90-4	191.7	95.8	0.0	0.0	44.7	76.7	23.5
IFSI	94-3	223.0	97.7	0.0	0.0	46.3	78.7	26.1
IFSI	95-l	206.1	96.8	0.0	0.5	49.0	79.7	23.6
Golden Harvest	H-2633W	177.3	88.9	0.0	0.0	50.0	78.7	23.1
LG Seeds	NB749W	199.2	94.4	0.0	1.0	48.7	81.0	22.4
NC+	6555W	183.8	94.0	3.9	0.5	51.3	81.3	22.7
NC+	6989W	213.9	96.8	0.5	0.5	51.3	81.0	24.1
Northrup King	N7580W	197.0	96.8	0.5	1.0	48.3	80.3	22.7
Northrup King	X6545W	200.4	91.7	0.0	0.0	51.7	79.0	21.1
Northrup King	X6955W	186.3	86.6	1.0	0.0	49.7	79.0	21.6
Pioneer Brand	3203W	208.4	95.4	1.0	0.0	51.7	80.3	24.6
Pioneer Brand	3281W	196.3	96.8	0.0	0.0	45.0	80.0	21.0
Pioneer Brand	3287W	181.2	97.2	0.0	0.0	44.3	75.0	21.7
Pioneer Brand	X1155FW	207.9	99.1	0.9	0.0	47.0	75.3	21.8
SeedTec	ST-7585W	222.1	94.4	0.0	0.5	53.0	80.7	23.5
SeedTec	ST-7590W	206.6	93.5	0.0	0.0	53.7	85.7	26.3
Sturdy Grow	SG765W	210.9	97.7	0.0	0.0	52.3	79.7	20.9
Sturdy Grow	SG777W	205.7	97.2	0.9	0.0	48.3	78.7	21.7
Sturdy Grow	SG797W	190.2	95.4	1.0	0.0	52.0	83.0	23.9
Trisler	T-4215W	191.5	89.8	0.0	1.4	47.7	79.3	26.9
Vineyard	V442W	176.3	88.0	0.6	0.0	46.0	78.0	22.2
Vineyard	V448W	189.8	97.2	0.5	0.0	48.0	78.7	24.0
Vineyard	V449W	194.0	95.4	0.0	0.5	46.7	82.3	23.1
Vineyard	V453W	196.2	97.2	0.0	0.0	48.0	80.3	22.4
Whisnand	51AW	201.2	95.8	0.0	1.9	52.0	82.0	23.1
Whisnand	52AW	209.5	94.9	3.6	0.5	47.0	77.3	23.4
Whisnand	92AW	185.9	95.4	0.0	0.0	42.7	79.0	27.4
Wilson	E1789	206.3	96.3	0.5	1.4	51.7	80.7	22.0
Zimmerman	Z62W	220.8	96.8	0.0	0.4	49.0	79.7	22.1
Zimmerman	Z64W	230.3	94.9	0.0	0.0	49.7	82.0	23.0
Zimmerman	Z71W	212.6	100.9	0.0	0.0	49.0	81.3	26.0
Zimmerman	Z72W	195.4	105.6	0.4	0.0	50.7	81.0	21.4
Zimmerman	Z73W	212.5	117.6	0.0	0.8	53.7	82.3	22.3
White check	(K55xCI66)FR802W	158.8	69.0	1.6	0.6	53.3	82.7	27.2
Yellow check	B73xMol7	206.5	94.9	0.5	0.5	47.3	79.0	20.6
Yellow check	Pioneer 3245	219.1	96.8	0.0	0.5	46.0	79.7	21.7
Yellow check	Pioneer 3394	193.3	99.1	0.0	0.0	47.0	75.3	20.0
Mean		199.0	95.3	0.4	0.4	48.9	79.9	23.0
LSD (0.05)		19.9	9.2	NS	NS	6.8	3.0	1.8

EFFECT OF APPLICATION METHOD, TIME, AND RATE OF SUPPLEMENTAL N ON IRRIGATED SOYBEANS

L.D. Maddux and P.L. Barnes

Summary

A study was initiated in 1996 to evaluate N application method, time, and rate on irrigated soybeans. Soybean yield for the 0 N control plot was 71.8 bu/a. Fertigation at the R1 and R3 growth stages resulted in yields of 73.7 and 73.8 bu/a, but this slight yield increase was not statistically significant. No significant differences were observed with fertigation at R5, UAN cultivated in at R1, or NH_4 sidedressed at R1. This study will be continued in 1997.

Introduction

Irrigated soybean yields in Kansas commonly exceed 60 bu/a. Nitrogen demand during grain fill is quite high at these yield levels. Some producers have been applying about 30 lbs/a supplemental N to soybean fields through irrigation systems at the R3 stage of growth based on research conducted using broadcast N fertilizer. This research was designed to determine the optimum N rate, method, and time of N application to provide maximum economic soybean yields.

Procedure

A sprinkler irrigated site on a Eudora silt loam soil at the Kansas River Valley Experiment Field was used. N rates included 0, 30, and 60 lbs N/a. Application methods were: (1) UAN dribbled at the last cultivation at R1 (beginning bloom), (2) Anhydrous ammonia (NH_4) knifed on 30 inch centers at R1, and UAN fertigated at (3) R1, (4) R3 (beginning pod), and (5) R5 (beginning seed). The treatments were arranged in a randomized complete block design with 4 replications. A minimum of 0.5 inch of water was applied to all plots with each fertigation treatment. Leaf samples were taken at approximately R6 (pod fill). Grain yields were determined by machine harvesting and seed weights were determined.

Results

This is the first year of this study and only yield results will be presented here. There was no significant differences in soybean yields due to N application method and time or N rate as shown in Table 7. However, there was a slight trend to increased yield with fertigation treatments at R1 and R3 growth stages. This research will be continued next year.

Table 7. Effect of N application rate, method and time on irrigated soybean yields, 1996, Topeka.

Appl'n Method & Time	N Rate	Yield
	lbs/a	bu/a
None	0	71.8
UAN, Cultivate, R1	30	72.3
UAN, Cultivate, R1	60	68.4
NH_4, Sidedress, R1	30	71.7
NH_4, Sidedress, R1	60	71.2
UAN, Fertigation, R1	30	73.9
UAN, Fertigation, R1	60	73.5
UAN, Fertigation, R3	30	72.4
UAN, Fertigation, R3	60	75.1
UAN, Fertigation, R5	30	74.0
UAN, Fertigation, R5	60	69.3
LSD(.05)		NS
N Application Method & Time:		
UAN, Cultivate, R1		70.5
NH_4, Sidedress, R1		71.5
UAN, Fertigation, R1		73.7
UAN, Fertigation, R3		73.8
UAN, Fertigation, R5		71.6
LSD(.05)		NS
N RATE:		
	30	72.9
	60	71.5
LSD(.O5)		NS

EFFECT OF PREPLANT AND SPLIT N APPLICATIONS ON AMMONIUM NUTRITION OF CORN

L.D. Maddux and P.L. Barnes

Introduction

Corn can utilize N as either ammonium (NH_4^+) or nitrate (NO_3^-). Ammonium-N is readily converted to NO_3^- by soil organisms, so that NO_3^- is usually the primary form available for plant uptake. Previous field studies have suggested that corn responds most to ammonium nutrition prior to the six-leaf (V6) growth stage. Maintaining N in the ammonium form decreases the chances of N loss from denitrification or leaching. Therefore, N use efficiency as well as corn yield should be enhanced by the use of preplant ammonium-based fertilizers with a nitrification inhibitor (NI) and/or split N application. This study was designed to evaluate the effect of NI, N rate, and preplant and split applications of urea ammonium nitrate (UAN) on the N nutrition and yield of corn and on the soil NH_4^+:NO_3^- ratios at the V6 growth stage.

Procedure

Field plots were established on a Eudora silt loam soil at the Kansas River Valley Experiment Field near Rossville in 1993. Preplant UAN was knifed 6 inches deep on 24 inch centers at 30, 50, 80, 130, 150, and 180 lbs N/a in late April or early May. These preplant UAN treatments were applied with no NI, with N-Serve at 0.5 lbs ai/a, or DCD at 3 lbs/a (DCD treatments were not used in 1996). A sidedress treatment of 100 lb N/a was applied to the 30, 50, and 80 lbs N/a preplant treatments at V6. A no N control was also included.

Pioneer Brand 3377 hybrid corn was planted in late April or early May at 26,200 seeds/a with an insecticide applied in the furrow or as a T-band. Recommended herbicides were applied preplant, incorporated, for weed control. No irrigation was applied in 1993 as the growing season was extremely wet, but plots were irrigated as needed in 1995 and 1996. In 1994, the corn was destroyed be a severe windstorm just prior to tasseling.

Soil samples were taken prior to V6 application from the preplant N application band, dried, ground, and analyzed for NH_4^+ and NO_3-. Five whole plants were harvested at V6, tasseling, and physiological maturity (PM). Plants were weighed for dry matter determination and analyzed for N content. Grain was harvested mechanically and corrected to 15.5% moisture for yield determination.

Results

The soil and plant data for 1996 has not been analyzed, so only yield data will be presented here. The Ni's were effective in maintaining elevated soil NH_4^+ concentrations until V6 (data not shown). All N treatments increased grain yield over that on the control all three years (Table 8). No consistent differences in N treatment was observed in 1993 or 1996. In 1995, the preplant N treatments tended to yield higher than the split N treatments. For some unexplainable reason, the 50 + 100 lbs N/a treatment with or without NI had the lowest yield in 1993. Yields were low in 1993 and 1995. No inhibitor effect was observed in 1993 and 1995, but in 1996, a 9 bu/a yield increase was obtained with N-Serve. The lack of a yield response to N rate and application time in 1996 would indicate that this yield increase is most likely due to an ammonium nutrition effect. The lack of response to the sidedress treatment would suggest that leaching of N was not a problem.

Summary

Research has suggested that corn responds most to ammonium nutrition early in the growing season (prior to V6). This study evaluated the effect of nitrification inhibitors (NI), N rate, and preplant and split applications of urea ammonium nitrate (UAN) on the N nutrition and yield of corn and on the soil NH_4^+:NO_3^- ratios at the V6 growth stage from 1993 through 1996. No yield was obtained in 1994. The NI's, N-Serve and DCD were effect in maintaining N in the ammonium form until V6. NI's had no significant effect on corn yield except in 1996, when N-Serve resulted in a 9 bu/a yield increase. Cool, wet early

growing seasons in 1993 and 1995 resulted in low yields and could have contributed to the lack of yields in those two years. Yields in excess of 200 bu/a were obtained in 1996.

Table 8. Effect of N rate, application time, and nitrification inhibitor on grain yield, Rossville.

N Rate		NI	Grain Yield		
Preplant	V6		1993	1995	1996
----------------lbs/a----------------			---------------------------- bu/a----------------------------		
180	0	None	132	131	191
180	0	N-Serve	133	140	202
180	0	DCD	130	126	
150	0	None	142	140	199
150	0	N-Serve	140	143	204
150	0	DCD	132	137	
130	0	None	136	147	186
130	0	N-Serve	136	132	196
130	0	DCD	137	135	
80	100	None	142	132	193
80	100	N-Serve	131	132	200
80	100	DCD	133	125	
50	100	None	126	140	197
50	100	N-Serve	128	131	202
50	100	DCD	129	134	
30	100	None	136	127	190
30	100	N-Serve	138	130	202
30	100	DCD	141	132	
0	0	None	54	63	143
LSD(.05)			13	12	15
NITROGEN MEANS:					
180	0		132	132	196
150	0		138	140	202
130	0		137	138	191
80	100		136	131	196
50	100		128	134	200
30	100		138	129	196
LSD(.05)			7	8	NS
NITRIFICATION INHIBITOR MEANS:					
		None	136	135	192
		N-Serve	135	135	201
		DCD	134	132	
LSD(.05)			NS	NS	7

BEST MANAGEMENT PRACTICES TO REDUCE ROW CROP POLLUTION IN KANSAS

Philip L. Barnes, Larry D. Maddux, Charles W. Rice, and A. Paul Schwab

Introduction

Quality drinking water is taken for granted by many in the United States. But concerns are being raised about the quality of drinking water. In particular, groundwater has come under increased scrutiny over the last two decades. Groundwater is an important supply for drinking water in central and western Kansas.

In Kansas, nitrate and pesticides are common groundwater pollutants. The Kansas Department of Health and Environment (KDHE) identifies fertilizers and organic wastes as the largest contributors to nitrate contamination of groundwater. Approximately 14% of all wells in the statewide groundwater monitoring network exceed 10 parts per million (ppm). The type of well appears to be a significant determinant of nitrate concentration. Approximately 4% of Kansas public water supplies using groundwater exceed 10 ppm whereas over 30% of farmstead wells have nitrate concentrations exceeding 10 ppm.

Twelve pesticides have been found in Kansas groundwater. Nearly all findings of pesticides have been in groundwater less than 30 feet deep and the sources appear to be spillage or mishandling of pesticides, pesticide solutions, equipment rinse water, leftover solutions, and containers. However, contamination of groundwater by atrazine, alachlor, metolachlor, metribuzin, bromacil, and trifluralin has been attributed to field application. Atrazine has been found in 20 of 175 public water supplies sampled. The mean of detected concentrations is 10.4 parts per billion (ppb) with the highest concentration being 110 ppb. Atrazine is the most commonly found pesticide in farmstead wells.

Eastern Kansas has limited groundwater supplies and depends on surface water to supply drinking water. Thus surface water shows evidence of water quality impairments caused by nonpoint pollution sources. Quality monitoring data collected by KDHE indicates:

1. Ninety two percent (92%) of Kansas monitoring sites have nutrient impacts. Only the Verdigris River Basin is relatively free of nutrient impairments.
2. Seventy percent (70%) of the monitored sites have impairments caused by suspended solids. The Verdigris and Neosho River Basins are the least impacted. The greatest impairments occur in the Solomon, Cimarron, Lower Arkansas, and Kansas-Lower Republican River Basins.
3. Forty two percent (42%) of the monitoring sites have impairments caused by pesticides. The Kansas-Lower Republican River Basin has the highest rate of impairment, and the Neosho and Cimarron River Basins have the lowest rate of impairment.

Overall, 70% of Kansas lakes that have been sampled show water quality impairments from nonpoint source pollution. Nutrients are the most frequent cause of impairment, followed by suspended solids, and pesticides.

Groundwater Quality and Agriculture- An Overview

This review will focus on the impact of nitrates (NO_3^-) in groundwater, especially related to production agriculture.

The health implications of NO_3^- in groundwater have been known since 1945. The condition of methemoglobinemia (blue baby syndrome) was identified then and linked to high levels of NO_3^- in drinking water of infants. Adults eating solid foods are not at risk from this malady, but babies from 3-6 months are at risk, because most of their diet is water-based. Commonly, the remedy is to provide another water source for infants and expectant mothers.

With so few infants dying per year (<four per year), one would wonder why such a

large emphasis has been placed on this problem. One reason is that once NO_3^- groundwater contamination occurs, especially from non-point pollution, remediation is extremely difficult. Movement in groundwater can be slow and the chemical and biological processes used to correct problems in groundwater are slow as well, making prevention of groundwater contamination by NO_3^- much more feasible and effective than remediation. Treatment at the tap also can be technically or economically infeasible. In Kansas, groundwater NO_3^- levels in the major aquifers have ranged from near the established national drinking water standard of 10 ppm NO_3^--N (Chase and Council Grove Aquifer and glacial drift aquifers) to less than 1 ppm NO_3^--N (alluvial aquifers).

Since the discovery of the NO_3^- problem, investigators and government agencies have begun searching for the source of the problem. A study in New Jersey found a close relationship between NO_3^- contamination an both well depth and proximity to septic systems. Application of nitrogen (N) fertilizer (agricultural or residential) increased the NO_3^- level in groundwater as well. However, agricultural and residential areas that were fertilized did not have different amounts of NO_3^- in the groundwater. A nationwide survey of groundwater supplies in 1987 reported no serious problems in agricultural locations. However, the need for continued monitoring of these locations was recommended because of the potential for NO_3^- contamination.

Other research has shown more serious problems from agricultural practices, especially feedlots and high N input with row crops. High potential for NO_3^- contamination was reported from both feedlots and irrigated corn in western Kansas, but feedlots posed a more serious threat to groundwater. Higher NO_3^- contamination also was found in groundwater under feedlots and irrigated corn than under grassland and residential lawns in western Nebraska. Loading of NO_3^- was concentrated in the surface meter of soil with feedlots but throughout the 1.5m to 9.5 m soil depth with irrigated corn. This suggested that more NO_3^- movement into the groundwater was occurring with the irrigated corn. Another study listed karst regions, rainfed and irrigated row crops, irrigated arid regions, and areas of animal waste storage and application as being particularly sensitive to NO_3^- contamination of groundwater.

The high potential for groundwater contamination in row crop production has given impetus to research on NO_3^- leaching in areas where row crops are grown. Some researchers have concluded that the accumulation of NO_3^- in soils and groundwater under heavily fertilized irrigated areas is a slow process and unimportant when compared to other sources of NO_3^- contamination. Others have pointed out that even total elimination of N fertilizer use in agriculture would not eliminate NO_3^- leaching because of the release of NO_3^- that occurs with cultivation. However, annual losses of only 55 kg N ha^{-1} would be sufficient to bring the surface layer of the aquifer to the 10 mg L^{-1} NO_3^--N standard. So losses that may seem insignificant or go unnoticed can have a large influence on NO_3^- levels in groundwater.

Research on control of NO_3^- leaching has helped scientists gain an understanding of the processes involved and given farmers ways to minimize leaching of NO_3^-. A study in Iowa concluded that high fertilizer N application years in the Big Spring Basin of Iowa also were years of highest N loss to groundwater. Fertilizer accounted for 55-60% of N applied to cropland in the Big Spring Basin. Because it is the largest and the most controllable N input, fertilizer N has become the focus of NO_3^- leaching research. Part of the problem is that potential NO_3^- leaching occurs in the late fall to early spring when crops are not growing and farmers have fewer management options to control NO_3^- movement.

Use of conservation tillage systems has been predicted to increase past the year 2000. The present and possible future increasing use of conservation tillage systems has raised concerns in the scientific community about their influence on NO_3^- leaching. However, some researchers consider N management a more critical factor influencing NO_3^- leaching than tillage systems. The amount of fertilizer N applied to cropland and number of years fertilized are both correlated with NO_3^- contamination of groundwater. Nitrogen fertilizer use increased from 1955 to 1980 but has remained constant since then. The emphasis on N fertilizer efficiency may have lowered N fertilizer applications.

Management Practices to Prevent Groundwater Pollution

The following section describes practices used to reduce nitrate, the contaminant most commonly polluting Kansas groundwater.

Matching fertilizer application rate to crop needs

The process of arriving at N recommendations on a field basis by matching the N requirement with a yield goal can be summarized in the following steps:

1. Select realistic yield goals, Whitney.

2. Determine the total nitrogen required to attain the selected yield goal. Figure 1 shows the response to different rates of applied N fertilizer for both irrigated and dryland crops in Kansas. Figure 1 can be used to quantify the total N needed to achieve the yield goals for Kansas crops and soils.

3. Determine the amount of carryover nitrate-N already available in the soil (includes soil organic matter, soil inorganic N, and residues from nonleguminous crops)
.

4. Determine the amount of nitrate-N available from the irrigation water to be applied during the crop's growing season. Groundwater in most areas of Kansas have relatively low concentrations of nitrate.

5. Determine the amount of nitrate-N available from sources other than fertilizer. This could include a manure application, where the N applied would be calculated by multiplying the concentration of N in the manure times the weight of manure applied per acre. Other sources could include other organic wastes or previous years' legume crops such as alfalfa or soybeans. During studies on the Kansas River Valley Experiment Field near Topeka, Kansas the following results were obtained in a soybean corn rotation. Yields of corn following a previous soybean crop averaged 51 bu. higher than yields of continuous corn when no N was applied. This yield advantage decreased as N fertilization rate increased to 150 lbs. Soybeans following corn yielded an average of 4 bu. higher than continuous soybeans. Nitrogen uptake data suggest that 1 lb N/bu of soybeans can be supplied to a subsequent corn crop, when no N fertilizer is applied.

6. Subtract amounts determined in Steps 3, 4, and 5 from the amount determined in step 2. This gives the amount of N to be applied in fertilizer to attain the selected yield goal.

Major points of these management practices to remember are:

1. Setting realistic yield goals.

2. Soil testing to account for N in the root zone before application.

3. Accounting for N applied as manure, crop residues, or N-fixing legume crops.

Matching nitrogen application to crop needs and vulnerable times of leaching

Periods of time with the highest probability for leaching occur early in the spring before the plant starts its rapid uptake of N. Another time of vulnerability occurs in the fall after the plants have matured. Nitrate- N also can be lost if the root zone is saturated by a late-season irrigation or rainfall.

Management practices that can reduce spring losses include a split application, where a small amount of nitrate N is applied with P and K as a starter fertilizer. The remainder of the nitrogen applied after the crop is actively growing as a sidedress application knifed between the crop rows.

Another management practice that has been used with some success involves applying a nitrification inhibitor with ammonium (non-leaching) forms of N fertilizer to restrict the growth of nitrification bacteria that reduce ammonium fertilizer to its nitrate form. Experiments performed at various locations in Kansas have shown that fertilizer can be maintained in its ammonium form for time periods from 4 to 6 weeks.

These management practices can be summarized as follows:

1. Supplying nitrate-N when the plant needs it can be accomplished by splitting the application of fertilize.

2. Nitrification inhibitors can maintain early applied ammonium fertilizers in that form until it is needed by the plant.

3. Crop irrigation should be scheduled to prevent saturation of the root zone, which could lead to water movement below the root zone and potential leaching of nitrate N or water soluble pesticides.

Management Practices to Prevent Surface Water Pollution

In recent years, the concentrations of nutrients and pesticides running off fields and entering streams, rivers, and lakes, especially in eastern Kansas, have caused concerns. These surface waters are major source of drinking water to the population centers in Kansas.

The concentration of atrazine in surface water has particularly become an issue since the Environmental Protection Agency (EPA) established a maximum contaminant level (MCL) of 3 parts per billion (ppb) annual average for atrazine in drinking water. This is an enforceable level for public water systems and, according to the EPA, is a concentration that is safe to consume over a 70-year lifetime with no adverse health effects.

Concentration in most of the surface water in central and eastern Kansas is near or slightly above the MCL. Elevated concentrations usually occur in the summer months following herbicide applications.

Pesticide and nutrient concentrations in streams and rivers must be reduced, so that public water supplies do not exceed drinking water MCLs. Kansas State University (KSU) initiated research projects in the late 1980's to determine management practices that reduce pesticide and nutrient runoff losses from applications made to row crops. This section will discusses how pesticide and nutrients are lost from fields and management strategies that can be implemented to reduce this form of nonpoint pollution.

Mechanisms of surface water pollution

The movement of atrazine from crop fields is determined by the properties of the chemical; the rainfall timing, intensity, and duration; soil texture; and the hydrologic soil group.

The most important characteristics that influence nutrient and chemical runoffs are adsorption and persistence. Solubility of chemicals also plays a role. Adsorption is a term that describes a chemical’s tendency to bind or stick to soil particles, primarily clay and organic matter.

Nutrients such as P and some herbicides, such as Prowl or Treflan, are strongly adsorbed, where as others, such as, nitrate N and atrazine are adsorbed weakly.

Weakly adsorbed nutrients and pesticides tend to leave the field in the water and not with eroding soil particles. Therefore, even if soil erosion is eliminated, these chemicals will still be lost in the water running off the field. Some KSU studies have found that higher chemical concentrations may occur in water runoff from no-till fields than from conventionally tilled field.

The term persistence refers to the time required for a chemical to break down following application. The longer a chemical lasts before it degrades, the longer the period of control. However, the longer a chemical is present in the environment, the greater the chance that it will run off with surface water or leach to groundwater. Atrazine, for example, has a half-life of approximately 60 days, which means that half of the atrazine applied in April or May will be degraded within 60 days of application.

The closer the occurrence of rainfall following chemical application, the greater the chemical concentration in the runoff water. Rainfall that soaks into the soil prior to runoff will move some of the chemical below the surface of the soil, leaving less chemical subject to runoff losses.

The duration and intensity of the rainfall determines the amount of water running off the field and, therefore, the amount of chemical running off the field. As rainfall intensity increases, the water runoff rate is increased, and more chemical is removed from the soil surface and lost in runoff. Lower intensity storms will move the chemical into the soil deep enough so that when runoff begins, relatively little chemical is available for runoff. Infiltration into the soil will be greatest when the soil is dry at the start of the precipitation event.

Soil texture has an influence on the amount of chemical lost to runoff. A soil with high clay content will have a higher potential for runoff of chemical than a coarse textured sandy soil. The opposite is true for leaching potential. A soil texture that is more permeable, such as a sandy loam, will generally have less chemical runoff than a less permeable soil, such as a clay loam. The chemical is more readily carried down with water from the soil surface and, therefore, less likely to run off.

Management practices for reducing chemicals in runoff

Results of KSU research indicate that certain management practices can greatly decrease chemical concentrations in runoff. The greatest reduction can be achieved with a combination of practices.

These practices are designed to (1) reduce the availability of a chemical for loss after application; (2) reduce the rate of chemical used in a field; and (3) provide a mechanism for deposition of the chemical before it leaves the field.

The following practices have been found to reduce chemical loss in runoff:

1. Incorporate the chemical into the top 2 inches of soil. If you use tillage prior to planting crops, consider applying nutrients and herbicides preplant and incorporating them into the top 2 inches of soil with a field cultivator, tandem disk, or other appropriate tillage implement. Research has shown that incorporation will reduce runoff losses by as much as 67 % compared to surface application without incorporation.

2. Change the time of the chemical application. The potential runoff of nutrient and herbicides can be decreased by 50 % by applying atrazine prior to April 15 compared to applications in May and June. This is an excellent strategy, particularly for no-till fields, where preplant incorporation and some of the other management practices may not be appropriate. Following chemical application, gentle rains are needed to wash the chemical off plant residues and move it into the topsoil, where it is less likely to be lost in runoff water.

3. Use split application of a chemical. Apply chemicals in split applications, for example, one half to two thirds before April 15 and half to one third just prior or immediately following

planting. This has the potential to reduce chemical runoff by 25 to 33 % compared to applying all the chemical at planting time.

4. Reduce application rates of soil-applied chemical. Reducing chemical rates by one-third reduces the chemical runoff by 33 %.

5. Use postemergence applications of chemical. Using postemergence applications results in 67 % less chemical runoff compared to typical preemergence soil application of chemicals.

6. Use a reduced rate soil application followed by a postemergence chemical application. This practice can reduce chemical runoff by 25 %.

7. Use alternative chemicals or non-chemical methods. If alternative chemicals or nonchemical methods such as cultivation are used to replace a chemical, it is eliminated in the runoff.

8. Establish vegetative filter or buffer strips. Vegetative filter or buffer strips that reduce water flow rate from the field can result in a 25 % reduction in chemical loss in runoff. Remember that the chemical is not removed from the water when it is passing over a vegetative filter or buffer. It is the proportion of the chemical-containing water that infiltrates into the strips soil that reduces the chemical loss from the runoff.

9. Banding chemicals at planting or cultivation. Banding the chemical application over the row reduces the total chemical rate on a field basis by 50 to 66 %, with a corresponding reduction of chemical runoff compared to a broadcast surface application without incorporation. This system works especially well for ridge tillage production and other situations where cultivation will be used.

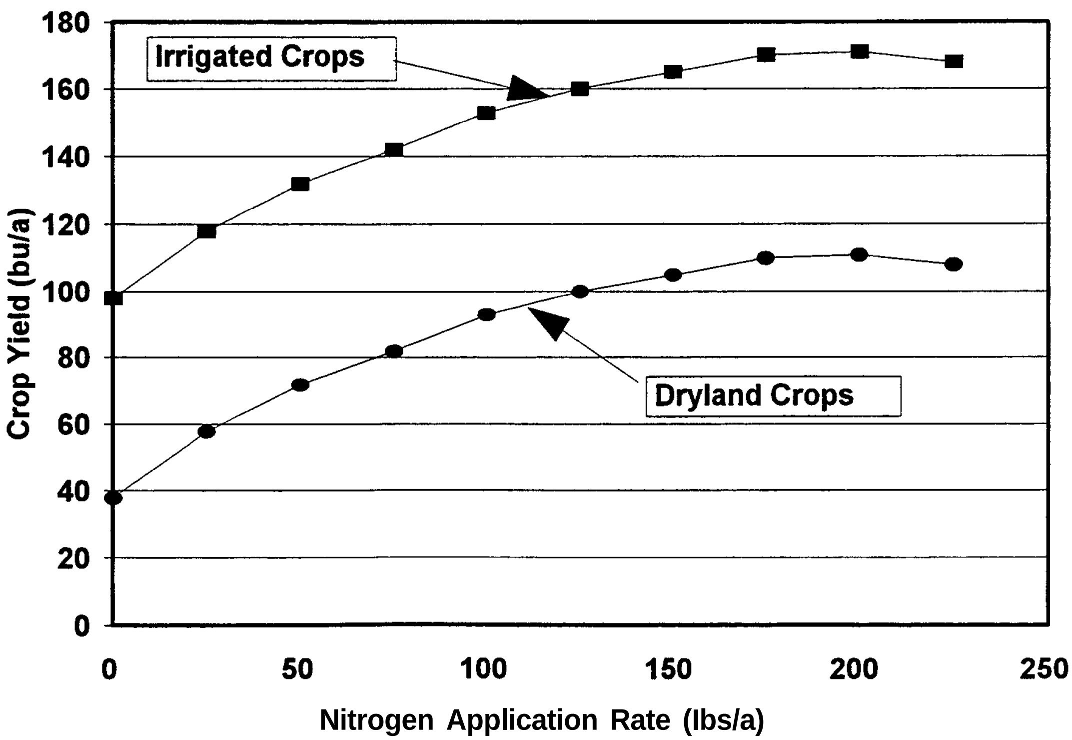


Figure 1. Yields of irrigated and dryland crops in Kansas with different nitrogen rates.

HIGH OIL CORN HYBRID PERFORMANCE

S.A. Staggenborg and L.D. Maddux

Summary

A study was conducted to assess the effects of ten high oil corn hybrids. Grain yields ranged from 155 to 196 bu./a with oil contents that ranged from 8.1 to 7.0 percent. These hybrids also produced higher levels of lysine, protein and energy.

Introduction

Interest in high oil corn performance has increased in northeast Kansas. Due to isolation requirements and small market areas, these hybrids are not routinely entered into university performance trials. The objectives of this study was to evalate the performance of several high oil corn hybrids.

Materials and Methods

Ten corn high oil corn hybrids were evaluated in 1996 at the Rossville Unit of the Kansas River Valley Experiment Field (Table 1). All hybrids utilized "Top Cross" pollinators to achieve elevated oil levels. A non high oil corn hybrid Golden Harvest 'H 2573' was planted to assess oil and yield differences. A 150 foot isolation was utilized between the non-high oil hybrid and each high oil hybrid group of the same pollinator. All plots were planted April 26, 1996. Irrigation events of approximately one acre/inch were applied on July 11, 19, 26 and August 9 and 15. All plots were harvested September 24, 1996.

Statistical analysis of these hybrids pose a unique problem in that isolation groups have a set of unique treatments. Variances were compared between the six Pfister hybrids which utilized pollinator 19 and the four other hybrids that used pollinator 21. Since variances were not different, the data were combined and analyzed as a randomized block design with one restriction.

Results

The 1996 growing season resulted in excellent grain yields. Yields ranged from 155.2 to 196.7 bu./a. The non high oil hybrid H2573 was not well adapted to irrigation and did not yield as well as some of the high oil hybrids. Research conducted in 1996 at other universities indicated that there was an eight to ten percent drop in yield of a high oil hybrid when compared to its non high oil counterparts. Yields from one corresponding non high oil counter part grown in an adjacent study indicated a potential yield drop of approximately 15%. There were differences in most of the other components measured. Oil contents which ranged from 8.1 to 7.0 percent. Lysine levels ranged from 0.287 to 0.260 percent. Energy per acre ranged from 19,931 to 25,225 Mcal/a. High grain yields combined with moderate oil content appeared to be the optimal combination to maximize energy/a. Protein content followed a similar trend as oil content.

Conclusions

The high oil corn hybrids illustrated the ability to produce excellent grain yields. This study was not designed adequately to answer the questions concerning yield drop as a result of oil production.

Table 1. Yield, oil content, lysine, energy, protein and test weight for ten high oil corn hybrids at Rossville in 1996.

Hybrid	Block	Yield (bu/a)	Oil (%)	Lysine (%)	Energy (Mcal/a)	Protein (%)
Pfister 577-19	A	160.8	8.17	0.287	20377.4	7.50
Pfister 2376-19	A	179.6	7.03	0.273	21882.6	7.20
Pfister 2650-19	A	172.3	7.80	0.270	22214.6	6.87
Pfister 2680-19	A	172.2	7.67	0.270	21362.3	6.70
Pfister 2725-19	A	168.7	7.40	0.270	21253.8	7.07
Pfister 3001-19	A	164.5	7.93	0.277	21171.7	7.13
Hawkeye 565A	B	155.2	7.00	0.277	19931.1	7.70
Hoegemeyer 641	B	178.6	7.20	0.273	20240.6	7.47
Hoegemeyer 655	B	188.3	7.20	0.260	24087.9	7.00
Hoegemeyer 666	B	196.7	7.43	0.263	25225.0	6.83
$LSD_{(0.10)}$	- - -	11.4	0.38	0.008	3171.4	0.201
GH 2573	N/A	180.2	5.17	0.230	22488.9	6.50

SANDYLAND EXPERIMENT FIELD

Introduction

The Sandyland Experiment Field was established in 1952 to address the problems of dryland agriculture on the sandy soils of the Great Bend Prairie of SC Kansas. In 1966, an irrigated quarter was added to demonstrate how producers might use water resources more efficiently and determine proper management practices for, and adaptability of, crops under irrigation on sandy soils.

Research at the field has help define adapted varieties/hybrids of wheat, soybeans, alfalfa, grain sorghum, and corn. As irrigated production of corn, soybean, wheat, and alfalfa grew in importance, research determined proper management strategies for irrigation, fertilizer, pest control, and related cultural practices. Present research focuses on variety/hybrid evaluation, the evaluation of new pesticides for the area; the practicality of dryland crop rotations vs. continuous wheat; corn nitrogen fertilizer requirements; re-examining accepted cultural practices for corn and grain sorghum; and the long-term effects of cropping systems on yield, soil conditions, and residue cover. Work is now underway to maximize the efficiency of irrigation inputs from both engineering and agronomic standpoints.

Soil Description

Soil surface horizons range from Pratt, Carwile, and Naron loamy fine sands to Farnum, Naron, and Tabler fine sandy loams. Subsoils are much more varied, ranging from loamy fine sand to clay. These soils are productive under dryland conditions with intensive management and favorable precipitation patterns. Under irrigation, these soils are extremely productive, and high quality corn, soybean, and alfalfa are important cash crops.

1996 Weather Information

The dry weather pattern characterizing the latter half of 1995 and early 1996 ended during the spring of 1996 (Table 1). Precipitation for the period from March 1 through November was at or above average, with excellent rainfall throughout most of the growing season. Cool conditions during May through mid-June slowed growth of corn and early-planted soybeans and grain sorghum; however, it was not nearly as detrimental as the spring weather pattern during 1995. Wheat yields were higher than expected after the severe fall/winter conditions, ranging from 10 to 40 bu/a. The rebound in yields was due largely to an almost ideal grain-fill period. The abundant moisture and lack of extreme heat resulted in yields of irrigated corn and soybean slightly above average at best and well above 1995 yields. Dryland corn yields for much of the area were in excess of 100 bu/a. Grain sorghum yields for much of the area were twice the long-term average of 50 to 60 bu/a. Corn and grain sorghum were harvested at much higher grain moisture than normal because of the lack of heat and high humidities in late summer and early fall. Unlike the last several years, the area escaped an early frost, allowing for successful double-cropping of grain sorghum and soybeans. The largest negative weather factor was the series of storms in July and early August that were accompanied by high winds and large hail. The storms devastated fairly large areas of irrigated corn and soybean as well as grain sorghum and resulted in 100% loss of many circles, particularly in the Macksville-Lewis area. However, these did not significantly affect Sandyland.

Soil moisture was excellent for establishment of the 1997 wheat crop, although a fall windstorm resulted in some seedling damage on lighter soils planted late.

Total 1996 precipitation measured 31.8 inches compared to the long-term average of

25.5 inches. Although heavier than normal precipitation was not as extreme as that in the spring of 1995. As of Jan. 1, 1997, subsoil moisture was adequate.

The lowest temperatures for 1996 were -11°F on February 3 and 4; -10°F on February 3, -5°F on January 7, and -5°F March 3. The yearly high was 103°F on July 4. During the period from May 1 to September 30, temperatures were 90°F or higher on 56 days and 100° or higher on 4 days. Only 6 days in August had temperatures 90°F or higher, and no temperatures of 100° or higher were recorded.

The frost-free season lasted from April 8 until October 18, resulting in a growing season of 193 days, approximately 8 days more than the average. The first hard frost occurred on November 7. The absence of a hard freeze until November allowed soybean and sorghum crops to mature normally, resulting in excellent yields.

Abundant rainfall made alfalfa cutting difficult, and alfalfa yield and quality were lower for many producers. Wheat disease pressure was extremely light, although fall rust pressure may impact the 1997 crop. Overall disease pressure was light to moderate. However, corn borer pressure, especially southwestern corn borer, was heavy.

Table 1. Precipitation at the Sandyland Experiment Field, St. John, 1996.

Month	15-Year Average	Dryland Quarter	Irrigation Quarter
		inches	
January	0.55	0.2	0.2
February	0.8	0.1	0.03
March	2.1	2.1	2.7
April	2.5	2.4	3.1
May	4.1	4.8	5.7
June	4.0	3.8	4.3
July	2.7	4.4	4.9
August	2.7	5.1	5.4
September	2.2	4.9	5.45
October	1.8	1.4	1.5
November	1.2	2.8	2.7
December	1.0	0.0	0.03
Annual Total	25.5	31.8	35.9

CROP PERFORMANCE TESTING AND NEW PROJECTS

Victor L. Martin

Introduction

During the 1996 cropping season, performance tests were conducted on dryland wheat and grain sorghum, as well as irrigated wheat, soybeans, and both full- and short-season corn hybrids. The extremely dry fall/winter period combined with extremely cold temperatures and severe wind damage rendered the dryland wheat performance test unusable. The irrigated wheat performance test escaped winter kill until the subzero temperatures in early March. These plus soil borne mosaic virus (SBMV) and other diseases harmed susceptible varieties and effectively eliminated many varieties from the test. Because of the large variability, the irrigated wheat test also was abandoned. Information from the other tests can be found in the crop performance test reports at your county extension office.

A new alfalfa variety trial was established in September, 1996. Data collection will commence in May 1997. For information concerning previous alfalfa variety tests, please contact the Sandyland Experiment Field.

Several studies were discontinued after the 1995 growing season and several new studies were initiated. These studies include a dryland tillage-rotation study as well as Bt corn studies and fertilizer research. Information about these can be found in the Kansas Fertilizer Research, Report of Progress #778 and the Southwest Research-Extension Center Field Day - 1996 Report of Progress #768. You also can contact the Sandyland Experiment Field, if your local extension office does not have this information.

SOYBEAN HERBICIDE EVALUATION

Victor L. Martin and Dallas E. Peterson

Introduction

Irrigated soybean is an extremely important production component for producers on the sands of the Great Bend Prairie in SC Kansas. Soybeans are grown in rotation, typically after corn; continuously; and double-cropped after wheat. Herbicide strategies exist that are normally effective in controlling grasses in this area. Consistent broadleaf control is more difficult, especially when soybeans are produced for more than 1 year at the same location. The problem is increasing as ALS-resistant weeds, especially Palmer pigweed, are increasing in numbers This study was designed to evaluate pre- and postemergence strategies primarily for broadleaf weeds on sandy soils. The study involved herbicides currently labelled for use on sandy soils and the use of a soybean variety tolerant to SU herbicides (STS tolerant).

Procedures

A Pratt loamy fine sand was used for this study. Corn was present on this site in 1994 and soybeans in 1993. Tillage consisted of offset disking during the fall of 1995 with tandem disking and packing two times prior to planting. Preplant incorporated (PPI) treatments were disked once immediately following application. Fertilizer consisted of 100 lb/a of 18-46-0 in mid-April. PPI and preemergence treatments were applied on June 19 and June 20. Post-emergence applications were made on July 3. Soybeans, Asgrow STS 3304, were planted in 30-inch rows at 125,000 seeds/a on June 19. Plots were 20 ft long by 10 ft (four 30-inch rows) wide. Irrigation totalled 13.25 inches and was applied from June 14 through September 9 in 19 irrigations. Treatments totalled 26, including an untreated check. This resulted in 104 plots in four replications arranged in a randomized complete block design.

Treatments were applied using a tractor-mounted compressed air sprayer at 30 psi and 20 gal water/a (Table 2). A wind screen was used to minimize herbicide drift. Herbicides for the surrounding field consisted of 1 qt/a Dual + 2.5 pts/a Pursuit Plus at planting. Herbicide injury and weed pressure were monitored throughout the growing season, with ratings taken on July 1, 10, and 25. Plots were harvested with a combine equipped with a two-row row header.

Results

Results are listed in descending order of yield in Table 3. Two numbers within the same column must differ by more than the LSD to be significantly different.

No significant crop injury was noted, even with treatments containing Pinnacle (Synchrony). In past years, non-STS soybeans were consistently and severely stunted by any treatment containing Pinnacle, which essentially burned off 100% of the leaves.

The only grass species present was crabgrass, and control varied widely among products (Table 3). After the July 25 rating, all plots were sprayed with Poast to suppress crabgrass and maximize broadleaf pressure.

The primary broadleaf weeds present were puncture vine and pigweed species (predominantly Palmer amaranth). Other broadleaf weeds present in insignificant numbers were lambsquarters, carpet weed, and cocklebur. Almost all products provided adequate to excellent broadleaf weed control. As with all studies of this type, a timely cultivation would have enhanced weed control.

To provide adequate grass control on the total POST treatments evaluated, a producer will need to use a PRE grass herbicide such as Lasso or Dual. Remember that after the final weed rating, all plots were sprayed with Poast to suppress crabgrass. This increased yields significantly for many of the treatment combinations.

Always read and follow label recommendations.

Table 2. Soybean herbicide treatments, Sandyland Experiment Field, 1996.

No. and Treatment	Rate	Time	Adjuvant/Rate
	lb or oz a.i./a		
1 Firstrate + Dual	0.039+2.0	PPI	
2 Stellar	0.65 oz	POST	COC(0.5% v/v)
3 Canopy	4.5	PRE	
4 Broadstrike+Dual	1.92	PPI	
5 Broadstrike+Treflan	0.80	PPI	
6 Synchrony	0.21 oz	POST	COC/AmSulf (3.4lb/a)
7 Stellar + Synchrony	1.29+0.21oz	POST	COC(0.5% v/v)
8 Authority + Classic	2.56+0.51oz	PRE	
9 Pursuit+Treflan	.063oz+0.5lb	PPI	
10 Stellar + Synchrony	0.65+0.21oz	POST	COC(0.5% v/v)
11 Authority + Classic/ Synchrony	2.56+0.51 /0.21oz	PRE/ POST	COC(1.0% v/v)
12 Authority + Classic	3.2+0.64oz	PRE	
13 Stellar	1.29 oz	POST	COC(0.5% v/v)
14 Stellar + Synchrony	1.94+0.21oz	POST	COC(0.5% v/v)
15 Squadron	14 oz	PRE	
16 Pursuit + Blazer	.016lb+4oz	POST	Sunit(1.5pt/a)+AA mSulf(3.4lb/a)
17 Stellar	1.94 oz	POST	COC(0.5% v/v)
18 Authority + Classic	3.66+0.73oz	PRE	
19 Firstrate+Dual	0.031+2.0lb	PPI	

(continued)

Table 2. Soybean herbicide treatments, Sandyland Experiment Field, 1996.

No. and Treatment	Rate	Time	Adjuvant/Rate
	lb or oz a.i./a		
20 Dual/Pursuit	2.0/0.063lb	PRE/ POST	X-77(0.25%v/v)+ AmsSulf(3.4lb/a)
21 Synchrony+Cobra	0.21+1oz	POST	COC(0.5% v/v)
22 Pusruit+Dual	0.063+2.0	PPI	
23 Pursuit+Dual	0.063+2.0	PRE	
24 Check Treatment			
25 Authority+Classic+Dual	3.2oz+0.64oz+24 oz	PRE	
26 Resource	0.43oz	POST	COC(0.5% v/v)

Table 3. Soybean herbicide evaluation: weed control 5 weeks after planting and yield, Sandyland Experiment Field, 1996

	% Soil Surface Free of		
Number	Grasses	Broadleaves	Yield
1	85	89	40.7
2	26	85	39.0
3	80	91	37.3
4	85	94	36.7
5	71	100	36.2
6	25	99	35.6
7	18	96	35.1
8	38	83	35.0
9	94	96	34.9
10	23	96	34.1
11	71	100	34.0
12	31	91	33.6
13	33	85	33.5

(continued)

Table 3. Soybean herbicide evaluation: weed control 5 weeks after planting and yield, Sandyland Experiment Field, 1996

	% Soil Surface Free of		
Number	Grasses	Broadleaves	Yield
14	11	99	33.5
15	92	97	33.4
16	60	89	33.3
17	19	93	32.7
18	51	99	32.1
19	86	94	32.0
20	94	95	31.3
21	16	98	30.3
22	94	98	27.8
23	70	76	26.4
24	21	45	26.1
25	82	95	25.7
26	16	64	23.3
LSD(0.05)	8.2	7.0	3.2

CORN HERBICIDE EVALUATION

Victor L. Martin and Dallas E. Peterson

Introduction

Weed control is a major problem in irrigated corn production, especially when postemergence cultivation is eliminated. This problem is accentuated on sandy soils low in organic matter. Additionally, concerns have arisen about the use of atrazine, a common herbicide in SC Kansas, and the potential for its movement into groundwater. Atrazine is one of the best, most cost-effective herbicides for season-long broadleaf control on the sandy soils of the Great Bend Prairie. However, problems with atrazine do exist, especially when corn is grown continuously, because populations of atrazine-resistant weeds develop. This study was initiated to determine the effectiveness of alternatives to herbicide programs containing preemergence (Pre) atrazine applications on sandy soils in SC Kansas and to compare newly labelled, not yet labelled, and nonresidual compounds for use in Kansas to more conventional programs.

Procedures

A loamy fine sand (Pratt and Naron) was used for this study, which was cropped to soybeans in 1995 and corn in 1994. The entire site was prepared in the fall of 1995 with one tandem disking and packing prior to planting; preplant incorporated (PPI) treatments received an additional disking. Fertilization included 100 lb/a 18-46-0 and 125 lb/a N applied as urea (46-0-0) prior to spring tillage and 100 lb/a N at V-6. A 13-day corn hybrid, NC+ 4616, was planted on May 8 at 34,000 seeds/a at a depth of 1.5 inches immediately after PPI herbicide treatment application. No soil insecticides were used. Plots were 20 ft long and 10 ft (four 30-inch rows) wide with four replications in a randomized complete block.

Treatments totalled 36. Please note that Broadstrike treatments contained standard Dual, whereas all others used the safened Dual II. It should be noted that Harness also contains a safener for corn.

Preplant incorporated (PPI) treatments were applied on May 8, immediately prior to planting, preemergence (Pre) treatments on May 9, and postemergence (Post) treatments on May 24, except for the >8" high Broadstrike Plus treatment (June 11). Treatments involving cultivation were cultivated with a Lilliston rolling cultivator on June 11. Treatments were applied using a tractor-mounted compressed-air sprayer at 30 psi and 20 gal/a water. Crop injury and weed pressure were monitored throughout the growing season and examined extensively immediately prior to Post treatments and 2 weeks after Post treatments. Plots were irrigated as necessary from April 26 until September 9 with a total of 13.25 inches of water applied in 20 irrigations. Plots were hand-harvested in mid-October, and corn was mechanically shelled. Yields were adjusted to 15.5% moisture.

Results

Treatments are listed in order of descending yield (Table 4). Minor crop injury was noted in the Balance treatments. As in most years, the only grass present was crabgrass.

The predominant broadleaf weeds were puncture vine and pigweed species, predominantly Palmer amaranth, although some lambsquarter, carpet weed, and cocklebur also were present. Broadleaf control was variable, and the single weed species that determined yield was Palmer amaranth. As pressure from this weed increased, yields decreased.

Yields also were affected by crabgrass pressure; however, treatments providing the best control were not in the top yield group. Because of the wet cool spring weather, crabgrass control was less than normally expected. Of the 10 top-yielding treatments, all included a preemergence grass herbicide, three were total preemergence programs, three contained preemergence atrazine, and three used postemergence atrazine.

Basis, the new postemergence SU for grass and weed control from DuPont, was less effective than in 1995, but cultivation greatly enhanced its effectiveness. Balance, a new product from Rhone-Poulenc, controlled crabgrass early, but control broke down after 8 weeks. Balance was unable to control Palmer amaranth in 1996. Dual and Atrazine greatly increased the effectiveness of Balance treatments.

One of the main purposes of this study is to determine the effectiveness of herbicide programs not involving preemergence atrazine. In 1996, weather conditions favored the inclusion of atrazine, which appeared to significantly increase the effectiveness of the treatment combinations.

This study will continue to examine weed control options for corn on sandy soils, however, after 4 years we can safely state that effective weed control is indeed possible without high use rates of preemergence Atrazine. The difficulty is comparing cost effectiveness, but with the advent of SU compounds with very low use rates, this appears to be less of a problem than in the past.

Table 4. Corn herbicide evaluation study: % weed control 3 and 8.5 weeks after planting and grain yield at 15.5% moisture, Sandyland Experiment Field, 1996.

			% Soil Surface Free of				
			Grass		Broadleaf		
Treatment	Rate	Time	5/27	6/26	5/27	6/26	Yield
	lb ai/a or oz/a						
1 Dual II	2.0 lb	Pre	90	39	97	95	178
Broadstrike Plus	0.17 lb	Post					
Atrazine	0.75 lb	<8"					
X-77	0.25% v/v						
AmSulf	3.4 lb/a						
2 Harness	1.5 lb	Pre	94	45	99	90	170
Permit	0.50 oz	Post					
NIS	1 qt/a						
3 Partner	2.5 lb	Pre	93	56	91	56	167
Atrazine	1.0 lb	Pre					
4 Dual II	2.0 lb	Pre	87	54	58	93	167
Broadstrike Plus	0.17 lb	Post					
Atrazine	0.75 lb	>8"					
X-77	0.25% v/v						
AmSulf	3.4 lb/a						

(continued)

Table 4. Corn herbicide evaluation study: % weed control 3 and 8.5 weeks after planting and grain yield at 15.5% moisture, Sandyland Experiment Field, 1996.

			% Soil Surface Free of				
			Grass		Broadleaf		
Treatment	Rate	Time	5/27	6/26	5/27	6/26	Yield
	lb ai/a or oz/a						
5 Dual II	2.0 lb	Pre	93	48	98	87	161
Broadstrike Plus	0.085 lb	Post					
Atrazine	0.75 lb	<8"					
X-77	0.25% v/v						
AmSulf	3.4 lb/a						
6 Atrazine	1.0 lb	Pre	84	26	94	79	161
Balance	1.5 oz						
7 Dual II	2.0 lb	Pre	84	36	75	80	159
Scorpion III	0.21 lb	Post					
X-77	0.25% v/v						
AmSulf	3.4 lb/a						
8 Dual II	1.5 lb	Pre	96	60	94	58	155
Atrazine	1.0 lb	Pre					
Balance	1.50 oz	Pre					
9 Dual II	2.0 lb	Pre	89	35	100	76	155
Beacon	0.57 oz	Post					
Buctril	0.25 lb	Post					
COC	1% v/v						
AmSulf	3.4 lb/a						
10 Broadstrike SF + Dual	1.93 lb	Pre	89	25	93	81	152
11 Basis	0.25 oz	Post	44	85	93	64	151
Banvel	2.0 oz	Post					
COC	1% v/v						
AmSulf	3.4 lb/a						
Cultivation							
12Broadstrike Plus	0.21 lb	Pre	80	29	98	90	148
Dual	2.0 lb	Pre					
13 Basis Atrazine	0.25 oz	POST	29	75	92	59	147
COC	0.375 lb	POST					
AmSulf	1% v/v						
Cultivation	3.4 lb/a						
14 Harness	1.0 lb	Pre	95	48	89	41	146
Balance	1.5 oz	Pre					
15 Dual II	2.0	Post	88	25	100	95	142
Exceed	0.66 oz	Post					
COC	1% V/V						
AmSulf	3.4 lb/a						
16 DupontDPX-79406	0.375 oz	Post	55	23	98	78	138
Atrazine	0.375 lb	Post					

(continued)

Table 4. Corn herbicide evaluation study: % weed control 3 and 8.5 weeks after planting and grain yield at 15.5% moisture, Sandyland Experiment Field, 1996.

			% Soil Surface Free of				
			Grass		Broadleaf		
Treatment	Rate	Time	5/27	6/26	5/27	6/26	Yield
	lb ai/a or oz/a						
17 Harness	0.875 lb	Pre	96	61	97	80	136
Batallion	0.065 lb	Pre					
18 Dual II	2.0 lb	Pre	93	46	81	48	134
Marksman	0.80 lb	Post					
19 Dual II	2.0 lb	Pre	94	49	83	46	133
Atrazine	1.0 lb	Pre					
20 Dual II	2.0	Pre	93	51	82	55	131
Accent	0.023 lb	Post					
Buctril	0.25	Post					
X-77	0.25% v/v						
21 Basis	0.25 oz	Post	54	90	95	55	131
COC	1% v/v						
AmSulf	3.4 lb/a						
Cultivation							
22Broadstrike Plus	0.21 lb	PPI	93	39	96	85	130
Dual	2.0 lb	PPI					
23 Basis	0.25 oz	Post	68	14	93	74	128
Atrazine	0.50 lb	Post					
COC	1% v/v						
AmSulf	3.4 lb/a						
24 Dual II	2.0 lb	Pre	94	69	90	41	127
Balance	1.50 oz	Pre					
25 Broadstrike SF + Dual	1.93 lb	PPI	92	55	97	91	127
26 Dual II	2.0 lb	Pre	87	33	59	65	126
Broadstrike Plus	0.085 lb	Post					
Atrazine	0.75 lb	Post					
X-77	0.25% v/v	>8"					
AmSulf	3.4 lb/a						
27 Dual II	1.5 lb	Pre	90	39	84	49	125
Balance	1.5 oz	Pre					
28 Basis	0.25 oz	Post	51	14	94	56	121
COC	1% v/v						
AmSulf	3.4 lb/a						
29 Accent Buctril	0.50 oz	Post	34	5	100	97	115
NIS	0.25 lb	Post					
AmSulf	1 qt/a						
	3.4 lb/a						

(continued)

Table 4. Corn herbicide evaluation study: % weed control 3 and 8.5 weeks after planting and grain yield at 15.5% moisture, Sandyland Experiment Field, 1996.

			% Soil Surface Free of				
			Grass		Broadleaf		
Treatment	Rate	Time	5/27	6/26	5/27	6/26	Yield
	lb ai/a or oz/a						
30 Basis	0.25 oz	Post	34	6	96	80	114
Banvel	2 oz	Post					
COC	1% v/v						
AmSulf	3.4 lb/a						
31 Atrazine	0.75 lb	Pre	91	20	90	51	113
Balance	1.50 oz						
32 Balance	1.13 oz	Pre	69	10	83	49	104
33 Balance	1.88 oz	Pre	88	40	84	35	96
34 Balance	1.50 oz	Pre	88	29	79	31	94
35 Cultivation			40	58	34	21	18
36 Check			21	29	42	24	14
LSD(0.05)[1]			6.1	10.3	5.5	7.7	13.1

1 Two treatments must differ by more than the LSD to be different.

GRAIN SORGHUM HERBICIDE EVALUATION

Victor L. Martin and Dallas E. Peterson

Introduction

Next to wheat, grain sorghum is the most important dryland crop in the Great Bend Prairie region of South Central Kansas. Until the advent of seed safeners that permitted the use of Lasso and Dual for grass control, crabgrass was the most troublesome weed in the area. Crabgrass still poses problems, especially when conditions are too dry to activate the grass herbicide or when excessive rainfall moves the herbicide below the germination zone. The predominant broadleaf weeds are puncture vine and pigweed. Pigweed is becoming especially important as Palmer pigweed (amaranth) increases in severity.

Most areas of the state are able to use pre-emergence applications of atrazine successfully to control broadleaf weeds. The low clay and organic matter sandy soils of the Sandyland area make this practice risky, because the chances of severe crop injury and stand reduction are high.

This study was initiated to examine several weed control options on the sandy soils of the Great Bend Prairie.

Procedures

The loamy fine sand used for this study was cropped to grain sorghum in 1995 and 1994. The entire site was tandem disked and packed prior to planting. Site pH was 6.5 with high phosphorus and potassium levels. Nitrogen was applied in a split application of urea with 50 lb N/a applied preplant and 75 lb N/a side dressed. The grain sorghum hybrid NC+ 6B50 was planted on June 12 at 51,000 seeds/a. Plots were 25 ft long and 10 ft (four 30-inch rows) wide with four replications in a randomized complete block.

Treatments totalled 10. Preemergence (PRE) treatments were applied on June 12, and postemergence (POST) treatments were applied on June 26. Treatments were applied using a tractor-mounted compressed-air sprayer at 30 psi and 20 gal/a water. Crop injury and weed pressure were monitored throughout the growing season. Plots were mechanically harvested, and yields were adjusted to 12.5% moisture.

Results

Treatments (Table 5)are listed in order of descending yield (Figure 1). No grass weed ratings are reported because all plots, even check plots, were essentially free of grass weeds. Broadleaf weed data are presented; however, all treatments resulted in essentially broadleaf-free plots. Yield data are reported in order to demonstrate possible yield reduction from grain sorghum plant stunting and stand reduction from herbicide damage.

Yields for all plots were well above the long-term area average of 60 bu/a. The best treatments involved Dual in combination with less than 1 lb a.i./a Propazine, Banvel, and Marksman. Some yield reduction, although not statistically significant, occurred with 1.2 lb a.i./a Propazine, Buctril + Atrazine, and the higher rates of Atrazine, even when applied postemergence. No pattern or significance was apparent for treatment effects on grain moisture or test weight (Figure 1.)

Table 5. Treatments for grain sorghum herbicide evaluation study, Sandyland Experiment Field, 1996.

# Treatment	Rate	Timing
	lb a.i./a	
1 Dual	2.0	PRE
Propazine	0.4	PRE
2 Dual	2.0	PRE
Banvel	0.25	POST
3 Dual	2.0	PRE
Atrazine	0.4	PRE
4 Dual	2.0	PRE
Propazine	0.8	PRE
5 Dual	2.0	PRE
Marksman	0.8	POST
6 Check		
7 Dual	2.0	PRE
Atrazine	1.0	POST
8 Dual	2.0	PRE
Buctril	0.188	POST
Atrazine	0.375	POST
9 Dual	2.0	PRE
Atrazine	0.8	PRE
10 Dual	2.0	PRE
Propazine	1.2	PRE

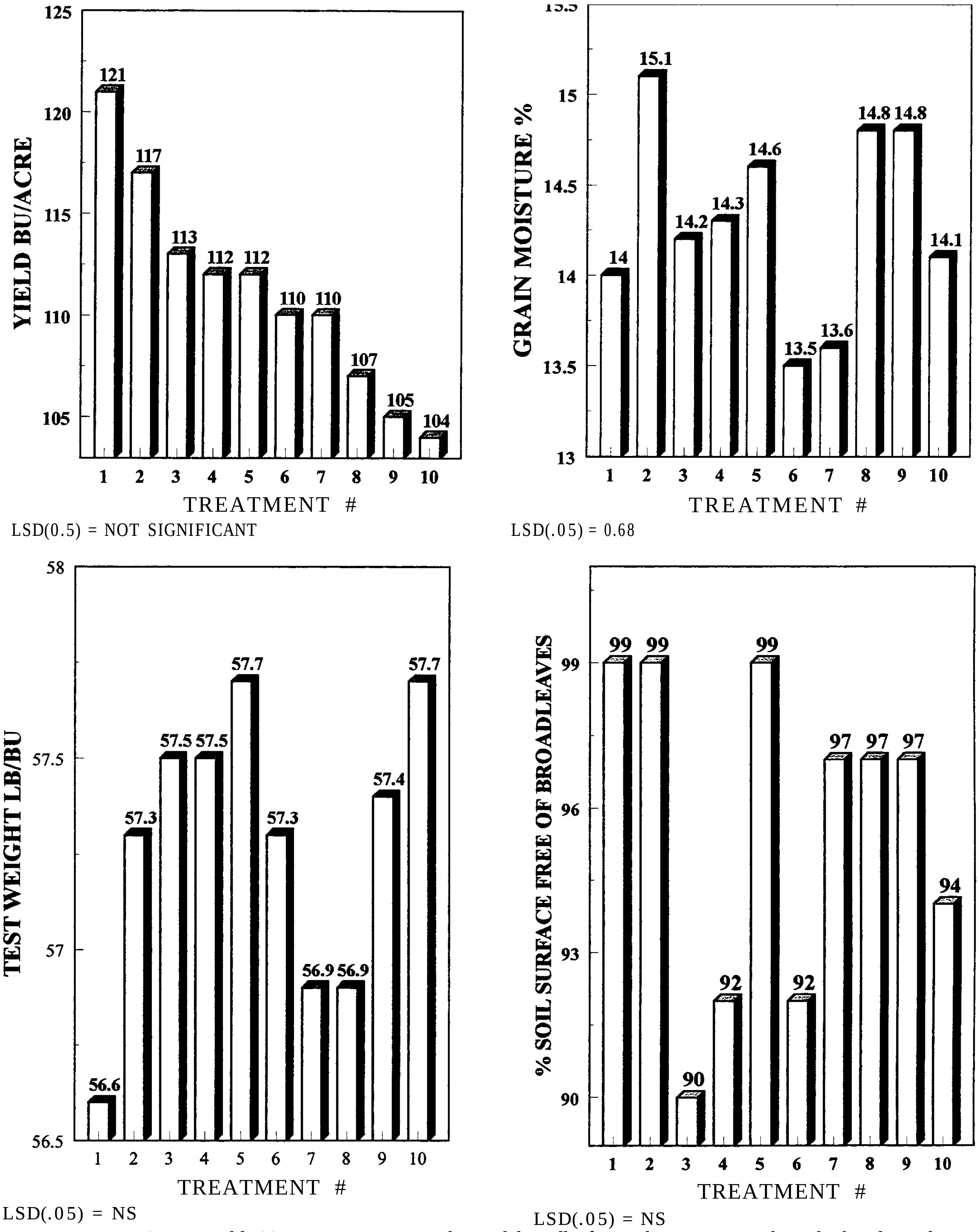


Figure 1. G-rain yield, % moisture, test weight, and broadleafcontrol in grain sorghum herbicide trial, Sandyland, 1996.

EFFECT OF PLANTING DATE, IRRIGATION RATE, AND TILLAGE ON PRODUCTION OF VARIED MATURITY CORN

Victor L. Martin, Gary A. Clark, Richard L. Vanderlip, Gerald W.Warmann, and Dale L. Fjell

Introduction

Corn is the most common and important cash crop produced under irrigation in SC Kansas with 13% of the state's crop being produced in the nine county area of the Great Bend Prairie. The sandy soils and climate of the region in combination with irrigation result in average yields of 150 to 160 bu/a in most years. Under intensive management with favorable weather, yields of 190 to 200+ bu/a are expected on producers' "better" ground. Typically, corn is planted from mid-April to mid-May with plant populations averaging 24,000 to 28,000 plants/a. Normally, a full- season hybrid (112 days or greater to black layer) is planted, although hybrids of shorter maturity are increasing in popularity.

Even though irrigated corn production has been an economic boom to Kansas, it has not been without problems, especially in western Kansas, where aquifer depletion is a major concern. Although vast improvements have been and are being made in irrigation technology, many questions remain.

The aquifer in SC Kansas in the region of the Great Bend Prairie has not experienced the dramatic decrease in water levels that have occurred in western Kansas. The structure of the aquifer and the soils of the region have allowed for lesser decreases, and years of high rainfall such as in the mid-1970's, 1992, 1993 and potentially 1996 have provided significant recharge of the aquifer in much of the region. This fact enables groundwater to be viewed as a renewable resource, especially with careful management of irrigation and agronomic systems to maximize water use efficiency.

An additional factor compounds the view of sustainable irrigation, especially in the Rattlesnake Creek Watershed where the Quivira National Wildlife Refuge is located and from which it receives its water. Although groundwater may be viewed as renewable for irrigators, the lowering of water table levels associated with irrigation have diminished stream flow into Quivira and resulted in less water than needed to maintain the refuge during many years. The result is a need not only for managing irrigation to sustain itself, but also for developing practices to help ensure adequate surface waters to maintain the Quivira Wildlife Refuge. Although switching hardware on pivots and using irrigation scheduling will potentially help decrease irrigation inputs, the selection of proper agronomic practices (planting date, tillage, hybrid maturity) is potentially as important in reducing water usage. This study is one aspect of the solution.

The primary objective of this study is to determine the effect of no-tillage vs. conventional tillage, hybrid maturity, planting date, level of irrigation inputs, and their interactions on the yield, water usage, and economic return for corn produced on the sandy soils of SC Kansas. This is the first year of a multi-year study. The study involves the departments of Agronomy, Biological and Agricultural Engineering, and Agricultural Economics.

Procedures

The soil for this study is predominantly loamy fine sand with some fine sandy loam. The site was cropped to grain sorghum in 1994 and 1995 and was in wheat for the prior

2 years. Fertilization consisted of 100 lb/a 18-46-0 in March. Nitrogen was applied as granular urea (46-0-0). The application was split in to two 125 lb N/a increments, preplant and V6. Plots for all planting dates received 1 qt/a Dual II + 1 pt/a atrazine preemergence followed by 1 qt/a Marksman postemergence. Plots for the first two planting dates also received 2/3 oz/a Accent to control crabgrass and volunteer grain sorghum. All plots were planted at 34,000 seeds/a with a John Deere no-till row planter.

Treatments were as follows:

1. Main plots - Planting Dates: April 16, May 2, May 15.

2. Split plots - Irrigation Levels: High (18"/year), Medium (15"/year), Low (12").

3. Sub-subplots - Tillage: No-tillage, Chisel-disk

4. Final split plots - Hybrid: Early (Pioneer 3563-103 day), Medium (Dekalb DK 591-108 Day), Late (Pioneer 3162-118 day)

Plots were arranged in a randomized complete block with three replications. Irrigation level differences were achieved by replacing the overhead system with drops, pressure regulators, and three different nozzles, resulting in the ability to apply 0.46", 0.39", and .31" per irrigation

Measurements included final plant population, dates of 50% emergence and silking, grain yield, and grain moisture.

Results

These data from the first year of the study do not include all the information collected but rather an overview. As will be noted, part of the site where the medium irrigation rate was applied contained large variations in corn yield, most likely related to soil compaction. This resulted in wide yield variation and lower than expected yields. The treatments will be moved in 1997 to avoid this problem area.

Precipitation was much above normal during the growing season and resulted in the need for less irrigation than normal (Table 6). The maximum difference in water applied was 2 inches.

Although no definite conclusions will be drawn from this first year of the study, the data are still of interest. Mid-May planting significantly decreased yield overall, increasing irrigation levels slightly increased yield, no-tillage resulted in lower yields, and the 108- and 103-day hybrids were competitive with the 118-day hybrid (Figure 2).

Early hybrid yields were unaffected by planting date, and yields decreased with increasing maturity and planting date (Figure 3). Except for the variation caused by soil compaction, no significant differences were found from the irrigation rate X hybrid interaction, although the trend was for the high irrigation rate to increase yield. Differences were not significant; however, yields of all three hybrids were lower overall with the no-tillage system.

The difference in yield between no-tillage and the conventional tillage system was greatly influenced by hybrid and planting date (Figure 4). Planting later most negatively affected the full-season hybrid, and this was accentuated when tillage was eliminated. Overall, contrary to conventional wisdom, yield decreases were greater under no-tillage with later, not earlier, planting.

In 1996, no-tillage yields were lower than conventional tillage yields even at the low irrigation level (Figure 5) This is not terribly surprising, because the summer was wet and relatively mild.

As stated earlier, this is the first year of a long-term study and no firm conclusions should or can be made. The data are presented for your information. After we have several years of information, we will be able to discuss the agronomic and economic consequences of the planting date, irrigation level, tillage, and hybrid maturity interactions and start to make recommendations.

Table 6. Irrigations amounts and numbers for irrigated corn study, Sandyland, 1996.

		Irrigation Total (inches)		
Planting Date	Irrigation Number	Low	Medium	High
April 16	9	3.7	4.0	4.3
May 2	11	4.3	4.8	5.3
May 15	12	4.6	5.2	5.7

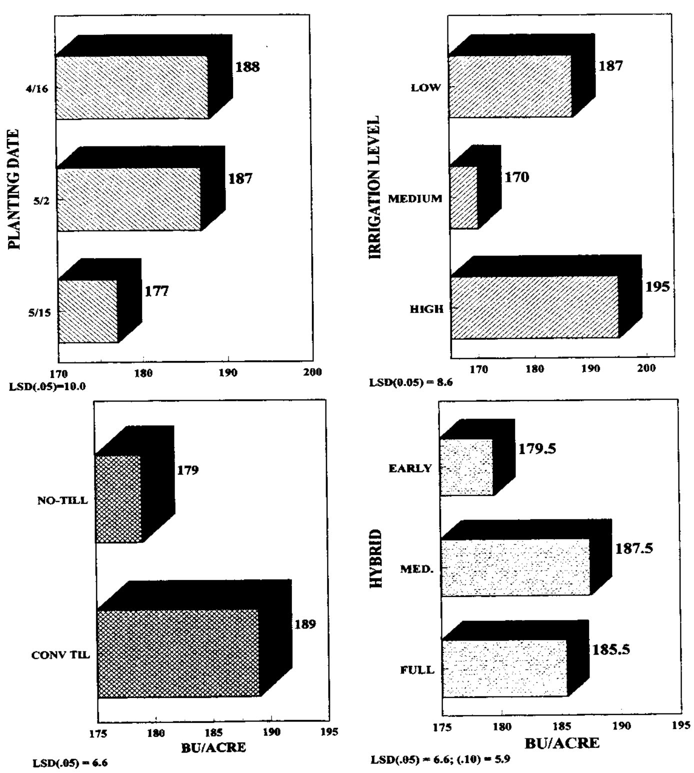
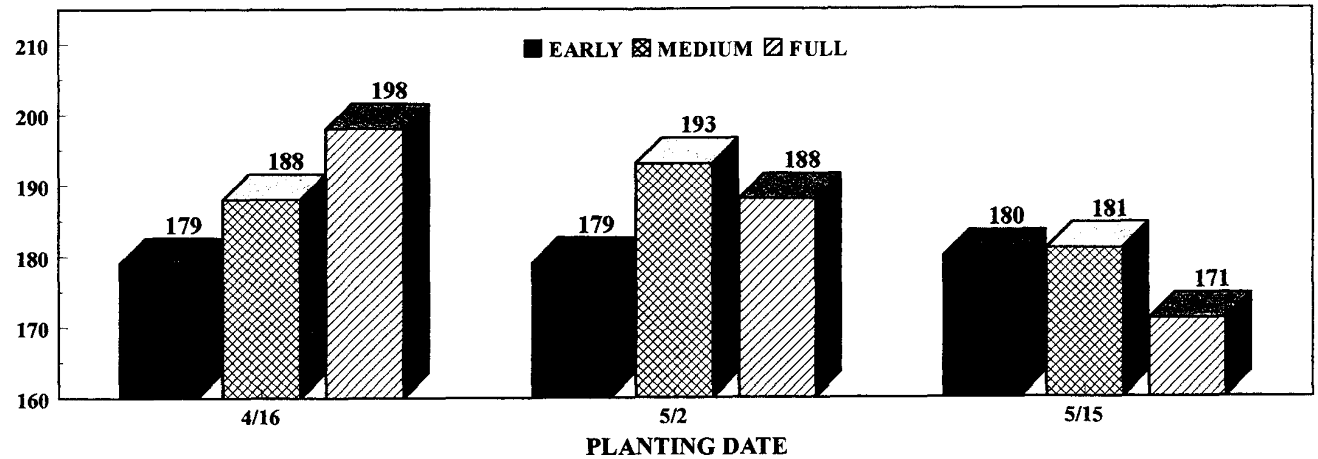
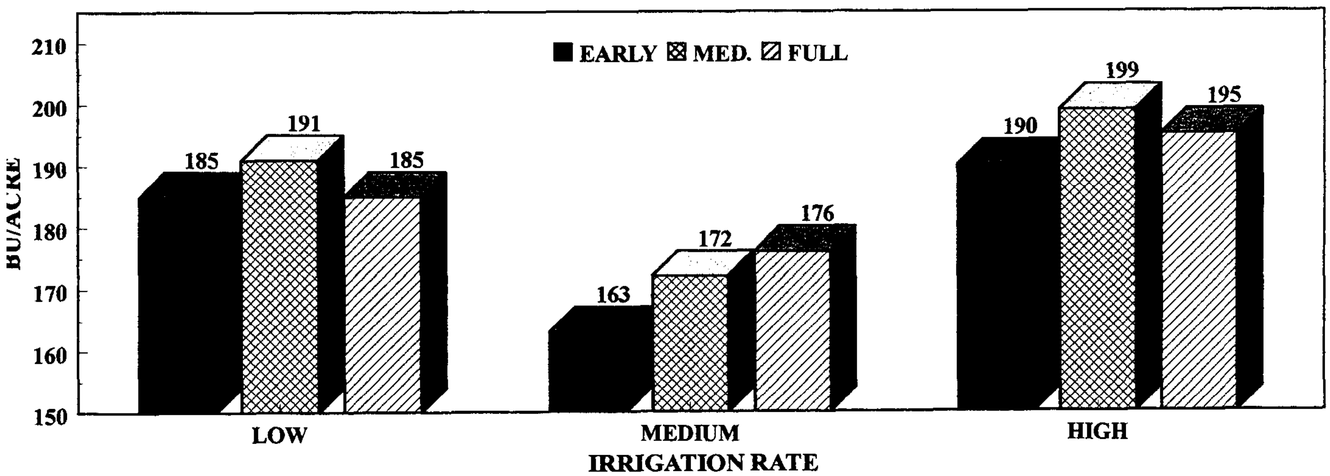


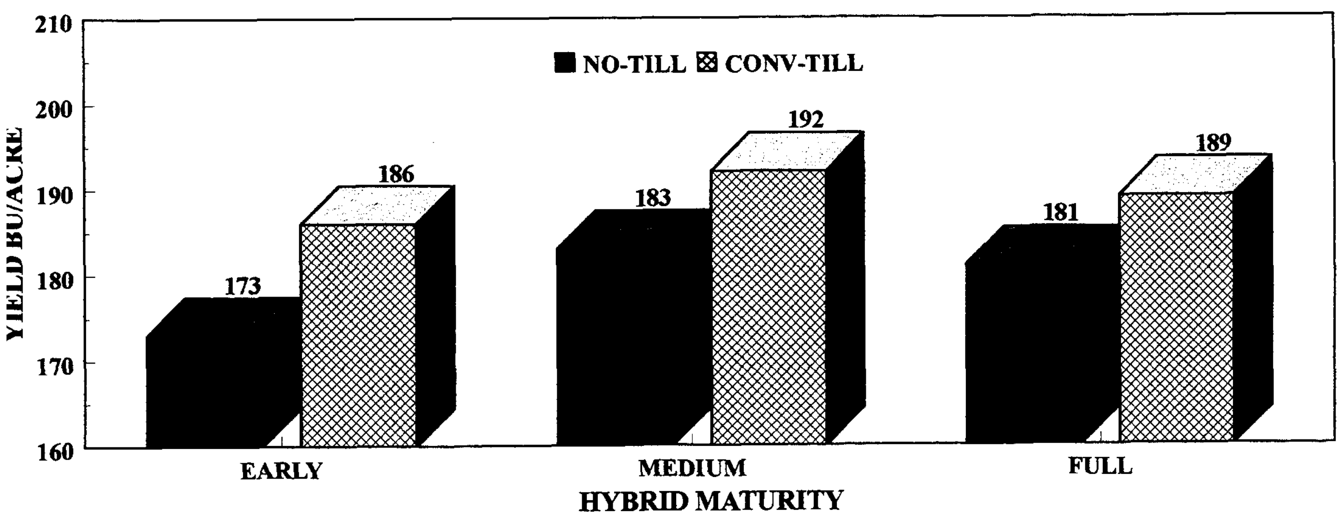
Figure 2. Corn grain yields in planting date x irrigation level x tillage x hybrid maturity study, Sandyland, 1996.



D(.05) = 7.1; (.10) = 5.9

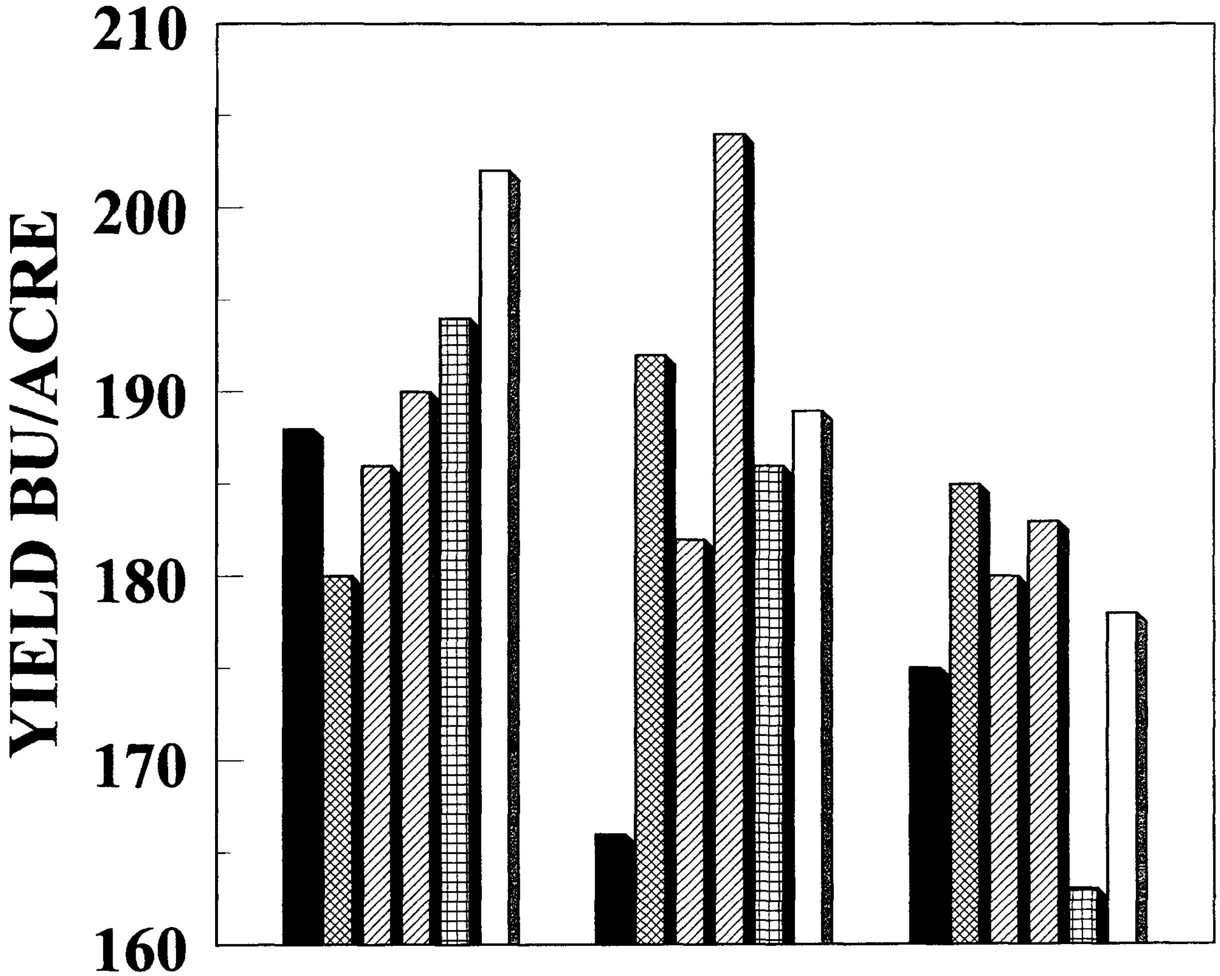


SD(.05) = NS



SD(.05)= NS

Figure 3. Effects of interactions of hybrid with planting date, irrigation level, and tillage on yield of irrigated corn, Sandyland, 1996.

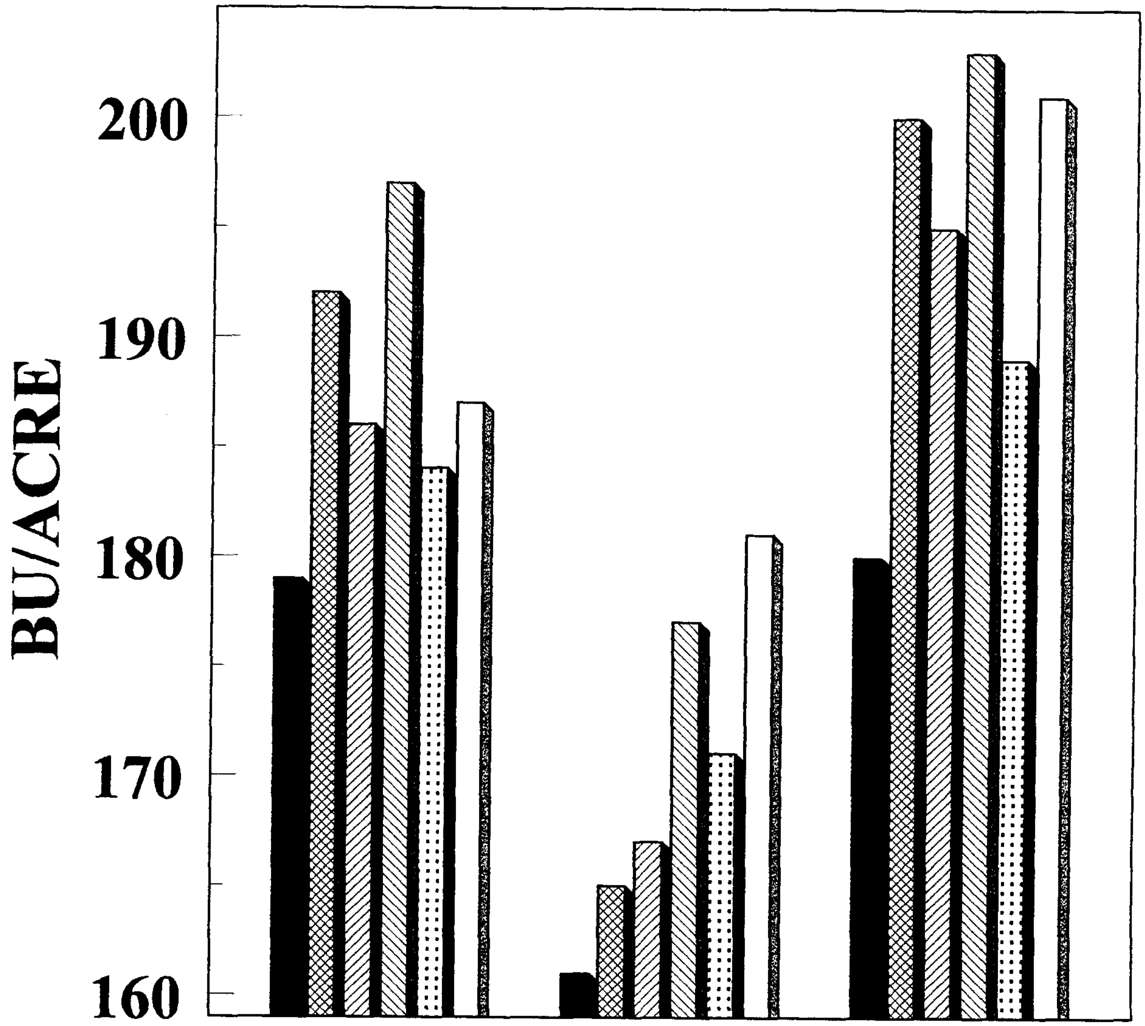


DATE	4/16	5/2	5/15
EAR NT	188	166	175
EAR CT	180	192	185
MED NT	186	182	180
MED CT	190	204	183
FULL NT	194	186	163
FULL CT	202	189	178

LSD(.10) = 7.2

NT=NO-TILLAGE; CT=CHISEL-DISK

Figure 4. Effects of hybrid x planting date x tillage across irrigation levels on yield of irrigated corn, Sandyland, 1996.



IRR LEV	LOW	MEDIUM	HIGH
EAR NT	179	161	180
EAR CT	192	165	200
MED NT	186	167	195
MED CT	197	177	203
FULL NT	184	171	189
FULL CT	187	181	201

LSD(.10) = 7.2 UNPROTECTED

EAR=EARLY MED=MEDIUM; FULL=FULL SEASON

Figure 5. Effects of interaction of hybrid x irrigation level x tillage across planting date on yield of irrigated corn, Sandyland, 1996.

YIELD AND ECONOMIC FEASIBILITY OF A GRAIN SORGHUM-WHEAT ROTATION ON DRYLAND SANDY SOILS

Victor L. Martin, Richard L. Vanderlip, and Gerald W. Warmann

Introduction

Although Kansas typically leads the nation in grain sorghum production, dryland wheat acreage dwarfs that of grain sorghum. Although the practice of continuous long-term wheat production is slowly changing, much dryland ground is in continuous wheat. The new Freedom to Farm legislation will speed the change from continuous wheat, as will several other factors.

The problems with continuous wheat on the sandy soils of south central Kansas are several. Continuous wheat production on the highly erodible soils typical of the Great Bend Prairie must entail leaving significant amounts of wheat straw on the soil surface (reduced tillage) for a producer to remain in compliance with NRCS guidelines. As tillage is decreased and straw is allowed to accumulate on the soil surface, disease pressure increases; volunteer wheat and weeds, especially cheat weeds, are more difficult to control; and planting through the residue can be difficult. Continuous wheat cropping compounds the problems. Crop rotation can play a major role in managing these problems, while maintaining adequate surface cover.

Presently, two crops are most practical for dryland crop rotations on the sandy soils of the region, corn and grain sorghum. Dryland corn production in the area has been increasing over the last 5 years. The two major advantages when rotating wheat with corn are that atrazine can be applied safely at spring planting to control cheat grasses and the corn usually can be harvested early enough to allow a return to wheat.

Planting dryland corn has two major disadvantages. Dryland corn production entails greater risk and management skills, especially on sandy soils. If the summer is hot and dry and timely rains, particularly near flowering, do not occur, the producer risks yields of 20 to 30 bu/a or less. Eliminating tillage and weed pressure are also critical to maximize available water, much more so than under irrigation. Other disadvantages are the increased input costs and need for different equipment than is used for wheat.

Rotating with grain sorghum is the other primary option. Sorghum has the advantage of being better able to withstand drought, produce more consistent yields, and produce less residue to manage. The disadvantages include the inability to safely use atrazine preemergence on sandy soils and the need for available soil water for a longer period of time during the growing season. Most importantly, it is difficult if not impossible to harvest the sorghum and return to wheat in the same season. This has meant that farmers rotating out of wheat to sorghum have had a fallow year before returning to wheat. The need to idle land for a year has resulted in many producers being unwilling to rotate to sorghum until or unless weed and disease pressure resulted in almost negligible yields. If producers could successfully plant shorter-season grain sorghum significantly earlier than the typical mid- to late- June planting and minimize the amount of tillage involved, it might be practical for them to move to a grain sorghum-wheat rotation.

The primary objective of this study is to determine the agronomic and economic feasibilities of a grain sorghum-wheat rotation compared to continuous wheat. The study also will determine the effect of tillage, weed control intensity, planting date, and their interactions on the yield and quality of grain sorghum and wheat.

Procedures

The soil for this study is a fine sandy loam. The site was cropped to wheat for 2 years prior to planting in 1996. Fertilization consisted of 100 lb/a 18-46-0 preplant with 120 lb/a N applied as urea (46-0-0) using a split application with 50 lb/a N preplant and 75 lb/a sidedressed. Plots were planted with a six-row John Deere no-till planter on the appropriate date at 51,000 seeds/a. Entire plots were harvested mechanically in mid-October. Grain moisture and test weight were determined, and all yields were adjusted to 12.5% moisture. Dates of 50% emergence and bloom, final plant population, heads/plant, and final plant height also were determined. Wheat 2163 was planted on October 25 at 90 lb/a using a Marliss no-till 10-inch drill. Wheat will be harvested, and total system yields will be determined.

Treatments are as follows:

1. Main plots: Planting date - May 21, June 10.

2. Split plots: Tillage - No-tillage and Conventional (Chisel-Disk).

3. Split-split plots: Weed control - Standard (Dual followed by Marksman. No-till preplant weed control with Roundup or Landmaster. Conventional preplant control by tillage). Reduced(Preplant with no-till using Roundup and a rescue treatment of 2,4-D or Banvel if necessary. Conventional tillage will have only tillage for weed control and a 2,4-D or Banvel rescue treatment if necessary.)

4. Final split: Hybrid maturity - Early (NC+ 5C35) and Medium (NC+ 6B50).

A continuous wheat treatment using the above factors also is included for comparison. The tillage and weed control levels will be tested during the wheat crop and fallow periods. Plots were planted in a randomized complete block design in four replications.

Results

Precipitation was much above average during the 1996 growing season (Table 1), and temperatures were relatively mild. The wet conditions from May through June prevented the application of Marksman, so the standard weed control treatment consisted of Dual only in 1996. The study calls for harvesting sorghum by the first of October and having wheat planted by the second week of October. The wet cool conditions of August and September delayed maturity and, therefore, harvest and wheat planting. Wheat was not planted until late October.

This is only the first year of a multi-year study, and no conclusions can be drawn yet; however, the data are of interest. Planting on May 21 versus June 10 increased yields overall by 6 bu/a regardless of tillage and weed-control levels (Figure 6). Overall, no-tillage yields were lower than conventional tillage yields but not significantly so. The conventional weed-control treatment (Dual only) significantly increased yields over no herbicide inputs, and the medium maturity hybrid (NC+ 6B50) significantly outyielded the early maturity hybrid (NC+ 5C35). We should note that the long-term average sorghum yield for the area is 50 to 60 bu/a. Yields in 1996 were exceptionaly high throughout the region.

Tillage did not affect yields for the May 21 planting; however, no-tillage significantly decreased yields for the June 10 treatments (Figure 7). The cause is not known and may simply be an artifact of randomization. This trend will be monitored closely to see if it continues. As expected, the need for chemical weed control was greater for earlier planting (Figure 7). Surprisingly, herbicide application was more beneficial under the chisel-disk system than no-tillage.

Examining the interaction of all factors demonstrates the benefits of planting earlier regardless of hybrid maturity (Figure 8) and the need for chemical weed control inputs regardless of tillage when planting early. Finally, these data show no-tillage to be competitive with conventional tillage, even when planting early during a cool, wet spring.

This is only the first year of a study designed to last a minimum of three rotation cycles. Although no conclusions can be drawn yet, the initial data indicate the potential for success.

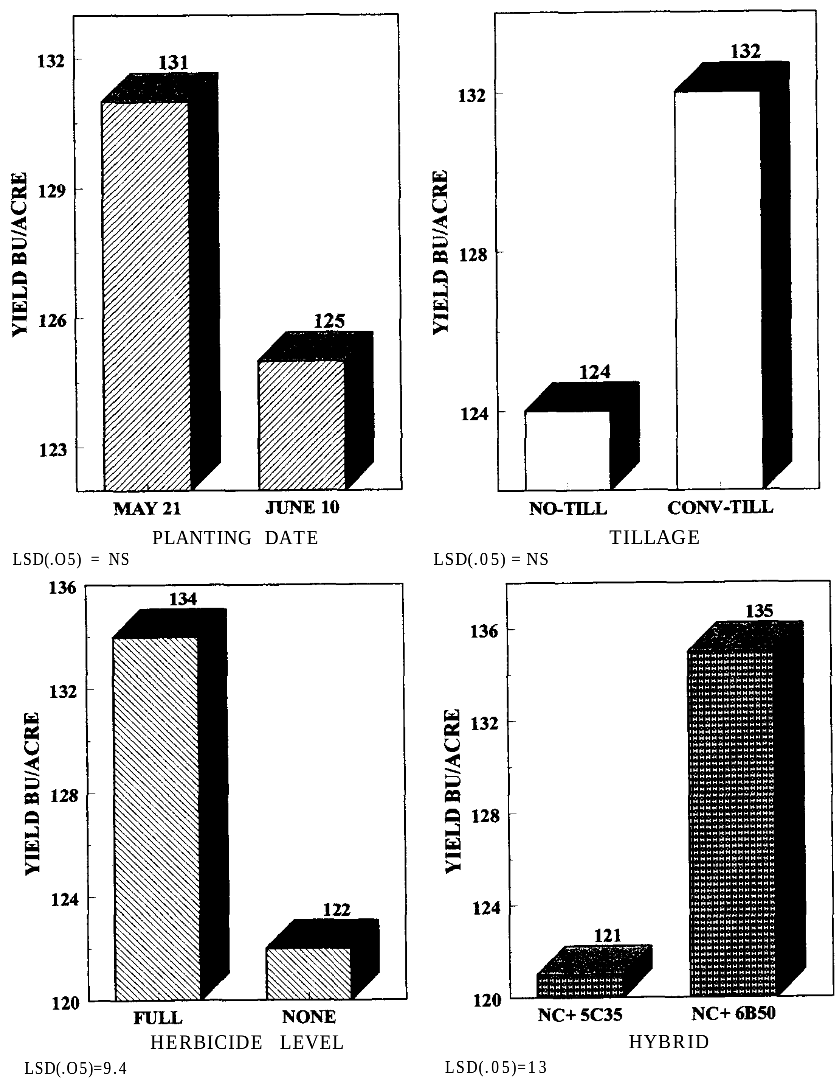


Figure 6. Grain sorghum yield in planting date x tillage x herbicide level x hybrid study, Sandyland, 1996.

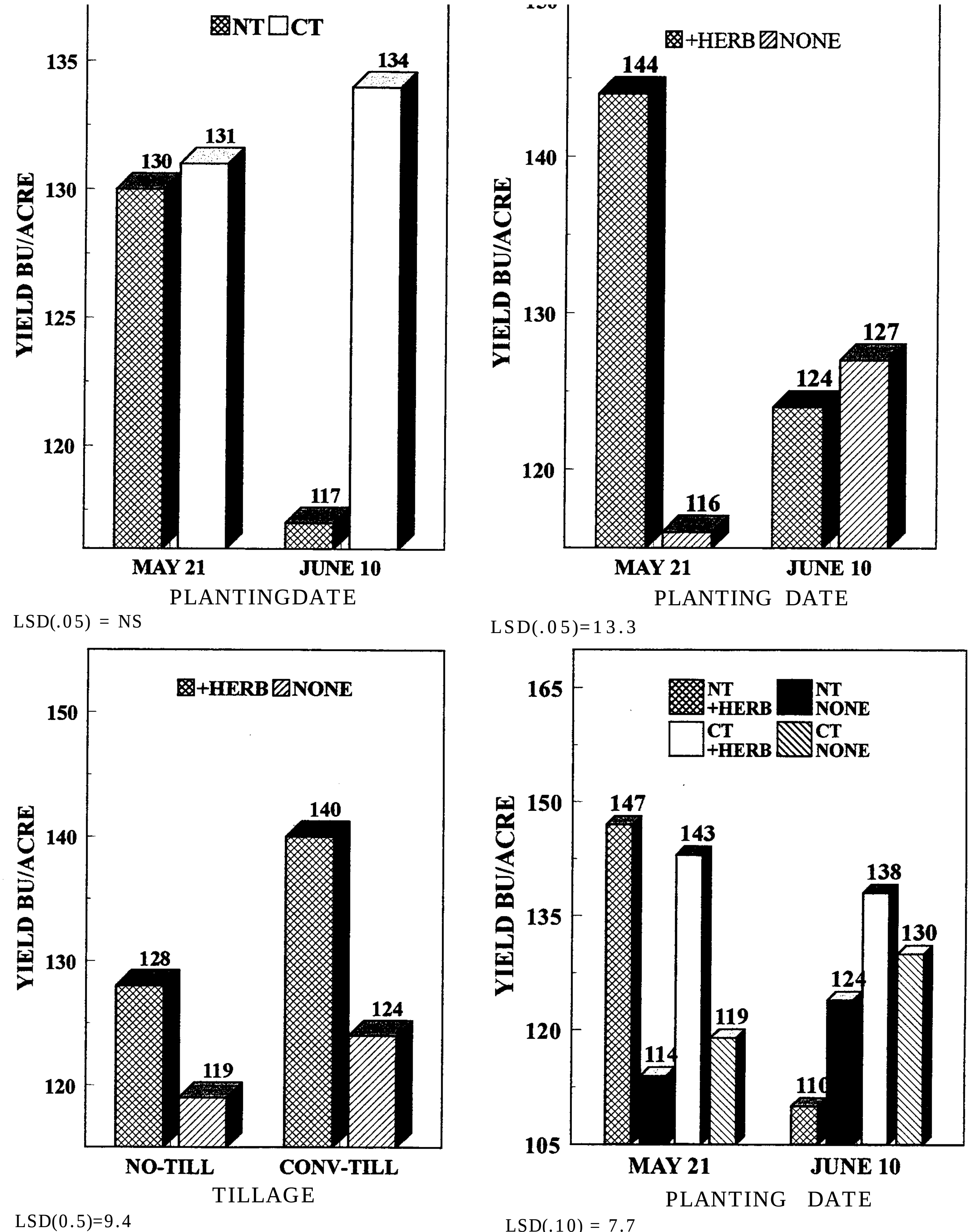
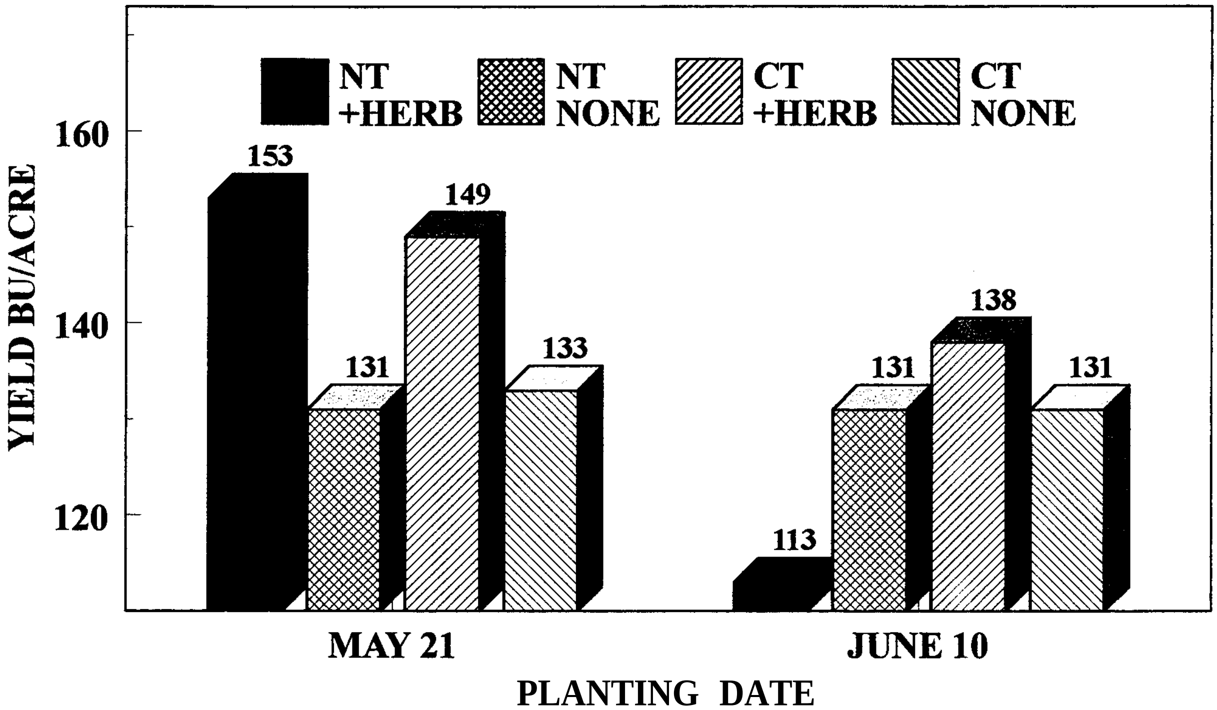


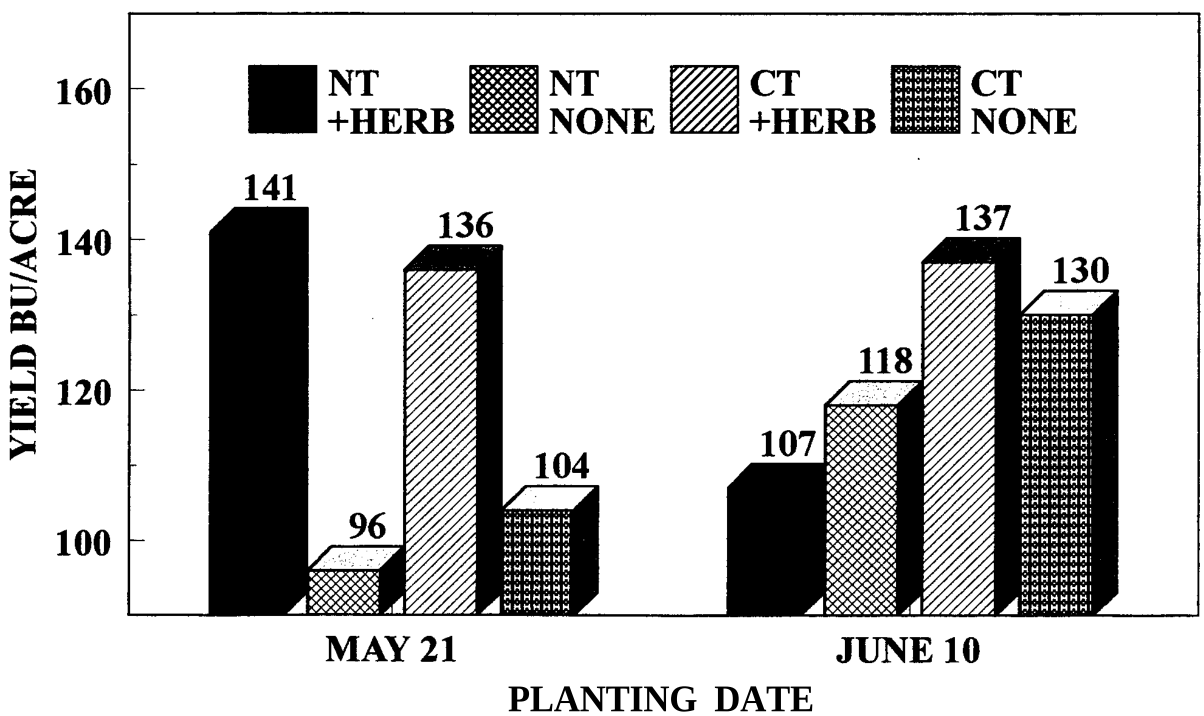
Figure 7. Effect of tillage x planting date; herbicide level x planting date; herbicide level x tillage; and tillage x herbicide level x planting date on grain yield, Sandyland, 1996.

NC+ 6B30 (MEDIUM MATURITY)



LSD(.05)= NOT SIGNIFICANT

NC+ 5C35 (EARLY MATURITY)



LSD(.05)=NOT SIGNIFICANT

Figure 8. Interaction of planting date x tillage x herbicide level by hybrid maturity, Sandyland, 1996.

SOUTH CENTRAL KANSAS IRRIGATION SCHEDULING AND WATER MANAGEMENT DEMONSTRATION PROJECT

Gary A. Clark, Danny H. Rogers, Dale L. Fjell, and Victor L. Martin

Introduction

The South Central Kansas Irrigation Scheduling and Water Management Demonstration Project is a 5 year cooperative effort between Kansas State University (K-State) Research and Extension and the Water Protection Association of Central Kansas (Water PACK). The overall goal of this project is to increase the understanding, adoption, and use of improved irrigation management and scheduling procedures by using current technology and climatic forecasting with field feedback on crop growth, soil moisture, applied water, and rainfall.

During the summer of 1996, extension and research professionals with K-State initiated field demonstrations and applied research on irrigation scheduling and water management practices in cooperation with Water PACK members on demonstration farm sites located in South Central Kansas. Cooperator/farm demonstration sites have been selected in each of the 13 representative Water PACK counties and will be used for the duration of the project. Eight sites were identified and monitored in 1996. Each site is located on or near a paved road and is identified with a large sign that lists the project title, the cooperator(s), the project sponsors, and current irrigation scheduling information.

During the course of the project, an overall evaluation of the irrigation system and weekly visits for system and field/crop measurements will be done on each demonstration site. For example, Figures 1 and 2 show the soil sampling locations and changes in water content from irrigation for one of the sites in 1996. Other system evaluations include nozzle discharge and uniformity (Figure 3) and water application/yield tests (Figure 4) to measure the effectiveness of an irrigation schedule. The cooperator fields will be open to peripheral visits throughout the summer production period, with more detailed field tours and project updates scheduled in August of each year. Annual winter seminars of educational programs and project updates also will be held in multiple locations within the project region.

We expect that by the end of the project period substantial numbers of farmers and crop consultants in South Central Kansas will be aware of the benefits of irrigation scheduling and field water management, including water and energy conservation, sustainability of water resources, reduced chemical leaching, reduced equipment maintenance and wear, and enhanced crop growth and development. We also expect that these individuals will know how to access and use the regional weather station network to obtain real-time weather data for irrigation scheduling purposes. This project also should result in a greater public awareness of resource stewardship by area farmers.

Fig 1. Sampling Locations for Soil Moisture Analysis

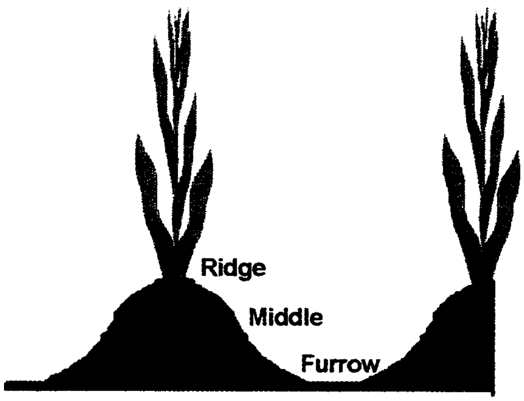


Fig 2. Average Change in Water Content of the Soil after Irrigation

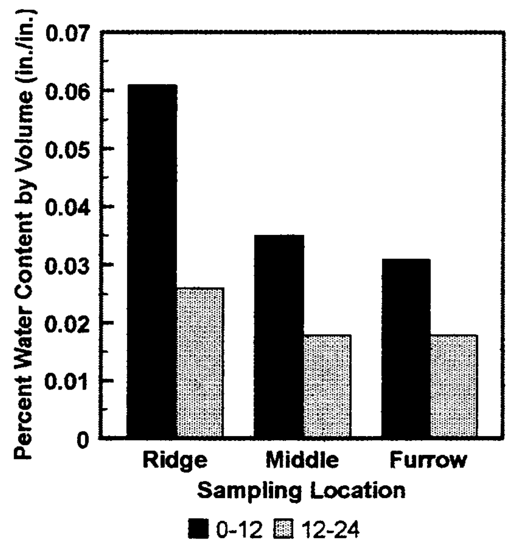


Fig 3. Nozzle Discharge for a Complete Pivot System

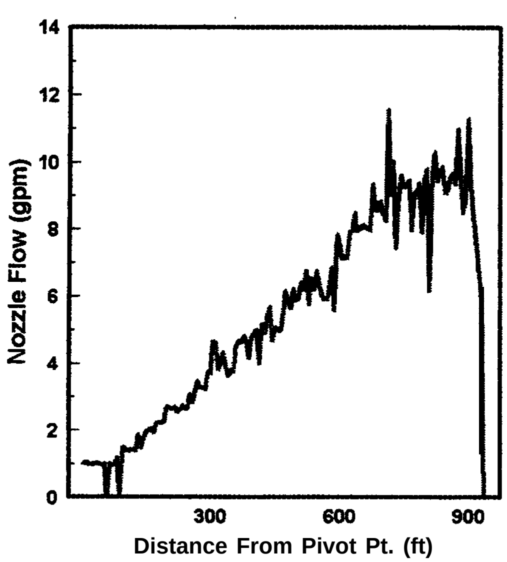
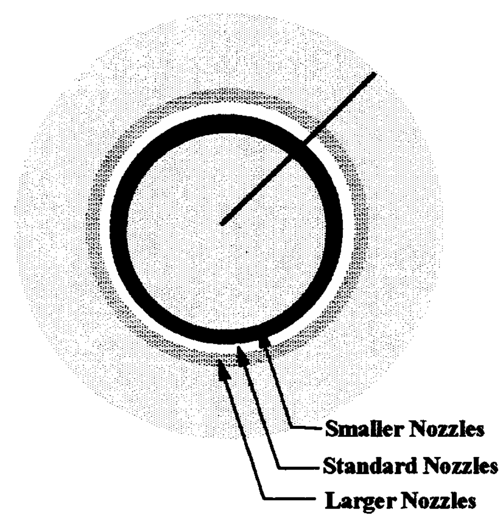


Fig 4. Center Pivot System Irrigation Application Tests



SOUTH CENTRAL KANSAS EXPERIMENT FIELD

Introduction

The South Central Kansas Experiment Field was established in 1951 on the US Coast Guard Radio Receiving Station located southwest of Hutchinson. The first research data were collected with the harvest of 1952. Prior to this, data for the South Central area of Kansas were collected at three locations (Kingman, Wichita, and Hutchinson). The current South Central Field location is approximately 3/4 miles 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 crop and crop rotation, variety improvement, and selection of hybrids and varieties adapted to the area. Experiments deal with problems related to production of wheat, grain and forage sorghum, oats, alfalfa, corn, soybeans, rapeseed/canola, and sunflower and soil tilth. Breeder and foundation seed of wheat and oat varieties are produced to improve seed stocks available to farmers. A large portion of the research program at the field is dedicated to wheat breeding and germplasm development.

Soil Description

The soil survey for the South Central 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 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 inches. 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 Counties. 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 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 unsuited for cultivated crop production and has been seeded to switchgrass. Small pockets of the Tabler-Natrustolls are found throughout the Field.

1996 Weather Information

Precipitation in 1996 totaled 26.01 inches, 3.09 inches below the 30-year average of 29.1 inches (Table 1). As in previous years, precipitation in 1996 was not distributed evenly through the year or within a given month. The highest monthly total was recorded in September (4.74 inches) rather than May or June. This year was also different from previous years in that, when the totals were high, most of the precipitation was not received as heavy downpours. Therefore, most of the rainfall received did not run off and was beneficial to crop production. The soil conditions at planting of the 1996 winter wheat crop (October 1995) were good because of the above-normal rainfall received in August and September of 1995. After planting, precipitation was considerably below the long-term average, and temperatures averaged slightly below normal. These conditions resulted in limited wheat growth and considerable damage to the fall tillers. This caused considerable concern, because the dry weather continued into early April. The moisture received in March through May was timely, and temperatures were favorable for grain filling. These conditions allowed for near-normal wheat yields. Precipitation received in July, August, and September along with below-normal temperatures were very beneficial for the grain sorghum and other summer annual crops. Soil moisture at wheat seeding time for the 1997 crop was considered excellent. A frost-free growing season of 178 days (April 23 - October 18, 1996) was recorded. This is 5 days less than the average frost-free season of 183 days (April 19 - October 17).

Table 1. Precipitation at South Central Kansas Experiment Field, Hutchinson.

Month	Rainfall (inches)	30-yr Avg* (inches)	Month	Rainfall (inches)	30-yr Avg (inches)
1995			April	1.57	2.91
September	3.84	3.01	May	4.41	4.14
October	0.07	2.46	June	1.25	4.23
November	0.05	1.33	July	3.86	3.21
December	0.96	1.00	August	3.78	3.02
1996			September	4.74	2.96
January	0.08	0.61	October	1.41	2.45
February	0.02	0.96	November	3.00	1.33
March	1.71	2.32	December	0.22	0.96
			1996 Total	26.01	29.10

* Most recent 30 years.

TEST WITH ALFALFA

William F. Heer, Kraig L. Roozeboom, and James P. Shroyer

Introduction

Several questions have been asked regarding the effects of preplant tillage and application of nitrogen (N) fertilizer on establishment of alfalfa. To answer some of the questions, two research studies were established, one using four preplant tillage factors and the second using four N rates applied at seeding. The previous crop for the first preplant tillage study was winter wheat. The remaining three have been in oat stubble.

Procedures

The tillage study in wheat stubble was planted in the fall of 1990. Differences in dry matter production by tillage occurred in the first year but did not continue into the second and third years. This indicated that tillage may affect yield in the year of establishment, but thereafter no yield differences should be realized when planting alfalfa into wheat stubble. A similar study established in oat stubble in the fall of 1992 is being continued. As with the wheat stabble study, this study was designed to evaluate stand establishment and yield under four tillage systems (conventional, disk, no-till burn, and no-till) prior to planting. Fall establishment of alfalfa was good in all tillage treatments. However, in the spring, the stand in the no-till plots appeared to be thinning out (a condition that occurred in a previous planting). To evaluate this condition, a third study was established using only no-till practices with five alfalfa varieties (Kanza, Riley, Cody, KS 1002, and KS 1001) and four rates of N fertilizer (0, 50, 75, and 125 lb/a) applied at seeding time. Data for plot weight, subsample wet and dry weights, and plant height were taken. The plot weight and subsample wet and dry weights were used to calculate dry matter production on a per acre basis.

Results

The alfalfa in the no-till plots (that seeded into standing oat stubble) showed signs of stand thinning and desiccation. Sufficient stands persisted in the 1992 seeding, and the data from that seeding are in Table 2. Dif-ferences in yield by tillage that existed in the first cutting in 1993 did not continue into the second and third cuttings for that year. The first cutting differences were sufficiently large to result in significantly different total yields by tillage for 1993, with the no-till burn treatment having the greatest yield (Table 2). The wet April of 1994 resulted in no significant differences in yield by tillage for the first cutting. However, as the summer of 1994 became hot and dry, yields were reduced and differences by tillage were apparent. By the end of the growing season, the no-till and offset disk treatments had the highest yields. A yield reduction in the fourth cutting of the no-till treatment after the extended dry period quite possibly was the effect of the earlier reported problem with stands in the no-till plots. In 1995, only three cuttings were taken from these plots. The reduced number of cuttings was the result of a cold wet spring and hot, dry weather in July and August. These conditions appear to have affected the offset disk treatment more than the others, because it had a lower total yield (Table 2). This follows the trend that was seen in the earlier study with alfalfa seeded into wheat stubble; the offset disk treatment also had reduced yields. The cool wet conditions of 1996 resulted in no total yield differences. However, the first cutting following the dry harsh winter had significant yield differences (Table 2). As with previous differences, it was the offset disk treatment that had the lowest yield for that cutting. No differences occurred in the percent dry matter by treatment in any of the four cuttings. The only difference in plant height occurred in the first cutting, where the disk treatment reduced plant height compared to the other treatments.

The study with varieties and N rates was also cut four times for dry matter yield. The dry matter yields for 1995 and 1996 are listed in Table 3. The only significant differences by cutting date in 1996 occurred at the 75 lb/a N rate for the second cutting and the 0 N rate for the third cutting. These differences were the results of Riley having lower yields than the other varieties. Where the yearly total yields were significant (Kanza, Cody, and KS1001), only the 0 N treatment produced significantly lower yields.

Table 2. Dry matter yield of alfalfa established in oat stubble with tillage, Hutchinson, KS.

	1996 Yield				Average Yield			
Tillage	1st[1]	2nd	3rd	4th	1996	1995	1994	1993
		t/a [2]						
Offset disk	1.1	1.0	0.8	0.6	3.4	4.2	6.2	4.3
No-till	1.4	0.8	0.7	0.7	3.5	5.0	6.1	3.4
Conventional	1.4	0.9	0.7	0.6	3.5	5.0	5.5	3.4
No-till burn	1.3	0.9	0.7	0.6	3.5	4.9	5.7	4.4
L.S.D.$_{(P=0.05)}$	0.2	NS	NS	NS	NS	0.3	NS	0.6
C.V. $_{(\%)}$	7.2	12	26	11	10	3.6	4.9	9.2

[1] Cutting.
[2] On an oven dry basis.

Table 3. Dry matter yield of alfalfa seeded into oat stubble with starter N fertilizer, Hutchinson, KS.

	Kanza		Riley		Cody		KS1002		KS1001	
N Rate	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
lb/a					t/a[1]					
0	1.7	4.5	1.3	4.1	1.4	4.4	1.4	4.8	1.4	4.2
50	1.5	4.7	1.3	4.6	1.5	4.6	1.5	4.7	1.5	4.6
75	1.7	5.2	1.2	4.4	1.4	4.4	1.5	4.6	1.5	5.0
125	1.7	5.2	1.6	4.6	1.0	5.1	1.0	4.7	1.5	4.8
L.S.D. $_{(P=0.05)}$	NS	0.7	NS	NS	NS	0.7	NS	NS	NS	0.7

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.
[1] Dry matter basis.

OATS FOR FORAGE AND GRAIN

William F. Heer, Kraig L. Roozeboom, and James P Shroyer

Introduction

Oats are utilized not only for grain but also as a forage. Most of the time, oats planted for forage are utilized as a hay crop to feed livestock. The performance test for spring cereals did not report grain yields from oat varieties this year. Therefore, the forage and grain yields from the oat performance test of the South Central Field are reported here.

Procedures

Two sets of oat plots were planted on 22 February 1996 using the same drill and seeding rate. Soil conditions at planting were less than ideal because of the dry winter. Therefore, some of the varieties had poor emergence. At the soft dough stage, the set of plots used for forage yield was trimmed to harvest length and prepared for harvesting with a Carter Forage Harvester. When the plots reached the hard dough stage (19 June), they were harvested. Data for plot weight, subsample wet and dry weights, and plant height were taken. The plot weight and subsample wet and dry weights were used to calculate dry matter production on a per acre basis. The grain yield plots were harvested on 16 July. The late harvest date was a result of later maturity caused by weather conditions and wet soil.

Results

The data for forage dry matter and grain yield are summarized in Table 4. The 1996 growing season was not ideal for the production of oat grain or forage. The early months were dry (Table 1), and the plants that did emerge were stressed until May. In May, above-normal precipitation was received and temperatures were cool. However, June was again very dry but not as hot as usual. This again slowed plant development. The major factor affecting yields in 1996 (Table 4) was the reduced stands. We also should note that plant height does not mean increased production. When looking at a variety for forage, both plant height and percent dry matter need to be evaluated. A taller variety may have a lower percent dry matter and, therefore, produce fewer total tons of forage per acre on a dry matter basis than one of the shorter varieties. For this reason , plant height and percent dry matter data are not shown. The varieties need to be evaluated for either grain or forage production, because a variety that has high grain yield potential may not have a high forage yield potential.

PERFORMANCE TESTS WITH OTHER CROPS

William F. Heer and Kraig L. Roozeboom

Introduction

Performance tests for winter wheat, grain and forage sorghum, and sunflower were conducted at the South Central Kansas Experiment Field. This is the first year for the sunflower test. Results of these tests can be found in the following publications.

1996 Kansas Performance Tests with Winter Wheat Varieties. KAES Report of Progress 769.

1996 Kansas Performance Tests with Grain and Forage Sorghum Hybrids. KAES Report of Progress 775.

1996 Kansas Performance Tests with Sunflower Hybrids. KAES Report of Progress 780.

Table 4. Grain and forage yields of oat, Hutchinson

	Yield		
		Dry Matter	
Variety	Grain 1996	1996	1995
	bu/a	t/a	
Armor	42	3.2	6.1
Bates	50	3.5	6.0
Bay	16	1.9	----
Belle	33	2.2	----
Brawn	60	4.0	5.9
Dane	25	1.2	5.8
Don	43	3.8	5.8
Gem	27	3.1	----
Hazel	29	3.2	6.1
Horicon	44	2.6	4.9
Larry	33	2.5	5.2
Ogle	35	2.7	6.2
Praire	52	3.9	6.2
Premier	52	3.3	5.7
Settler	----	----	5.0
Starter	27	1.8	4.7
Mean	37.5	2.9	5.7
$LSD_{(P=0.05)}$	12.7	0.6	0.6
C.V. $_{(\%)}$	28.5	13.4	7.5

EFFECT OF SEED TREATMENTS ON WHEAT EMERGENCE AND YIELD

Robert L. Bowden, William F. Heer, Curtis R. Thompson, and Alan Schlegel

Introduction

Several new seed treatments are being tested their effects on winter wheat in the Great Plains region. This study was designed to evaluate the effects of 11 seed treatments on emergence (fall stand), fall and spring growth (estimated by percent cover), and grain yield of winter wheat.

Procedures

A 1995 seed lot of hard red winter wheat variety Karl 92 with symptoms of scab was obtained from the Kansas Crop Improvement Association. Germination in a standard lab test was 63%. Seed was treated with a commercial slurry treater using a total volume of 16 fl oz/100 lb (cwt). Treatments applied are listed in Table 5. Gustafson Pro-Ized Seed Colorant was added at 0.2 fl oz/cwt to all unpigmented treatments including the nontreated check. Seed was planted at 50 lb/a at the South Central Experiment Field in Hutchinson, KS on 10 October and at the Southwest Research-Extension Center at Tribune, KS on 2 October. Planting depth was approximately 1.25 in. at Hutchinson and 1.75 in. at Tribune. The experiments at each location were arranged as a randomized complete block. Plots were 5 X 20 ft with five replicates at Hutchinson and 5 X 30 ft with four replicates at Tribune. Soil moisture at planting was good, and germination was fairly uniform. Seedling emergence was counted 25 October at Hutchinson and 3 November at Tribune in two 3-ft sections of the middle row in each replicate.

Results

Plots at Tribune subsequently were lost to drought, extreme cold, and high winds during the winter. At Hutchinson, weather was dry in the late fall, winter, and early spring, but rains were adequate in May (Table 1). Foliar disease pressure and barley yellow dwarf incidence were extremely low. The percent ground cover was estimated on 1 April, and plots were harvested with a small plot combine on 21 June. Yields were standardized to 60 lb/bu and 13% moisture (Table 5). At Hutchinson, stand counts for all treatments except Raxil-thiram, Baytan + Thiram 42S, and Vitavax Extra were significantly better than the check. No significant differences among treatments were detected for % ground cover or grain yield. This lack of difference most likely was due to the lack of any significant disease pressure at this location in 1996. At Tribune, stand counts revealed that no treatments were significantly better than the check, but the Raxil-thiram and Baytan + Thiram 42S treatments had significantly lower stands. This apparent phytotoxicity might have been related to greater planting depth at Tribune.

Table 5. Winter wheat stand, percent cover, and grain yield as affected by seed treatment, Hutchinson and Tribune, KS, 1996.

	Hutchinson			Tribune
Treatment and Rate (fl oz/cwt)	Stand	Cover	Yield	Stand
	(plants/3-ft)	(%)	(lb/a)	(plants/3-ft)
Check	37.8 A*	56	58.4	38.7 AB
Raxil-thiram (3.5)	38.5 AB	57	60.6	31.2 C
Baytan 30F (1.25) + Thiram 42S (2)	42.6 ABC	61	60.6	30.3 C
Vitavax Extra (3)	45.1ABCD	56	61.0	37.2 ABC
RTU Vitavax-thiram (6) + Gus LSP (0.25)	45.4 BCD	57	59.2	35.1 ABC
Vitavax 200 (4) + Gus LSP (0.25)	46.2 CD	61	62.2	35.7 ABC
Dividend 3F (0.5)	46.3 CD	57	56.8	34.4 BC
Raxil-thiram (3.5) + Gus LSP (0.25)	47.4 CD	63	59.0	33.5 BC
RTU Vitavax-thiram (6)	48.4 CD	59	59.0	42.3 A
RTU Vitavax-thiram (6) + Gaucho 480FS (2)	50.4 D	55	60.6	39.3 AB
Vitavax 200 (4)	51.0 D	55	59.6	35.7 ABC
LSD	7.4	NS	NS	6.5
CV	12.8	8.5	7.0	12.6

* Data within column followed by same letter are not significantly different according to Fisher's protected LSD (*P*=0.05).

EFFECTS OF NITROGEN RATE ON YIELD IN CONTINUOUS WHEAT AND IN ALTERNATIVE CROP ROTATIONS IN SOUTH CENTRAL KANSAS

William F. Heer

Summary

Evaluation of nitrogen (N) rates on continuous winter wheat and in two rotations involving "alternative" crops for the area have been established at the South Central Field. The continuous winter wheat study was established in 1979. The first of the alternative rotations was established in 1986 and discontinued in 1995. That rotation included corn followed by winter wheat followed by grain sorghum. The second rotation, (established in 1990) has soybeans substituted for the corn. The grain sorghum crop in 1996 was the last funded for this rotation. Both rotations used no-till seeding into the previous crop's residue. The continuous wheat was revised to utilize both conventional and no-till production practices.

Continuous Wheat Long-Term Nitrogen Rate by Tillage Study

Researchers: W.F. Heer

Introduction

A long-term N rate study with winter wheat was established on the South Central Kansas Experiment Field in the fall of 1979. As stated above, it was revised in 1987 to include a tillage factor. The purpose of the current study is to evaluate the yield response of continuous winter wheat to six rates of N under conventional and no- tillage systems.

Procedures

The conventional tillage plots were plowed after the wheat was harvested in June of 1995. These plots then were disked as necessary to control weed growth until the N fertilizer was applied. Rates of 25, 50, 75, 100, and 125 lb. N/a were applied using 34-0-0 as the N source prior to the last tillage (field cultivation) on the conventional and seeding the no-till plots. All plots also received 40 lbs. P_2O_5/a as 0-46-0 with the seed. The plots then were cross seeded to Karl winter wheat at a rate of 60 lbs/a conventional and 90 lbs/a no-till.

Results

The data from the plots are summarized by N rate in Table 6. Like previous wheat crops, grain yields for the oats in 1994 also peaked at the 75 lb N rate, indicating that N was not the yield-limiting factor. The wheat yields for 1995 were not affected by cheat but more by the weather conditions. The cool wet winter with lush growth was followed by a warm period. This then was followed by cool wet conditions during seed setting and grain filling. The data reflect these conditions. The yield increases expected with increasing N rate did not materialize this year. The yields were up and down, with the lower N rates having the highest yields. This is most likely the result of their stage of growth not being as advanced when the weather turned to the cold wet conditions. The no-till plots also had greater yield reductions than the conventional treatments. In 1996, climate was again the major factor affecting the yields. After being extremely wet through the summer, weather turned extremely dry in the fall of 1995 (Table 1). This caused the no-till plots to be extremely hard from compaction and drying out. These conditions resulted in reduced emergence in the no-till treatments. The lack of precipitation also resulted in reduced fall growth in both the conventional and no-till plots. The no-till treatments had significantly less dry matter than the conventional plots at all N rates except the no-N check. Plant height was also significantly less in the no-till treatments for all N rates. These reductions carried through to grain yield, with the no-till having significantly lower yields at all N rates. As with previous years, yields increased with increasing N rate to the 75 lb/a rate for both tillage treatments. Thus, N is not the apparent yield-limiting factor.

Soybean-Winter Wheat-Grain Sorghum Rotation with Six Nitrogen Rates

Researchers: W.F. Heer and J.L. Havlin

Introduction

Research was initiated in 1990 at the South Central Experiment Field to (1) evaluate the production potential of no-tillage, dryland, short-season soybeans in a soybean-winter wheat-grain sorghum rotation and (2) quantify the fertilizer N response for each crop in the rotation.

Procedures

To evaluate the above objectives, soybeans are planted into the previous year's grain sorghum stubble. Wheat is planted into soybean stubble in the same year of soybean harvest, and grain sorghum is planted into the previous year's wheat stubble. Prior to planting the wheat and grain sorghum plots, N rates of 25, 50, 75, 100, and 125 lb/a are applied to the assigned plots. A no-N check is included. Nitrogen fertilizer is not applied prior to planting of soybeans. All crops are planted no-till at their normal seeding times. Maturity group 1 short-season soybeans are used with wheat and grain sorghum varieties common to the area. In addition to the N rates, all plots receive 40 units of P_2O_5 placed in the furrow at planting.

Results and Discussion

Soybeans

The soybeans have been planted in late May each year. The variety Hardin was selected based on yield comparison data from the Harvey County Experiment Field. Soybeans were first planted in 1991. This proved to be a less than ideal year for the production of dryland soybeans in the south central region of Kansas. The lack of timely precipitation resulted in very low yields (Table 7). The soybean season for 1992 was the exact opposite of that in 1991. It was moist and cool with timely precipitation. Thus, yields were extremely good for this area of Kansas. The 1993 growing season started out to be a repeat of 1992. However, things changed in mid July, and July, August, and September were extremely dry. As expected, the early beans had already set their pods and were able to produce respectable yields as reported in Table 9. Seed N increased slightly. These increases were significant only at the higher N rates. Weather conditions in 1994 provided timely rains for the production of soybeans. The above-normal precipitation in April provided excellent soil moisture at planting (early May). The cool wet July (above-normal precipitation) and warm temperatures in August allowed for excellent yields from the MG I soybeans. As with the other crops, 1995 was not a kind year to the soybean. Cool wet conditions delayed planting. Early plant growth also was slowed by the cold weather conditions. This resulted in plants that were shorter than in previous years and behind the normal stage of growth when the weather turned hot and dry in late July and early August. These conditions are reflected in the low seed yields for the 1995 crop, about one-half those of previous years. Seed N and P_2O_5 percents were not affected by previous crop N applications. Soybean yields for 1996 seem to reflect the presence of the rotation and N rates (Table 7). The no-N check rate had decreased yields when compared to the other N rates. Yield increases occurred with increasing N rate up to the 100 lb/a rate. Other crops (wheat, corn, and grain sorghum) also usually have increasing yields with increasing N rate to

75 lb/a N. Therefore, we feel that the soybeans are starting to show the influence of the crop rotation after 5 years of no real (significant) response. Wheat has been planted in the soybean stubble for harvest in 1997.

Grain Sorghum

The grain sorghum in the soybean rotation survived the adverse growing season of 1991, when it failed in the corn rotation (data in previous year's reports). However, in the soybean rotation, the plots seeded to sorghum were following 2 years of wheat, because the rotation had not cycled sufficient times to show the effects of the two previous crops in the rotation on the third. In 1992 and 1993, when sorghum followed wheat that had followed soybeans, the grain yields for sorghum were similar to those for sorghum in the corn rotation. Seed N also increased with increasing N rate. Early-season development of grain sorghum was excellent in 1994. This again was due to the moisture and temperatures in June and July. However, the hot dry conditions in August and September are reflected in reduced yields for 1994 when compared to 1993 (Table 8). No significant differences in grain yield occurred with N rate for the 1994 grain sorghum. The grain sorghum crop (when compared to the wheat and soybean crops) seems to have been least affected by the weather conditions of 1995. Yields of the no-N check rate were lower than last year's, but yields with the other N rates were comparable to those of previous years. Percent N in the grain again increased with increasing N rate. The grain sorghum yields for 1996 express the lack of residual soil N in the check treatments. Once the N rate reach 75 lb/a no difference occurred in yield. However, a significant yield increase occurred from 0 to 25 lb/a N rate and from the 25 to 50 lb/a N rate. The no-N check in this rotation produced lower grain yields than the corresponding treatments in other rotations on the South Central Field. The 0 N treatment had lower number of heads per unit area and the highest grain moisture at harvest. These two factors could account for most of the yield reduction in the check treatments.

Wheat

Wheat yields also reflect the differences in N rate. However, when comparing the wheat yields from the soybean rotation with those from continuous no-till wheat the latter show the effects of residual N from soybean production in the previous year. This is especially true for the 0 to 75 lb. N rates in 1993 and the 0 to 125 lb rate in 1994 (Table 9). Yields in 1996 reflect the added N from the previous soybean crop with yield increases with N rate being 8 to 10 bu/a higher than those from continuous wheat at the same N rate. However, plots were replanted to spring wheat because of poor emergence and winter kill in the fall planting. As the rotation continues to cycle, the differences at each N rate may stabilize after four to five cycles, with a potential to reduce fertilizer N applications by 25 to 50 lbs/a where wheat follows soybeans.

Table 6. Grain yields from long-term nitrogen rate study.
Hutchinson, KS.

	Grain Yield			
	1993	1994	1995	1996
N-Rate	Wheat	Oat	Wheat	Wheat
lb/a		bu/a		
0	15	29	21	34
25	17	53	20	38
50	16	61	20	39
75	21	72	23	39
100	18	71	19	37
125	15	70	17	35
LSD*$_{(P=0.01)}$	5	12	4	5
CV$_{(\%)}$	22	13	7	12
CONV	28	58.	27	47
N-T	6	61	13	27

* Unless two yields differ by at least the amount of the least significant difference, (LSD), little confidence can be placed in one's being greater than the other.

Table 7. Effects of nitrogen on SOYBEANS in a soybean-wheat-sorghum rotation, Hutchinson, KS.

	Yield					
N-Rate	1991	1992	1993	1994	1995	1996
b/a			bu/a			
0	5.8	53	31	26	12	16
25	5.4	50	32	26	10	18
50	5.3	52	31	24	11	18
75	5.3	51	30	27	11	20
100	5.8	51	28	26	12	22
125	5.7	53	29	28	11	20
LSD$_{(0.01)}$	NS	NS	4	3	NS	2
CV $_{(\%)}$	11	7	7	9	17	10

* 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 8. Effects of nitrogen on SORGHUM in a soybean-wheat- sorghum rotation, Hutchinson, KS.

N Rate	Yield					
	1991	1992	1993	1994	1995	1996
lb/a	bu/a					
0	34	52	67	72	54	32
25	35	72	82	68	68	76
50	38	80	96	72	75	93
75	44	91	97	73	73	107
100	51	91	88	72	76	106
125	45	94	95	75	69	101
$LSD_{(0.01)}$	15	11	14	NS	7	6
CV $_{(\%)}$	21	7	9	12	11	6

* 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 9. Effects of nitrogen on WHEAT in a soybean-wheat-sorghum rotation, Hutchinson, KS.

	Yield					
N-Rate	1991	1992	1993	1994	1995	1996[1]
lb/a	bu/a					
0	51	31	24	23	19	35
25	55	36	34	37	26	36
50	55	37	41	47	34	36
75	52	37	46	49	37	36
100	51	35	45	50	39	36
125	54	36	46	52	37	36
$LSD_{(0.01)}$	NS	4	6	2	1	1
CV $_{(\%)}$	7	6	9	5	7	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.
[1] Spring wheat yields.

PLANTING DATE AND HYBRID MATURITY EFFECTS ON SUNFLOWER YIELDS

Stewart R. Duncan, Scott A. Staggenborg, William F. Heer, W. Barney Gordon, Gerald E. Wilde, and Ronald J. Seyfert

Introduction

Kansas is the fourth highest sunflower-producing state in the nation. The development of a crushing market in northwest Kansas has led to a 350+ % increase in harvested sunflower acreage in the central corridor of Kansas, from 7,000 acres in 1990 to 25,000 acres in 1995. Production questions have grown along with producer numbers. Past experience has led many central Kansas growers to plant sunflowers in mid-June to mid-July to avoid complications from sunflower head moth larvae. This experiment was begun in 1996 at three different sites in the central corridor of Kansas to evaluate yields of two different maturity sunflower hybrids planted at five different planting dates, at approximately 28-day intervals, with and without sunflower moth control.

Procedures

Sunflowers were planted at the South Central Kansas Experiment Field near Hutchinson, Kansas on a Clark silt loam complex soil, at the North Central Kansas Experiment Field near Scandia, Kansas on a Crete silt loam soil, and on the Steve Clanton farm in Ottawa County near Minneapolis, Kansas on a Roxbury silt loam soil, all under dryland conditions. Planting dates at Hutchinson were April 12, May 15, June 11, and July 12. At Scandia, sunflowers were planted on April 11, May 16, June 16, and July 17. Planting dates in Ottawa County were April 12, May 15, June 14, July 12, and August 9. Duplicate plots were planted for the head moth control factor in the study. Hybrids planted were Mycogen Capri (medium early maturity, 90d) and Mycogen Cavalry (medium maturity, 99d). Planting rates were 21,000 seed/a at Scandia and Ottawa County and 42,000 seed/a, thinned to 21,000 at Hutchinson. Plots were monitored for sunflower head moth larvae beginning with ray petal appearance. At 10 and 100% bloom, head moth control plots were sprayed with Warrior® or Asana® at 0.03 or 0.05 lb ai/a, respectively, in 20 gallons of water. Larval counts were taken at 3 weeks after 100% bloom. At Hutchinson, the April and May planting-date plots were harvested on September 12, and the June and July planting-dates plots were harvested on October 24 and 30, respectively. The April, May, June and July planting-date plots at Scandia were harvested on August 25, September 9, September 24, and October 20, respectively. The Ottawa County plots of July plantings were harvested on October 14. Yields were adjusted to 10% moisture.

Results

Environmental and cultural problems resulted in varied yield results from the three locations (Table 1). Strong winds and driving rain caused 100% lodging and led to abandonment of the April and May planting-date plots at the Ottawa County site. Birds and deer destroyed the June planting-date plots in Ottawa County before they could be harvested. April- and May-planted sunflowers experienced extreme weed pressure early in the season at Hutchinson. Even though 42,000 seeds/a were dropped at Hutchinson, because of weed pressure and planter problems, only the April and May plantings had to be thinned to the desired population of 21,000. Final plant stands for the June and July plantings were 14,000-15,000 plants/a. None of the July planted plots were treated for head moth larval control. Past research in Kansas has fixed seed loss at 8.8 lb/a for each larva/head. Even though spraying for head moth larval control enhanced seed yields at Hutchinson in the April and May plantings (Table 1), none of the planting dates returned yields that would justify planting sunflowers. Head moth larval pressure was intense (Table 1), and when combined with other cultural problems, resulted in yields that were unacceptable. Mid-May plantings, with adequate head moth larval control were not reduced as compared to mid-June plantings at Scandia. Larvae/head were reduced greatly with treatment, but the difference was significant only for the April planting at Hutchinson and the May plantings at Hutchinson and Scandia. The yields in Ottawa County were acceptable as compared to normal double-cropped sunflower yields. The Scandia yields from this year indicate the need to control head moth if planting in May vs. June and that the May planting was harvestable 14 days earlier. Only at Scandia were the yield differences between hybrids evident. The fuller season hybrid (Cavalry) had superior yields to the early hybrid (Capri), as would be expected, if head moths were controlled. This study will be continued for another 2 years.

Table 1. Effects of planting date, hybrid maturity, and head moth control program on sunflower yields at three central Kansas locations, 1996.

		Hutchinson		Scandia		Ottawa County	
Planting Date	Sprayed	Yield	Larvae	Yield	Larvae	Yield	Larvae
		lb/a	no./head	lb/a	no./head	lb/a	no./head
April	Yes	438 ab†	2.1	758 c	5.7	-----	2.3
	No	190 cd	44.6	360 cd	54.0	-----	26.5
May	Yes	381 abc	11.1	1848 a	1.9	-----	0.5
	No	58 d	88.5	1209 b	21.3	-----	10.0
June	Yes	364 abc	45.3	2044 a	3.3	-----	1.5
	No	300 bc	116.6	1980 a	10.9	-----	7.0
July	Yes	541 a	1.5	304 d	1.5	927	0.6
	No	396 abc	4.4	304 d	2.7	866	1.2
$LSD_{(0.05)}$		209		401		NS	

		Yield		
Hybrid	Sprayed	Hutchinson	Scandia	Ottawa County
			lb/a	
Capri	Yes	448	1154 b	-----
	No	251	885 c	990
Cavalry	Yes	414	1322 a	-----
	No	219	1041 b	803
$LSD_{(0.05)}$		NS	125	NS

† Seed yields (adjusted to 10% moisture) at a location must differ by more than the LSD to be significantly different.

CORN YIELD RESPONSE TO HYBRID MATURITY, PLANTING DATE, PLANTING RATE, AND WEED INFESTIONS[3]

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Summary

Corn planting rates historically have been selected conservatively to avoid crop disasters from drought stress in dry years. Current corn hybrids are more drought tolerant than previous generations. Because of this drought tolerance, increasing seeding rates should result in increased grain yields. This 3-year study was designed to assess corn yield response to plant populations, planting dates, hybrid maturity, and weed infestation levels. Under weed-free conditions, increasing seeding rates from 14 to 26,000 plants/a resulted in a 17 bu/a yield increase across six environments. This relationship was not as consistent under weedy conditions. At the two eastern locations, grain yields decreased in the weed-free plots and increased in the weedy plots as planting date was delayed. At Belleville, maximum grain yields were acheived with an early May planting date. When growing season length did not reduce grain yields, the full-season hybrid outyielded the short-season hybrid.

Introduction

Historically, conservative plant populations have been used to avoid complete disasters under extreme drought conditions. Previous corn hybrids often suffered severe drought stress during hot, dry years when planted at high plant populations. Improvements in drought and heat tolerance in corn hybrids may enable producers to improve grain yields by increasing plant densities. Because grain yield is associated closely with seed number per acre, increasing plant densities also will increase yield potential by increasing potential seed number per acre. Under stressful conditions, yields should not decline, as they did 20 years ago, when corn planted at high plant populations encounters drought or temperature stress (Figure 1).

Corn producers in northeast Kansas have utilized early planting dates to increase the length of the growing season. On average, approximately 260 heat units can be accumulated during the month of April in northeast Kansas. Early plantings often require preplant or preemergence weed control measures, because most summer annual weeds emerge in late April and early May. Delaying planting dates can reduce the amount of soil-applied herbicide needed because additional tillage or chemical burn-down can eliminate some of these weeds after they have emerged.

The objectives of this study were to evaluate the effects of plant populations, hybrid maturity, and planting date on corn yield and the plant's ability to compete with weeds.

Procedures

Field studies were conducted from 1994 through 1996 at the Cornbelt Experiment Field near Powhattan, the Kansas River Valley Experiment Field near Rossville, and the North Central Experiment Field near Belleville, KS. Two corn hybrids, Golden Harvest 'H-2573' (115 day relative maturity) and 'H-2404' (105 day relative maturity), were planted on approximately April 1, May 1, and June 1 each year. Final stands of 14-, 20-, and 26,000

[3]Project funded by the Kansas Corn Commission.

plts/a were established. One half of each plot was established as a weed-free plot by applying soil applied herbicides (metolachlor & atrazine, ~ 1.5 - 2 lb a.i./a each) at planting. The remaining half of each plot was not treated with any herbicides after the initial preplant burn-down herbicide (glyphosate, ~1.5 - 2 lb a.i./a) was applied. Corn yields were determined at maturity. Planting delays in 1995 resulted in missing planting dates, so these data are not included.

Results

Under weed-free conditions, increasing plant populations from 14- to 26,000 plants/a increased grain yields in five of the six environments (Tables 2, 3, 4). An average yield increase of 13 bu/a was realized by increasing seeding rates from 14 to 20,000 plants/a. Increasing the seeding rate to 26,000 plants/a resulted in an additional 4 bu/a increase. Assurance that increasing plant populations will not decrease yields in dry years is essential for the adoption of higher seeding rates. These data suggest that yields do not decrease at high plant populations under dry conditions. The April planting date at Scandia in 1996 illustrates this point. Low rainfall amounts during the month of June resulted in severe water stress during ear development and early tassel stages. However, grain yields were not severely reduced at the highest plant population compared to yields at 14,000 plants/a (Table 3).

Under weedy conditions, the grain yield response to increasing plant populations was not as consistent. At Powhattan and Rossville, increasing plant populations did not increase grain yields under weedy conditions two-thirds of the time (Tables 2 and 3). At Scandia, lower weed infestation levels in 1994 did not reduce yields compared to the other two locations and resulted in a similar yield responses to plant population in the weedy plots and weed-free plots (Table 4).

Grain yields decreased at Powhattan and Rossville as planting date was delayed (Tables 2 and 3). Under weed-free conditions, delaying planting from early April to early May reduced grain yields 6% compared to 25% when planting was delayed until early June. When the crop had to compete with weeds, the early planting dates generally resulted in the lowest grain yields. Under these conditions across years and locations, grain yields from the April planting dates were 57 bu/a compared to 70 bu/a for May and 66 bu/a for June plantings. Later plantings allowed a larger number of weeds to emerge and be controlled by the preplant chemical burn-down. Delaying planting also positioned the crop for rapid early season development as a result of the warmer air and soil temperatures.

At Scandia, maximum grain yields were attained from early May planting dates for both weed infestation levels (Table 4). Grain yields from the April planting dates were 23% higher than yields from the June planting dates. In 1994, the April and May planting dates resulted in similar yields that were approximately twice those attained from a June planting date. In 1996, drought and temperature stress in late June and early July reduced grain yields for the April planting date. Adequate rainfall during the remainder of the growing season resulted in higher grain yields from the plots planted in early May and June.

At Rossville in 1994, H-2573, the full-season hybrid, produced yields that were 21 bu/a higher than H-2404 (Table 2). In 1996, H-2573 outyielded H-2404 when planted in April and May. No differences occurred between the two hybrids when planted in June.

At Powhattan in 1994, no consistent differences occurred between the two hybrids (Table 3). In 1996, the results were similar to those at Rossville, in that H-2573 produced higher yields than H-2404 when planted in April. No hybrid differences occurred with planting in May and June that year.

At Scandia, the early-maturing hybrid outyielded the full-season hybrid as planting dates were delayed in 1994. The H-2573 appeared to compete well in the weedy plots because grain yields were not reduced by the presence of weeds (Table 5). In 1996, the full-season hybrid outyielded the early-maturing hybrid when planted in April and May, because the growing season was not limited by frost.

Conclusions

Maximum grain yields were achieved at the early April planting dates at the two eastern locations. Yields declined as planting date was delayed. At Scandia, the early May planting date resulted in the highest grain yields. Weed control measures were extremely important at the early planting dates, because large reductions in yields were encountered in the weedy plots at early planting dates. These results indicate that when corn is planted in June, producers could use fewer herbicides, because many weeds had emerged by planting time and were controlled by preplant burndown herbicides. The reduced yields from the later planting date must be weighed against the lower cost of reduced herbicide use. Increasing plant population from 14,000 to 20- or 26,000 plants/a increased grain yields by about 17 bu/a under weed-free conditions. Increasing corn population was not an effective means of increasing the crop's ability to compete with existing weeds.

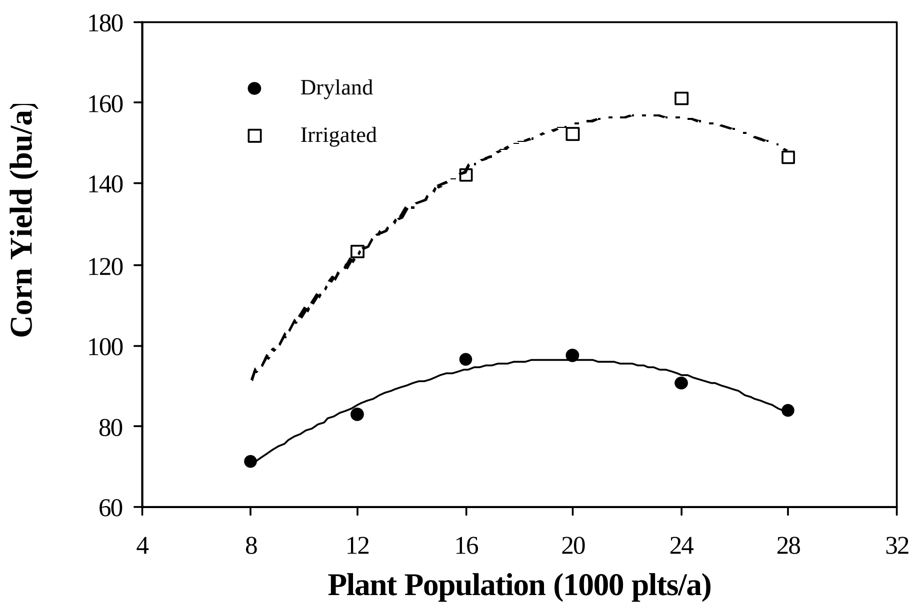

Figure 1. Corn yield response to plant population in Kansas. Data averaged across five dryland sites in 1966-67 and three irrigated sites in 1966-67.

Table 2. Corn yields for three planting dates, three plant populations, two hybrids, and two weed infestation levels at Rossville in 1994 and 1996.

	1994Yield						1996 Yield					
Population	April		May		June		April		May		June	
Hybrid	W[1]	WF	W	WF	W	WF	W	WF	W	WF	W	WF
			bu/a						bu/a			
14,000	45.3	115.2	73.4	74.8	32.7	67.1	11.5	81.6	30.7	76.9	38.5	59.9
20,000	63.0	126.6	70.3	126.9	41.7	78.7	6.1	89.9	18.9	87.9	43.3	61.9
26,000	65.1	141.5	91.2	143.8	60.9	89.4	5.4	91.3	54.7	104.6	43.0	62.5
$LSD_{(0.05)}$			18.9[2]						13.5[2]			
H-2404	34.2	92.8	74.5	122.1	37.8	63.6	5.2	70.3	21.5	82.3	50.2	70.4
H- 2573	79.1	157.3	82.0	86.6	52.4	92.7	10.2	105.0	48.1	97.3	33.1	52.5
$LSD_{(0.05)}$			15.4[δ]						11.1[δ]			

1 W=Weedy, WF=Weed-free.
2 LSD for comparison of plant populations differences within columns (DateXWeed) only.
δ LSD for comparison of hybrid differences within columns (DateXWeed) only.

Table 3. Corn yields for three planting dates, three plant populations, two hybrids and two weed infestation levels at Powhattan in 1994 and 1996.

	1994 Yield						1996 Yield					
Population	April		May		June		April		May		June	
Hybrid	W[1]	WF	W	WF	W	WF	W	WF	W	WF	W	WF
			bu/a						bu/a			
14,000	48.9	109.0	64.7	104.3	88.0	91.4	121.3	111.6	113.8	97.9	78.9	93.3
20,000	51.8	116.7	73.8	110.5	96.8	101.4	120.4	128.2	96.1	126.2	89.9	102.1
26,000	50.6	124.5	74.0	111.6	107.3	102.5	119.4	117.7	110.2	129.5	67.4	92.1
$LSD_{(0.05)}$			9.3[2]						10.8[2]			
H- 2404	60.0	114.9	57.5	104.9	95.2	97.7	113.0	114.2	118.7	114.9	79.9	96.3
H- 2573	40.9	118.6	66.3	112.6	99.6	99.1	127.7	124.1	94.8	120.8	77.6	95.4
$LSD_{(0.05)}$			7.9[δ]						8.9[δ]			

1 W=Weedy, WF=Weedfree.
2 LSD for comparison of plant populations differences within columns (DateXWeed) only.
δ LSD for comparison of hybrid differences within columns (DateXWeed) only.

Table 4. Corn yields for three planting dates, three plant populations and two hybrids at Scandia in 1994 and 1996.

Population	1994Yield			1996 Yield		
Hybrid	April	May	June	April	May	June
		bu/a			bu/a	
14,000	181.0	182.9	97.0	42.7	90.2	65.9
20,000	200.5	195.7	112.5	43.4	100.7	84.4
26,000	200.9	201.5	92.8	52.7	119.8	100.4
$LSD_{(0.05)}$		NS			15.3[1]	
H-2404	186.9	202.9	123.9	35.2	86.3	78.6
H-2573	201.4	183.9	76.7	57.3	120.9	88.5
$LSD_{(0.05)}$		14.5[2]			12.5[2]	
Population Effect						
14,000		153.7			N/A	
20,000		169.6			N/A	
26,000		167.1			N/A	
$LSD_{(0.05)}$		7.3			N/A	

1 LSD for comparison of plant populations differences within columns (Date) only.
2 LSD for comparison of plant populations differences within columns (Date) only.

Table 5. Corn yields for two hybrids and two weed infestation levels at Scandia in 1994 and 1996.

Weed	1994 Yield		1996
Level	H-2404	H-2573	Yield
		bu/a	
Weedy	168.8	159.3	65.8
Weed-free	173.7	151.8	89.7
$LSD_{(0.05)}$	6.1[1]		15.8

1 LSD for comparison of weed level differences within columns (Hybrids) only

GRAIN SORGHUM RESPONSE TO ROW SPACINGS AND SEEDING RATES IN NORTHEAST KANSAS[4]

Scott A. Staggenborg, Dale L. Fjell, Dan L. Devlin, W. Barney Gordon, and Brian H. Marsh

Summary

Research was conducted in 1995 and 1996 at three locations in northeast Kansas to evaluate the effects of row spacings and plant populations on grain sorghum yields. Two hybrids were planted in 10-, 20- and 30-in. rows at 30,000, 60,000 and 90,000 plts/a. Two hybrids and two weed levels were used to evaluate their effects on yield. In environments where yields exceeded 100 bu/a, the narrow rows produced higher yields than the conventional row spacing. In environments in which moisture and temperature stress limited grain yields, no yield differences occurred between the three row spacings. Over a majority of the location-years evaluated, increasing plant populations from 30 to 60,000 resulted in a slight increase in grain yield. However, increasing from 60 to 90,000 plants/a did not result in an increase in yield. Narrow rows spacings, but not increased seeding rates, increased the sorghum crop's ability to compete with weeds. These results suggest that seeding rates should be high enough to avoid replanting, because there is no yield penalty for overplanting. The late-maturing hybrid outyielded the early-maturing hybrid in 1996 when the growing season was not limited by an early freeze, as it was in 1995.

Introduction

Kansas ranks first in grain sorghum production on an annual basis, with this production coming from approximately 3.5 million acres. Grain sorghum is important in most dryland production systems found in the western three-fourths of the state . Wheat is the only crop with more acres in this region.

Research conducted at Kansas State University from 1959 until 1963 indicated that grain sorghum planted in narrow rows (20 in.) produced greater grain yields than soybeans planted in 40 in. rows. Research conducted at Hays, KS reported a 9-bu advantage of 12-in. rows over 24-in rows. This work also emphasized the lack of yield response to seeding rates in grain sorghum. Final stands above 40,000 plants/a were all that were required to maximize grain yields, regardless of row spacing.

Weed control costs per acre normally rank second only to fertilizer costs in grain sorghum production budgets. Several studies have reported on sorghum's competitive growth habits and abilities. Such results suggest that cultural practices such as narrow rows and higher plant populations may influence the weed competition occurring in a sorghum field.

Improved seed-metering accuracy in grain drills and renewed interest in crop rotations has increased the interest in planting grain sorghum in narrow rows. This type of production system also would allow wheat producers to plant two crops with one piece of machinery.

The objectives of this study are to determine the influence of row spacing and seeding rates on grain sorghum yields and its ability to compete with weeds.

[4]Funded by the Kansas Grain Sorghum Commission.

Procedures

Field experiments were conducted during 1995 and 1996 at the North Agronomy Farm in Manhattan, the Cornbelt Experiment Field near Powhattan, and the North Central Experiment Field near Belleville. Planting dates were May 24, 1995 and May 17, 1996 for Manhattan; June 15, 1995 and May 22, 1996 for Powhattan; and June 14, 1995 and June 10, 1996 for Belleville. Early- (Pioneer '8699') and a late- (Pioneer '8310') maturing grain sorghum hybrids were planted at rates to achieve final stands of 30,000, 60,000, and 90,000 plts/a in 10-, 20-, and 30-in row spacings. One half of each plot was established as a weed-free control plot by applying soil applied herbicides (metolachlor & atrazine, ~ 1.5 - 2 lb a.i./a each) at planting. The remaining half of each plot was not treated with any herbicides after the initial preplant burn-down herbicide (glyphosate, ~1.5 - 2 pts/a) was applied. Grain yields were determined at maturity and are displayed in Tables 6, 8, 10 12, and 14). The yields at Powhattan from 1996 were not included in this report because of stand establishment problems.

Results

In general, narrow rows resulted in a yield advantage in high-yielding environments. In environments where water was limiting, no differences occurred between the row spacing treatments. These data indicated that in environments with yields above 100 bu/a under weed-free conditions, narrower rows of 10 of 20 in. resulted in a yield advantage compared to a conventional row spacing. This is illustrated at Manhattan in 1995, where average grain yield in the weed-free plots was 138 bu/a. The 10-in. rows outyielded the 20- and 30-in. rows by 23.5 bu/a (Table 7).

At Powhattan in 1995, yields from the 10- and 20-in. rows were not different, and both were higher than yields from the 30-in. rows (Table 9). The average yield of weed-free plots was 89.7 bu/a. At Belleville in 1995, no significant row spacing effect or interaction with row spacings occurred. The average yield at Belleville in 1995 was 81.8 bu/a.

In 1996 at Manhattan, no row spacing differences occurred under weed-free conditions. However, the 10- and 20-in. rows outyielded the 30-in. rows under weedy conditions (Table 13). At Belleville in 1996, the 10-in. rows outyielded the 20- and 30-in. row at the higher two plant populations (Table 16). The average yields were 108.7 bu/a for the medium population treatment and 113.4 bu/a for the highest plant population. At a final stand of 30,000 plants/a, the average grain yield was 101.9 bu/a and no differences occurred between the three row spacings. The 10-in. rows outyielded the 20- and 30-in. rows when planted to the later maturing '8310' compared to the early-maturing hybrid (Table 7). Row spacing had no effects on yield for the early maturing hybrid. In 1996, the growing season was not limited by a frost as it was in 1995, allowing the full-season hybrid enough time to express its higher yield potential. As seen in other environments, the 10-in. rows had a yield advantage in environments where yields were favorable or not limited by moisture or growing-season length.

Across all five environments, plant populations had a smaller effect on final grain yield than row spacing. Plant population had no effects on grain yield at Manhattan in either year. The lower plant population produced less yield than plant populations of 60 and 90,000 plants/a at Powhattan in 1995 (Table 9). Hybrid maturity affected grain yield response to plant populations at Belleville in 1995 (Table 11). These data suggest that a final plant population of 60,000 plants/a or greater is necessary to maximize yields.

The effects of weed infestation on grain yield depended largely on the level of infestation and the weed type present. At Manhattan in both years, velvetleaf was overseeded on the weedy half of each block. Timely rains after planting resulted in substantial weed emergence in both years. In 1995, the presence of weeds reduced grain yields by over 90 bu/a. Timely rains during the growing season apparently made more resources available for growth of both species present, because weeds reduced yields by over 60 bu/a in 1996.

At Powhattan, the weeds present were primarily grassy species. The sorghum apparently was better able to compete with the lower profile grassy weeds, because grain yields were reduced by 21 bu/a when the weeds were not controlled. At Belleville in 1995 and 1996, dry conditions reduced weed germination and emergence. In 1995, the weedy plots resulted in grain yields higher than those in the weed-free plots. Very few weeds were present in the weedy plots, and the 12 bu/a difference is difficult to explain. In 1996, more weeds were present in the weedy plots compared to 1995. However, the overall difference between yields from the weed-free and weedy plots was 8.6 bu/a. Increasing seeding rates enabled the sorghum plant to be more competitive for water and light, as indicated by higher yields at 60 and 90,000 plts/a under weedy conditions (Table 16).

In general, hybrid maturity affected grain yields differently each year. On 21 September, 1995, many areas in the state experienced freezing temperatures for several hours. This freeze event appeared to have limited the yields of the late maturing hybrid '8310' at Powhattan, where '8699' outyielded the '8310' by 13 bu/a. At Manhattan and Belleville, no yield differences occurred in 1995.

As mentioned earlier, the 1996 growing season was favorable for crop growth. Rainfall was adequate and temperatures were moderate through July and August. The first freeze event did not occur until mid to late October. In 1996, '8310' outyielded '8699' by 16.3 bu/a of Manhattan (Table 9) and by 18.2 bu/a. at Belleville (Table 17).

Conclusions

Under favorable growing conditions that allowed yields over 100 bu/a, narrow rows (10 or 20-in.) increased grain yields compared to conventional 30-in. rows. These results indicated that in environments where moisture limits yields, no differences will occur between narrow and conventional rows. No consistent yield response to plant populations was observed in this study, suggesting that producers should select seeding rates high enough to ensure adequate stands and to avoid replanting. No adverse effects on yield resulted from high plant populations. Our results indicated that when growing-season length does not limit grain yields, late maturing hybrids outyield early maturing hybrids. Narrow rows allowed the sorghum crop to be more competitive and increase yields compared to the conventional row spacings when grown in the presence of severe velvetleaf infestations. Higher plant populations did not increase grain yields under severe weed pressures.

Table 6. Grain sorghum yields at Manhattan in 1995 for two hybrids at three row spacings and plant population and two weed infestation levels. Also includes significant interactions and main effects of each treatment.

Row Spacing	Weed Level	Grain Yield					
		Pioneer '8699'			Pioneer '8310'		
		30,000	60,000	90,000*	30,000	60,000	90,000*
10	Weed-free	137.5	112.2	135.9	143.2	162.1	135.0
	Weedy	47.9	44.4	50.2	61.1	49.0	36.1
20	Weed-free	97.1	111.7	130.5	104.3	120.8	125.9
	Weedy	35.4	37.1	22.4	5.9	23.5	47.0
30	Weed-free	119.4	117.0	108.3	109.4	116.4	119.8
	Weedy	0.9	21.1	18.3	11.5	31.5	21.9
Interaction $LSD_{(0.10)}$				NS			

* plants/a

Table 7. Effects of row spacing and weed infestation on grain sorghum yield at Manhattan in 1995.

Variable	Grain Yield
	bu/a
Row Spacing (in)	
10	96.3
20	72.8
30	69.8
$LSD_{(0.10)}$	8.7
Weed Infestation	
Weed-free	121.3
Weedy	30.2
$LSD_{(0.10)}$	6.7

Table 8. Grain sorghum yields at Powhattan in 1995 for two hybrids at three row spacings and plant populations and two weed infestation levels.

Row Spacing	Weed Level	Grain Yield					
		Pioneer ‘8699'			Pioneer ‘8310'		
		30,000	60,000	90,000*	30,000	60,000	90,000*
10	Weed-free	92.5	103.2	104.9	67.8		94.0
	Weedy	79.3	94.9	83.6	43.6	71.0	76.1
20	Weed-free	89.0	103.9	97.2	87.5	93.4	89.4
	Weedy	68.0	74.2	71.8	52.9	70.1	69.7
30	Weed-free	85.3	93.5	97.3	71.8	80.7	73.5
	Weedy	69.4	68.3	66.8	56.6	60.0	58.0
Interaction $LSD_{(0.10)}$		NS					

*Plants/a

Table 9. Effects of row spacing, plant population, hybrid, and weed infestation on grain sorghum yield at Powhattan in 1995.

Variable	Grain Yield
	bu/a
Row Spacing (in)	
10	83.2
20	80.6
30	72.6
$LSD_{(0.10)}$	4.8
Plant Population (plts/a)	
30,000	71.7
60,000	83.6
90,000	81.6
$LSD_{(0.10)}$	4.8
Hybrid	
Pioneer ‘8699’	85.6
Pioneer ‘8310’	72.6
$LSD_{(0.10)}$	3.9
Weed Infestation	
Weed-free	89.7
Weedy	68.4
$LSD_{(0.10)}$	9.3

Table 10. Grain sorghum yields at Belleville in 1995 for two hybrids at three row spacings and plant populations and two weed infestation levels.

Row Spacing	Weed Level	Grain Yield					
		Pioneer '8699'			Pioneer '8310'		
		30,000	60,000	90,000*	30,000	60,000	90,000*
10	Weed-free	69.2	72.4	76.2	89.7	74.3	81.0
	Weedy	61.4	89.2	97.5	77.1	49.7	66.9
20	Weed-free	60.6	75.1	67.7	81.3		96.3
	Weedy	87.9	87.8	87.6	93.3	80.4	74.8
30	Weed-free	86.7	87.2	87.2	97.3		87.1
	Weedy	100.1	109.6	119.2	105.3	107.4	73.1
Interaction $LSD_{(0.10)}$		NS					

*Plants/a

Table 11. Effects of hybrid by plant population and hybrid by weed infestation interactions on grain sorghum yield at Belleville in 1995.

Variable	Grain Yield	
	Pioneer '8699'	Pioneer '8310'
Plant Population (plts/a)		
30,000	80.1	63.4
60,000	89.6	77.6
90,000	86.9	76.8
Hybird X Population $LSD_{(0.10)}$	6.5	
Weed Infestation		
Weed-free	96.3	83.2
Weedy	74.8	62.0
Hybrid X Weed $LSD_{(0.10)}$	11.4	

Table 12. Grain sorghum yields at Manhattan in 1996 for two hybrids at three row spacings and plant population and two weed infestation levels.

Row Spacing	Weed Level	Grain Yield					
		Pioneer '8699'			Pioneer '8310'		
		30,000	60,000	90,000*	30,000	60,000	90,000*
10	Weed-free	139.0	107.9	112.4	130.2	136.4	112.3
	Weedy	32.8	69.2	74.3	54.5	74.7	79.9
20	Weed-free	94.1	120.6	111.2	112.6	137.1	145.6
	Weedy	85.2	46.3	44.1	55.2	96.1	92.6
30	Weed-free	105.4	108.9	107.6	122.6	121.6	115.1
	Weedy	12.7	32.2	40.5	46.3	51.0	41.7
Interaction $LSD_{(0.10)}$		NS					

Table 13. Effects of hybrid by plant population and hybrid by weed infestation interactions on grain sorghum yield at Manhattan in 1996.

Row Spacing (in)	Weed Infestation Level	
	Weed-free	Weedy
10	122.7	65.6
20	119.6	66.8
30	113.5	37.4
Weed X Row Spacing $LSD_{(0.10)}$	11.4[1]	

1 LSD for comparing grain yields at different row spacings within the same weed infestation level.

Table 14. Hybrid effects on grain sorghum yield at Manhattan in 1996.

Hybrid	Grain Yield
	bu/a
8699	78.4
8310	94.7
$LSD_{(0.10)}$	6.6

Table 15. Grain sorghum yields at Belleville in 1996 for two hybrids at three row spacings and plant populations and two weed infestation levels.

Row Spacing	Weed Level	Grain Yield					
		Pioneer '8699'			Pioneer '8310'		
		30,000	60,000	90,000*	30,000	60,000	90,000*
10	Weed-free	81.9	109.1	105.0	118.8	137.6	155.1
	Weedy	42.5	108.6	117.1	116.9	125.8	144.6
20	Weed-free	106.4	102.4	95.9	125.0	110.4	112.6
	Weedy	95.5	90.8	103.0	92.6	123.9	121.8
30	Weed-free	117.3	91.5	92.5	116.9	100.0	97.3
	Weedy	119.8	99.0	102.1	89.3	105.2	113.4
Interaction $LSD_{(0.10)}$				NS			

*Plants/a

Table 16. Effects of hybrid by plant population and hybrid by weed infestation interactions on grain sorghum yield at Belleville in 1996.

Variable	Plant Populations (plts/a)		
	30,000	60,000	90,000
Row Spacing (in)			
10	90.0	120.3	130.5
20	104.9	106.9	108.3
30	110.8	98.9	101.3
Row Spacing X Population $LSD_{(0.10)}$		16.1	
Weed Infestation			
Weed-free	111.0	108.9	117.0
Weedy	92.8	108.5	109.7
Weed X Population $LSD_{(0.10)}$		13.1[1]	

1 LSD for comparing grain yields at different plant populations within the same weed infestation level.

Table 17. Effects of hybrid by row spacing interaction on grain sorghum yield at Belleville in 1996.

Row Spacing (in)	Grain Yield	
	Pioneer '8699'	Pioneer '8310'
	bu/a	
10	94.0	133.1
20	99.0	114.4
30	103.7	103.7
Hybird X Row Spacing $LSD_{(0.10)}$	13.1	

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