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Southwest Research-Extension Center, Field Day 1999

Abstract

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FIELD DAY

1999

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REPORT OF PROGRESS
837

KANSAS STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
AND COOPERATIVE EXTENSION SERVICE

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Mahbub Alam - Extension Specialist, Irrigation and Water Management. Mahbub received his M.S. from the American University of Beirut, Lebanon, and a Ph.D. from Colorado State University. He joined the staff in 1996. Mahbub previously worked for Colorado State University as an Extension Irrigation Specialist. His extension responsibilities are in the area of irrigation and water management.

Randall Currie - Weed Scientist. Randall began his agriculture studies at Kansas State University, where he received his B.S. degree. He then went on to receive his M.S. from Oklahoma State University and his Ph.D. from Texas A & M University. His research emphasizes weed control in corn.

Jeff Elliott - Research Farm Manager. Jeff received his B.S. from the University of Nebraska. In 1984, Jeff began work as an Animal Caretaker III and was promoted to Research Farm Manager in 1989.

Paul Hartman - Area Extension Director, Paul received his B.S. and M.S. in Animal Sciences and Industry from Kansas State University. Prior to that, he served as County Extension Agricultural Agent in Stanton and Pratt counties.

Larry Buschman - Entomologist. Larry received his M.S. at Emporia State University and his Ph.D. at the University of Florida. He joined the staff in 1981. His research includes studies of the biology, ecology, and management of insect pests, with emphasis on pests of corn, including spider mites.

Troy Dumler - Extension Agricultural Economist. Troy received his B.S. and M.S. from Kansas State University. He joined the staff in 1998. His extension program primarily focuses on crop production and machinery economics.

Dave Frickel - Research Associate - Tribune. Dave received his B.S. from the University of Nebraska-Lincoln in 1987. He began his work here as an Agricultural Technician. In 1991, he moved to his current position.

CONTENTS

WEATHER INFORMATION

CROPPING AND TILLAGE SYSTEMS

WATER MANAGEMENT RESEARCH

INSECT BIOLOGY AND CONTROL RESEARCH

WEED SCIENCE RESEARCH

AGRONOMIC RESEARCH

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WEATHER INFORMATION FOR GARDEN CITY

by
Jeff Elliott

Once again, we had a wet year; in fact, 1998 was the tenth consecutive year with above average precipitation. Precipitation totaled 22.19 inches compared to 17.91 inches for the 30-year average. We accumulated 14.49 inches of growing-season precipitation (April - September) compared to 13.90 inches in an average year. July had 6.61 inches precipitation, which was the wettest July since 1958 and the third wettest since our records began in 1908. January was the driest month in 1998 and the driest January since 1986. Snowfall was light, measuring 12.15 inches, which was 5.55 inches below average. Measurable snowfall was recorded only in January, March, and December.

As usual, July was the warmest month in 1998 with an average temperature of 79.3°. This was the warmest July since 1986. January was the coolest month with an average temperature of 32.6°, slightly above the normal January temperature of 27.9°.

Daily minimum temperatures below zero were recorded on 4 consecutive days starting on December 22 and ending on Christmas day, with the low of -12° on December 22. Temperatures of 100° or above were recorded on 20 days in 1998, with the highest of 107° on June 27.

Six record high temperatures were broken or tied in 1998. They were: 100ϒ on May 31, 107ϒ on June 27, 99ϒ on September 26, 94ϒ on September 27, 97ϒon September 30, and 79ϒon November 25. No record low temperatures occurred.

The last spring freeze (32ϒ) occurred on April 30, 4 days later than average. The first fall freeze (31ϒ) fell on October 18, 6 days later than average. The resulting frost-free period was 171 days compared to 169 days average.

Open pan evaporation from April 1 through October 31 totaled 69.38 inches. This is similar to the 73.76 inches average. Mean wind speed was 4.65 mph, considerably less that the 5.5-mph average.

Table 1. Weather data. Southwest Research-Extension Center, Garden City, KS.

	Precipitation inches		Temperature(°F)						Wind MPH		Evaporation inches	
			98 Average		Mean		98 Extreme					
Month	1998	Avg.	Max.	Min.	1998	Avg.	Max.	Min.	1998	Avg.	1998	Avg.
January	0.06	0.33	44.5	20.8	32.6	27.9	64	9	4.3	4.8		
February	0.62	0.45	49.9	27.2	38.6	32.8	74	18	5.6	5.5		
March	2.03	1.15	48.7	25.6	37.2	41.3	85	6	7.1	7.0		
April	0.93	1.56	64.0	34.6	49.3	52.7	91	25	6.1	7.0	7.77	8.75
May	2.69	3.11	80.2	50.3	65.3	62.2	100	33	4.3	6.4	10.13	10.67
June	0.85	2.87	88.3	55.2	71.8	72.4	107	38	4.7	6.0	13.22	12.89
July	6.61	2.60	92.4	66.2	79.3	77.9	102	62	3.8	5.2	11.86	14.19
August	3.13	2.16	90.4	63.3	76.9	75.4	100	56	3.3	4.5	10.53	11.66
September	0.28	1.59	89.5	57.1	73.3	66.6	102	46	3.6	4.9	9.58	8.84
October	2.38	0.98	73.1	42.8	58.0	55.0	90	31	4.9	4.8	6.29	6.76
November	2.37	0.76	58.6	31.5	45.1	41.1	79	24	4.5	4.8		
December	0.24	0.35	47.4	18.7	33.1	30.7	72	-12	3.6	4.5		
Annual	**22.19**	**17.91**	**68.9**	**41.1**	**55.0**	**53.0**			**4.7**	**5.5**	**69.38**	**73.76**

Average latest freeze in spring	April 26	1998:	April 30
Average earliest freeze in fall	Oct. 12	1998	Oct. 18
Average frost-free period	169days	1998:	171 days

All averages are for the period 1961-90.

WEATHER INFORMATION FOR TRIBUNE

by

David Frickel and Dale Nolan

Precipitation for 1998 totaled 17.49 inches, which is 1.53 inches above normal. Precipitation was above normal in 5 months. July was the wettest month with 6.53 inches, which was 3.93 inches above normal, and January was the driest month with only 0.04 inch precipitation. The largest single amount of precipitation was 1.93 inches on July 25, and a total of 3.17 inches was recorded for the 4-day period July 23 through July 26. Measurable snowfall occurred in only 3 months; January with 1.0 inches, March with 6.75 inches, and December with 7.25 inches. Snowfall for the year totaled only 15.0 inches with a total of 14 days of snow cover. The longest consecutive period of snow cover, 7 days, was from December 20 to December 26.

The air temperature was above normal for 8 months of the year, with July being the warmest month with a mean temperature of 77.1°, and the average high temperature was 92.2°. The coldest month was December with a mean temperature of 30.4°, average high was 45.9°, and average low was 14.8°. Record high temperatures were set on March 26 and 27; April 12; May 31; June 27; September 26; and November 23 and 29. Record low temperatures were set on April 17; and June 6 and 18. Deviation from the normal was greatest in September, when the mean temperature was 6.0° above normal. Temperatures were 100° or above 15 days, compared to the 30-year average of 10 days, and 90° or above on 57 days, compared to the 30-year average of 63 days. The lowest temperature for the year was -15° on December 22, and the highest was 106° on July 21. The last temperature of 32° or less was on June 6, 34 days later than normal, but no crop damage was apparent. The first temperature of 32° or less in the fall was on October 6, 3 days later than the normal date. The frost-free period was 122 days, which is 31 days less than the average of 153 days.

Open pan evaporation from April through September totaled 69.87 inches, which is 1.80 inches below normal. Wind speed for the same period averaged 4.8 mph, 0.9 mph less than normal.

Table 1. Weather data. Southwest Research-Extension Center, Tribune, KS.

	Precipitation inches		Temperature (°F)						Wind MPH		Evaporation inches	
			1998 Average		Normal		1998 Extreme					
Month	1998	Normal	Max.	Min.	Max	Min.	Max.	Min.	1998	Avg.	1998	Avg.
January	0.04	0.36	45.7	18.4	43.3	14.2	65	7				
February	0.47	0.40	49.5	24.1	48.7	18.7	73	16				
March	1.55	0.99	51.5	22.2	56.6	25.4	86	2				
April	0.91	1.13	63.0	31.3	67.5	35.1	88	16	5.8	6.6	7.13	8.82
May	2.53	2.69	79.7	46.2	76.0	45.3	96	32	4.8	6.0	11.33	10.95
June	0.85	2.71	86.3	50.0	86.9	55.3	105	32	5.1	5.7	15.42	13.71
July	6.53	2.60	92.2	61.9	92.7	61.3	106	56	4.5	5.5	13.52	15.64
August	1.12	1.98	88.9	57.8	89.9	59.2	101	52	4.2	5.2	11.63	13.01
September	0.59	1.54	87.8	53.1	81.3	49.9	101	43	4.6	5.4	10.84	9.55
October	1.12	0.74	71.5	36.5	70.4	37.3	89	26				
November	1.48	0.49	56.9	28.2	54.7	25.3	82	18				
December	0.30	0.33	45.9	14.8	44.9	16.6	72	-15				
Annual	**17.49**	**15.96**	**68.2**	**37.0**	**67.7**	**37.0**	**106**	**-15**	**4.8**	**5.7**	**69.87**	**71.67**
Average latest freeze in spring[1]					May 3		1998:	June 6				
Average earliest freeze in fall					October 3		1998:	October 3				
Average frost-free period					153 days		1998:	122 days				

[1] Latest and earliest freezes recorded at 32°F. Average precipitation and temperature are 30-year averages (1961-1990) calculated from National Weather Service. Average temperature, latest freeze, earliest freeze, wind, and evaporation are for the same period calculated from station data.

EFFECTS OF HYBRID MATURITY AND PLANT POPULATION ON LIMITED-IRRIGATED CORN

by

Charles Norwood

SUMMARY

Irrigated and dryland corn were compared in the wheat-corn-fallow rotation to determine if early corn had an advantage over full-season corn grown with very limited irrigation. Precipitation was above average during most of the growing season; thus, full season corn yielded more. However, results may differ in drier years.

INTRODUCTION

Fully irrigated corn in western Kansas usually consists of full-season hybrids (115 day or later) grown at populations of 30,000 to 35,000 plants/a. Research has shown no advantages to shorter-season corn in terms of yields, average water use rates, and water use efficiencies. Full irrigation of corn has been proven to be more profitable than limited irrigation. However, some farmers are converting irrigated acres to dryland because of declining groundwater. Very limited irrigation, meaning once or twice a season, may enable these farmers to conserve the remaining groundwater, while still producing adequate yields. The objective of this study is to determine whether very limited irrigation is an alternative to returning acres to dryland.

PROCEDURES

Two corn hybrids having maturities of 104 and 115 days were planted on May 13, 1998 at seeding rates of 18,000 and 33,000 seeds/a. The corn was planted in the stubble remaining from the 1997 wheat crop, following about 11 months of fallow. Single irrigation treatments were at the 8-leaf stage, and two irrigations were at the 8-leaf and tassel stages. Each irrigation consisted of 6 inches of water applied through gated pipe. A dryland treatment was included. The plots were bordered to prevent runoff.

RESULTS AND DISCUSSION

Results are presented in Table 1. Populations were somewhat lower than desired, 15,000 and 25,000 plants/a for the early hybrid and 17,000 and 27,000 plants/a for the later hybrid. Yield of the early hybrid increased with population at each irrigation level. Yield of the later hybrid was reduced by the high population in the dryland plot and increased only slightly with one irrigation. With two irrigations, yield of the later hybrid increased 25 bu/a at the high population. The later hybrid yielded more than the earlier hybrid at the low population when not irrigated, and at both populations when irrigated once or twice. Both hybrids produced similar yields with dryland and high population.

The corn was stressed prior to tassel by lack of rainfall. The combination of irrigation and rainfall during the remainder of the growing season resulted in excellent yields. As in previous studies, the later maturing hybrid produced the most grain. However, results may differ in years of less rainfall.

Table 1. Yield of limited irrigated corn as affected by number of irrigations, hybrid maturity, and plant population. Garden City, KS, 1998.[1]

		Number of Irrigations		
Hybrid	Population	0	1	2[2]
		bu/a		
NK4640Bt (104)[3]	15000	119	133	136
NK4640Bt	25000	134	156	171
NK7333Bt (115)	17000	138	167	168
NK7333Bt	27000	129	174	193

[1] Date of planting: May 13, 1998

[2] Each flood irrigation consisted of 6 inches of water; one irrigation at the 8-leaf stage, two irrigations at 8-leaf and tassel stages.

[3] Bracketed numbers indicate days to maturity.

LSD (0.10)		
	Hybrid at same irrigation and population	13
	Irrigation at same hybrid and population	12
	Population at same hybrid and irrigation	9

YIELD OF NO-TILL DRYLAND CORN AS AFFECTED BY HYBRID, PLANTING DATE, AND PLANT POPULATION

by
Charles Norwood

SUMMARY

Dryland corn was grown in the wheat-corn-fallow rotation from 1996 to 1998 to compare hybrids, planting dates, and plant populations. Later planting produced better yields in all years. Yields generally increased with hybrid maturity in 1996 and 1998, because of favorable weather conditions. Yields from the early planting of all hybrids were low in 1997 because of dry July weather. Late-July rainfall greatly improved yields from the later planting date in 1997, sometimes more than 100%, but was too late to improve yields of the early planting. Except for the first planting date in 1997, higher populations generally improved yields.

INTRODUCTION

The wheat-sorghum-fallow rotation produces more grain and is more profitable than the wheat-fallow rotation. A logical step up from wheat-sorghum-fallow is wheat-corn fallow. Corn traditionally is thought to lack sufficient heat and drought tolerance for dryland production in southwest Kansas. However, research at Garden City indicates that dryland corn may be feasible, if attention is given to hybrid, planting date, and plant population. No-till has proven to be essential for adequate yields in dry years and has increased yields substantially in wet years. This no-till dryland corn study compares hybrids of five different maturities planted on two dates at three plant populations. The objectives of this study are to determine the corn maturity class, planting date, and plant population, or, more likely, a combination of these factors, that will allow successful dryland corn production in southwest Kansas.

PROCEDURES

Dryland corn was grown in the wheat-corn-fallow rotation in 1996 through 1998 to compare different maturity hybrids at different planting dates and plant populations. Five Pioneer hybrids having days to maturity of 75, 92, 98, 106 and 110 were planted in mid-April and early May each year. The two earliest hybrids were not planted in 1996. Populations were 12,000; 18,000; and 24,000 plants/a. The hybrids were no-till planted into the stubble remaining from the previous wheat crop.

RESULTS AND DISCUSSION

Results are given in Table 1. Yields of hybrids in 1996 increased with plant population. The 110-day hybrid produced the most yield, particularly at the highest population. Yields were improved by later planting, probably because of more favorable weather conditions. Yields were improved drastically by later planting in 1997, sometimes more than 100%. Hybrids planted on the second date were able to take advantage of rainfall that came too late for the earlier planting. The 110-day hybrid again produced the most grain, but yields were reduced at the high population. Results from the first and second planting dates in 1998 were similar to those of 1996, with corn planted on the second date yielding more. The 75-day hybrid was the lowest yielding on both dates. This hybrid apparently did not have enough yield potential to utilize the more favorable weather conditions following the later planting date.

Early planting can increase irrigated corn yield, and dryland yield, if there is no stress. Under dryland conditions in western Kansas, however, yield is determined by weather conditions, and rainfall distribution is most important. The best yield will result from the planting date followed by the best rainfall distribution. Thus far in this study, that has been the later of the two planting dates, but this could easily change if good rainfall distribution follows the first date, and poor distribution follows the second date. Yields also will increase with increasing maturity and higher plant populations, provided rainfall is sufficient. However, higher populations use more soil water, or, at least, water is depleted faster than at a lower population. The results of dryland corn research done so far support a population of 18,000 plants, with the qualification that yields in dry years may be reduced compared to those of lower populations. The results of this and other studies also indicate that the yield reduction from a population too high in dry years is less than the yield reduction resulting from a population too low in wet years.

Based on this research, a farmer should plant two or more hybrids on more than one date, at populations not exceeding 18000 plants per acre. This recommendation will be revised in accordance with future research results.

Table 1. Effects of hybrid, planting date, and plant population on dryland corn (wheat-corn-fallow rotation), Garden City, KS, 1996-1998.

		Planting Date								
Hybrid	Population	4/16/96	5/8/96	Avg	4/17/97	5/6/97	Avg	4/15/98	5/12/98	Avg
					bu/a					
3984 (75)[1]	12000	—	—	—	37	43	40	34	48	41
	18000	—	—	—	36	58	47	44	65	54
	24000	—	—	—	35	64	50	44	75	59
	Avg	—	—	—	36	55		41	63	
3860 (92)	12000	—	—	—	51	88	70	85	99	92
	18000	—	—	—	45	108	77	100	130	115
	24000	—	—	—	46	99	73	106	137	122
	Avg	—	—	—	47	98		97	122	
3737 (98)	12000	78	112	95	42	65	54	100	110	105
	18000	100	139	120	38	87	63	123	135	129
	24000	128	156	142	55	106	81	118	142	130
	Avg	102	136		45	86		114	129	
3514 (106)	12000	99	84	92	69	92	81	106	118	112
	18000	106	133	120	39	84	62	125	137	131
	24000	128	143	136	50	104	77	130	145	137
	Avg	111	120		53	93		120	133	
3394 (110)	12000	102	117	110	64	106	85	122	133	127
	18000	126	161	144	40	130	85	140	160	150
	24000	159	173	166	22	93	58	147	161	154
	Avg	129	150		42	110		136	151	
Hybrid avg	12000	93	104		53	79		89	102	
	18000	111	144		40	93		107	125	
	24000	138	157		41	93		109	132	

[1] Numbers in brackets are days to maturity

LSD (0.10)	Date within hybrid (averaged over populations)	7	19	na
	Hybrid within date (averaged over populations	8	17	na
	Date within population (averaged over hybrids	9	14	7
	Population within date (averaged over hybrids)		11	4
	Hybrid within population (averaged over dates)	na	16	na
	Population within hybrid (averaged within dates)	na	14	na
	Hybrid averaged over populations and dates	na	na	5

YIELD OF DRYLAND CORN AS AFFECTED BY SLOPED VERSUS FLAT LAND

by
Charles Norwood

SUMMARY

Four corn hybrids ranging in maturity from 92 to 110 days were grown on sloped and flat land. Yield was unaffected by hybrid maturity. Yield on flat land averaged 41 bu/a more in 1997 and 14 bu/a more in 1998 than yield on a slope. Yield tended to increase with hybrid maturity in 1998, particularly on flat land. No yield differences occurred among hybrids in 1997.

INTRODUCTION

Dryland corn is not as drought and heat tolerant as grain sorghum. For dryland corn to yield well, particular attention needs to be given to hybrid maturity, planting date, and plant population. Because the yield of dryland corn depends on stored soil water and growing season rainfall, it probably should be planted where maximum accumulation of water can occur. This study was designed to compare the yield of corn grown on a slope with that grown on flat land.

PROCEDURES

Five Pioneer hybrids of 92-, 98-, 106-, and 110-day maturities were planted on sloped and flat plot areas in a wheat-corn-fallow rotation. The hybrids were planted in the stubble remaining from the 1996 and 1997 wheat crops. Planting dates were April 23, 1997 and May 8, 1998. The planting rate was 18,000 seeds/a. Actual populations were closer to 12,000 plants/a in 1997 because of crusting. About 16,000 plants/a emerged in 1998.

RESULTS AND DISCUSSION

Yields are presented in Table 1. Growing season rainfall was above average in both years, but rainfall distribution was poor in 1997, particularly in July. Yields were variable in 1997 because of nonuniform stands and did not differ significantly between hybrids. Yields were from 31 to 53 bu/a higher on the flat plot area. Average yields were only 27 bu/a on the slope vs. 68 bu/a on the flat plot area. Less water was stored during fallow on the sloped area, and much of the rainfall ran off, reducing yield. Water ran onto the flat area, increasing yield. Yields were much better in 1998, but average yields were still 14 bu/a higher on the flat area. Yields generally increased with hybrid maturity in 1998, particularly on the flat area. Preliminary conclusions are that yields of dryland corn in dry years will be reduced substantially on sloped land. In years of low rainfall, less water will be stored on a slope, and much of the growing season rainfall will run off.

Table 1. Yield of dryland corn on sloped vs flat land, Garden City, KS, 1997-1998.

	1997		1998	
Hybrid (days to maturity)	Slope	Flat	Slope	Flat
	bu/a			
Pioneer 3860 (92)	37a[1]	68a	74b	85c
Pioneer 3737 (98)	32a	73a	85ab	97b
Pioneer 3514 (106)	18a	71a	94a	104ab
Pioneer 3394 (110)	20a	60a	88ab	108a
Average	27	68	85	99

[1] Means within a column followed by a different letter differ at P<0.10.

Southwest Research-Extension Center

THE ECONOMIC EFFECT OF TILLAGE INTENSITY IN A WHEAT-SORGHUM-FALLOW ROTATION

by

Troy Dumler and Alan Schlegel

SUMMARY

Grain yields of wheat and grain sorghum increased with decreased tillage intensity. Yields for no-till wheat were 7 bu/a higher than those for conventional-till, whereas reduced-till yields were 4 bu/a higher than those for conventional tillage. Grain sorghum yields for no-till and reduced-till also were considerably higher than those for conventional tillage. Production costs also increased with reduced tillage. The increased wheat yields were offset by these increased costs, resulting in returns being only slightly higher for no-till. However, the increased grain sorghum yields associated with reduced and no-till resulted in higher net returns.

INTRODUCTION

In the semi-arid regions of western Kansas and the Great Plains, research has shown that reduced tillage often has resulted in increased grain yields. Increased grains yields offer the opportunity for increased returns. This study was conducted to determine the economic impact of reducing tillage based on 8 years of agronomic data from Tribune, Kansas.

PROCEDURES

Research on different tillage intensities in a wheat-sorghum-fallow rotation at the K-State Southwest Research-Extension Center at Tribune was conducted from 1991-1998. The three tillage intensities were conventional, reduced, and no-till. The conventionally tilled rotations were tilled as needed to control weed growth during the noncrop period. On average, this resulted in four tillage operations per year, usually with a blade plow or field cultivator. The reduced tillage rotations used a combination of herbicides and tillage (one to three tillage operations) to control weed growth during the noncrop period. The no-till rotations exclusively used herbicides to control weed growth during the noncrop period. All tillage systems used herbicides for in-crop weed control.

The actual tillage operation and herbicide application for each year of the study was used to determine the production costs for the three tillage intensities. These costs were based on average custom rates for southwest Kansas. Custom rates also were used for planting, harvesting, and fertilizer application costs. The remaining costs, including seed, fertilizer, and herbicides, were based on historical costs over the study period. Wheat and grain sorghum prices were average yearly prices for southwest Kansas from 1991 to 1998. Land costs and government payments were not included in the study.

RESULTS AND DISCUSSION

On average, wheat yields over the 8-year period were higher for no-till than for reduced and conventional tillage (Figure 1). However, in some years, no-till wheat yields were less than or approximately equal to those for reduced and conventional tillage. Production costs, like yields, were also higher for no-till, resulting in returns being only slightly higher for no-till (Figure 2).

Grain sorghum yields for reduced-till averaged 19 bu/a more than yields for conventional tillage (Figure 3). Over this same time period, no-till yields averaged 5.5 bu/a more than reduced-till yields. Thus, there is a greater advantage to reducing tillage with grain sorghum than wheat. Similar to wheat, production costs for grain sorghum increased as tillage decreased. Figure 4 shows the sorghum tillage and herbicide cost components for conventional, reduced, and no-till. Although tillage costs decreased with reduced tillage, herbicide costs increased to a greater extent; therefore, total costs/a increased. Nevertheless, even with increased production costs, no-till sorghum returns were nearly twice those of conventional-tillage sorghum (Figure 5). According to Figure 6, which includes both wheat and sorghum returns, the no-till rotation was clearly the most profitable. The returns per tillable acre for no-till, reduced-till, and conventional-till were $46.67, $42.55, and $29.71, respectively.

Figure 1. Wheat yields under different tillage intensities in a WSF rotation, Tribune, KS.

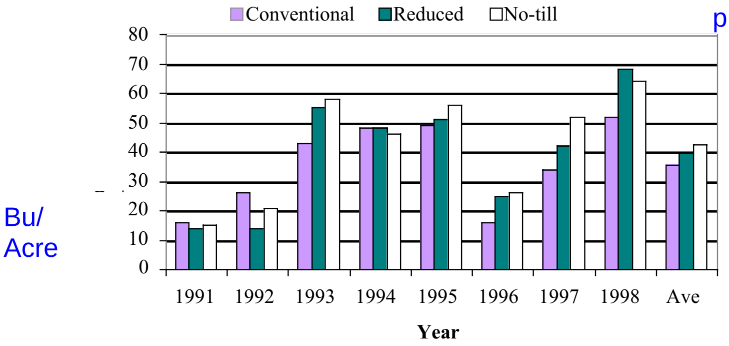


Figure 4. Sorghum tillage and herbicide costs in a WSF rotation, Tribune, KS.

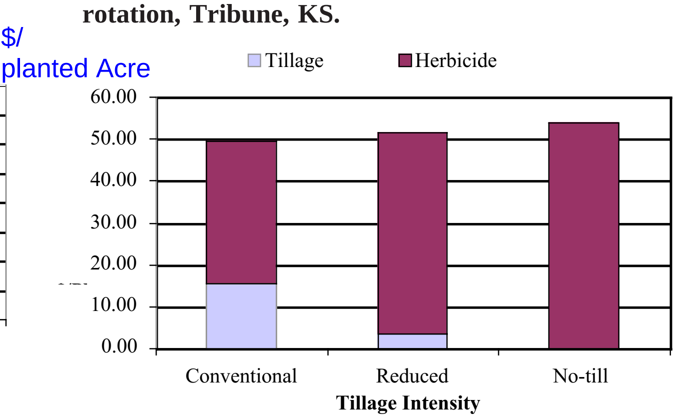


Figure 2. Wheat returns per tillable acre in a WSF rotation, Tribune, KS.

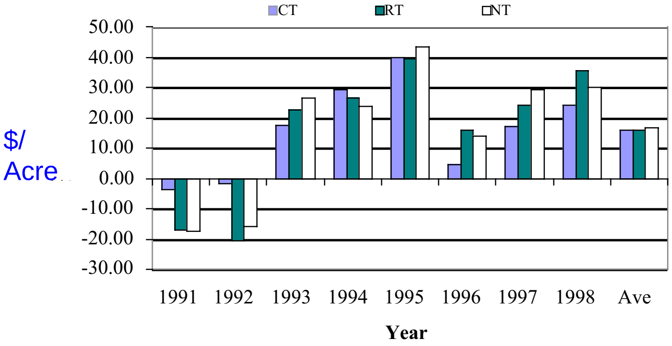


Figure 5. Sorghum returns per tillable acre in a WSF rotation, Tribune, KS.

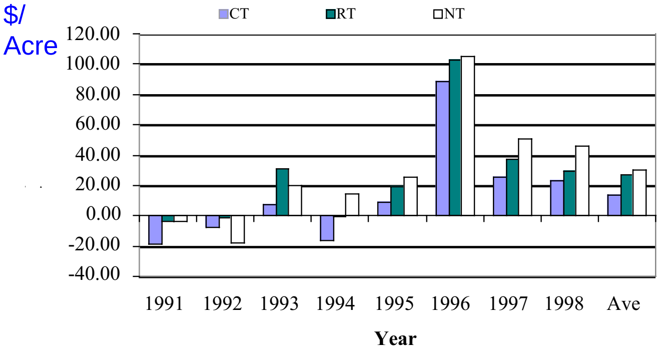


Figure 3. Grain sorghum yields under different tillage intensities in a WSF rotation, Tribune, KS.

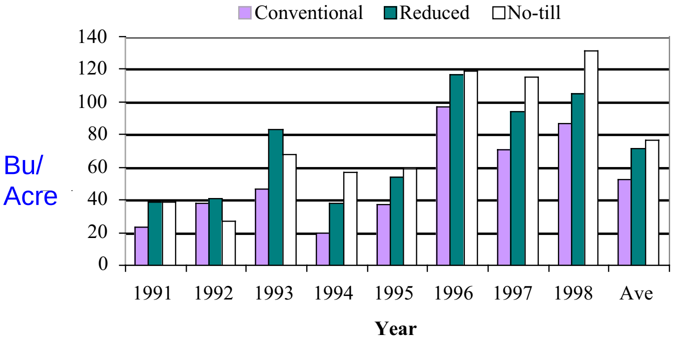
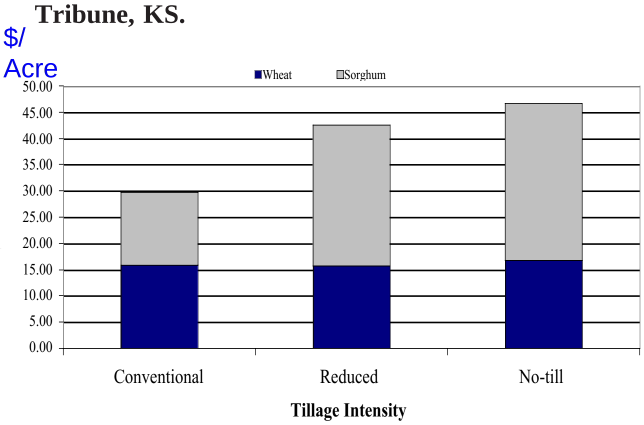


Figure 6. Returns per tillable acre in a WSF rotation, Tribune, KS.



K-STATE
Southwest Research-Extension Center

RESIDUAL SOIL NITROGEN AND PHOSPHORUS AFTER MANURE APPLICATIONS

by
Alan Schlegel, Mahbub Alam, Chuck Rice[1]*, and Gary Pierzynski*[1]

SUMMARY

Soil chemical properties were measured in irrigated fields in western Kansas with a history of animal waste applications. The fields varied in the type of waste applied (solid cattle manure or effluent water from swine or cattle wastewater lagoons) and the duration of application (from 3 to 30 years). At most sites, soil phosphorus (P) levels were increased (up to 150 ppm) by waste applications, indicating that application rates exceeded crop P demands. The highest P concentration in the surface soil (0 to 6-inch depth) was 200 ppm Bray-1 P, which is the maximum level established for continued application of swine waste. Soil nitrate levels also were increased (as much as 100 ppm) by waste applications. At some sites, considerable nitrate (30 to 50 ppm) had leached past the crop root zone to a depth of at least 10 feet.

INTRODUCTION

Application of animal wastes can enhance soil chemical and biological properties and serve as a valuable nutrient source for crop production. However, improper use of animal manure can adversely affect the environment. Two concerns associated with land application of animal waste are phosphorus (P) loss in surface water runoff, which causes eutrophication of streams and lakes, and nitrate leaching through the soil profile into the groundwater. The purpose of this study was to sample fields that have received land application of animal wastes and compare the soil chemical properties to similar fields that have not received manure applications.

PROCEDURES

Soil samples were collected from seven irrigated fields in western Kansas (in cooperation with local landowners) that had a history of manure application. The type of manure, number of years of application, and application method varied among sites. The application rate was unknown for most sites. The longest history of application was about 30 years. Two sites received swine wastes (effluent water) and the others received cattle manure (two sites received solid manure and three sites received effluent water). Each field was divided into three subfields. In each subfield, three soil cores to a depth of 10 ft were collected; divided into 12-inch increments (except for the surface foot), and composited. For the surface foot of soil, 6 additional cores were collected; divided into 0- to 2-inch, 2- to 4-inch, 4- to 6-inch, 6- to 8-inch, and 8- to 12-inch increments; and composited. Similar fields that had not received manure (identified by the landowner) also were sampled in the same manner. The samples were dried and sent to the KSU Soil Testing Laboratory for analyses.

RESULTS AND DISCUSSION

Soil P levels were increased to about 200 ppm Bray-1 P (0- to 6-inch depth) in a field that had received manure for about 30 years (Table 1). In an adjacent field that had not received solid cattle manure, the soil P level was about 45 ppm. Soil nitrate levels also were considerably greater in the manured field (Table 2), with some accumulation below the crop root zone (generally about 5 ft). For instance, soil nitrate was 32 ppm in the 9- to 10-ft depth in the manured field compared to less than 1 ppm in the nonmanured field. At the second site that received solid cattle manure, soil P levels were about 180 ppm following three annual application of cattle manure (20 ton/year); however, similar soil P levels were observed in an adjacent area that had not received manure in the past 3 years. Also, at this site, soil nitrate levels were similar for both the manured and the control field, with considerable nitrate throughout

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Table 1. Phosphorus levels in soil with a history of animal waste application, western Kansas.

Depth	3 Years -CS	30 Years -CS	3 Years -LEC	10 Years -LEC	15 Years -LEC	8 Years -LES	30 Years -LES
inch	Bray 1-P (ppm)						
0-2	198	220	128	51	121	72	179
2-4	188	190	124	36	125	82	161
4-6	150	183	97	23	114	62	70
6-8	92	79	47	16	92	37	40
8-12	54	44	14	12	53	15	23

CS-solid manure from cattle.
LEC-lagoon effluent from cattle.
LES-lagoon effluent from swine.

the soil profile (40 to 50 ppm at the 9- to 10-ft depth).

Three fields were sampled that had received effluent water from wastewater lagoons at cattle facilities. The impact of effluent water application varied considerably among the sites. Soil P levels at the site with the longest history of effluent water application (about 15 years) were about 120 ppm (Table 1). Soil nitrate levels also were elevated at this site, with over 50 ppm nitrate in the 5- to 10-ft depths (Table 2). At another site, soil P levels were relatively unchanged following 10 years of effluent water application (about 37 ppm Bray-1 P for manured and nonmanured fields). However, the effluent water did increase soil nitrate levels; about 17 ppm nitrate occurred in the 5- to 10-ft depth in the field receiving effluent water compared to about 1 ppm in the control field. At a third site that had received effluent water for only 3 years, soil P levels were increased to about 115 ppm compared to about 10 ppm in an adjacent area that had not received effluent water. Soil nitrate levels were increased by effluent water application, but mostly in the upper profile. For instance, in the top foot of soil, the nitrate level was more than 100 ppm in the field receiving effluent water compared to less than 5 ppm in the area not receiving effluent water. This nitrogen would be readily available for crop growth. However, some movement of nitrate was observed below 5 ft, with 25 ppm nitrate in the treated area compared to 11 ppm in the untreated area.

Two sites were sampled that had received applications of effluent water from swine lagoons. At the site with the longest history of application (since 1970), soil Bray-1 P levels were about 135 ppm averaged across the top 6 inches of soil (Table 1). Considerable accumulation of nitrate occurred in the soil profile, with the highest concentration (170 ppm nitrate) at the 5- to 6-ft depth (Table 2). Nitrate had leached past the crop root zone; about 59 ppm occurred at the 9- to 10-ft depth. At another site that had received effluent water for about 8 years, soil P levels were about 70 ppm. Similar to the previous site, the highest level of soil nitrate (120 ppm) was at the 5- to 6-ft depth. Soil nitrate levels were also above 100 ppm in the 6- to 8-ft depths. Below 8 feet, soil nitrate levels decreased to 34 ppm in the lowest depth (9 to 10 ft). A concern with application of swine waste is accumulation of heavy metals (copper and zinc) in the soil that can have phytotoxic effects on crops. For these two sites, heavy metal accumulation was not a problem; DTPA-extractable Cu was less than 2 ppm, and DTPA-extractable Zn was 4 ppm.

Table 2. Nitrate levels in soil with a history of animal waste application, western Kansas.

Depth	3 Years -CS	30 Years -CS	3 Years -LEC	10 Years -LEC	15 Years -LEC	8 Years -LES	30 Years -LES
	NO_3-N (ppm)						
0-2 inches	24.1	63.2	106.5	7.6	13.7	4.0	60.9
2-4 inches	16.4	24.6	113.2	9.9	9.5	5.6	32.4
4-6 inches	14.0	18.8	121.6	16.6	21.2	8.3	29.9
6-8 inches	17.9	14.5	120.4	21.1	20.7	11.7	30.0
8-12 inches	20.0	15.4	133.1	23.6	31.7	18.0	26.8
1-2 feet	15.6	61.6	94.3	23.5	9.4	18.2	28.7
2-3 feet	14.3	48.2	77.2	17.3	13.4	31.2	25.8
3-4 feet	24.1	31.9	57.5	29.9	30.7	56.4	39.4
4-5 feet	16.9	31.2	46.6	36.9	58.6	85.5	94.4
5-6 feet	17.3	16.3	28.9	33.2	83.8	122.0	170.7
6-7 feet	17.0	7.0	30.2	23.9	93.3	115.5	159.8
7-8 feet	20.3	10.9	25.1	14.1	87.6	113.6	116.1
8-9 feet	28.7	23.0	20.2	12.9	68.1	65.4	66.1
9-10 feet	42.9	32.3	22.7	12.3	52.7	34.4	59.0

CS-solid manure from cattle.
LEC-lagoon effluent from cattle.
LES-lagoon effluent from swine.

IRRIGATED CORN AND GRAIN SORGHUM RESPONSES TO NITROGEN AND PHOSPHORUS FERTILIZATION

by
Alan Schlegel

SUMMARY

Long-term research shows that phosphorus (P) and nitrogen (N) fertilizers must be applied for optimum grain yields of irrigated corn and grain sorghum in western Kansas. In this study, N and P fertilization increased corn yields more than 100 bu/a. Application of 160 lb N/a tended to be sufficient to maximize corn yields. Phosphorus increased corn yields by 75 bu/a when applied with at least 120 lb N/a. Application of 40 lb P_2O_5/a was adequate for corn, and higher rates were not necessary. Grain sorghum yields were increased over 40 bu/a by N and about 20 bu/a by P fertilization. Application of 80 lb N/a was sufficient to maximize yields in most years. Potassium fertilization had no effect on sorghum yield.

INTRODUCTION

This study was initiated in 1961 to determine responses of continuous corn and grain sorghum grown under flood irrigation to N, P, and potassium (K) fertilization. The study is conducted on a Ulysses silt loam soil with an inherently high K content. Because corn did not respond to K, it was discontinued in 1992. However, a yield increase from P fertilization has been observed since 1965, and concern has existed that the level of P fertilization might not be adequate. So, beginning in 1992, a higher P rate was added to the corn study.

PROCEDURES

Initial fertilizer treatments in 1961 to corn and grain sorghum in adjacent fields were N rates of 0, 40, 80, 120, 160, and 200 lb N/a without P and K; with 40 lb P_2O_5/a and zero K; and with 40 lb P_2O_5/a and 40 lb K_2O/a. In 1992, the treatments for the corn study were changed with the K variable being replaced by a higher rate of P (80 lb P_2O_5/a). All fertilizers were broadcast by hand in the spring and incorporated prior to planting. The soil is a Ulysses silt loam. The corn hybrids were Pioneer 3379 (1992-94), Pioneer 3225 (1995-97), and Pioneer 3395IR (1998) planted at 32,000 seeds/a in late April or early May. Sorghum (Mycogen TE Y-75 from 1992-1996, Pioneer 8414 in 1997, and Pioneer 8505 in 1998) was planted in late May or early June. Both studies were furrow irrigated to minimize water stress. The center two rows of all plots were machine harvested after physiological maturity. Grain yields were adjusted to 15.5% moisture for corn and 12.5% for sorghum.

RESULTS AND DISCUSSION

Nitrogen and P fertilization increased corn yields averaged across the 7-year period by over 100 bu/a. In 1995, hail during the growing season reduced overall yields about 40%, but yields were still increased up to 80 bu/a by N and P fertilization. The apparent N fertilizer requirement was about 160 lb/a. Application of 40 lb P_2O_5/a increased yields more than 70 bu/a when applied with at least 120 lb N/a. No significant yield difference occurred between applications of 40 and 80 lb P_2O_5/a, averaged across all N rates. However, at 160 and 200 lb N/a, corn yields were 4 bu/a greater with 80 than with 40 lb P_2O_5/a.

Grain sorghum yields were increased 43 bu/a by application of 80 N/a, averaged across the last 6 years. Phosphorus increased sorghum yields by about 20 bu/a, but K had no effect on sorghum yields.

Table 1. Effects of N and P fertilizers on irrigated corn. Tribune, KS, 1992-1998.

		Grain Yield						
Nitrogen	P_2O_5	1992	1993	1994	1995	1996	1997	1998
lb/a		bu/a						
0	0	73	43	47	22	58	66	49
0	40	88	50	43	27	64	79	55
0	80	80	52	48	26	73	83	55
40	0	90	62	66	34	87	86	76
40	40	128	103	104	68	111	111	107
40	80	128	104	105	65	106	114	95
80	0	91	68	66	34	95	130	95
80	40	157	138	129	94	164	153	155
80	80	140	144	127	93	159	155	149
120	0	98	71	70	39	97	105	92
120	40	162	151	147	100	185	173	180
120	80	157	153	154	111	183	162	179
160	0	115	88	78	44	103	108	101
160	40	169	175	162	103	185	169	186
160	80	178	174	167	100	195	187	185
200	0	111	82	80	62	110	110	130
200	40	187	169	171	106	180	185	188
200	80	165	181	174	109	190	193	197
MEANS								
Nitrogen, lb/a	0	80	48	46	25	65	76	53
	40	116	90	92	56	102	104	93
	80	129	116	107	74	139	146	133
	120	139	125	124	83	155	147	150
	160	154	146	136	82	161	155	157
	200	154	144	142	92	160	163	172
	$LSD_{.0.05}$	14	7	13	7	10	12	11
P_2O_5, lb/a	0	96	69	68	39	92	101	91
	40	149	131	126	83	148	145	145
	80	141	135	129	84	151	149	143
	$LSD_{.0.05}$	10	5	9	5	7	9	7

Table 2. Effects of N, P, and K fertilizers on irrigated sorghum. Tribune, KS, 1992-1998.

N	P_2O_5	K_2O	Grain Yield 1992	1993	1994*	1996	1997	1998
lb/a			bu/a					
0	0	0	27	46	64	74	81	77
0	40	0	28	42	82	77	75	77
0	40	40	35	37	78	79	83	76
40	0	0	46	69	76	74	104	91
40	40	0	72	97	113	100	114	118
40	40	40	72	92	112	101	121	114
80	0	0	68	91	96	73	100	111
80	40	0	85	105	123	103	121	125
80	40	40	85	118	131	103	130	130
120	0	0	56	77	91	79	91	102
120	40	0	87	120	131	94	124	125
120	40	40	90	117	133	99	128	128
160	0	0	62	93	105	85	118	118
160	40	0	92	122	137	92	116	131
160	40	40	88	123	125	91	119	124
200	0	0	80	107	114	86	107	121
200	40	0	91	127	133	109	126	133
200	40	40	103	123	130	95	115	130
MEANS								
Nitrogen								
0	lb/a		30	42	75	77	80	76
40			64	86	100	92	113	108
80			80	104	117	93	117	122
120			78	105	118	91	114	118
160			81	113	122	89	118	124
200			91	119	126	97	116	128
	$LSD_{.05}$		10	10	14	9	10	8
P_2O_5-K_2O								
0-0	lb/a		56	81	91	79	100	103
40-0			76	102	120	96	113	118
40-40			79	102	118	95	116	117
	$LSD_{.05}$		7	7	10	7	7	6

*Note: No yield data were collected for 1995 because of freeze.

Southwest Research-Extension Center

FOUR-YEAR DRYLAND CROP ROTATIONS IN WESTERN KANSAS

by

Troy Dumler and Alan Schlegel

SUMMARY

Yields were lower for second crops of wheat and sorghum in a wheat-wheat-sorghum-fallow and wheat-sorghum-sorghum-fallow rotation than for the first crops. However, the difference was smaller for wheat than for sorghum. The second-crop grain sorghum yields were much more variable than second-crop wheat yields in these 4-year rotations. Returns per acre were highest for the wheat-wheat-sorghum-fallow rotation, followed by wheat-sorghum-fallow and wheat-sorghum-sorghum-fallow.

INTRODUCTION

Research in western Kansas has shown that increasing cropping intensity from a wheat-fallow rotation to a wheat-summer crop-fallow rotation can increase economic returns. Besides increasing returns through increased acres planted, increased cropping intensity also can be beneficial by reducing production and marketing risks through diversification and by reducing erosion. This study determined the economic feasibility of implementing 4-year crop rotations. The rotations evaluated were wheat-wheat-sorghum-fallow and a wheat-sorghum-sorghum-fallow.

Procedures

This study was initiated in 1995 at the Southwest Research-Extension Center in Tribune, KS. Complete yield data for the wheat-wheat-sorghum-fallow (WWSF) and wheat-sorghum-sorghum-fallow (WSSF) rotations were available for 1997 and 1998. Tillage was used initially during summer-fallow prior to the first wheat crop, but both rotations were exclusively no-till in 1998. To determine the production costs for each rotation, average custom rates for southwest Kansas were used for tillage operations, herbicide applications, fertilizer applications, planting, and harvesting. Average 1997 and 1998 costs were used for fertilizer, seed, and herbicides. The market prices for wheat and sorghum in 1997 and 1998 were average prices in southwest Kansas. Land costs and government payments were not included.

Although a separate wheat-sorghum-fallow (WSF) rotation was not included in the study, the two 4-year rotations were compared to a WSF rotation by using the net returns for wheat and the first sorghum crop in the WSSF rotation. Thus, we could determined whether it would be more profitable to increase cropping intensity from two crops in 3 years to three crops in 4 years.

RESULTS AND DISCUSSION

The wheat yields in the WWSF and WSSF rotations are shown in Fig. 1. In all three cases, wheat yields increased from 1997 to 1998. In both years, the second-crop wheat yielded lower than wheat following fallow, but in 1998, the difference was only 1 bu/a. The sorghum yields for the WWSF and WSSF rotations are shown in Fig. 2. The first-year sorghum yields in the WSSF rotation were the highest in both years. The sorghum yields, like the wheat yields, were higher in 1998 than 1997. However, the second-crop sorghum yields in the WSSF rotation were more variable than those of the first sorghum crops. In fact, these yields varied from 45 bu/a in 1997 to 100 bu/a in 1998.

Fig. 3 shows the returns per tillable acre for the WWSF, WSSF, and WSF rotations. On average, the WWSF rotation had the highest net return at $72.76/a. However, the difference between this rotation and the WSSF and WSF rotations was not large. The WSF rotation had returns of $68.00/a, and the WSSF rotation returned $66.75/a.

Fig. 4 illustrates the yields at three price levels needed in the second wheat crop in a WWSF rotation to break even with a WSF rotation. Focusing on the middle price level of $3.30/bu, 35 bu/a would be needed in the second wheat crop if wheat yielded 40 bu/a in a WSF rotation. With lower wheat prices, higher yields are needed in a second wheat crop to break even with a WSF rotation. This occurs because the sorghum acres, which have higher returns than wheat, are reduced. The situation is similar for sorghum (Fig. 5). If the WSF sorghum yield is 80 bu/a, 65 bu/a would be needed in the second sorghum crop in WSSF rotation to break even with the WSF rotation, given that the sorghum price was $2.20/bu.

Fig. 1. Wheat yields (W) in a 4-year rotation, Tribune, KS.

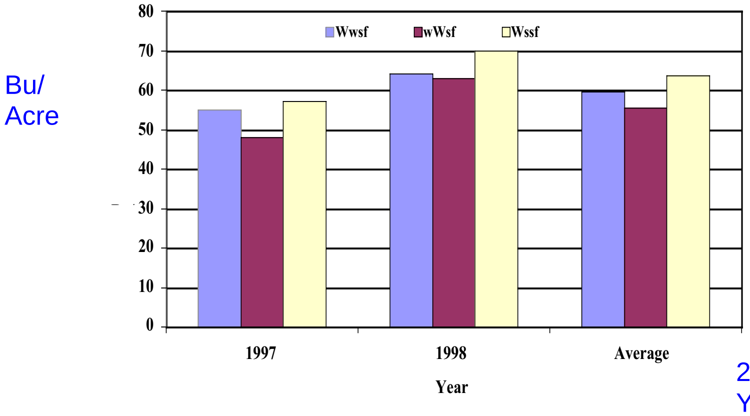


Fig. 2. Sorghum yields (S) in a 4-year rotation, Tribune, KS.

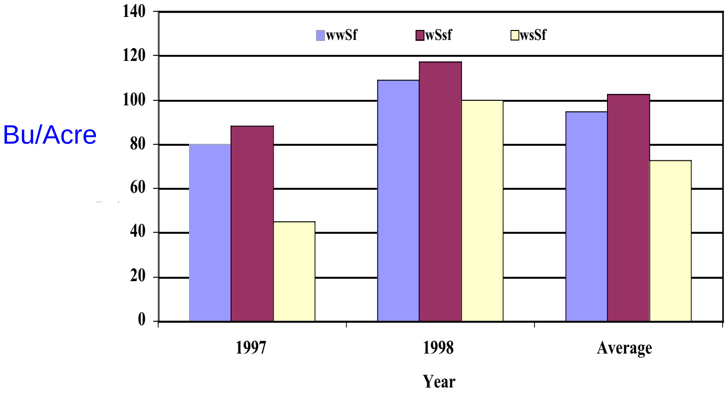


Fig. 3. Returns per tillable acre under different rotations, Tribune, KS.

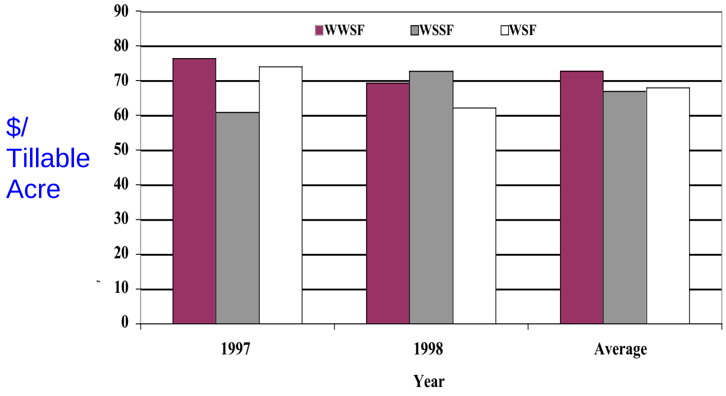


Fig. 4. Wheat yield needed in a WWSF rotation to equal WSF returns, Tribune, KS.

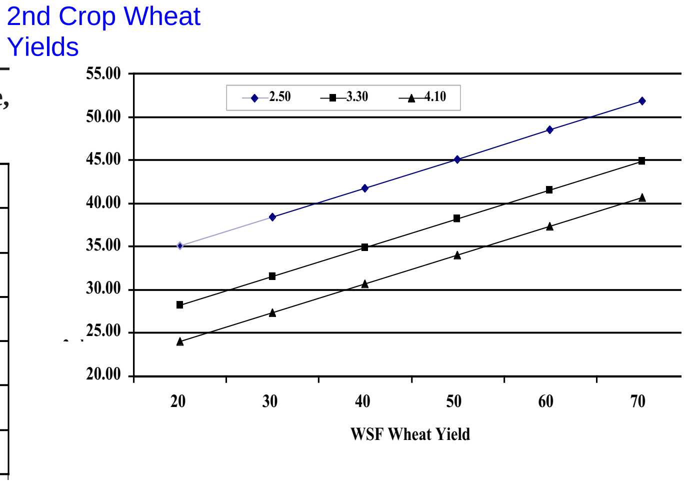
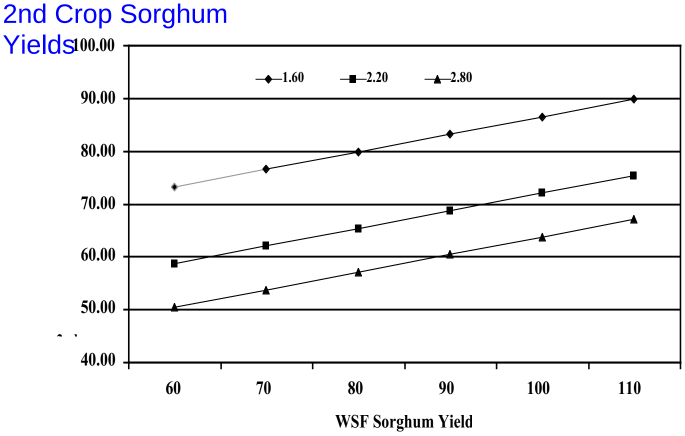


Fig. 5. Sorghum yield needed in a WSSF rotation to equal WSF returns, Tribune, KS.



TESTING SUBSURFACE DRIP-IRRIGATION LATERALS WITH LAGOON WASTEWATER

by
Todd Trooien, Freddie Lamm[1], Loyd Stone[2], Mahbub Alam,
Danny Rogers[3], Gary Clark[3], and Alan Schlegel

SUMMARY

Using subsurface drip irrigation (SDI) with lagoon wastewater has many potential advantages. The challenge is to design and manage the system to prevent emitter clogging. A study was designed and conducted in 1998 to test the operation of five types of driplines (with emitter flow rates of 0.15, 0.24, 0.40, 0.60, and 0.92 gal/hr/emitter) with lagoon wastewater. Filtration was with a disk filter (200 mesh), and shock treatments of chlorine and acid were injected periodically. Nearly 21 inches of wastewater were applied through the system from June to September. Flow rates of the two lowest flow-rate emitter treatments (0.15 and 0.24 gal/hr/emitter) decreased by 15 and 11% of the original flow rates, respectively, indicating that some emitter clogging had occurred. Only a fraction (5%) of the original flow rate was reclaimed in the 0.24 gal/hr/emitter plots, and none in the 0.15 gal/hr/emitter plots. The three highest flow-rate emitter treatments showed no signs of clogging; their flow rates did not decrease through the season. Long-term effects (>1 growing season) of wastewater on SDI have not yet been tested. The disk filter and automatic backflush controller performed adequately in 1998. Based on these results, the use of SDI with lagoon wastewater shows promise, but the smaller emitter sizes may not be appropriate.

INTRODUCTION

Use of subsurface drip irrigation (SDI) with water from animal waste lagoons has many potential advantages. They include, but are not limited to, reduced human contact with wastewater; no runoff of wastewater into surface waters; placement of phosphorus-rich water beneath the soil surface where runoff potential is reduced; greater water application uniformity resulting in better control of the water, nutrients, and salts; reduced irrigation system corrosion; reduced climatic-based application constraint (especially high winds and low temperatures); and increased flexibility in matching field and irrigation system sizes.

Very small emitters in SDI systems may be prone to clogging by the various constituents of the wastewater. The worldwide leading cause of microirrigation system failure is emitter clogging. The design and management challenge of using SDI with wastewater is to prevent emitter clogging. Given that challenge, the objective of this project was to measure the performance of five different dripline types as affected by irrigation with filtered but untreated water from a beef feedlot runoff lagoon.

PROCEDURES

This project was conducted at Midwest Feeders, Ingalls, KS, a beef cattle feedlot.

In April 1998, driplines were installed 17 inches deep and on a lateral spacing of 60 inches. Each plot was 20 ft wide (four driplines) and 450 ft long. The system installation was completed and the first wastewater was used for irrigation on June 17. After completion of the system, the lagoon wastewater was the only water applied with the SDI system. No clean water was used for irrigation, flushing, or dripline chemical treatment. Each dripline type was replicated three times, and two border plots were included, giving a total of 17 plots.

Five drip irrigation lateral line (dripline) types, each with a different emitter flow rate (and thus different emitter size), were tested. Emitter flow rates

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were 0.15, 0.24, 0.40, 0.60, and 0.92 gal/hr/emitter. This wide range of emitter flow rates was selected to determine the optimum emitter size that would be less prone to clogging when used with lagoon wastewater. Agricultural designs of SDI in the Great Plains with fresh, clean groundwater typically use lower flow rate emitters.

The wastewater was filtered with a plastic grooved-disk filter, and the flow capacity was based on the filter manufacturer's recommendations. The disks were selected to provide 200-mesh equivalent filtration even though the manufacturer's recommendation for all driplines was filtration of 140 mesh or finer. A controller was used to automatically backflush the filter after every hour of operation or when the differential pressure across the filter reached 7 psi. Acid and chlorine also were injected into the system on July 9, July 27, August 4, August 31, September 4, October 6, and November 17 to help keep bacteria and algae from growing and accumulating in the driplines and to clean lines of existing organic materials. Acid was added to reduce the pH to approximately 6.3. Driplines were flushed on August 4, September 2, October 6, and November 17.

To test the system, irrigations of 0.20 to 0.40 inches were applied daily from June through early September. Each plot received the same application amount for a given day, so the run times for plots varied according to their emitter flow rates and emitter spacings. Each plot received the same seasonal application amount of nearly 21 inches. This amount is in excess of the typical crop water requirement but allowed a more thorough test of the SDI system. Following the final corn irrigation on Day of Year (DOY) 247, the system was not used until DOY 279, 280, and 321, when the system flow rates were tested.

Emitter flow rates for entire plots were measured weekly. Pressure gauges at the head and tail ends of the plots were used to measure the pressure within the driplines. Totalizing flow meters measured the amount and rate of wastewater delivered to each plot.

To test the flow rate of the driplines in an entire plot, the flow amount to each plot was measured and timed for approximately 30 minutes. Inlet and flushline pressures were recorded. To account for the variation due to fluctuating pressures from test to test, the inlet pressure was normalized to the design pressure using the manufacturer's emitter exponent for the dripline.

PRELIMINARY RESULTS

The three higher-flow emitter sizes (0.4, 0.6, and 0.92 gal/hr/emitter) showed little sign of clogging (Fig. 1). Flow rates at the end of the season for those emitters were within 2% of the initial flow rates, indicating that very little emitter clogging and resultant decrease of flow rate had occurred. The absence of emitter clogging indicates that emitters of these sizes may be adequate for use with lagoon wastewater.

The two lower-flow emitter sizes (0.15 and 0.24 gal/hr/emitter) showed some signs of emitter clogging (Fig. 1). Within 30 days of system completion, the flow rates of plots with both lower-flow emitters began to decrease. The 0.15 gal/hr/emitter plots showed a gradual decrease of flow rate throughout the remainder of the test. By DOY 321, the flow rate had decreased by 15% of the initial flow rate. The 0.24 gal/hr/emitter plots showed a decrease of flow rate of 11% of the initial flow rate by DOY 245. Following harvest and the first (32-day) idle period, flow rates in the 0.24 gal/hr/emitter plot increased approximately 5% over the minimum measured flow rate. This increase indicated that some cleaning of the emitters had occurred in response to the flushing. The flow rate then stabilized for the rest of this test at about 9% less than the initial flow rate.

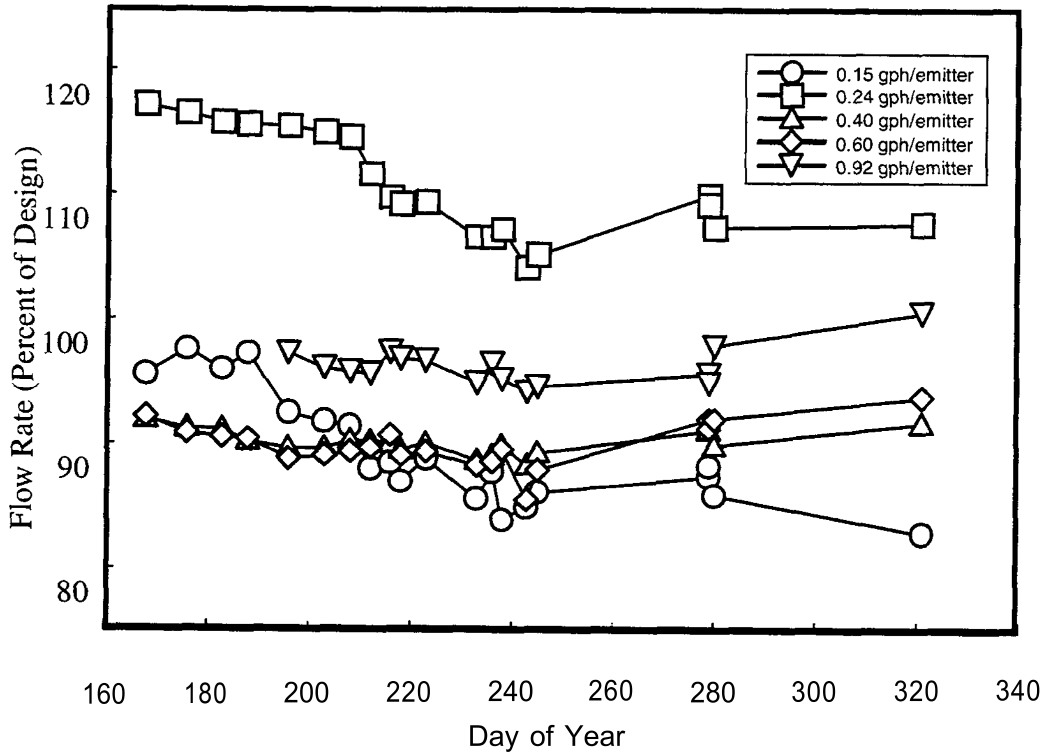
The disk filter and automated backflush controller operated well in 1998. Based on our observations, the hourly backflush frequency was adequate to prevent excessive differential pressure accumulation, and the set point of 7 psi was never reached.

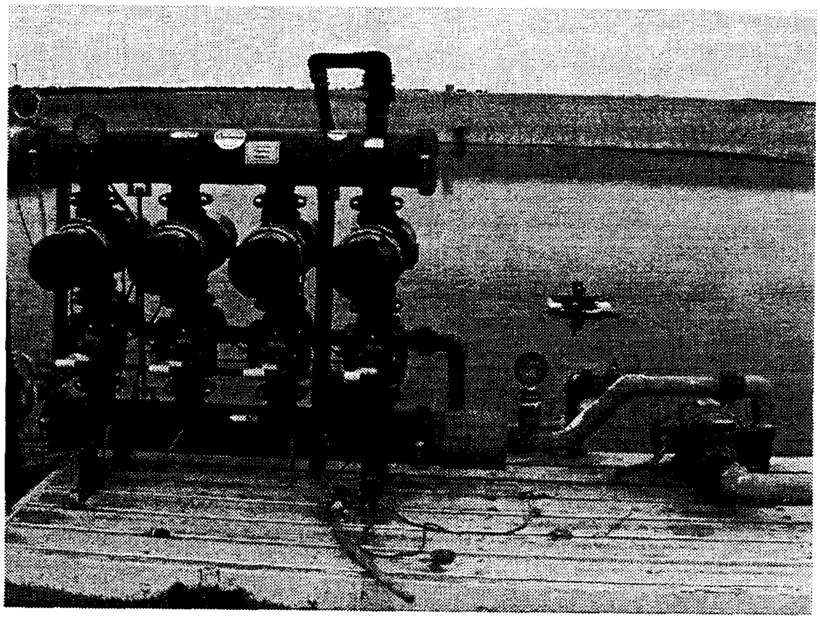
CONCLUSIONS

These results show that the drip irrigation laterals tested with SDI have potential for use with lagoon wastewater. However, the smaller emitter sizes normally used with groundwater sources in western Kansas may not be appropriate for use with lagoon wastewater, because they may be prone to clogging.

The results of this study, while very encouraging, should be considered preliminary. Questions still remain about the long-term, multiseason performance of SDI systems using livestock wastewater. Efficient long-term performance probably will be necessary to justify the higher investment costs of SDI systems.

Figure 1. Measured flow rates for five dripline types in a subsurface drip-irrigation system using livestock wastewater, Midwest Feeders, Ingalls, KS, 1998.





Acknowledgements

We thank Midwest Feeders for providing the site, wastewater, and assistance with the project. We also thank the numerous companies that donated irrigation products and services in support of this project. Funding for the project was recommended by the Governor's office, approved by the Kansas legislature in 1998, and administered through KCARE at Kansas State University.

FIELD APPLICATION OF ET-BASED IRRIGATION SCHEDULING IN WESTERN KANSAS[1]

by
Mahbub ul Alam, Todd Trooien, and Danny Rogers[2]

SUMMARY

Irrigation-scheduling demonstration fields planted to corn were set up in nine counties in southwestern Kansas. Each site was equipped with soil-water sensors at two locatioins and placed at three depths. Soil samples were taken to evaluate soil water. Neutron access tubes were installed at two sites with different soil textures. Evapotranspiration (ET) data from the weather station at the Southwest Research-Extension Center were used to calculate water balance. The Southwest Kansas Groundwater Management District #3 installed 12 weather stations that make ET data available. A simple device called an ET gauge also was installed along with a rain gauge. The local ET data from the ET gauge and GMD weather stations were in good agreement for the growing season. Scheduling based on ET helped producers to take advantage of rainfall to meet the crop's water need. The average corn yeild from the demonstration fields was 205 bu/a. Soil sensors helped in validating soil water status and making irrigation scheduling decisions. Irrigation scheduling for better irrigation management is the key to water conservation. An intensive educational effort is necessary to make the adoption of irrigation scheduling by farmers a reality. Spreadsheets and computer software are now available that make data retrieval faster and allow quick decisions.

INTRODUCTION

Irrigation scheduling means providing an appropriate quantity of water to the crop at the proper time to secure profitable production. Irrigation provides for consistent annual production of corn, grain sorghum, wheat, alfalfa, soybean, and sunflower in western Kansas. About 2 million acres in this region depend on the Ogallala aquifer, a confined system with very limited recharge. The water level is declining, and depletion of this nonrenewable reserve has become a major focus for economic sustainability. Introduction of center pivot irrigation systems has improved application uniformity, but irrigation scheduling and good management are required to achieve efficient water use. Various methods are available to make a decision on irrigation timing and to calculate the amount. Farmers have used the appearance of the crop to decide when to irrigate. However, by the time the visual symptoms become apparent, the crop already has suffered from stress, and the optimum production may have been affected. Evapotranspiration (ET)-based irrigation with appropriate soil-water monitoring is the most scientific method to implement irrigation scheduling.

Irrigation scheduling tools like soil-water sensors, ET data, and computer software to keep track of a water budget are available, yet field adoption of irrigation scheduling is limited. Unlike other agricultural inputs, irrigation necessitates continuous decision making during the entire crop season. Crop water demand, although varied in quantity, occurs throughout the growing season. Farmers in western Kansas tend to simplify the situation by turning on the pivot system and running it until the end of the season. This may be appropriate for irrigation wells with insufficient capacity. Long hot days with southwest dry winds make farmers fearful of falling behind in satisfying the crop demand. However, those who have high capacity wells, have the opportunity to shut down the irrigation system occasionally.

Crop water demand is low in the early growing season. The root system is less prolific and is drawing from the top layer of the reserve. Information on crop water use (ET), available soil water capacity, and root depth may help in deciding on when to irrigate and

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[1] This research was funded by the Kansas Corn Commission from check-off funds.

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how much to apply, especially at this time when the root zone is small.

Most of the farmers hire consultants who guide them through the season. Consultants do not want to take risks with water application, because this is considered to be a relatively cheap input. They use a push type rod or regular soil probe to evaluate soil water from feel and appearance and tend to be conservative.

Kansas State University has launched an educational program, and County Extension Agents have set up demonstration sites to work one-on-one with owners/operators. According to the request of the owner of the demonstration field, agricultural consultants are involved in the program whenever possible. The goals are to educate producers in southwest Kansas and demonstrate the field application of ET-based irrigation scheduling.

PROCEDURES

Irrigation-scheduling demonstration fields planted to corn were set up in nine counties within southwest Kansas. The farmer operators agreed to keep irrigation application records and bulk yield data. Each demonstration site was equipped with soil-water sensors like gypsum blocks, Watermark sensors, and tensiometers. Three types of sensors were used to see which one suited the particular soil type. These were set up in two locations per field at three different depths. The choices for depths of placement in 1998 were 9, 18, and 30 inches below the soil surface.

Soil samples were taken periodically for gravimetric evaluation of soil water. Neutron access tubes were installed at two sites with different soil textures (Ulysses silt loam and Tivoli fine sand).

The ET data from the weather station at the Southwest Research-Extension Center were used to calculate water balance. Simple tools like atmometers (ET gauge) and rain gauges were set up to record ET and rainfall at each local site.

Southwest Kansas Groundwater Management District #3 has installed 12 new weather stations, which will make ET data available to local farmers. A sample of the spreadsheet that was used to track water balance using ET data, rainfall, and soil water status is shown in Table 1.

RESULTS AND DISCUSSION

This project was started in 1997. The plan in the first year was to record conditions without interfering with farmers' irrigation plans. This gave us the information to look for any opportunities to turn off the system occasionally. In 1998, a hot and dry spell occurred from mid June to mid July. Soil water in some fields fell below management allowable depletion levels. Fortunately, rain fell before the reproductive stage, and production did not suffer. Some fields with sandy soil showed some scorching in spite of good soil water conditions.

The reference ET data from ET gauges and Penman reference ET from Groundwater Management District (GMD) weather stations in the counties within District #3 are shown in Fig. 1. The cumulative ETs from both the sources are in good agreement for the growing season.

The ET gauge data for Farm No.1 and Farm No. 4 are compared to the data obtained from the weather station at the Southwest Research-Extension Center because of lack of data from GMD Stations.

Table 1. 1998 irrigation schedules, southwest Kansas.

Field: Test
Soil Type: Silt Loam
Allowable Depletion, %: 50
Initial Depletion, inches: 0
Root Zone Depth, ft: 3
Available Water Holding Capacity, in/ft: 2
Allowable Depletion, inches: 3

			Net Irrigation						Soil Water Depletion	
Month	Day	Rain	1	2	ETr	Growth Stage	Crop Coeff	Crop ET	1	2
May	14	0	0	0	0.24	Emerge	0.20	0.05	0.05	0.05
May	15	0	0	0	0.28		0.20	0.06	0.11	0.11
May	16	0	0	0	0.39		0.20	0.08	0.19	0.19
May	17	0	0	0	0.34		0.20	0.07	0.26	0.26
May	18	0.5	0	0	0.09		0.20	0.01	0.00	0.00

Fig. 1. Reference ET data from ET gauges at the farms and Penman reference ET from the KSU and GMD #3 weather stations, southwest Kansas.

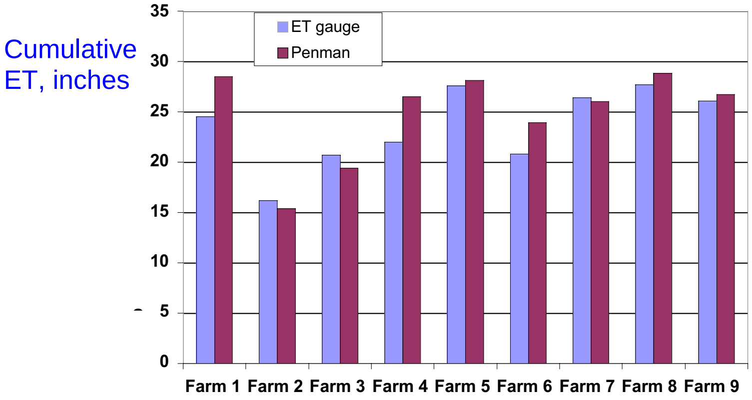


Fig. 2. Soil water tension data obtained using gypsum blocks, Farm 5, southwest Kansas.

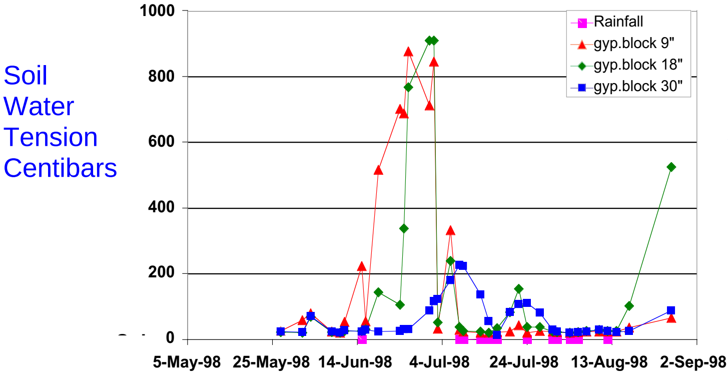


Figure. 3: Rainfall, irrigation, and ETa, southwest Kansas.

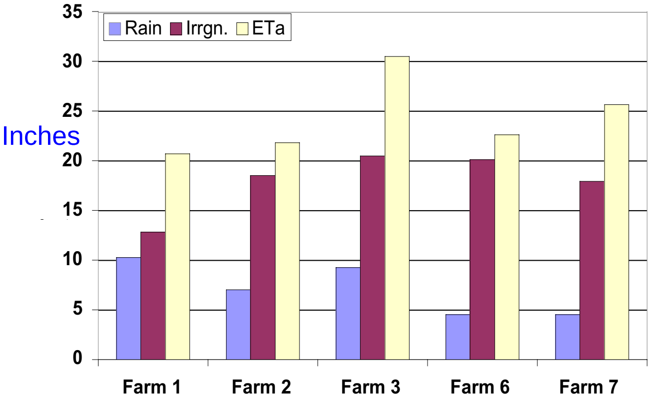
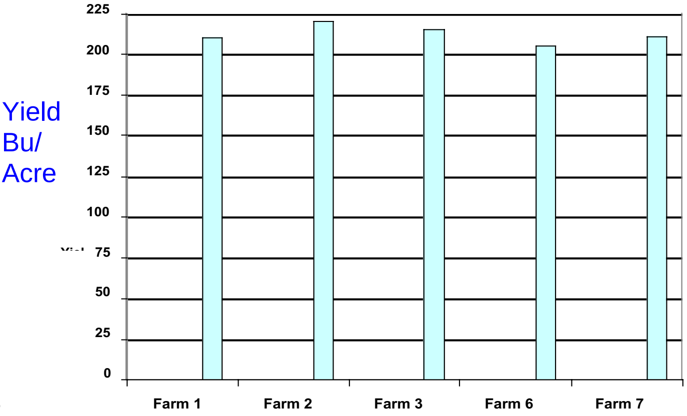


Fig. 4. Corn yield on irgation demonstration plots, southwest Kansas, 1998.



Soil water monitoring results for the gypsum block on Farm No. 5 are presented in Fig. 2. The dry weather period is reflected in the data set. The soil water tension rose to 9 bars between mid-June and mid-July. The irrigation system was able to catch up after rainfalls on July 9 (0.4 inch) and July 13 (1.1 inches). Tensiometer and Watermark sensors showed similar trends within the limits of their reading scales.

Fig. 3 compares rainfall amount and irrigation applied to ET actual (ETa). It shows that the scheduling procedure helped the producers to take advantage of rainfall to meet the crop's water need. They were able to shut off the system when soil water was recharged.

The corn yield data for 1998 are shown in Fig: 4. The average yield for the demonstration plots was above 205 bu/a.

The ET data from the Southwest Research-Extension Center were posted manually on a web page in 1998. This will be automated in 1999, which will help producers to download the data automatically using the web browser. A spreadsheet has been developed to link data acquisition via the web browser from the web page. The producer or consultant can update the ET scheduling spreadsheet in the early morning. This will help make an irrigation decision quicker and easier.

The web address for the Kansas State University weather station at Garden City was: www.oznet.ksu.edu/wkarc/swrec/weather1.htm for 1998 and the website has been changed to http://www.oznet.ksu.edu/wdl/wdl/et99b.htm for 1999.

The web address for Groundwater Management District weather stations is: www.ink.org/public/ksgm

Irrigation field days were held at each site for educational purposes. A series of educational seminars and hands-on training on ET-based irrigation scheduling also were presented in cooperation with the Groundwater Management District #3. This effort will continue.

EVALUATION OF CORN BORER RESISTANCE AND GRAIN YIELD FOR BT AND NON-BT CORN HYBRIDS[1]

by

Larry Buschman, Phil Sloderbeck, Randy Higgins,[2] and Merle Witt

SUMMARY

Twenty-six corn hybrids (15 Bt- and 11 non-Bt-corn) were evaluated for corn borer resistance and grain yield performance. The yield losses to girdling by southwestern corn borers averaged 30 bu/a for the unsprayed non-Bt hybrids, 2.9 bu/a for sprayed non-Bt hybrids, and 19.4 bu/a for hybrids with event 176. Hybrids with Bt11, MON810, and CBH351 had virtually no yield losses. A yield loss of 20.9 bu/a was associated with spider mite leaf damage. Grain yields averaged 187.9 bu/a across all hybrids in the sprayed block and 165.0 bu/a in the unsprayed block.

PROCEDURES

Corn plots were machine-planted on 13 May at 30,000 seeds/a at the Southwest Research-Extension Center near Garden City, KS. Spot replanting was done as necessary. Across hybrids, the number of plants with ears at harvest varied from 91 to 117 plants per 60 row-ft. Preplant herbicides applied on 10 April were 2 qt Milo-Pro, 1 qt 2,4-D and 1 pt Roundup/a. Postemergence herbicides applied on 2 June were 7 oz. Accent and 0.5 pt Banvel with 0.2 qt surfactant/a. The soil was a saline-Richfield silt-loam with a pH of 7.5 to 8.0. The field was furrow irrigated on 18 June, 2 July, 18 July, and 24 Aug. with 4.6, 4.1, 4.2, and 4.1 inches of water, respectively. Monthly rainfalls for April through Aug. were 0.9, 2.7, 0.9, 6.61, and 3.1 inches. The plots were four rows wide (10 ft) by 30 ft long. Two border rows (5 ft) of Bt corn were planted between the plots, and 10-ft alleyways at the end of each plot were left bare. The border rows and alleyways were included to reduce larval migration between plots. The experimental design was a split-plot with four replications. The main plots were insecticide-protected versus insecticide unprotected, and the sub-plots were the corn hybrids. The protected blocks were sprayed on 17 July with Capture (bifenthrin) at 0.08 lb. AI/a. We used 26 hybrids with relative maturity ratings of 110 to 118 days. An attempt was made to pair each non-Bt hybrid with its Bt sister line or with another related hybrid. Pioneer 3162IR was included as the standard commonly used hybrid.

On 22 and again on 29 June, 25 to 30 neonate European corn borers (ECB) were placed in the whorls of 10 plants in each plot to supplement the native first generation infestation. However, shot-hole damage was minimal, so no data were collected on first generation corn borers. In Sept., spider mite damage was evaluated by examining three leaves (the ear-leaf and the second leaf above and below it) on six plants in each plot. The percentage of each leaf having spider mite damage was recorded and averaged for each plot. Second generation corn borer infestations were entirely native. Data for second generation corn borers were taken from five consecutive plants in one of the two center rows of each plot. The plants were dissected to record corn borers and corn borer tunneling. Kernel damage was recorded as the estimated percentage of kernels damaged at the tip (mostly corn earworm) and at the base or side of the ear (mostly corn borer damage). In addition, lodged plants in the middle two rows were counted and separated into those girdled by southwestern corn borer (SWCB) and those that lodged from European corn borer tunneling or stalk rot. Yield was determined by separately harvesting ears from standing plants and from fallen plants. The lodged corn was harvested by hand, and the standing corn was machine harvested. The two middle rows of each plot were harvested in late October. Grain yield was calculated separately for standing and fallen corn and corrected to 15.5% moisture.

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[1] This research was supported by Kansas Corn Commission Check-off Funds through the Kansas Department of Agriculture.

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The data were analyzed both as a two-factor experiment (including both sprayed and unsprayed plots) and as two single-factor experiments (sprayed and unsprayed plots analyzed separately). To simplify the discussion, results are averaged across the four Bt events and the sprayed and unsprayed non-Bt hybrids.

RESULTS AND DISCUSSION

First generation corn borer pressure was light, and no data were collected. Second generation ECB and SWCB pressures averaged 0.13 and 0.35 larvae per plant, respectively, in the unsprayed non-Bt plots (Tables 1 & 2). In hybrids with Bt11, MON810, CBH351, and Bt176 and the insecticide treatment, second generation ECB larvae were reduced by 100, 100, 100, 61, and 76%, respectively; second generation SWCB larvae were reduced by 100, 100, 100, 22, and 86% (Fig. 1); girdled plants were reduced by 100, 98, 99, 38, and 90%; corn borer tunneling was reduced by 100, 99, 98, 50, and 87% (Fig. 2); and yield losses from SWCB lodged plants were reduced by 100, 97, 99, 35, and 90%. The yield losses to girdling by SWCB averaged 30.0 bu/a for the unsprayed non-Bt hybrids, 2.9 bu/a for sprayed non-Bt hybrids, and 19.4 bu/a for hybrids with event 176 (Fig.3). Hybrids with Bt11, MON810, and CBH351 had virtually no yield loss.

Fig. 1. Second generation SWCB larvae per plant at Garden City, KS, 1998.

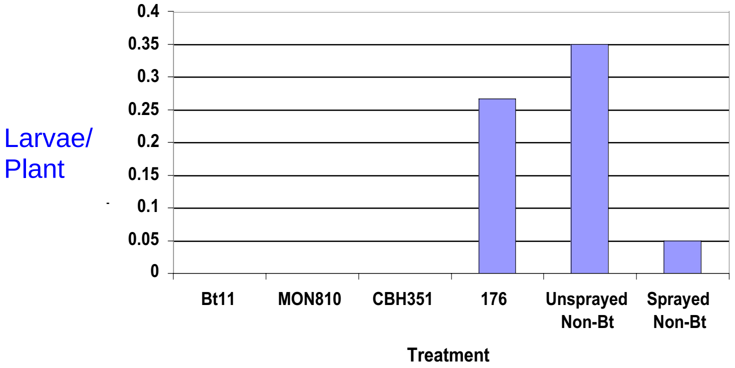


Fig. 2. Second generation SWCB tunneling at Garden City, KS, 1998.

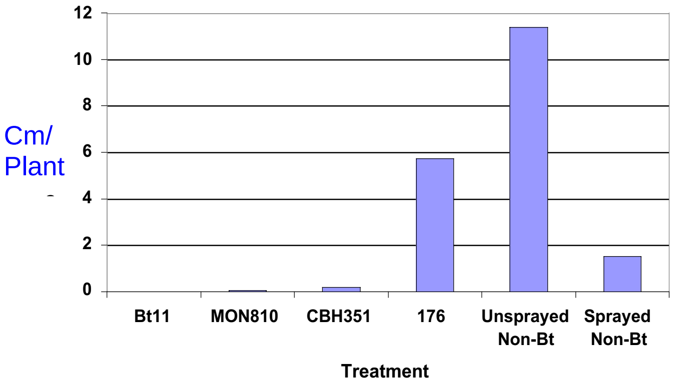
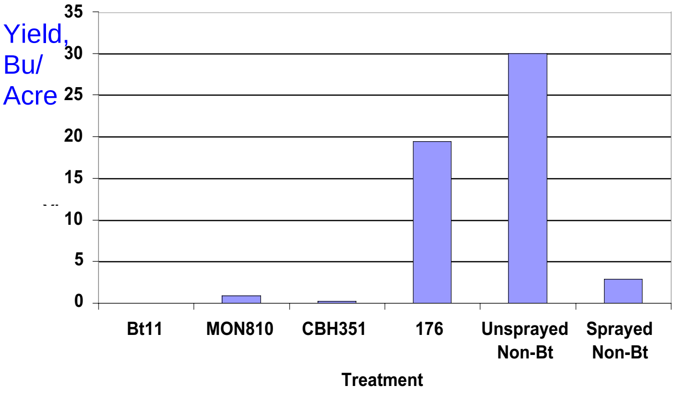


Fig. 3. Grain yield losses caused by SWCB at Garden City, KS, 1998.



Spider mite pressure was high during the hot dry spell in August (Fig. 4). In the unsprayed block, spider mite leaf damage averaged 59.1%, and in the Capture-sprayed block, it averaged 27.1%. Capture is a good miticide that apparently was able to suppress the spider mite damage during the hot dry period in August. Across the Bt hybrids (with no corn borer damage), the yield difference between sprayed and unsprayed was 20.9 bu/a. This yield loss appeared to be associated with a 24% difference in spider mite leaf damage.

Corn earworm damage to kernels in the ear tip was relatively light, averaging only 1.5% in the unsprayed non-Bt (Tables 1 & 2). Hybrids with Bt11 and Mon810 averaged 51 and 30% reductions in kernel damage, respectively (Fig. 5). Hybrids with Bt176 or CBH351 and sprayed non-Bt hybrids had small reductions in kernel damage. Damage at the ear base was minor and did not differ significantly across the hybrids.

Grain yields averaged 187.9 bu/a across all hybrids in the sprayed block and 165.0 bu/a in the unsprayed block (Tables 1 & 2, Fig. 6). The standard hybrid, Pioneer 3162IR, yielded 203.0 bu/a in the sprayed block, but only 159.1 bu/a in the unsprayed block. A number of Bt and non-Bt hybrids were among the top yielders.

When the plants were at the pretassel stage, a windstorm on 2 July caused significant stalk breakage in some of the hybrids. The hybrids with the highest breakage (plants broken per 60 row-ft) were as follows: DeKalb 621 (11.0), DeKalb 621BtY (8.3), Novartis 4494 (6.0), Garst 8325Bt (5.3) Novartis Max454 (4.8) and Garst 8325 (4.3). The other hybrids had 4 or fewer plants broken per 60 row-ft.

Fig. 4. Percent of ear zone leaves with spider mite damage at Garden City, KS, 1998.

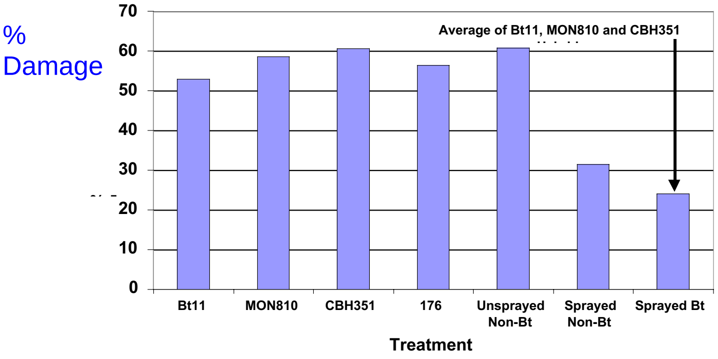


Fig. 6. Grain yield from standing and fallen plants at Garden City, KS, 1998.

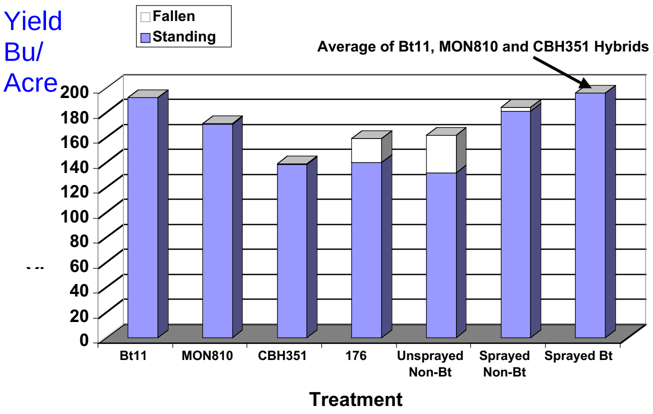
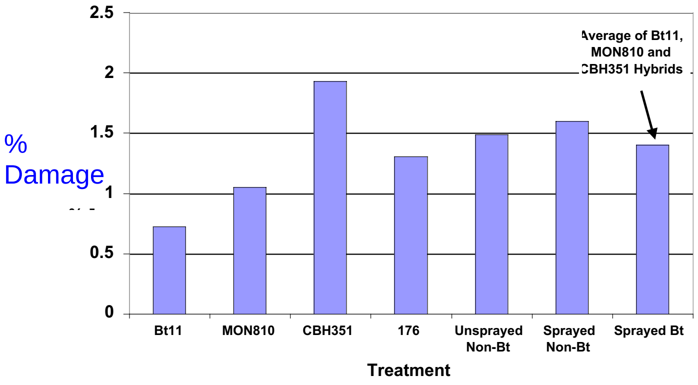


Fig. 5. Percent of ear tip kernel damage at Garden City, KS, 1998.



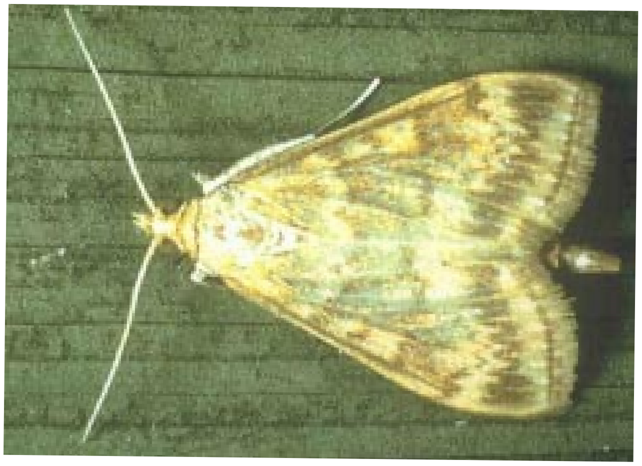


Table 1. Evaluation of corn borer resistance of Bt and non-Bt corn hybrids, unsprayed block at Garden City, KS, 1998.

			2nd Gen. Corn Borer							
Hybrid	Bt Event	Company	ECB Larvae per Plant	SWCB Larvae per Plant	% SWCB Girdled Plants/Plot	Cm of Tunneling per Plant	Ear Tip Damage (% kernels)	Yield Standing (Plts. bu/a)	Yield Fallen Plts. (bu/a)	Total Yield (bu/a)
4494		Novartis Seeds	0.20	0.50 b	25.75 ab	17.35 abc	1.55 b-f	120.3 lmn	43.2 b	163.6 c-h
MAX454	176	Novartis Seeds	0.00	0.40 bc	11.50 ef	7.00 e-h	1.49 b-g	146.1 f-k	18.1 fgh	164.1b-h
7590Bt	Bt11	Novartis Seeds	0.00	0.00 e	0.00 h	0.00 h	0.85 d-i	189.7 ab	0.0 i	189.7 ab
7590		Novartis Seeds	0.05	0.15 cde	11.50 ef	3.80 gh	1.37 b-h	157.4 e-j	21.5 efg	179.0 a-e
7639Bt	Bt11	Novartis Seeds	0.00	0.00 e	0.00 h	0.00 h	0.60 hi	193.8 a	0.0 i	193.8 a
H-2530Bt	MON810	Golden Harvest	0.00	0.00 e	0.00 h	0.25 h	2.05 ab	155.6 e-j	0.0 i	155.6 e-i
H-2530		Golden Harvest	0.20	0.35 bcd	15.75 cde	10.15 c-g	1.66 a-d	138.1 h-m	22.4 efg	160.5 d-h
3162IR		Pioneer	0.20	0.35 bcd	21.00 bcd	15.33 a-d	1.39 b-h	129.6 k-n	29.6 c-f	159.1 e-i
31B13	MON810	Pioneer	0.00	0.00 e	0.25 h	0.00 h	0.99 d-i	173.8 a-e	0.1 i	173.9 a-f
32J55		Pioneer	0.05	0.15 cde	12.25 ef	5.3 fgh	1.69 a-d	155.6 e-j	19.7 e-h	175.3 a-f
33A14	MON810	Pioneer	0.00	0.00 e	0.00 h	0.00 h	1.44 b-h	186.3 a-d	0.0 i	186.3 a-d
8325		Garst	0.15	0.45 b	9.00 efg	20.02 ab	1.42 b-h	161.5 d-h	12.6 ghi	174.1 a-f
8325Bt	MON810	Garst	0.00	0.00 e	0.00 h	0.03 h	1.51 b-g	169.4 a-f	0.0 i	169.4 a-g
8342Bt	MON810	Garst	0.00	0.00 e	0.00 h	0.00 h	0.85 d-i	186.9 abc	0.0 i	186.9 abc
7997		Cargill	0.30	0.80 a	15.25 def	20.46 a	1.60 a-e	136.8 h-m	24.9 d-g	161.7 c-h
7821BT	MON810	Cargill	0.00	0.00 e	0.25 h	0.00 h	0.78 e-i	169.3 a-f	0.4 i	169.7 a-f
8021BT	MON810	Cargill	0.00	0.00 e	0.00 h	0.00 h	0.66 ghi	168.8 b-f	0.0 i	168.8 a-g
580		DeKalb	0.10	0.10 de	14.00 ef	3.70 gh	0.68 ghi	121.5 k-n	19.8 e-h	141.3 hi
580BtY	MON810	DeKalb	0.00	0.00 e	0.00 h	0.15 h	0.74 f-i	159.1 e-i	0.0 i	159.1 e-i
621		DeKalb	0.00	0.30 bcd	30.50 a	12.90 b-e	1.35 b-h	108.2 n	56.9 a	165.0 b-h
621BtY	MON810	DeKalb	0.00	0.00 e	2.75 gh	0.00 h	0.45 i	164.6 c-g	7.5 hi	172.1 a-f
7250		Mycogen	0.15	0.30 bcd	23.25 b	6.95 e-h	1.33 b-h	126.8 k-n	40.5 bc	167.2 b-h
2787	176	Mycogen	0.10	0.25 b-e	14.75 def	6.60 e-h	1.12 c-i	136.4 i-m	18.2 fgh	154.6 e-i
2801	176	Mycogen	0.05	0.15 cde	8.50 fg	3.55 gh	1.29 b-i	136.9 h-m	21.9 efg	158.9 e-i
8366IT		Garst	0.00	0.35 bcd	24.00 ab	8.55 d-g	1.89 abc	106.5 n	36.9 bcd	143.5 ghi
8366Bt/LL	CBH351	Garst	0.00	0.00 e	0.00 h	0.40 h	1.42 b-h	143.4 g-l	0.0 i	143.4 ghi
8366IT		Garst	0.15	0.40 bc	22.50 bc	12.00 c-f	1.96 abc	118.2 mn	31.4 b-e	149.6 f-i
8366Bt/LL	CBH351	Garst	0.00	0.00 e	0.25 h	0.00 h	2.44 a	133.7 j-m	0.4 i	134.1 i
LSD value p=0.05			0.20	0.27	6.95	7.52	0.86	24.9	12.9	26.0
F-test Prob.			0.1193	<0.0001	<0.0001	<0.0001	0.0007	<0.0001	<0.0001	0.0006

Table 2. Evaluation of corn borer resistance of Bt and non-Bt corn hybrids, sprayed block at Garden City, KS, 1998.

			2nd Gen. Corn Borer							
Hybrid	Bt Event	Company	ECB Larvae per Plant	SWCB Larvae per Plant	% SWCB Girdled Plants/Plot	Cm of Tunneling per Plant	Ear Tip Damage (% kernels)	Yield Standing Plts (bu/a)	Yield Fallen Plts (bu/a)	Total Yield (bu/a)
4494		Norvartis Seeds	0.00	0.00	0.7 cd	1.0 b	1.67 c-g	196.3 a-f	1.3 def	197.6 a-g
MAX454	176	Novartis Seeds	0.00	0.00	0.5 d	0.0 b	1.65 c-g	205.1 a-d	1.0 ef	206.1 a-d
7590Bt	Bt11	Novartis Seeds	0.00	0.00	0.0 d	0.0 b	0.89 ghi	218.0 a	0.0 f	218.0
7590		Novartis Seeds	0.00	0.00	2.5 b	0.1 b	1.22 e-i	204.9 a-d	4.5 abc	209.3 ab
7639Bt	Bt11	Novartis Seeds	0.00	0.00	0.0 d	0.0 b	0.69 hi	207.9 abc	0.0 f	207.9 abc
H-2530Bt	MON810	Golden Harvest	0.00	0.00	0.0 d	0.0 b	1.37 d-i	185.0 b-i	0.0 f	185.0 b-j
H-2530		Golden Harvest	0.00	0.05	0.7 cd	1.4 b	1.45 c-h	162.9 hij	1.1 def	164.0 ijk
3162IR		Pioneer	0.10	0.00	1.5 bcd	1.2 b	1.22 e-i	200.4 a-e	2.6 b-f	203.0 a-e
31B13	MON810	Pioneer	0.00	0.00	0.0 d	0.0 b	1.91 c-f	195.6 a-g	0.0 f	195.6 a-h
32J55		Pioneer	0.05	0.00	2.3 bc	0.3 b	1.27 e-i	216.5 a	4.0 a-d	220.5 a
33A14	MON810	Pioneer	0.00	0.00	0.0 d	0.0 b	0.94 ghi	210.0 ab	0.0 f	210.0 ab
8325		Garst	0.00	0.10	0.0 d	1.5 b	2.05 a-e	188.4 b-h	0.0 f	188.4 b-i
8325Bt	MON810	Garst	0.00	0.00	0.0 d	0.0 b	1.33 d-i	201.0 a-e	0.0 f	201.0 a-g
8342Bt	MON810	Garst	0.00	0.00	0.0 d	0.1 b	0.98 ghi	187.3 b-i	0.0 f	187.3 b-j
7997		Cargill	0.00	0.00	5.3 a	1.9 b	1.52 c-h	149.1 j	5.5 ab	154.5 k
7821BT	MON810	Cargill	0.00	0.00	0.0 d	0.0 b	1.40 d-i	202.0 a-e	0.0 f	202.0 a-f
8021BT	MON810	Cargill	0.00	0.00	0.3 d	0.0 b	0.97 ghi	187.4 b-i	0.5 f	187.9 b-j
580		DeKalb	0.05	0.00	1.3 bcd	0.2 b	1.05 f-i	176.5 e-i	2.8 b-f	179.3 e-k
580BtY	MON810	DeKalb	0.00	0.00	0.0 d	0.0 b	0.49 i	180.9 d-i	0.0 f	180.9 d-k
621		DeKalb	0.20	0.25	4.7 a	8.7 a	1.19 e-i	171.2 f-j	5.9 a	177.1 e-k
621BtY	MON810	DeKalb	0.00	0.00	0.0 d	0.0 b	0.85 ghi	175.1 e-j	0.0 f	175.1 g-k
7250		Mycogen	0.00	0.10	2.3 bc	0.7 b	1.40 d-i	176.9 e-i	4.6 abc	181.1 c-j
2787	176	Mycogen	0.05	0.00	0.3 d	0.5 b	1.25 e-i	181.2 c-i	1.4 def	182.6 c-j
2801	176	Mycogen	0.00	0.05	1.3 bcd	0.7 b	2.22 a-d	171.9 f-j	3.5 a-e	175.4 f-k
8366IT		Garst	0.00	0.10	0.5 d	1.3 b	2.84 ab	168.9 g-j	0.9 ef	169.9 h-k
8366Bt/LL	CBH351	Garst	0.00	0.00	0.0 d	0.0 b	1.98 b-f	177.1 e-i	0.0 f	177.1 e-k
8366IT		Garst	0.00	0.00	1.5 bcd	0.0 b	2.36 abc	160.6 ij	1.7 c-f	162.3 ijk
8366Bt/LL	CBH351	Garst	0.00	0.00	0.3 d	0.1 b	2.97 a	161.1 ij	0.3 f	161.4 jk
LSD value p=0.05			0.12	0.13	1.7	3.4	0.93	27.0	2.9	26.6
F-test Prob.			0.4305	0.0993	<0.0001	0.0130	<0.0001	<0.0001	<0.0001	<0.0001

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Southwest Research-Extension Center

IMPACT OF FALL-APPLIED HERBICIDES FOR BINDWEED CONTROL IN WEED-FREE WHEAT

by
Randall Currie

SUMMARY

Treatment responses were very consistent across all locations. This test clearly showed the impact of injury to growing wheat from herbicide application in the fall in the absence of weed pressure. All treatments reduced yield at least 5 bu/a, with the exception of the applications of .023 lb/a picloram or 0.25 lb/a quinclorac. Except for treatments containing more than 0.375lb/a of dicamba, no treatment reduced yield more than 12 bu/a. These results should allow the producer to weigh the cost of crop injury against the future value of controlling bindweed. Prior work has shown that conventional applications applied 11 months before planting do not injure wheat and often provide better control than fall applications in growing wheat. Therefore, the loss of yield from fall herbicide applications can be avoided by timely planning a year prior to planting.

INTRODUCTION

Often when wheat prices are poor and cattle prices are high, producers will plant wheat early to increase fall forage production. This often will not allow the producer to properly apply bindweed control measures prior to planting wheat. In previous field day reports, fall application of bindweed-control treatments in growing wheat has been described as a modestly effective method to make the best of a poor situation. However, the studies could not separate the effects of the herbicide injury from the injury inflicted by the bindweed itself. Therefore, these studies were initiated to measure the impact of the herbicide treatments in the absences of weeds to allow the producer to better judge what bindweed control method to use.

PROCEDURES

Wheat was planted as described in Table 1 in an area with little prior history of weed pressure. Continuous wheat was grown at the south Garden City location. All other locations were cropped to a fairly weed-free wheat-fallow-wheat rotation. Treatments were applied in the fall to growing wheat as described in Table 2. In all areas, weed pressure was very low throughout the test period.

RESULTS AND DISCUSSION

Although the magnitude of injury differed across the three locations, the relative degree of injury associated with each treatment did not, as evidenced by no statistically significant location by treatment interaction. The means of the individual locations are presented to show the consistency of responses across locations, but the reader need look only at the means averaged over the locations. All treatments containing dicamba caused some level of injury. This injury tended to increase with higher rates, from 16% at the lowest rate to 30% at the highest rate. All treatments but the 2,4-D reduced head number/foot of row. Only picloram/dicamba tank mixes reduced wheat height.

All treatments reduced yield at least 5 bu/a, with the exception of the applications of .023 lb/a picloram or 0.25 lb/a quinclorac. Except for treatments containing more than 0.375lb/a of dicamba, no treatment reduced yield more than 12 bu/a.

Previous work has shown that in a wheat-fallow-wheat rotation, no yield loss is seen from bindweed-control treatments applied 11 months prior to planting. Also, control from these treatments is often superior to that from applications made in growing wheat in the fall. However, none of the treatments applied in this study caused greater than a 15 bu yield loss on average. In some situations, this yield loss may not be excessive; for example, spot spraying less than 10% of a field of wheat that is to be saved for seed or as part of an aggressive bindweed control program on land that will be planted to seed wheat in the future.

Table 1. Crop information, Garden City and Hays, KS, 1998.

Location:	Garden City	Garden City	Hays
Site:	North	South	—
Crop name:	Winter wheat	Winter wheat	Winter wheat
Variety:	TAM 107	TAM 107	Ike
Planting date:	9/26/97	9/26/97	10/7/97
Planting method:	Great Plains drill	Great Plains drill	JD LZ1010 hoe drill
Rate, unit:	60 lb/a	60 lb/a	60 lb/a
Depth, unit:	1.5 inches	1.5 inches	2.0 inches
Row spacing, unit:	9 inches	9 inches	10 inches
Soil temperature, unit:	73 F	73 F	70 F
Soil moisture:	Good moisture	Good moisture	Good moisture
Emergence date:	10/4/97	10/4/97	10/14/97

Table 2. Application information, banvel injury test, Garden City and Hays, KS, 1998.

Location:	Garden City	Garden City	Hays
Site:	North	South	—
Application date:	10/15/97	10/16/97	11/6/97
Time of day:	3:00 pm	3:00 pm	2:15 pm
Application method:	Broadcast	Broadcast	Broadcast
Application timing:	Post	Post	Post
Air temperature, unit:	78 F	67 F	42 F
% Relative humidity:	28%	31%	60%
Wind velocity, unit:	6 mph NW	10 mph NW	4-7 mph NE
Soil temperature, unit:	72 F	72 F	62 F
Soil moisture:	Dry top ˚ inch	Dry top ˚ inch	Dry top ˚ inch
% Cloud cover:	40%	20%	0%
Appl. equipment:	Windshield sprayer	Windshield sprayer	Tractor Sprayboom
Boom length, unit:	10 ft	10 ft	8.3 ft
Nozzle type:	Teejet XR	Teejet XR	Teejet XR
Nozzle size:	8004 VS	8004 VS	110015 FF
Nozzle spacing:	20 inches	20 inches	20 inches
Pressure, unit:	35 psi	35 psi	24 psi
Ground speed, unit:	4.8 mph	4.8 mph	3.0 mph
Carrier:	H_2O	H_2O	H_2O
Appl. rate:	12 gpa	12 gpa	12 gpa

Note: The Hays site was fertilized with 55 lb nitrogen/a in the form of urea. Both Garden City sites were fertilized with 60 lb nitrogen/a in the form of anhydrous ammonia.

Table 3. Percent biomass reductions of wheat plants based on visual estimates, Garden City and Hays, KS, 1998.

Treatment	Rate(lb AI/a)	G.C. North 4/1/98	G.C. South 4/1/98	Hays 4/13/98	Avg.
1 Dicamba	0.125	7.5	25.0	18.8	17.1
2 Dicamba	0.25	30.6	22.5	12.5	21.9
3 Dicamba	0.375	24.4	41.3	20.0	28.5
4 Dicamba	0.50	32.5	37.5	25.0	31.7
5 Dicamba, 2,4-D	0.125, 0.25	33.1	30.6	21.3	28.3
6 Dicamba, 2,4-D	0.25, 0.25	26.3	40.0	20.0	38.8
7 Dicamba, Quinclorac	0.125, 0.25	12.5	19.4	16.3	16.0
8 Dicamba, Quinclorac	0.25, 0.25	21.9	20.0	20.0	20.6
9 Dicamba, Picloram	0.25, 0.023	21.9	28.8	17.5	22.7
10 2,4-D	0.50	28.8	30.6	12.5	24.0
11 Picloram	0.023	3.8	16.3	0.0	6.7
12 Quinclorac	0.25	6.3	18.1	12.5	8.5
13 Check	—	0.0	0.0	0.0	0.0
LSD (0.05) =		21.5	26.0	6.3	11.2

Table 4. Wheat yield in bushels/acre, Garden City and Hays, KS, 1998.

Treatment	Rate(lb AI/a)	G.C. North 6/29/98	G.C. South 6/30/98	Hays 6/24/98	Avg.
1 Dicamba	0.125	40.2	38.3	68.4	49.0
2 Dicamba	0.25	38.0	30.7	61.8	43.5
3 Dicamba	0.375	36.1	27.3	60.6	41.3
4 Dicamba	0.50	34.9	25.1	59.4	39.8
5 Dicamba, 2,4-D	0.125, 0.25	42.9	28.5	59.1	43.5
6 Dicamba, 2,4-D	0.25, 0.25	40.2	35.1	60.3	45.2
7 Dicamba, Quinclorac	0.125, 0.25	41.8	34.1	66.1	47.3
8 Dicamba, Quinclorac	0.25, 0.25	40.3	30.4	59.4	43.3
9 Dicamba, Picloram	0.25, 0.023	40.6	28.4	64.6	44.5
10 2,4-D	0.50	42.5	32.2	56.6	43.8
11 Picloram	0.023	49.3	37.2	73.9	53.4
12 Quinclorac	0.25	43.6	35.3	72.8	50.6
13 Check	—	49.7	40.6	74.5	54.9
LSD (0.05) =		6.7	8.7	3.8	5.3

Note: Moisture of wheat adjusted to 12.5% to determine bu/a.

Table 5. Percent reductions of wheat head density per foot of row, Garden City and Hays, KS, 1998.

Treatment	Rate(lb AI/a)	G.C. North 6/26/98	G.C. South 6/26/98	Hays 6/19/98	Avg.
1 Dicamba	0.125	28.5	20.6	5.8	16.9
2 Dicamba	0.25	18.9	22.9	8.8	16.9
3 Dicamba	0.375	16.5	34.7	8.0	19.7
4 Dicamba	0.50	25.1	29.6	7.2	20.6
5 Dicamba, 2,4-D	0.125, 0.25	28.6	30.2	6.6	21.8
6 Dicamba, 2,4-D	0.25, 0.25	12.1	27.0	6.9	15.3
7 Dicamba, Quinclorac	0.125, 0.25	24.0	22.3	6.6	17.6
8 Dicamba, Quinclorac	0.25, 0.25	28.5	28.4	8.1	21.7
9 Dicamba, Picloram	0.25, 0.023	23.6	25.4	7.7	18.9
10 2,4-D	0.50	13.7	21.7	8.2	14.6
11 Picloram	0.023	9.2	13.0	4.0	8.7
12 Quinclorac	0.25	16.1	23.1	5.0	14.7
13 Check	--	0.0	0.0	0.0	0.0
LSD (0.05) =		24.3	24.3	3.6	13.6

Table 6. Heights of wheat in inches, Garden City and Hays, KS, 1998.

Treatment	Rate(lb AI/a)	G.C. North 6/26/98	G.C. South 6/26/98	Hays 6/19/98	Avg.
1 Dicamba	0.125	29.6	24.1	34.3	29.3
2 Dicamba	0.25	26.6	23.6	33.5	27.9
3 Dicamba	0.375	27.9	24.0	34.0	28.6
4 Dicamba	0.50	24.6	22.4	34.0	27.0
5 Dicamba, 2,4-D	0.125, 0.25	26.9	24.6	34.3	28.6
6 Dicamba, 2,4-D	0.25, 0.25	26.8	22.3	34.2	27.7
7 Dicamba, Quinclorac	0.125, 0.25	28.9	23.6	34.5	29.0
8 Dicamba, Quinclorac	0.25, 0.25	26.6	23.3	33.9	28.7
9 Dicamba, Picloram	0.25, 0.023	24.5	21.6	33.5	26.5
10 2,4-D	0.50	28.1	24.1	33.7	28.6
11 Picloram	0.023	27.3	23.4	35.5	28.7
12 Quinclorac	0.25	27.8	24.9	35.1	29.2
13 Check	—	28.5	25.5	36.6	30.2
LSD (0.05) =		3.7	2.5	1.2	1.7

COMPARISONS OF BINDWEED CONTROL BY SIX FALL-APPLIED HERBICIDES AT FOUR RATES

by
Randall Currie

SUMMARY

All herbicides provided good control at some rate in some years. However, herbicides varied greatly in consistency from year to year. In general, variability in control declined and overall control increased with increasing rates. Only quinclorac at 1 lb/a, glyphosate at 4 lb/a, and picloram at 0.25 lb/a or greater provided better than 93.5% control in all years. Quinclorac at 0.125 lb/a provided 81.8 to 95.7% control in all years. Dicamba at rates higher than 0.5 lb/a provided 72.8 to 100% control in all years. Although the averages across years are presented, these numbers should be used with great care.

INTRODUCTION

Fall-applied herbicide treatments are often very effective across a broad range of perennial weeds. Bindweed control, regardless of herbicide treatment, is often difficult to predict. However, in general, as the herbicide rate goes up, the efficacy and consistency of the treatment increase. Therefore, the objective of this study was to compare several herbicides at a broad range of rates to determine the rate of diminishing returns for each herbicide and to allow head-to-head comparisons of these herbicides at rates that produce similar levels of control.

PROCEDURES

Herbicide treatments were applied the fall after wheat harvest in a wheat-fallow-wheat rotation as described in Table 1. Bindweed control was measured in the following spring by calculating percent reduction in shoot length times shoot number per square foot.

RESULTS AND DISCUSSION

All herbicides provided good control at some rates in some years. However, herbicides varied greatly in consistency from year to year. In general, variability in control declined and overall control increased with increasing rates. Only quinclorac at 1 lb/a, glyphosate at 4 lb/a, and picloram at 0.25 lb/a or greater provided better than 93.5% control in all years. Quinclorac at 0.125 lb/a provided 81.8 to 95.7% control in all years. Dicamba at rates higher than 0.5 lb/a provided 72.8 to 100% control in all years. Although the averages across years are presented, these numbers should be used with great care. Because of losses to wildlife in 1998 in two or more of the replicates, only 2 years of data were used for the 0.25 and 0.5 lb/a quinclorac treatments.

Much yet needs to be learned about how climate affects these herbicides. The 1 lb/a rate of 2,4-D or glyphosate performed well in only 1 out of 3 years. Therefore, a producer should base his bindweed control choices on much more than one experience.

Table 1. Application information, bindweed study, Garden City, KS.

Application date:	9/10/92	9/20/94	9/25/97
Time of day:	8:20 am-4:30 pm	10:00 am-3:00pm	12:00 pm
Application method:	Broadcast	Broadcast	Broadcast
Application timing:	Post	Post	Post
Air temp., unit:	65-75 F	85 F	85F
Soil temp., unit:	59 F	82 F	72 F
Soil moisture:	Dry	Dry	Dry
Cloud cover:	0%	60%	0%
Appl. equipment:	Windshield Sprayer	Windshield Sprayer	Windshield sprayer
Boom length, unit:	10 ft	10 ft	10 ft
Nozzle type:	Teejet	Teejet	Teejet
Nozzle size:	8004XR	8004VS	8004 VS
Nozzle spacing:	20 inches	20 inches	20 inches
Pressure, unit:	30 psi	33 psi	35 psi
Boom height:	19 inches	19 inches	18 inches
Ground speed:	4 mph	3.3 mph	3.8 mph
Carrier:	H_2O	H_2O	H_2O
Spray volume:	2-3 liters	2-3 liters	2-3 Liters
Propellant:	CO_2	$C0_2$	CO_2
Appl. rate:	16.7 gpa	20 gpa	16 gpa

Note: Fertilized on 9-1-93 with 78.5 lb nitrogen/a.

Table 2. Percent reductions of bindweed in 1 square foot, Garden City, KS, 1993-1998.

Treatment*	Rate(lb AI/a)	5/13/93	6/1/95	5/26/98**	Avg.
1 Quinclorac	0.125	81.8	95.7	83.7	87.1
2 Quinclorac	0.25	79.4	99.9	--***	89.7
3 Quinclorac	0.50	98.4	100.0	--***	99.2
4 Quinclorac	1.00	100.0	100.0	94.5	98.2
5 2,4-D	0.25	51.5	71.1	45.0	55.9
6 2,4-D	0.50	63.7	87.9	64.5	72.0
7 2,4-D	1.00	84.1	94.4	64.4	81.0
8 2,4-D	2.00	92.1	98.4	69.6	86.7
9 Dicamba	0.125	17.0	15.2	24.0	18.7
10 Dicamba	0.25	85.3	72.1	37.4	64.9
11 Dicamba	0.50	99.9	94.8	72.8	89.2
12 Dicamba	1.00	100.0	98.9	73.3	90.7
13 Glyphosate	0.50	55.8	41.1	56.6	51.2
14 Glyphosate	1.00	61.5	46.3	95.1	67.6
15 Glyphosate	2.00	66.2	69.0	99.0	78.1
16 Glyphosate	4.00	93.5	97.6	96.7	95.9
17 Imazethapyr	0.03125	39.8	58.8	25.3	41.3
18 Imazethapyr	0.0625	54.7	92.1	28.6	58.5
19 Imazethapyr	0.125	69.5	99.0	14.6	61.0
20 Imazethapyr	0.25	96.6	100.0	22.2	72.9
21 Picloram	0.0625	48.4	93.1	41.6	61.0
22 Picloram	0.125	75.1	98.6	51.5	75.1
23 Picloram	0.25	97.7	99.9	96.7	98.1
24 Picloram	0.50	99.9	100.0	100.0	99.9
LSD (0.05) =		27.5	18.5	53.7	23.0

* All chemical treatments were applied with 0.25% NIS.
** The 5/26/98 rating date is based on three replications instead of four due to an error in one of the reps.
*** Only two replicates available.

Southwest Research-Extension Center

COMPARISONS OF WOOLLYLEAF BURSAGE CONTROL BY NINE HERBICIDE TANK-MIXES APPLIED AT FLOWERING AND 30 DAYS LATER

by
Randall Currie

SUMMARY

Although time of application occasionally appeared to have an effect for most herbicides tested, this effect was not consistent across years. Regardless of time of application or tank-mix partner, picloram provided excellent woollyleaf bursage control. All other tank mixes provided poor or inconsistent control. The additon of dicamba to various tank mixes did not increase preformance more than the addition of 2,4-D.

INTRODUCTION

Woollyleaf bursage, also known as bur ragweed, is a noxious perennial weed infesting more than 80,000 acres in southwest Kansas. It is found most frequently in low-lying areas of fields but also in the higher areas because of movement of rootstocks and seeds by tillage equipment. Once established, this weed is very difficult to control. The objective of this study was to compare control of woollyleaf bursage by several herbicides applied at flowering and 30 days later.

PROCEDURES

The study was established in August, 1990, and replicated in the 1994, 1995, and 1997 growing seasons. The experimental design was a two-factorial randomized complete block with two levels of application timing, nine levels of herbicide treatment, and three replications (Tables 1 and 2). Herbicides were applied with a CO_2-pressurized, hand-held sprayer equipped with a six-nozzle boom. Application volume was 20 gal/a. Herbicides were applied at flowering on August 15 and on September 15.

Both treatments were evaluated for woollyleaf bursage control 9 and 11 months later. The percent weed control was calculated by dividing the number of stems per unit area in the treated plots by the number in the corresponding control plot, subtracting this from 1, and multiplying the difference by 100.

RESULTS AND DISCUSSION

Although a rate response was seen in clopyralid treatments, some level higher than 0.25 lb/a may be necessary to provide control. The more ecomomical 2,4-D tank-mix partner performed as well as dicamba with fluroxypr, picloram, or glyphosate. All tank mixes of picloram consistently provided over 93% control in all years, regardless of time of application. All other tank mixes provided poor or inconsistent control. In 10 out of 12 tank-mix timing combinations over 3 years, less than 60% control was achieved with tank mixes containing 1.5 lb/a of glyphosate. Although glyphosate clearly has activity on woollyleaf bursage, a weed shift to this species might be expected if competition from other weeds is removed by continuous applications of conventional 0.5 to 1.5 lb/a rates of glyphosate.

Table 1. Application information, woollyleaf bursage study, Garden City, KS.

Application date:	8/15/90	9/15/90	8/15/94	9/15/94	8/15/97	9/15/97
Time of day:	2:30 pm	2:30 pm	1:30 pm	11:45 am	3:00 pm	12:15 pm
Application method:	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast
Application timing:	flowering	30 DAF*	flowering	30 DAF	flowering	30 DAF
Air temperature, unit:	88 F	64 F	78 F	79 F	102 F	96 F
Wind velocity, unit:	6 mph S	0 mph	4-8 mph	10-15 mph	0-2 mph SE	0-5 mph NE
Dew presence:	None	None	None	None	None	None
Soil temperature, unit:	80 F	66 F	72 F	62 F	78 F	85 F
Soil moisture:	Good	Good	Good	Good	Good	Good
% Cloud cover:	75%	0%	10%	1%	0%	20%
Appl. equipment:	Backpack	Backpack	Windshield	Windshield	Windshield	Windshield
Boom length, unit:	10 ft.	10 ft.	10 ft.	10 ft.	10 ft.	10 ft.
Nozzle type:	Teejet	Teejet	Teejet XR	Teejet XR	Teejet	Teejet
Nozzle size:	11002 FF	11002 FF	8004 VS	8004 VS	8004 VS	8004 VS
Pressure, unit:	45 psi	45 psi	35 psi	33 psi	35 psi	36 psi
Carrier:	H_2O	H_2O	H_2O	H_2O	H_2O	H_2O
Spray volume, unit:	l.5 Liter	1.5 Liter	3 Liter	3 Liter	3 Liter	3 Liter
Propellant:	CO_2	CO_2	CO_2	CO_2	CO_2	CO_2
Appl. rate :	20 gpa	20 gpa	20 gpa	20 gpa	20 gpa	20 gpa

*Days after flowering.

Table 2. Percent control of woollyleaf bursage with nine herbicide tank mixes applied at flowering (Aug 15) and 30 days later (Sept 15), Garden City, KS.

		Nine Months after Treatment					
		1991		1995		1998	
Treatment	Rate(lb AI/a)	Flwr	30 DAF	Flwr	30 DAF	Flwr	30 DAF
1 Untreated	—	0.7	0.7	22.4	20.0	13.2	11.7
2 Clopyralid	0.12	1.8	13.8	39.4	7.1	0.0	5.6
3 Clopyralid	0.25	26.0	70.0	66.2	51.7	0.0	22.4
4 Fluroxypyr + Dicamba	0.75 + 0.5	89.5	19.3	63.6	67.5	49.7	50.1
5 Fluroxypyr + 2,4-D	0.75 + 1.0	95.6	13.5	64.8	31.5	8.1	58.7
6 Picloram + Dicamba	0.25 + 0.5	97.6	98.6	99.8	100.0	100.0	100.0
7 Picloram + 2,4-D	0.25 + 1.0	100.0	93.8	100.0	100.0	100.0	100.0
8 Glyphosate + Dicamba	1.5 + 1.0 *	44.5	43.8	73.6	51.8	20.7	82.8
9 Glyphosate + 2,4-D	1.5 + 1.0 *	95.6	9.2	68.3	30.1	16.6	83.8
10 2,4-D	2.0	—	—	33.6	27.5	34.2	45.0
LSD (0.05) =			29.0	33.0		31.2	

Table 3. Percent control of woollyleaf bursage with nine herbicide tank mixes applied at flowering (Aug 15) and 30 days later (Sept 15), Garden City, KS.

		Eleven Months after Treatment					
		1991		1995		1998	
Treatment	Rate(lb AI/a)	Flwr	30 DAF	Flwr	30 DAF	Flwr	30 DAF
1 Untreated	—	0.0	0.0	13.6	6.7	13.0	0.0
2 Clopyralid	0.12	7.3	4.2	15.7	25.5	17.0	0.0
3 Clopyralid	0.25	25.4	45.8	20.6	32.7	0.0	6.5
4 Fluroxypyr + Dicamba	0.75 + 0.5	64.6	5.4	20.3	32.9	15.7	21.2
5 Fluroxypyr + 2,4-D	0.75 + 1.0	85.0	11.1	41.4	3.2	2.6	3.1
6 Picloram + Dicamba	0.25 + 0.5	76.5	84.7	69.2	79.2	98.8	100.0
7 Picloram + 2,4-D	0.25 + 1.0	98.2	79.0	88.5	68.5	100.0	89.7
8 Glyphosate + Dicamba	1.5 + 1.0 *	34.3	23.6	27.6	9.2	3.5	31.9
9 Glyphosate + 2,4-D	1.5 + 1.0 *	75.1	24.4	12.6	29.7	10.7	0.0
10 2,4-D	2.0	—	—	33.2	6.3	17.4	2.3
LSD (0.05) =			31.2		21.7		14.7

* Plus 0.25% v/v surfactant.
Treatment 10 was not applied in 1991.

WINTER CEREALS FOR FORAGE AND GRAIN

by
Merle Witt

SUMMARY

When grain prices are low, producers more often consider wheat or other small grain cereal crops for winter pasturing in addition to harvesting for grain. This forage clipping comparison showed that wheat produced an average of 715 lb/a of dry matter, triticale an average of 702 lb/a of dry matter, and rye an average of 998 lb/a of dry matter prior to being allowed to mature for grain harvest. All three crops ultimately produced grain yields of about 80 bu/a.

INTRODUCTION

The production and use of small grain forages can be useful to producers based on the relative net returns of forage versus grain. Small grain cereals can be pastured until the jointing stage in early spring and then still produce a grain crop. This study was designed to address relative winter forage production as well as grain yields of some cereal grains that might be considered for dual-purpose use.

PROCEDURES

Ten varieties of wheat, triticale, and rye were seeded on October 16, 1997. Two Kansas wheats were included along with triticale and rye entries of Polish origin. The study was a randomized complete block design with four replications. Forage was collected by hand clipping at 1 inch above the soil surface, and data are shown as lb/a of oven-dried forage. Grain was harvested on June 30, 1998.

RESULTS AND DISCUSSION

Rye displayed its usual ability to produce higher forage yields during cold weather than other winter small grains. The forage yields of wheat and triticale were about 75% of rye forage yields. Results are shown in Table 1. All grain yields were similar, except that of Fidelio triticale. Fidelio was short statured, late maturing, and significantly lower yielding than other entries. Final grain-yield averages were 4615 lb/a, (77 bu/a at 60 lb/bu) for wheat, 4236 lb/a (85 bu/a at 50 lb/bu) for triticale, and 4692 lb/a (84 bu/a at 56 lb/bu) for rye.

Table 1. Forage and grain yields of irrigated winter cereals at Garden City, KS, 1998.

Cultivar	Forage Yield (lbs/a)	Grain Yield (lbs/a)	Test Weight (lbs/bu)	Heading Date (May)	Mature Height (inches)
WHEAT					
Jagger	750	4616	58	14	36
Karl 92	680	4614	59	14	33
TRITICALE					
Presto	782	4521	51	15	45
Fidelio	593	2834	46	20	36
Vero	809	4465	51	16	46
Chrono	628	4289	49	17	43
Disco	670	4447	47	18	45
Nemo	730	4857	48	17	44
RYE					
Amilo	1164	4586	51	14	45
Warko	831	4798	53	14	47
LSD (5%)	165	700	1.8	1.0	1.4
CV%	4.4	10.5	2.5	4.4	2.3

Planted:	October 16, 1997
Irrigated:	May 13, June 5, 1998
Forage Harvest:	April 13, 1998
Grain Harvest:	June 30, 1998.

NARROW-ROW SPACINGS FOR CORN

by
Merle Witt

SUMMARY

Grain yield was 12 bu/a higher in 15-inch rows than in 30-inch rows for four new corn borer-resistant Bt corn hybrids under irrigated conditions at Garden City.

INTRODUCTION

In an effort to increase yield potential, researchers are looking at row spacings that are narrower than the traditional 30 inches. Corn grown in closer rows more quickly shades the ground, because light energy is intercepted more completely by the crop early in the season. This increased crop utilization of early-season sunlight has increased corn yields as much as 10% in studies in some of the northern cornbelt states.

PROCEDURE

Four hybrids, Cargill 8021 Bt, Golden Harvest 2530 Bt, Northrup King 7590 Bt, and Pioneer 33A14 Bt were planted on May 12, 1998 in replicated split-plot design. Resulting stands were equalized at emergence by removal of excess plants in the 15-inch row treatments to provide populations of 30,000 plants/a for both row spacings. Plots were irrigated three times during the summer and kept weed-free with Prowl/Bladex herbicide. On October 5, 1998, 25-foot lengths of the center two rows of four-row plots were harvested for 30-inch row treatments, and 25-foot lengths of the center four rows of eight-row plots were harvested for 15-inch row treatments.

RESULTS AND DISCUSSION

Grain yields of these corn hybrids increased about 5% (12 bu/a) from use of narrow 15-inch row spacing as compared to the more traditional 30-inch row spacing. Yields are presented in Table 1. An important consideration is that equipment to plant and harvest narrow rows is required to take advantage of this 5% yield enhancement.

Table 1. Grain yield of corn at two row spacings at Garden City, KS, 1998.

Hybrid	15-inch rows	30-inch rows
Cargill 8021 Bt	214	205
G.H. 2530 Bt	206	195
N.K. 7590 Bt	222	209
P. 33A14	221	207
Avg.	216	204

Row spacing LSD (.05) = 8 bu/a
Hybrid LSD (.05) = 12 bu/a

CANOLA PRODUCTION

by

Merle Witt and Larry Buschman

SUMMARY

Cold-tolerant variety selections of winter canola are being developed for Kansas. Yields from 1998 on dryland averaged 836 lb of seed/a. Plots were not harvested in 1997 or 1996 because of freeze damage and plant survival averaging only 18%.

INTRODUCTION

Canola is a new type of oilseed rape. It differs from traditional industrial rape in having a much-reduced amount of erucic acid and a lowered level of glucosinolates. Because of these changes, it can provide both a healthful cooking oil and a high-quality protein meal supplement for livestock.

PROCEDURES

Twenty-four varieties and experimental lines were planted on September 5, 1997 at 9 lb seed/a in randomized complete block plots. Plots were combine harvested on June 25, 1998 by removing the reel to reduce shattering losses.

RESULTS AND DISCUSSION

Yields from 1998 on a dryland field are shown in Table 1. Excellent winter survival occurred in 1997-1998 such that yields ranging from 464 lb/a to 1280 lb/a were produced. However, in 1996-1997, stand survival following winter losses ranged from 0% to 58% depending upon variety. In 1995-1996, stand survival following winter losses ranged from 0% to 52% depending upon variety. At present, the most important factor in considering a canola variety to grow in Kansas is winter survival.

Table 1. Yield results from the Advanced Canola Nursery on dryland at Garden City, KS 1997-1998.

Entry	Yield (lb/a)
WW1089	1280
Wichita	1198
MO503-1	1130
Casino	1016
Ericka	1011
Jetton	987
ID.92.WC.2.24.5	976
ARC91022-59L-4	940
ID.92.WC.3.13.4	930
UGA448.7H	919
Selkirk	917
ID.WR.465.2.4	889
Aspen	757
Ceres	746
ARC91003-TL-3	740
Plainsman	735
KS3203	707
Winfield	698
ARC91004-12L-3	627
Falcon	625
Bridger	609
ID.92.SW.76.75	592
KS3579	565
KS1701	464
Mean	836
LSD	242
CV	14.5

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Golden Harvest
Golden World
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J.C. Robinson Seed Co.
Kaysoy
Kaystar Seed
L.G. Seeds
Midland Seeds
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Miller Preferred
MSG (Ohlde)
Mycogen Plant Sciences
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* Proposed merger of AgrEvo and Rhone Poulenc.

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