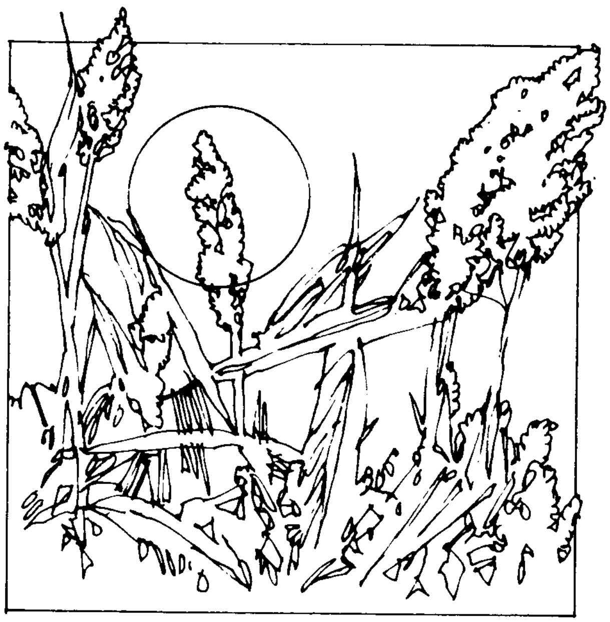
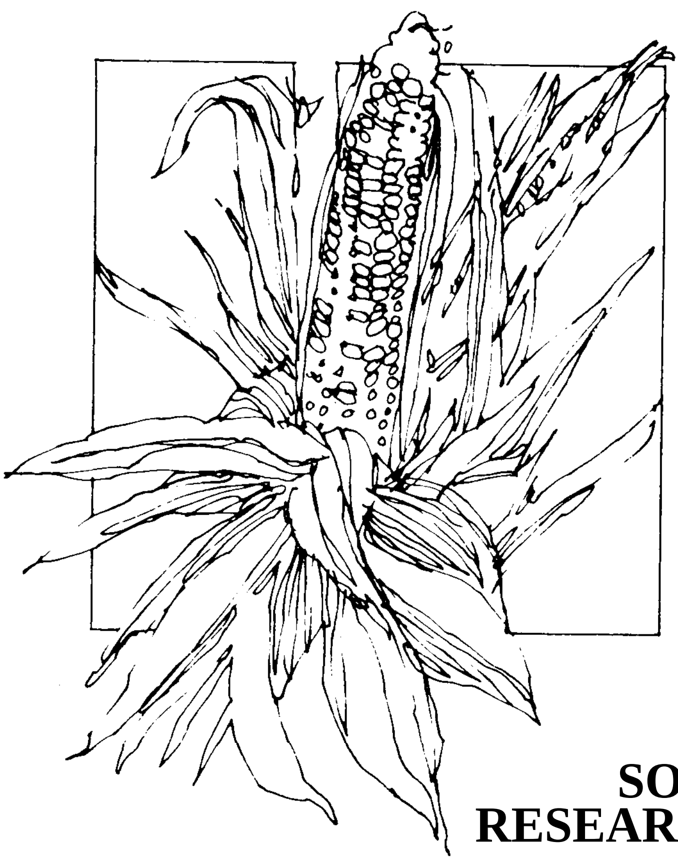
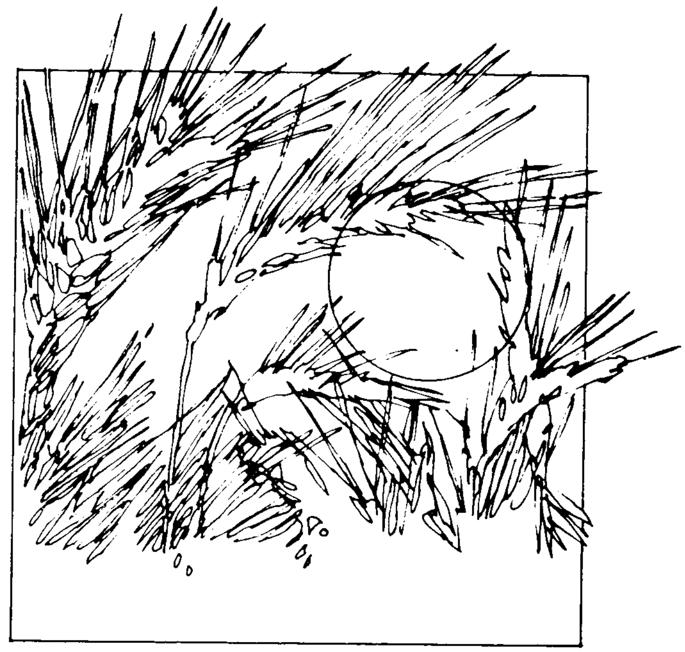


1992 FIELD DAY REPORT





SOUTHWEST KANSAS RESEARCH-EXTENSION CENTER

Report Progress 657 Agricultural Experiment Station
Kansas State University Walter R. Woods

Jim Schaffer - Center Head. Jim received his M.S. and Ph.D. degrees from Kansas State University. He rejoined the staff in 1988. He served as Extension Agronomist from 1980-1983. His research interests include crop production and management techniques.

Randall Currie - Weed Scientist. Randall began his agriculture studies at Kansas State University, where he received his B.S. degree. He then went onto receive his M.S. from Oklahoma State University and his Ph.D. from Texas A & M University.

Gary Dick - Corn Entomologist. Gary received his M.S. from Kansas State University. He rejoined the staff in 1989. He served as a Research Assistant for the Corn Entomology project from 1983 to 1984. His research is mainly on the biology, ecology, and control of spider mites in corn.

Steve Freeman - Animal Nutritionist. Steve received his M.S. from the University of Florida and his Ph.D. from New Mexico State University. He joined the staff in 1989. Research interests include effects of grain processing on nutrient digestion, health and nutritional management, and protein and fiber utilization by cattle.

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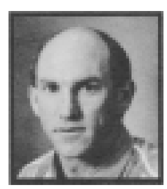
Paul Hartman - Associate Head anc Area Extension Director, Paul receivec his B.S. and M.S. in Animal Sciences and Industry from Kansas State University. Prior to that, he served a County Extension Agricultural Agent in Stanton and Pratt counties.

Kevin Dhuyvetter - Extension Agricultural Economist. Kevin receivec his M.S. from Iowa State University. He joined the staff in 1986 and returned in 1990 after spending 1C months with Iowa Farm Bureau. His interests are in crop and livestock production economics and marketing.

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



Thomas Eck - Ruminant Nutritionist. Tom received his M.S. from Texas Tech University and his Ph.D. from the University of Arizona. He joinec the staff in 1992. Research interests include grain processing and poor quality roughage utilization by feedlo cattle.

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

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Contribution 92-575-S from the Kansas Agricultural Experiment Station.

WEATHER INFORMATION AT GARDEN CITY

by
William Spurgeon and Charles Norwood

Climatic conditions were very favorable for crop growth in 1991, particularly for summer row crops. Above normal rainfall in May and timely rainfall in June, coupled with above normal rainfall in August, produced an excellent corn crop.

Precipitation totaled 20.72 inches or 2.86 inches above normal. Snowfall was above normal, with 7 inches in March and 17 inches in late October and early November. Three inches fell in January and only three tenths of an inch in February.

Temperatures were warmer than normal for most of the year except during the summer and the first part of November. Near normal to slightly cooler temperatures in July and August helped provide adequate energy for the crops without causing extreme stress. Only one record high temperature occurred (93° on October 18); however, six record lows occurred. The high for the year was 101° on July 8 and August 1. There were 4 days of 100° or higher temperatures. Three below 0° readings occurred, all of which were record lows. They were -8°, -5°, and -1° and occurred on January 1, November 3, and November 4, respectively.

Average wind speed was 5.1 mph or 1.0 mph below normal. However, extremely strong winds occurred twice in the spring, causing extensive damage to small structures and sand pitting of vehicles. Open pan evaporation was 71.01 inches or 7.31 inches below normal. The frost-free period was from May 6 through October 24, or 172 days, 2 days above normal.

A complete summary of the weather is presented in the accompanying table.

Table 1. Climatic data. Southwest Kansas Research-Extension Center, Garden City. 1991.

	Precipitation inches		Temperature (°F)						Wind MPH		Evaporation inches	
			Average[2]		Mean		Extreme					
Month	1991	Avg.[1]	Max.	Min.	1991	Avg.	Max.	Min.	1991	Avg.[1]	1991	Avg.[1]
January	0.23	0.35	38.0	13.6	25.8	27.7	57	-8	3.9	5.1		
February	0.01	0.45	59.2	21.4	40.2	33.1	71	6	4.6	6.0		
March	0.99	1.15	59.5	29.0	44.0	40.0	82	13	6.7	7.4		
April	1.06	1.42	67.3	40.3	53.8	52.5	85	31	6.7	7.7	8.41	8.79
May	5.36	3.26	78.7	53.3	65.9	62.5	90	31	6.6	7.1	10.00	10.96
June	2.60	2.87	87.6	62.3	75.0	73.2	96	53	6.1	7.3	12.33	13.90
July	1.83	2.51	92.0	63.3	77.6	78.4	101	56	4.6	6.2	12.91	14.96
August	4.10	2.19	88.3	61.8	75.1	76.0	101	51	4.1	5.5	10.96	12.78
September	0.68	1.52	81.5	53.3	67.4	67.4	90	36	4.6	5.7	9.10	9.80
October	1.02	1.07	72.5	36.5	54.5	55.0	93	13	4.8	5.3	7.30	7.13
November	1.74	0.75	45.7	22.7	33.7	40.3	66	-5	5.2	5.1		
December	1.10	0.32	45.4	23.6	34.5	31.7	68	13	3.9	4.9		
Annual	**20.72**	**17.86**	**68.0**	**40.1**	**54.0**	**53.2**			**5.1**	**6.1**	**71.01**	**78.32**

Average earliest freeze in fall	Oct. 13	1991:	Oct. 25
Average latest freeze in spring	April 25	1991:	May 5
Frost-free period	170 days	1991:	172 days

All averages are for the 30-year period 1951-1980, except for the October evaporation, which is the 1962-1982 average.

WEATHER INFORMATION AT TRIBUNE

by
Dale Bremer and David Frickel

Precipitation for 1991 totaled 20.65 inches or 4.74 inches above normal. Precipitation was above normal in 6 months. The wettest were June, July, and August with 4.31, 3.49, and 4.95 inches, respectively. The largest single amount of rainfall was 2.66 inches on August 3. March, November, and December were also above normal. The remainder of the year had below normal precipitation, including February, which was one of the driest on record with only a trace reported the entire month. Snowfall for the year totaled 28.1 inches, and the largest single amount, 6.0 inches, fell on March 17.

The air temperature was above normal for 3 months of the year and below normal the rest of the year. The warmest month was July, with an average temperature of 75.8^{0} and an average high temperature of 90.7^{0}. The coldest month was January, with an average temperature of 25.4^{0} and an average low of 13.7^{0}. Deviation from the normal was greatest in February, when the 40.2^{0} average temperature was 6.1^{0} above normal.

The highest temperature was 105^{0} on July 7, and a total of 8 days had of 100^{0} or higher. The lowest temperature was -4^{0} on November 3, which was the earliest subzero temperature ever recorded at the station by one full week. The -2^{0} reading on January 30 was the only other day of sub-zero temperature for the year. The last frost (30^{0}) in the spring was on May 1 (28^{0}), which was the normal date, and the first frost in the fall was on October 5 (25^{0}), which was 2 days earlier than normal. There were 157 frost-free days, 2 days less than the normal.

Open pan evaporation from April through September totaled 75.46 inches, which was 3.78 inches above the normal of 71.68 inches. Wind speed for the same period averaged 5.4 mph compared to the normal of 5.6 mph.

Table 1. Climatic data. Southwest Kansas Research-Extension Center, Tribune. 1991.

	Precipitation inches		Temperature (°F) Average[2]		Mean		Extreme		Wind MPH		Evaporation inches	
Month	1991	Avg.[1]	Max.	Min.	1991	Avg.	Max.	Min.	1991	Avg.[1]	1991	Avg.[1]
January	0.09	0.36	37.2	13.7	25.4	28.9	56	-2				
February	T	0.40	58.9	21.5	40.2	34.1	73	7				
March	1.30	0.99	57.4	26.1	41.8	39.9	80	12				
April	0.93	1.13	65.7	35.4	50.6	51.0	88	23	5.9	6.6	8.97	8.82
May	1.71	2.68	78.2	48.7	63.5	60.9	91	28	6.5	6.0	14.31	10.95
June	4.31	2.68	83.9	58.6	71.3	71.5	101	49	5.5	5.7	16.34	13.71
July	3.49	2.60	90.7	60.8	75.8	77.2	105	51	4.6	5.5	15.12	15.64
August	4.95	1.98	86.7	59.3	73.0	74.7	101	54	4.4	5.2	11.11	13.01
September	0.34	1.54	81.1	48.6	64.9	66	95	35	5.2	4.6	9.61	9.55
October	0.49	0.74	71.1	33.4	52.3	54.5	93	10				
November	2.32	0.48	46.2	22.3	34.3	39.7	71	-4				
December	0.72	0.33	44.0	19.7	31.9	32.0	64	2				
Annual	**20.65**	**15.91**	**66.8**	**37.3**	**52.1**	**52.5**			**5.4**	**5.6**	**75.46**	**71.68**

Average earliest freeze in fall[5]	Oct.7	1991: Oct. 5
Average latest freeze in spring	May 1	1991: May 1
Frost-free period	159 days	1991: 157 days

[1]30-year average [2]1991 average

EFFECT OF CROPPING SYSTEM AND REDUCED TILLAGE ON AVAILABLE SOIL WATER AND YIELD OF DRYLAND WINTER WHEAT AND GRAIN SORGHUM

by
Charles Norwood

SUMMARY

Increases in available soil water and yield from a reduction in tillage occurred more often in the WSF system than in the WF system and more often for sorghum than for wheat. Yields with reduced or no tillage were higher in 2 of 5 years for wheat in WSF 4 of 5 years for sorghum in WSF, but were unaffected and in WF. Wheat yields from the WF and WSF system usually did not differ, nor did sorghum yields from the SF and WSF systems.

INTRODUCTION

A long-term study is being conducted to determine the effects of cropping system and reduced or no tillage on dryland winter wheat and grain sorghum. The effects of reduced and no tillage on available soil water and yield are being determined. This report is a summary of the data collected from 1987 through 1991.

PROCEDURES

The wheat-fallow (WF), wheat-sorghum-fallow (WSF), sorghum-fallow (SF), continuous sorghum (SS), and continuous wheat (WW) systems were studied. Herbicides were used in place of some or all tillage. Treatments varied somewhat from year to year, but the following are currently in use.

WF
1. Conventional tillage (CT) - Tillage (blade or rodweed) as needed.
2. Reduced tillage (RT) - 1.0 lb atrazine after wheat harvest + tillage as needed.
3. Minimum (MT) - 1.0 lb atrazine after wheat harvest + 2.4 lbs Bladex the following spring + tillage as needed.
4. No-till (NT) - 1.0 lb atrazine after wheat harvest + 2.4 lbs Bladex the following spring + postemergent herbicides as needed.

WSF (prior to wheat)
1. Conventional tillage (CT) - Tillage (blade or rodweed) as needed.
2. Reduced tillage (RT) - 2.4 lbs Bladex in the spring + tillage as needed.
3. No-till (NT) - 2.4 lbs Bladex in the spring + postemergent herbicides as needed.

WSF (prior to sorghum)
1. Conventional tillage (CT) - Tillage (blade or rodweed) as needed.
2. Reduced tillage (RT) - 2.0 lbs atrazine after wheat harvest + tillage as needed.
3. No-till (NT) - 2.0 lbs atrazine after wheat harvest + 1.6 lbs Bladex 30 days prior to sorghum planting.

SS
1. No-till (NT) - (Varies) - 1.6 lbs Bladex or 1.6 lbs Bladex + 1.0 lb atrazine 30-45 days prior to sorghum planting, or 40-54 oz Landmaster, or 1.5 pts Paraquat.

SF
1. Conventional tillage (CT) - Tillage (blade or rodweed) only.

WW
1. Conventional tillage (CT) - Tillage (blade or disk if very heavy stubble) only.
2. No-till (NT) - One or two applications of 40-54 oz Landmaster or 1.5 pts Paraquat.

Preemergent herbicides (usually 3 lbs Ramrod + 1.0 lb atrazine) were used in the WSF-CT and SF treatments for sorghum. Reduced and NT sorghum usually received 4 lbs Ramrod preemergence. In years of light weed pressure, preemergent herbicides probably were not needed in the RT and NT plots.

Wheat was planted with a John Deere HZ drill in 16-inch rows at a rate of 40 lbs/A. Sorghum was planted with a Buffalo slot planter in 30-inch rows at a rate to result in 25,000 plants per acre. Available soil water was measured at 1-foot intervals to a depth of 5 feet at the end of fallow. Grain was harvested with a plot combine, and grain yields were reported at 12.5% moisture. The soil type was a Richfield silt loam with a pH of 7.8, organic matter content of 1.5%, and an available water holding capacity of 10.8 inches in a 5-foot profile. The experimental design was a randomized complete block with three replications.

RESULTS AND DISCUSSION

The use of atrazine in the WF and WSF system (WF-RT and WSF-RT) typically resulted in the elimination of two tillage operations, the one following harvest and the first operation in the following spring (Table 1). Atrazine, particularly at the 1.0 lb rate in WF-RT sometimes did not result in adequate volunteer control, making tillage or the use of postemergent herbicides necessary. The use of Bladex (following atrazine) in the WF system (WF-MT) resulted in the elimination of more than half of the tillage, whereas the use of Bladex prior to sorghum (WSF-NT) eliminated all tillage. Two tillage operations were typically eliminated when Bladex was used in the WSF system prior to wheat (WSF-RT). There were no SS-CT plots, but this treatment would require spring tillage similar to WSF-CT. Reduced or no till in the SF system is not practical, because of the long fallow period and is not currently being studied.

Table 1. Typical numbers of tillage operations performed in the various treatments .

System	CT	RT	MT	NT
WF	5-7	3-4	1-3	0
WSF(W)	3-4	2-3	-	0
WSF(S)	2-3	1-2	-	0
WW	2-3	-	-	0
SS	-	-	-	0
SF	5-7	-	-	-

Soil Water

The amount of available soil water (hereafter referred to as soil water) at wheat planting is presented in Table 2. The amount differed between tillage treatments in the WF system only in 1990. In the WSF system, the NT plots had more soil water only in 1989. The WF-CT and NT plots had more soil water than WSF-CT and NT in 1989, also. The advantage for WF in 1989 occurred because of the longer fallow period; much of the storage occurred early in fallow, before the beginning of the WSF fallow period. The WW treatment had less soil water than all WF and WSF treatments in 1987 and 1990; however, the amount did not differ from that in either WSF treatment in 1988 or WSF-CT in 1989.

Table 2. Effect of cropping system and tillage on the amount of available soil water at wheat planting. Garden City, KS. 1987-90.

	Cropping System				
Year	WF-CT	WF-NT	WSF-CT	WSF-NT	WW
	Inches available water in a 5-ft. profile				
1987	8.0a[1]	7.6a	6.9a	7.1a	3.7b
1988	7.1ab	7.9a	6.3bc	6.7abc	5.6c
1989	7.2a	8.0a	3.2c	5.4b	3.9c
1990	8.3b	9.7ab	9.1ab	9.8a	6.7c
1991	7.8a	7.7a	7.2a	7.1a	3.3b
Avg.	7.7	8.2	6.6	7.2	4.6

[1] Means within a row followed by the same letter do not differ ($P<0.05$).

The amount of soil water at sorghum planting is presented in Table 3. In the WSF system, more soil water was present in RT and NT than in CT in 1987, 1988, 1989; in 1990, the amount in NT, but not RT, exceeded that in CT. No significant differences occurred in WSF in 1991. No significant differences occurred between RT and NT in any year. Soil water in SS was less than that in all WSF treatments in 1988, 1990, and 1991, but more than in WSF-CT in 1987 and 1989. The longer fallow period of SF resulted in more soil water than in WSF-RT in 1991 and more soil water than in WSF-CT in 1987, 1989, and 1991.

Table 3. Effect of cropping system and tillage on the amount of available soil water at sorghum planting.

Year	Cropping System				
	WSF-CT	WSF-RT	WSF-NT	SS	SF
	Inches available water in a 5-ft. profile				
1987	5.3b[1]	8.4a	7.3a	7.9a	8.0a
1988	6.7b	8.5a	9.3a	4.7d	7.3b
1989	6.6b	8.7a	8.3a	8.1ab	8.8a
1990	7.7b	8.2ab	9.1a	6.0b	8.8ab
1991	8.0b	7.8b	8.9ab	6.6c	9.7a
Avg.	6.9	8.3	8.6	6.7	8.5

[1] Means within a row followed by the same letter do not differ (P<0.05).

Wheat Yield

Wheat yields are presented in Table 4. Tillage caused no difference in yield in the SF system. In the WSF system, RT and NT yielded more than CT in 1989, and NT yielded more than CT in 1991. Although an increase in soil water caused the increase in 1989, there was no difference in soil water in 1991 (Table 2). A yield reduction occurred in WSF-NT in 1990, because extremely cold temperature in December 1989 caused some tillers to abort. The NT plants were exposed more to the cold because of shallower planting. Under the same conditions, the yield of WF-NT was not reduced, because it was insulated from the cold by the wheat straw remaining from the previous crop.

A comparison of the WF and WSF systems indicates that their yields were similar, except in 1989, when more soil water at planting resulted in higher WF yields. The yield of WW was substantially less than those of either WF or WSF in 1987, 1989, and 1991. In 1988, WW yields were similar to those of WF and WSF, but all yields were low. Above average rainfall in 1990 resulted in high yields from all systems.

Table 4. Effect of cropping system and tillage on the yield of winter wheat.

Year	Cropping System								
	WSF-CT	WF-RT	WF-MT	WF-NT	WSF-CT	WSF-RT	WSF-NT	WW-CT	WW-NT
	– Bu/A –								
1987	23.7a[1]	26.7a	26.5a	26.7a	24.2a	25.6a	23.1a	9.9b	13.1b
1988	19.3ab	22.0ab	21.9ab	19.2ab	25.5a	22.8a	19.4ab	17.3ab	14.1b
1989	36.7ab	38.4ab	40.6a	42.9a	12.0d	31.2bc	22.7c	6.7d	8.9d
1990	49.1abcd	54.2abc	52.5abc	50.3abc	56.8a	55.2ab	46.2cd	47.7bcd	41.5d
1991	41.8bc	47.5abc	45.4abc	51.6a	41.3c	45.6abc	50.3ab	12.0d	15.3d
Avg.	34.1	37.8	37.4	38.1	31.9	36.0	32.3	18.6	18.6

[1] Means within a row followed by the same letter do not differ (P<0.05).
[2] Not harvested due to bird damage.

Grain Sorghum Yield

Grain sorghum yields are presented in Table 5. The yield of WSF-NT and RT exceeded that of WSF-CT in 4 of 5 years. The yield of WSF- NT exceeded that of WSF-RT in 2 of 5 years. Continuous sorghum and SF yield could not be statistically compared with WSF yields because of bird damage in 1988. However, SS yields were generally lower than WSF yields, whereas SF and WSF yields were similar.

Table 5. Effect of cropping system and tillage on the yield of grain sorghum.

	Cropping System				
Year	WSF-CT	WSF-RT	WSF-NT	SS	SF
	Bu/A				
1987	49.2c	61.5b	69.2a	56.2	64.2
1988	35.3b	49.0a	53.3a	--[2]	--[2]
1989	90.2b	99.4a	98.7a	55.4	70.8
1990	51.9a	55.4a	58.1a	38.1	53.1
1991	43.6c	54.4b	70.6a	33.4	70.8
Avg.	54.0	63.9	70.0	--	--

[1] Means within a row followed by the same letter do not differ (P<0.05).
[2] Not harvested due to bird damage.

IRRIGATED VERSUS DRYLAND CROPPING SYSTEMS

by

Charles Norwood

SUMMARY

A comparison of dryland WSF and WCF cropping systems with similar systems receiving a single irrigation indicate that substantial yield increases can occur in the irrigated systems. However, timely rains can result in dryland yields as high as irrigated yields. Consistent yield increases from irrigation occurred in 1 of 2 years for wheat and 1 of 3 years for sorghum and corn. More data are needed before conclusions can be made regarding the feasibility of these very limited irrigated systems in comparison to dryland.

INTRODUCTION

Because of declining water tables and increasing energy costs, many farmers can no longer afford to use full irrigation. They have been forced to reduce irrigation and some have converted irrigated acres to dryland. This study was designed to evaluate very limited irrigation, compared to dryland, with the objective of slowing the conversion of irrigated acres to dryland. Moisture conserving practices, such as no-till, are incorporated into the study.

PROCEDURES

The study is basically a comparison of the dryland wheat -sorghum or corn-fallow (WSF, WCF, or WS(C)F) system with WS(C)F systems in which the wheat, sorghum, or corn or both crops are flood irrigated. An irrigated wheat-fallow-dryland wheat-continuously irrigated wheat (alternate irrigated-dryland, or AID) system is included. Both the AID and WS (C) F systems allow two crops in 3 years. Also included are irrigated continuous wheat (IWW), corn (ICC), and sorghum (ISS) and dryland continuous sorghum (DSS) and wheat (DWW). The irrigated crops receive a single 6-inch irrigation. The wheat is irrigated at joint stage, the sorghum at boot stage, and the corn at tassel stage. In addition to the in-season irrigation, the irrigated continuous crops receive a 6-inch preirrigation. Water stored during fallow substitutes for the preirrigation for crops planted following fallow. The specific crop sequences are given in the tables.

The experimental design is a randomized complete block with four replications. The corn and sorghum are planted no-till into wheat stubble remaining from the previous crop. Atrazine, at a rate of 2 lb/A, is applied following wheat harvest; this is followed by 1.6 lb/A cyanazine applied 15 to 30 days preplant to the row crops in the spring. The irrigated wheat stubble in the AID system receives 1 lb/A atrazine after harvest, followed by tillage as needed. Tillage is performed as needed prior to wheat in the WCF, WSF, IWW, and DWW systems and for DSS, ISS, and ICC. The soil type is a Richfield silt loam with a pH of 7.5 and an organic matter content of 1.5%.

RESULTS AND DISCUSSION

Wheat Yield

Wheat yield data are presented in Table 1. Rainfall well above normal and ideal conditions during grain fill produced very high (also unrealistic) wheat yields in 1990. Irrigation did not significantly improve wheat yields. The situation was more normal in 1991, with yields ranging from 23 bu/A for DWW to 71 bu/A for irrigated wheat in the WSF and WCF systems. The single irrigation resulted in a 21 bu/A yield increase when comparing the dryland and irrigated WS(C)F systems. Irrigating both crops did not improve wheat yields over those obtained when only the wheat was irrigated. The irrigated yield from the AID system was similar to that of irrigated wheat in the WS(C)F system. Continuously irrigated wheat yielded less than the irrigated wheat in the WS(C)F systems and did not differ significantly from dryland wheat.

Sorghum Yield

Grain sorghum was generally unaffected by cropping system or irrigation in 1989 and 1990, because of timely rains (Table 2). Rainfall was below normal in 1991, resulting in irrigated WSF yields nearly 60 bu/A higher than dryland WSF yields. Dryland sorghum following irrigated wheat yielded 61 bu/A,

Table 1. Wheat yield as affected by cropping system and irrigation.

Cropping System [1]	1990	1991
	------- Bu/A -------	
Dryland sorghum (corn)-fallow -irrigated wheat	90.1b[1]	70.9a
Irrigated sorghum (corn)-fallow -dryland wheat	86.0b	46.8c
Irrigated sorghum-fallow -irrigated wheat	100.1a	65.4a
Dryland sorghum (corn)-fallow -dryland wheat	86.3b	49.8bc
Irrigated continuous wheat	75.5c	56.5b
Dryland continuous wheat	72.2c	22.9d
Irrigated wheat-fallow -dryland wheat	75.2c	51.0bc
Dryland wheat-continuous -irrigated wheat	85.8b	65.9a

[1]Wheat yields are averages from the WSF and WCF systems.
[2]Means within a column followed by the same letter do not differ (P< 0.05).

Table 2. Grain sorghum yield as affected by cropping system and irrigation.

Cropping System	1989	1990	1991	Avg.
	--------------Bu/A--------------			
Irrigated wheat-fallow -dryland sorghum	87.1a[1]	92.8ab	60.8b	80.2
Dryland wheat-fallow -irrigated sorghum	78.7a	91.9ab	90.8a	87.1
Irrigated wheat-fallow -irrigated sorghum	78.1a	99.0a	91.8a	89.6
Dryland wheat-fallow -dryland sorghum	80.0a	91.4ab	34.1c	68.5
Irrigated continuous -sorghum	81.1a	84.9b	86.3a	84.1
Dryland continuous -sorghum	75.3a	90.7ab	6.4d	57.5

[1]Means within a column followed by the same letter do not differ (P<0.05).

system, perhaps indicating carryover soil water from the irrigated wheat. Dryland continuous sorghum yielded only 6 bu/A.

Corn Yield

Corn yields (Table 3) were higher than sorghum yields. Because of rainfall, irrigated corn did not consistently yield more than dryland corn in 1989. In 1990 also no differences in yield occurred except that ICC yielded less than the other systems. This occurred in 1989 also, indicating that corn grown in rotation can yield more than continuous corn. (This isn't anything new, but the differences in 1989 and 1990 were substantial.) In 1991, yields of the irrigated treatments exceeded those of dryland by more than 50 bu/A. As with sorghum, dryland corn following irrigated wheat yielded substantially more than corn in the all dryland system, indicating carryover soil water.

Table 3. Corn yield as affected by cropping system and irrigation.

Cropping System	1989	1990	1991	Avg.
	--------------Bu/A--------------			
Irrigated wheat-fallow -dryland corn	101.8b[1]	115.3a	61.2a	92.8
Dryland wheat-fallow -irrigated corn	112.4a	114.7a	92.9ab	106.7
Irrigated wheat-fallow -irrigated corn	104.8ab	109.7a	98.3a	104.3
Dryland wheat-fallow -dryland corn	97.1b	114.3a	41.9d	84.4
Irrigated continuous -corn	84.9c	84.6b	84.2b	84.6

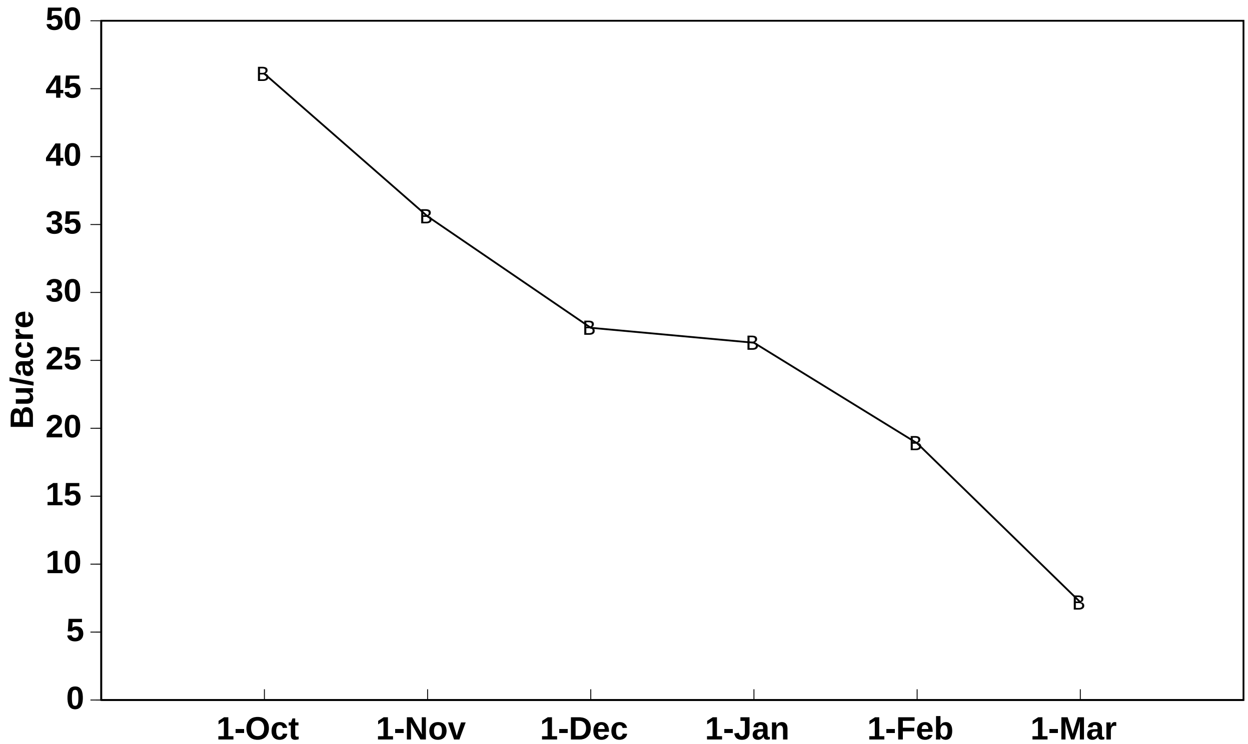
[1]Means within a column followed by the same letter do not differ (P<0.05).

LATE-PLANTED WINTER WHEAT

by
Merle Witt

Winter wheat in the Great Plains is not always planted at the optimum time for a variety of reasons. Sometimes replanting is necessary following stand loss to wind, pests, or winter killing. In other cases, the seedbed may be too dry or too wet to plant at a normal time. Additionally, planting may be purposely delayed in order to avoid diseases or insects, to pre-irrigate, or to accommodate a double-cropping sequence. In order to identify wheat responses to delayed establishment, sequential monthly planting dates from 1 October to 1 April were used during the 7 years from 1985-1991 at Garden City, Kansas. TAM 107 was seeded at a constant heavy rate in bordered drill strip plots in RCB design. Resulting relative grain yields tapered off with progressive planting dates as follows: 1 October = 100%, 1 November = 77%, 1 December = 59%, 1 January = 57%, 1 February = 41%, 1 March = 16%, 1 April = 0%. Wheat planted on April 1 did not vernalize or reproduce. Relative to wheat planted on the optimum date, 1 October, that planted on 1 March was the last to produce heads and grain but was the lowest yielding; gave the most delay in heading (26 days later); was the latest to ripen (17 days later), and the shortest statured (5” less); produced the smallest seed (43% less weight), the lowest test weight (21% less), the fewest heads/plant (58% fewer), the fewest kernels/head (33% fewer), and the fewest number of kernels per plant (73% fewer); and had the shortest grain filling period (9 fewer days). Little variation occurred through the range of dates for stand emergence or number of spikelets/spike. These results can assist farmers, seed sellers, crop insurers, and administrators of Farm Programs to make cropping decisions on “how late is too late” for planting winter wheat in the Central Great Plains.

Figure 1. Average winter wheat yields for 7-year period (1985-91) with late planting dates (LSD at 5% level = 1.5).



KSU Southwest Research-Extension Center

SOYBEANS ON DRYLAND

by
Merle Witt

A dryland soybean study has produced a 3-year average of 22 bushels per acre. Adjacent dryland grain sorghum has averaged 66 bushels per acre. Soybean yields averaged 28 bu/A in 1989, 23 bu/A in 1990, and 15 bu/A in 1991. Sorghum variety yield averages for the same 3 years were 66,50, and 84 bu/A. The group IV maturity (MG IV) soybeans had in each year the longest season and were the highest yielding of the four maturity groups in each year. A planting rate of 40 pounds per acre was the best choice among the three seeding rates (20,40, & 60 pounds per acre).

Soybeans were seeded on May 5, 1989; on May 2, 1990; and May 29, 1991. Plots were grown on a Keith silt loam soil in all 3 years, with Treflan at 2 pints per acre incorporated for weed control. In each of the 3 years, the soybeans followed a year of summer fallow preceded by a crop of grain sorghum. Grain yields are displayed in Table 1.

Days from planting to maturity of the four maturity groups (varieties) as an average over three planting rates and over 3 years were MG I (Weber 84), 104 days; MG II (Ohlde 2193), 112 days; MG III (Resnik), 120 days; and MG IV (Sparks), 124 days.

Table 1. Dryland Soybean - Maturity X Seeding Rate Study, 1989-91.

Maturity Group	Variety	lbs. Seeding Rate	GrainYield Bu/A 1989	1990	1991	3 yr Av.
I	Weber 84	20	19.5	20.3	9.0	16.3
I		40	23.2	22.9	12.9	19.7
I		60	21.7	24.5	14.3	20.2
Av.			21.5	22.6	12.1	18.7
II	Ohlde 2193	20	23.8	23.8	14.3	20.6
II		40	27.9	26.5	19.2	24.5
II		60	28.2	27.6	20.1	25.3
Av.			26.6	26.0	17.8	23.5
III	Resnik	20	26.3	20.2	9.8	18.8
III		40	26.9	23.4	15.4	21.9
III		60	28.9	23.2	15.0	22.4
Av.			27.4	22.3	13.4	21.0
IV	Sparks	20	34.9	19.8	18.2	24.3
IV		40	38.2	22.6	17.8	26.2
IV		60	37.0	24.1	19.0	26.7
Av.			36.7	22.2	18.3	25.7
Overall Avg.			28.0	23.3	15.4	22.2

LSD (5%) of MG (Varieties) =1.9 Bu/A
LSD 5% of Seeding Rates = 1.7 Bu/A

SHORT-SEASON CORN HYBRIDS

by

Alan Schlegel and Merle Witt

A test of short-season corn hybrids was conducted at two western Kansas locations. No entry fee was charged nor was an attempt made to solicit the broad range of entries that are available. This test was initiated to quickly evaluate the suitability of a few short-season hybrids to our environment, as well as to consider appropriate plant population levels suitable to produce high grain yields from these dwarfed plant types. Higher plant populations than used for full-season corn hybrids were found to be appropriate for top grain yields. Early-season corn data for Tribune and Garden City are shown in Tables 1 and 2, respectively.

LOCATION:	Tribune: Early corn
COOPERATOR:	Alan Schlegel
SOIL TYPE:	Ulysses silt loam
PLANTING DATE:	April 11, 1991
PLANTING RATE:	low-30,000 seeds/a high-40,000 seeds/a
HARVEST DATE:	September 23, 1991
FERTILIZER:	160 lbs n/a
IRRIGATION:	20" applied

Table 1. Early-season corn results at two seeding rates under fall irrigation at Tribune, KS.

Brand	Hybrid	Grain Yield 30K seeds	Grain Yield 40K seeds	Grain Moisture %	July Silking Date
		bu/acre			
Agripro	7255	168	207	16.2	10
Cargill	4327	197	204	19.7	11
DeKalb	535	164	189	17.3	10
Garst	8599	179	186	19.1	11
Golden H.	H2404	161	175	17.1	8
NC+	2661	190	173	17.2	11
Northrup-K.	N4545	184	193	17.8	11
Ohlde	1101	174	157	17.6	10
Pioneer	3417	211	231	22.3	13
Pioneer	3737	166	186	15.7	7
Triumph	9550	172	198	15.8	8
Average		179	191	17.8	10
LSD (.05)					
Hybrids =		18		2.0	2
Seeding rate		8			

LOCATION: Garden City: Early corn
COOPERATOR: Merle Witt
SOIL TYPE: Ulysses silt loam
PLANTING DATE: April 16, 1991
PLANTING POPN: low-27,000 plants/a
high-34,000 plants/a
HARVEST DATE: September 18, 1991
FERTILIZER: 150 lbs/a pre-plant
IRRIGATION: Pre-plant plus 20"

Table 2. Early -season corn results at two population levels under full irrigation at Garden City, KS.

		Grain Yield (bu/A)			July	
Brand	Hybrid	27,000 plants	34,000 plants	Grain Moisture	Silking Date	Height Inches
Agripro	AP7255	174	173	13.5	1.3	80
Cargill	4327	186	196	16.0	4.5	95
DeKalb	DK535	180	189	13.6	1.8	86
Garst	8599	174	179	14.8	4.5	82
Golden H.	H2404	170	182	14.2	2.0	76
NC+	2661	161	182	14.1	2.5	79
Northrup-K.	N4545	173	182	13.7	1.3	91
Ohlde	1101	179	178	14.1	2.2	77
Pioneer	3417	187	200	16.4	4.3	90
Pioneer	3737	164	191	12.9	1.7	90
Triumph	9550	165	179	13.4	1.3	81
Average		174	185	14.2	2.5	84

LSD (.05) for hybrids = 12.4 bu/A
LSD (.05) for population = 3.6 bu/A

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SOYBEAN INOCULANT EVALUATION

by
Charles Rice and Merle Witt*

SUMMARY

The objective of this study was to evaluate soybean inoculants. A new material, "HiStick", a very sticky adhering product from Agricultural Genetics Company, was to be tested for improved performance in attaching to seeds and providing Rhizobium bacteria for symbiotic nitrogen fixation.

PROCEDURE

This study was conducted on a soil mapped as Ulysses silt loam. The field had previously been in corn for 2 years (1990 and 1989) and grain sorghum (1988). Soybeans (Ohlde 3431) were inoculated and planted on 29 May 1991. Extreme care was taken to prevent cross contamination of the inoculants during planting. The dry seeds were mixed at the recommended rate of 1 pack (250 g) of HiStick per 3 bushels of seed. "Nitragin" soybean inoculant was also applied at the recommended rate. Control, non-inoculated, soybeans were also included in the study. The soybeans were harvested on 15 October, 1991 from a harvest area of 5 by 100 ft. Plant color and nodulation ratings were determined on 30 July 1991 near mid-flower. The nodulation rating was based on a scale of 10, with 0 being no nodulation and 10 being effective nodulation.

RESULTS

Plant color ratings at mid-flower showed no difference between the treatments. Nodulation ratings showed "HiStick" to have the best nodulation. The non-inoculated control had no nodules present at mid-flower. The "Nitragin" inoculant had an average rating of 4.25, with high variability. The "HiStick" had a rating of 7.5. Greater nodule weight per plant was also observed with the "HiStick" inoculant.

Grain yields and test weights are summarized in Table 1. There was no significant difference in test weights between the treatments. Grain yields were significantly improved by inoculation with "HiStick" and were greater than those of either the control or the other inoculation.

Table 1. Effect of soybean inoculants on soybean grain yield.

Inoculant	Soybean Yield	Test Wt.
	bu/a	
None	33.9	56.4
HiStick	43.5	56.0
Nitragin planter box	39.6	56.4
LSD (0.05)	3.6	n.s.

Assistant Professor, Agronomy, Kansas State University, Manhattan.

WHEAT-FOLIAR FUNGICIDE TO CONTROL RUST

by
Robert Bowden and Merle Witt*

Plots were established to estimate disease losses and evaluate commercial fungicides. Seed of two varieties (TAM 107 and Thunderbird) were planted at 75 lb/A on 25 Sept. 90. Plots were flood irrigated with approximately 4 in of water on 27 Mar and 15 May. Two commercial fungicides were compared to an unsprayed control and a disease-free control (two applications of Folicur). On 26 Apr. (growth stage Feekes 8 (flag leaf just visible)) and 8 May (Feekes 10 (boot)), fungicides plus 0.25% (v/v) X-77 spray adjuvant were applied in water at 20 gal/A. Disease ratings for percent of flag leaf covered by leaf rust were made on 4 June. Plots were harvested on 20 June.

Leaf rust was undetectable in plots on 8 May. However, leaf rust was severe on TAM 107 and moderate on Thunderbird on 4 June. Apparently, large amounts of inoculum were transported into the area in mid- to late May. The Bayleton plus Dithane M-45 tank mix was more effective in controlling leaf rust than Tilt, probably because the Tilt was partially exhausted by the time inoculum arrived. However, this difference was not reflected in yield differences between the two treatments. Using the unsprayed control and the disease-free control, the estimated yield loss was 21.8 bu/A (23%) for TAM 107 and 5.4 bu/A (7%) for Thunderbird. The two available commercial fungicide treatments recovered all the yield loss for Thunderbird and about half of the estimated loss for TAM 107. At prevailing local prices, either commercial fungicide would have been a profitable investment for irrigated wheat in western Kansas in 1991. However, severe leaf rust epidemics do not occur regularly enough in western Kansas to justify routine fungicide applications (Table 1).

Assuming a total expense of $15.00 per acre for fungicide plus application costs, and a wheat price of $3.50 per bushel, the Tilt treatment would have returned 330% and the Bayleton/Dithane treatment would have returned 318% on the investment for TAM 107. For Thunderbird, the Tilt treatment would have returned 139% and the Bayleton treatment would have returned 153% on the investment. This analysis is extremely dependent on wheat price. Folicur is not commercially available, so return on investment cannot be calculated.

Using the Folicur treatment as the standard, the TAM 107 experienced 21.8 bu/A (23%) yield loss primarily from leaf rust. The Thunderbird experienced 5.4% bu/A (7%) yield loss.

Table 1. Response of two wheat varieties to leaf rust fungicides.

	TAM 107			Thunderbird		
Chemical, rate/A, growth stage	Leaf Rust Rating	Yield bu/a	TestWeight (lb/bu)	Leaf Rust Rating	Yield (bu/A)	Test Weight (lb/bu)
Unsprayed control	36.3 D*	71.4 A	58.6 A	4.8 D	71.1 A	61.2 A
Tilt 3.6E, 4fl oz, Feekes 8	26.3 C	85.2 B	59.6 B	3.0 C	77.1 B	61.2 A
Bayleton 50DF, 2 oz + Dithane -45, 2 lb, Feekes 10	10.2 B	85.0 B	60.2 C	0.2 B	77.7 B	61.2 A
Folicur 3.6F, 4 fl oz, Feekes 8,10	0.1 A	93.1 B	60.5 C	0.0 A	76.5 B	60.8 A

*Means within a column followed by the same letter are not significantly different acocording to protected LSD (P=0.05).

*Asst. Professor, Plant Pathology, Kansas State University, Manhattan.

THIRTY YEARS OF NITROGEN AND PHOSPHORUS FERTILIZATION OF IRRIGATED CORN AND GRAIN SORGHUM

by
Alan Schlegel and Kevin Dhuyvetter

SUMMARY

Grain yields of irrigated corn and grain sorghum are increased by N and P applications. The economic optimal N rate is about 155/acre for irrigated corn and about 135 lb/acre for irrigated sorghum. The optimal N rate is fairly constant across yield potential. The addition of fertilizer P at 40 lb P_2O_5/acre is sufficient to maintain soil P levels for sorghum, but a higher rate is needed for corn. Nitrate accumulation in the soil profile is greater with sorghum than corn at equal N rates, reflecting the greater yield and N removal by corn. Application of P with N decreased nitrate accumulation, emphasizing the importance of a balanced fertility program. Application of N in excess of that needed for crop growth reduced net income and increased nitrate accumulation and leaching below the active crop root zone.

INTRODUCTION

Nitrogen (N) and phosphorus (P) fertilizers were applied for 30 years to irrigated continuous corn and grain sorghum at Tribune, KS. The objectives of the study were to evaluate the effect of long-term fertilization on grain production, soil chemical properties, and production economics.

PROCEDURES

Nitrogen and P fertilizers have been applied annually since 1961 to irrigated corn and grain sorghum grown on a Ulysses silt loam. Initial chemical properties of the surface soil (0-6 inch) were 17 ppm P (Bray-1), 1.4% organic matter, and pH of 7.9. Fertilizer treatments included N rates ranging from 0 to 200 lb N/acre in 40 lb increments with and without P at 40 lb P_2O_5/acre. Grain yield was adjusted to 15.5% moisture for corn and 12.5% for grain sorghum. Periodically during the study, surface soil samples (0-6 inch) were collected and analyzed for Bray-1 P. After harvest in 1990, soil samples to a depth of 10 ft. were collected and analyzed for NO_3-N.

Economic analyses were based on estimated yield response curves to determine net revenue, cost of production per bushel, and optimal economic N rate for corn and sorghum. The P rate for all analyses was 40 lb P_2O_5/acre. Because yields varied from year to year, the dataset was also partitioned by yield potential (low, medium, and high) based on annual average yields. Optimal economic N rates were determined for each yield potential. The cost/price assumptions used were N cost of $0.15/lb, corn price of $2.50/bu, sorghum price of $2.25/bu, fixed cost for corn of $200/acre, and fixed cost for sorghum of $120/acre. The fixed costs included all production expenses other than N cost.

RESULTS AND DISCUSSION

Corn yields averaged over 31 years were increased by N rates up to 160 lb N/acre (Table 1). Although no yield response to P was observed during the first 5 years of the study, since then the yield response to P has steadily increased. Phosphorus fertilizer, across all N rates, increased corn yields 24 bu/acre over 31 years, 37 bu/acre over the past 10 years, and 73 bu/acre in 1991. When P was applied with adequate N in 1991, corn yields were over 100 bu/acre greater.

Sorghum yields increased with increased N rates, particularly with the first increment of N. Similar to corn, sorghum yield response to P fertilizer was first observed after about 5 years and has steadily increased since then. When averaged across N rates, P increased sorghum yields 12 bu/acre over 31 years, 18 bu/acre over the past 10 years, and 24 bu/acre in 1991. For both corn and sorghum, P applied without N did not increase grain yield. The yield potential of sorghum was about 25% less than corn.

When no fertilizer P was applied, soil P levels reduced rapidly from about 18 ppm Bray-1 P initially to less than 10 ppm after about 5 years and then stabilized at this lower level for both corn and sorghum (Figs. 1 and 2). At low N rates, soil P was increased by application of P fertilizer to both corn and sorghum. However, at higher N rates on sor-

Table 1. Effect of nitrogen and phosphorus on yield of irrigated grain sorghum and corn, Tribune, KS.

Rate N	Rate P_2O_5	Sorghum 1991	Sorghum 1982-1991	Sorghum 1961-1991	Corn 1991	Corn 1982-1991	Corn 1961-1991
lb/acre		-----------		bu/acre[1]			-----------
0	0	67	72	72	64	82	70
	40	59	72	73	78	87	73
40	0	91	87	93	82	109	107
	40	121	109	107	119	131	119
80	0	100	95	105	82	115	121
	40	138	111	114	158	150	143
120	0	97	91	103	90	114	124
	40	135	115	118	180	166	159
160	0	109	93	103	89	120	131
	40	134	118	121	206	177	169
200	0	110	97	105	92	119	132
	40	134	117	121	196	173	166
MEANS							
Nitrogen							
0 lb/acre		66	73	73	73	86	73
40		112	101	102	106	124	115
80		125	107	112	129	139	136
120		123	107	114	156	151	148
160		125	108	114	166	155	155
200		130	111	116	164	155	155
LSD .05		10	4	3	10	8	4
Phosphorus							
0 lb/acre		96	89	97	83	110	114
40	120	107	109	156	147	138	
LSD .05		7	3	2	8	5	3

[1]Grain sorghum yields adjusted to 12.5% moisture and corn yields adjusted to 15.5% moisture.

Figure la. Effect of N rate on soil Bray-l P level with additional P fertilizer on corn.

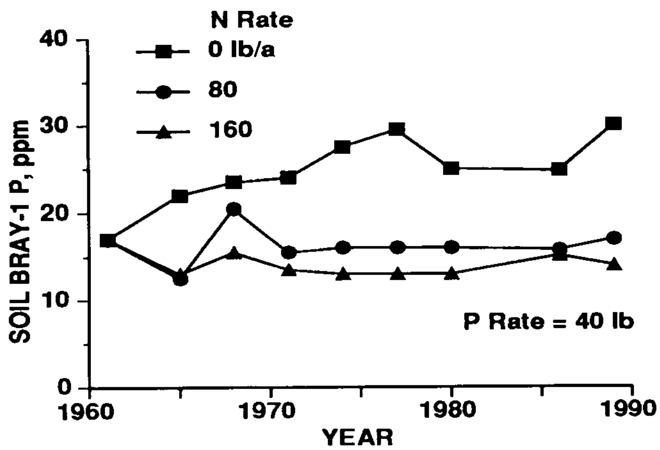


Figure lb. Effect of N rate on soil Bray-l P level without additional P fertilizer on corn.

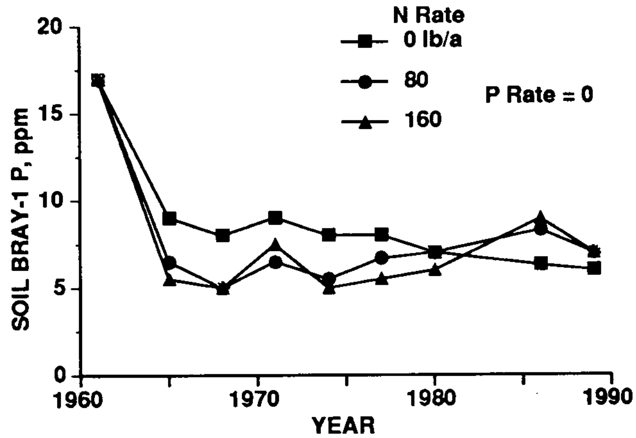


Figure 2a. Effect of N rate on soil Bray-1 P level with additional P fertilizer on grain sorghum.

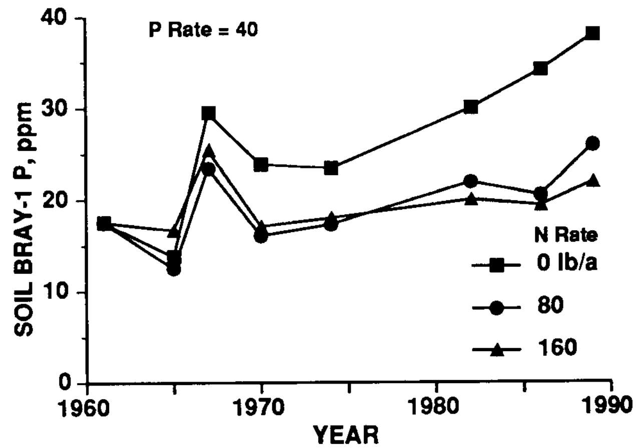
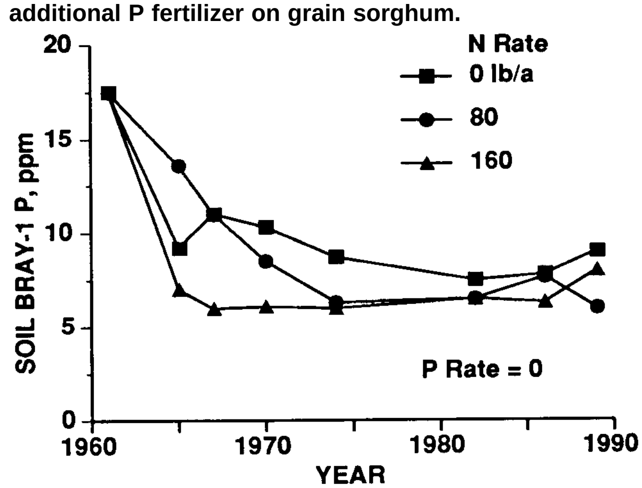


Figure 2b. Effect of N rate on soil Bray-1 P level without additional P fertilizer on grain sorghum.



ghum, application of P (40 lb P_2O_5/acre) only maintained soil P levels, indicating P removal was about equal to P additions. With corn, soil P levels tended to decline slightly even with application of P, indicating that P removal by corn exceeded that supplied by fertilizer P.

Nitrate levels in the soil profile after 30 years of N and P applications were greater with higher N rates (Fig. 3 and 4). At higher N rates, nitrate accumulation was less with corn than sorghum, reflecting greater N removal by corn. The addition of P reduced nitrate accumulation throughout the profile, particularly for sorghum. When high rates of N (160 lb/acre or above) were applied without P to sorghum, over 400 lb nitrate-N accumulated in the soil profile between 5 and 10 ft., which is below most root growth. With reduced possibility of plant uptake, this nitrate is more susceptible to further leaching and could contaminate groundwater. This emphasizes the importance of a balanced fertility program and the environmental hazard of applying N fertilizer in excess of crop requirements.

Figure 3. Effect of 30 years of N and P application to irrigated corn on NO_3-N content of the soil profile (0 to 10 ft), Tribune, KS.

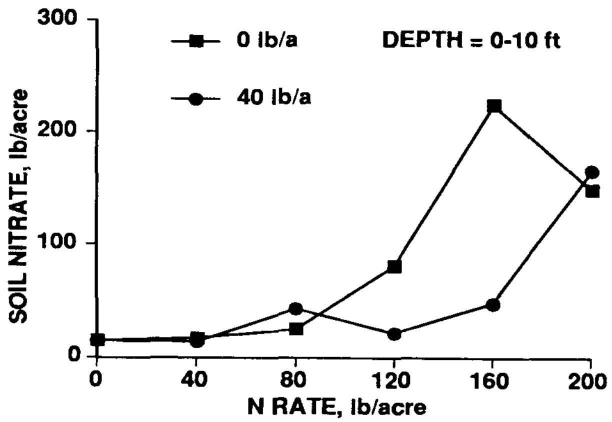
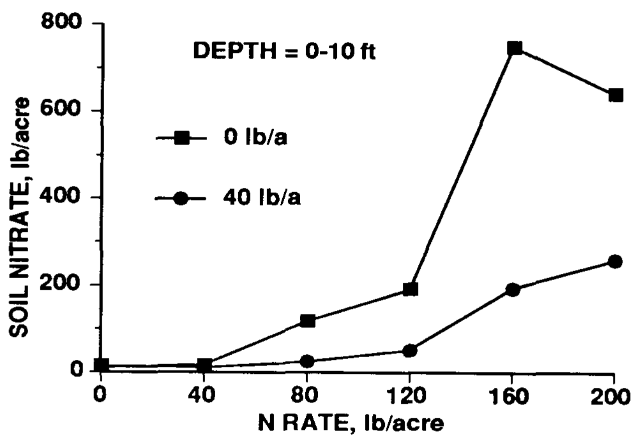
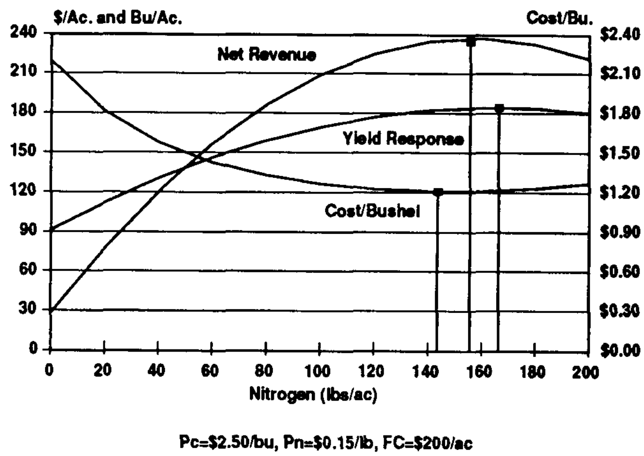


Figure 4. Effect of 30 years of N and P application to irrigated grain sorghum on NO_3-N content of the soil profile (0 to 10 ft), Tribune, KS.



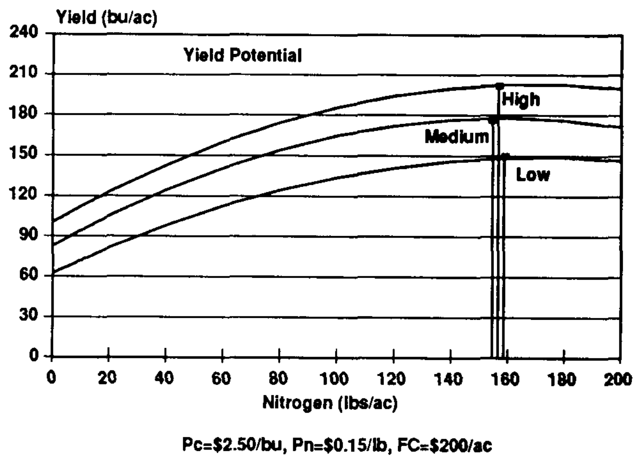
The economic optimal N rate for corn is about 155 lb N/acre using the long-term average yield (Fig. 5).

Figure 5. Estimated yield response, net revenue, and cost per bushel of irrigated corn averaged over 30 years, Tribune, KS.



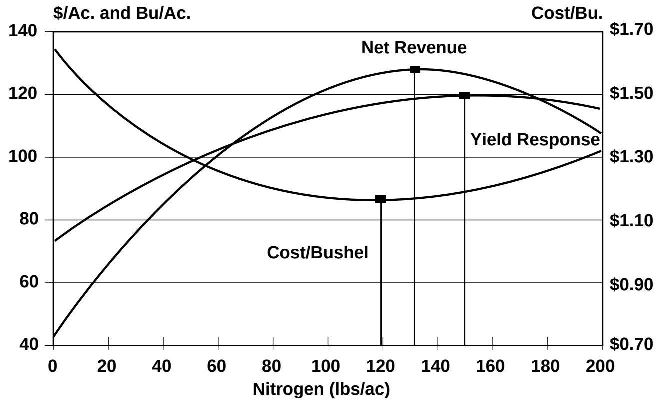
This is about 10 lb N/acre less than the N rate producing maximum grain yield and 10 lb N/acre more than that producing least cost per bushel production. When production functions were determined by yield potential, the economic optimal N rate remained at about 155 lb N/acre for years with low, medium, or high yield levels (Fig. 6).

Figure 6. Estimated economic optimal level of N for irrigated corn at three yield potentials, Tribune, KS.



For sorghum, the economic optimal N rate is about 135 lb N/acre based on long-term average yields (Fig. 7).

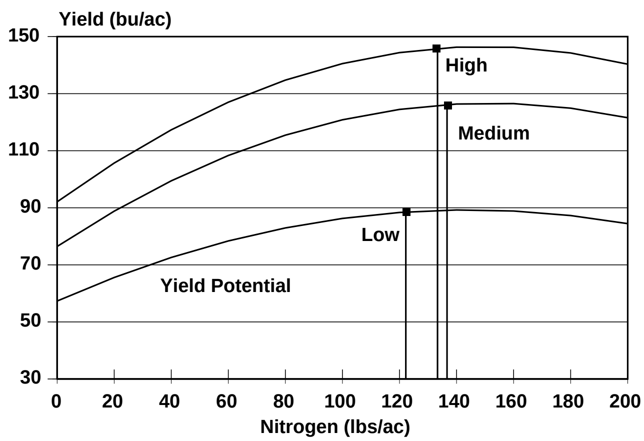
Figure 7. Estimated yield response, net revenue, and cost per bushel of irrigated grain sorghum averaged over 30 years, Tribune, KS.



Ps = $2.25/bu, Pn = $ 0.15/lb, FC = $120/ac

This compares to maximum grain yield obtained at 150 lb N/acre and least cost per bushel production obtained at 120 lb N/acre. The economic optimal N rate for sorghum at medium and high yield potentials remain about 135 lb N/acre, where as that for low yield potential is about 120 lb N/acre (Fig. 8).

Figure 8. Estimated economic optimal level of N for irrigated grain sorghum at three yield potentials, Tribune, KS.



Ps=$2.25/bu, Pn=$0.15/lb, FC=$120/ac

This suggests that, for a particular field, the optimum N rate is fairly constant. Therefore, the practice of applying additional N to provide adequate N in case of better than average growing conditions, so called "insurance" N, is unnecessary and reduces net return.

CORN BORER MOTH FLIGHTS IN FINNEY COUNTY, KANSAS, 1991

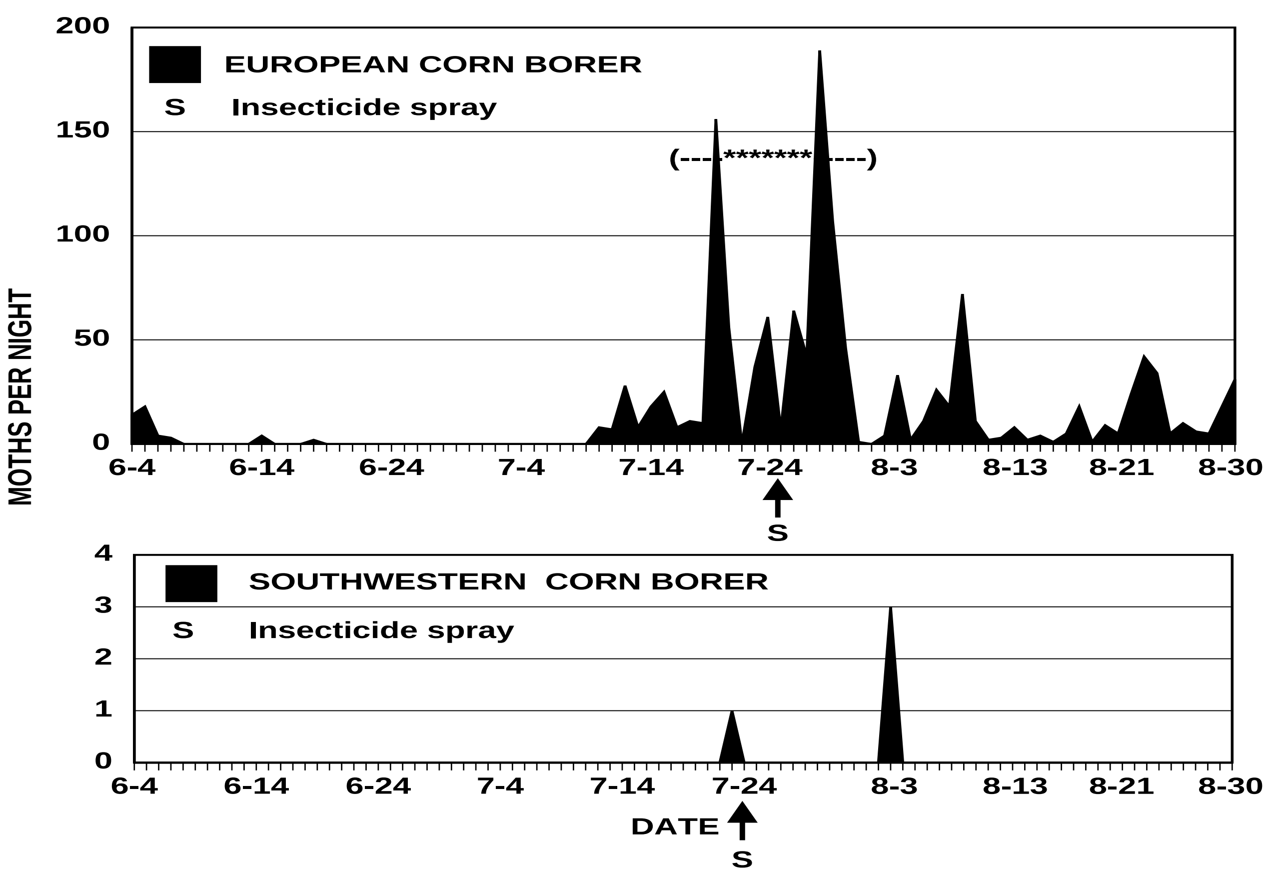
by
L. G. Wildman and Gary Dick

Corn borer moth flights at the Southwest Research-Experiment Station were monitored with a black light trap to give an indication of when fields should be scouted for corn borer second generation egg laying and larvae. European corn borer (ECB), Ostrinia nubilalis (Hubner), and Southwestern corn borer (SWCB), Diatraea grandiosella (Dyar), were monitored from May 4 to August 30, 1991.

The first generation of ECB reached a peak of 18 moths per night on May 5 and 6 (Fig. 1). The second generation moths were numerous, peaking on July 19 at 156 (132 females and 24 males). The incidence of SWCB moths was very low. Only four SWCB moths were found in the light trap for the entire monitoring time.

The European Corn Borer Software, developed by the KSU Department of Entomology, was used to predict the peak second generation egg laying period. The peak egg laying period was between July 16-Aug. 3 (--**--, Fig. 1). The 25-50% oviposition period, July 20-26, is indicated by asterisks (***). Spider mites occurred at damaging levels on the station. Bulk corn fields were sprayed on July 24 at a rate of 0.08 lbs/acre with Capture insecticide (S, Fig. 1). The entomology experimental plots were sprayed on July 29 using various insecticides.

Figure 1. European and Southwestern corn borer moths captured per night from light trap at the Southwest Research-Extension Center, Garden City. European corn borer second generation egg laying period was July 16 to Aug. 3, (--*--).



KSU Southwest Research-Extension Center

EFFICACY OF STANDARD AND SIMULATED CHEMIGATION APPLICATIONS OF INSECTICIDES FOR SECOND GENERATION CORN BORER CONTROL AND THEIR EFFECT ON SPIDER MITES, 1991

by

*Gary Dick, Phil Sloderbeck, Lisa Wildman, and Steven Posler**

SUMMARY

Several insecticides were evaluated for control of European corn borer and for their effect on spider mites on furrow-irrigated field corn. Corn borer oviposition was moderate to heavy in 1991. Eight of 13 treatments resulted in a significant reduction in numbers of fourth and fifth instar, European corn borer larvae compared to the untreated check. Nine of 13 treatments resulted in a significant reduction in proportion of plants infested with European corn borer compared to the untreated check. All treatments except the reduced-mite check resulted in a significant reduction in the amount of European corn borer tunnelling in corn stalks compared to the untreated check. The medium and high rates of Penncap-M 2FM ranked with the corn borer rates of Capture 2EC and Furadan 4L in effectiveness against European corn borer.

Banks grass mite was the predominant mite species present throughout the test period (98.9% and 97.3% Banks pre- and post-treatment, respectively). Significant differences occurred among treatments in their effect on spider mite numbers, but the usefulness of these data is questionable because spider mite numbers remained well below economic thresholds during the study period.

INTRODUCTION

This test was conducted to evaluate the efficacy of standard ground applications and simulated chemigation applications of several insecticides for the control of second generation European corn borer (ECB), Ostrinia nubilalis (Hübner), and southwestern corn borer (SWCB), Diatraea grandiosella (Dyar), on field corn in southwest Kansas. Populations of Banks grass mite (BGM), Oligonychus pratensis (Banks), and twospotted spider mite (TSM), Tetranychus urticae Koch, were observed to determine if any of the corn borer insecticides reduced mite numbers or caused spider mite numbers to "flare".

PROCEDURES

European Corn Borer. This test was conducted using a natural infestation of European corn borer in a furrow-irrigated corn field at the Southwest Research-Extension Center, Finney County, Kansas. Treatments were arranged in a randomized complete block design with four replications. Plots were four rows (10-ft) wide and 50 ft long with a 4-row (10-ft) border of untreated corn on each side and a 10-ft alley at each end. Plots were treated using CO_2-powered backpack sprayers with a tank mix of Banvel and Activator 90 on 19 June to control heavy populations of broadleaf weeds in the crop row that escaped pre-plant incorporated and post-emergence herbicide applications.

Simulated chemigation applications of insecticides were made using three Delavan 100/140, 3/4-in, raindrop nozzles mounted on a high clearance sprayer at tassel height between rows. This system was calibrated to deliver the equivalent of a 0.2-in irrigation on the two center rows (5227 gal/a). Standard insecticide treatments were applied with a high clearance sprayer using a 10-ft boom with three nozzles directed at each row (one nozzle directly over the row and one on each side of the row on 18-in drop hoses) and calibrated to deliver 23.6 gal/a at 2.4 mph and 31 psi.

Ample first generation ECB larvae were collected from the plot field and other local fields between 27 June and 2 July in order to use Kansas State University's European Corn Borer Software model to predict the second generation egg laying period. The model predicted 25-50% oviposition to occur during a 9-day period from 19 July to 27 July, which is about the same as in 1990 but earlier than in 1989. The predicted oviposition period coincided with peak light trap catches of European corn borer moths at the SWREC. During this period, we examined the plot field and other local corn fields visually for corn borer oviposition in order to fine-tune the insecticide application date. The ideal target date for a single application of corn borer insecticides was

22-24 July (mid 25-50% oviposition range) according to the predictive model. We decided to treat on 24 July, but while we were waiting for the lower end of the field to dry sufficiently to enter with the high clearance sprayer, we received one or two heavy thunderstorms, which prevented us from making timely insecticide applications. Treatments were finally applied on 29 July, which was about 3-4 days past the optimal timing predicted by the model. This was not entirely bad, because the ECB oviposition period extended well past the model-predicted cutoff date. The fact that treatments were applied late should be taken into account when interpreting the data. Comite was applied to one set of plots to produce a "reduced-mite check" designed to prevent spider mites from rendering corn plants unsuitable as hosts for corn borers and to help us determine the effect of spider mites on corn borer populations and corn yields.

Corn borer counts were made in early September by dissecting a total of 15 corn plants from the two center rows of each plot (8 consecutive plants left row, 7 consecutive plants right row). The number of live ECB larvae, the number of plants with tunneling, and the total length (cm) of tunneling were recorded and analyzed using SAS Proc GLM.

Spider Mites. To determine the effect of corn borer insecticides on spider mite populations, two plants were selected in each of the two center rows (four plants total) of each plot and flagged. Prior to application of corn borer insecticides, naturally occurring populations of BGM were relatively evenly distributed and had reached numbers such that we believed artificial infestation would not be necessary. A pre-treatment count was made on 23 July by visually searching every other leaf (one-half plant) on the flagged plants for large (adult female) spider mites. Two post-treatment, half-plant, spider mite counts were made on 6 and 12 August. Results were converted to mean number of spider mites per one whole plant ($n = 4$) and analyzed statistically using SAS Proc GLM. On the first and last sample dates, samples of spider mites were collected from plants adjacent to the marked plants using a Henderson-McBurnie leaf brushing machine and mounted on glass slides for microscopic determination of species. Percent control of mites was calculated using the Henderson & Tilton formula, which adjusts the percent control in treated plots for increases or decreases in mite numbers that occur in the untreated check plot.

Harvest yields (bu/acre), adjusted to 15.5% moisture, were estimated by collecting the ears from the 15 plants split during the corn borer damage analysis and adjusting these values to 1 acre using established stand counts. Test weights (lb/bu) of samples were determined electronically using a Dickey-John GAC-II.

RESULTS AND DISCUSSION

European Corn Borer. The ECB light trap catch reached a 5-year high on the night of 19-20 July. Corresponding oviposition was heavier than it had been for the past several years and occurred over an extended period of time. In other local fields surveyed to fine-tune treatment date, European corn borer infestations ranged from 16 to 168 egg masses per 100 plants. In the study field at the time of treatment, the corn borer infestation was 22 egg masses per 100 plants and fresh eggs were still being laid. This test historically includes an evaluation of SWCB, but very few occurred in our plots in 1991. This is the third straight year that we have experienced very low SWCB populations.

Throughout the mid-late growing season, drought conditions prevailed and one or more irrigations were delayed or missed because of the need to schedule irrigation around our treatment applications. This resulted in severe moisture stress in parts of two blocks, and yield was very low and erratic in these areas. However, this did not appear to adversely affect European corn borer oviposition.

Eight of the treatments significantly ($p < 0.01$) reduced the number of live ECB larvae per 15 plants compared to the untreated check (Table 1). Nine of the treatments significantly reduced the proportion of plants infested with live ECB larvae compared to the untreated check. All treatments except the reduced-mite check (Comite) significantly reduced the length of ECB stalk tunneling compared to the untreated check. Capture 2EC, Furadan 4F, and the medium and high rates of Penncap-M 2FM resulted in generally acceptable ($\geq$70%) control of length of tunneling, but the reduction in length of tunneling was not statistically greater compared to other treatments except Javelin WG. The Bacillus thuringiensis products (Javelin, Dipel, and MVP) did not perform as well in this test as they have the last 2 years. The relatively good efficacy of Penncap-M and the relatively poor efficacy of B. thuringiensis products may have been due to the lateness of treatments relative to peak ECB oviposition. No significant occurred differences in yield among treatments because of the irrigation problems and correspondingly erratic growing conditions.

Spider Mites. Banks grass mite was the predominant species present both before and 14 days after treatment (98.8% and 97.3%, respectively). Low numbers of TSM occurred in some plots but numbers were too low to have a significant impact on results of this test. Spider mite numbers reached only about 10% or less of the economic threshold in the most heavily infested plots. Overall, plots averaged only 12 mites per plant before treatment and 16 mites per plant 14 days after treatment.

Significant replication effects and significant replication by treatment interactions occurred. As a result, it is difficult to draw any conclusions from the data concerning the effect of corn borer insecticides on spider mite populations. Some corn borer insecticides that usually do not flare mites appeared to do so, and some insecticides that usually flare mites resulted in some apparent control. We do not believe these are reliable observations and we attribute them to the low and highly variable number of mites on individual plants (see coefficients of variability (C.V.), Table 2).

Table 1. Efficacy of standard and simulated chemigation applications of insecticides for second generation corn borer control, Southwest Research-Extension Center, 1991. Percent control calculated using the value obtained in the untreated check plot.

	Average Per 15 Plants (Rounded)							
Treatment	Rate lb [AI] /acre[1]	# Larvae	% Control	# Plants Infest.	% Control	Tunnel Length (cm)	% Control	Yield bu./ Acre[2]
STANDARD APPLICATION (23.6 gal/acre)								
Asana XL	0.04	9 c-h	47	9 b-d	31	60 b-d	63	135 a
Capture 2EC[3]	0.04	4 gh	76	5 e	62	27 cd	83	151 a
Furadan 4F	1.0	5 f-h	71	7 c-e	46	49 b-d	70	82 a
Javelin WG	1.0 lb	14 b-d	18	10 a-c	23	78 bc	52	87 a
Javelin WG	1.0 lb							
+ Kinetic	0.1%	15 bc	12	11 ab	15	101 b	38	134 a
Penncap-M 2FM	O.5	8 d-h	53	9 b-d	31	53 b-d	67	76 a
Penncap-M 2FM	0.75	4 gh	76	6 de	54	27 cd	83	130 a
Penncap-M 2FM	1.0	2 h	88	4 e	69	16 d	90	105 a
SIMULATED CHEMIGATION (5227 gal/acre)								
Dipel ES	2.0 pt	7 e-h	76	7 c-e	46	51 b-d	68	71 a
Javelin WG	1.0 lb	12 b-f	29	9 b-d	31	81 bc	50	175 a
Javelin WG	1.0 lb							
+ Crop Oil	1.0 qt	11 b-g	35	9 b-d	31	74 b-d	55	99 a
MVP	2.0 qt	9 c-h	47	10 a-d	23	83 bc	49	133 a
MYX-8018[3]	2.0 qt	12 b-e	29	10 a-c	23	81 bc	50	84 a
UNTREATED AND REDUCED-MITE CHECKS								
Untreated	0.0	17 ab	—	13 a	—	163 a	—	86
Reduced Mite Check								
(Comite 6.55EC)	2.4	21 a	—	13 a	—	161 a	—	147
ANOVA TABLE								
F-Value		6.29		5.91		5.58		1.77
F-Test Prob.		0.0001		0.0001		0.0001		0.08
Experiment C.V.		44%		26%		49%		47%

Means in the same column followed by the same letter do not differ significantly (DMRT).

[1]Except Dipel ES (pints/acre) and MVP and MYX-8018 (quarts/acre).

[2]Yield figures are not reliable due to severe moisture stress related to uneven irrigation water distribution and irrigation timing.

[3]**This product not currently registered for use on field corn.**

*Graduate Student, University of Nebraska, Lincoln.

Table 2. Effect of corn borer insecticides on spider mite numbers (DAT = Days after Treatment).

Treatment	Rate lb [AI] /acre[1]	Pre-Treat # mites	8 DAT # mites	8 DAT % control	14 DAT # mites	14 DAT % Control
STANDARD APPLICATION (23.6 gal/acre)						
Asana XL	0.04	7.7 bc	3.6 b-d	52	12.0 de	-57
Capture 2EC[2]	0.04	9.0 c	2.1 cd	75	16.4 c-e	-85
Furadan 4F	1.0	11.8 a-c	4.0 b-d	66	8.0 de	32
Javelin WG	1.0 lb	7.2 a-c	5.0 b-d	64	5.9 e	59
Javelin WG	1.0 lb					
+ Kinetic	0.1%	11.3 a-c	9.5 b-d	14	8.7 de	22
Penncap-M 2FM	O.5	13.5 a-c	10.9 a-d	18	17.9 c-e	-34
Penncap-M 2FM	0.75	10.4 a-c	13.0 a-d	-27	39.0 a	-284
Penncap-M 2FM	1.0	17.1 ab	21.4 a	-28	34.0 ab	-98
SIMULATED CHEMIGATION (5227 gal/acre)						
Dipel ES	2.5 pt	14.4 a-c	13.8 a-c	-12	30.0 a-c	-142
Javelin WG	1.0 lb	19.8 a	13.8 a-c	29	21.6 b-d	-10
Javelin WG	1.0 lb					
+ Crop Oil	1.0 qt	8.9 bc	11.0 a-d	-27	12.5 de	-42
MVP	2.0 qt	7.2 c	5.2 b-d	26	12.0 de	-67
MYX-8018[2]	2.0 qt	15.7 a-c	4.8 b-d	69	11.0 de	30
UNTREATED OR REDUCED-MITE CHECKS						
Untreated	0.0	14.7 a-c	14.4 ab	—	14.6 de	—
Reduced Mite Check						
(Comite 6.55EC)	2.4	12.0 a-c	1.5 d	87	3.5 e	71
ANOVA TABLE						
F-Value		1.99	2.83	—	6.62	—
F-Test Prob.		0.02	<0.01	—	<0.01	—
Experiment C.V.		227%	383%	—	272%	—

Means in the same column followed by the same letter do not differ significantly (DMRT).
[1]Except Dipel ES (pints/acre) and MVP and MYX-8018 (quarts/acre).
[2]**This product not currently registered for use on field corn.**

****

We would like to acknowledge the very able assistance of Steve Sandoval, Mike Sandoval, and Larry Powell. Their patience, persistence, and attention to detail resulted in useable, complete, and reliable data sets for all 8 tests we conducted this year (despite not having enough spider mites to yield meaningful data in several cases). The SWREC Farm Crew worked diligently through this summer's drought conditions to keep plots watered as well as our spraying and counting schedule would allow.

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EFFICACY OF MITICIDES AGAINST SPIDER MITES IN CORN, 1991

by
Gary Dick, Phil Sloderbeck, Lisa Wildman, and Steven Posler

SUMMARY

Despite artificially infestation of the study field, spider mite numbers were quite low in 1991 compared to the previous 2 years. Natural populations of predatory mites and insects apparently kept spider mite populations well below economic thresholds. The species composition of spider mites present remained above 98% Banks grass mites during this test. Significant differences in number of mites occurred among treatments and blocks, but also significant treatment-by-block interactions for all sample dates. Even though some treatments appear to have resulted in significantly lower numbers of mites per plant, it is difficult to draw any definite conclusions from the data because mite numbers were low and not evenly distributed among plots. No significant corn yield differences occurred among treatments. The results of this study may not be broadly applicable. This test should be repeated in the presence of much higher numbers of spider mites before any general conclusions can be made.

INTRODUCTION

This trial was conducted to evaluate the efficacy of several miticides against the Banks grass mite (BGM), Oligonychus pratensis (Banks), and the twospotted spider mite, Tetranychus urticae Koch.

PROCEDURES

This experiment was conducted in a furrow-irrigated corn field at the Kansas State University Southwest Kansas Research-Extension Center, Finney County, KS. Treatments were arranged in a randomized complete block design with four replications. Plots were four rows (10 ft) wide and 50 ft long with a 4-row (10 ft) border of untreated corn on each side and a 10-ft alley at each end. All treatments were applied on 8 and 9 August with a high clearance sprayer using a 10-ft boom with three nozzles directed at each row (one nozzle directly over the row and one on each side of the row on 18-in drop hoses). The sprayer was calibrated to deliver 23.6 gal/a at 2.4 mph and 31 psi.

Unlike the situation in 1990, spider mite numbers remained very low well into the growing season. As a result, plots were artificially infested. Two plants were selected from each of the two center rows of each plot and flagged (four plants per plot). On 9 July, spider mite-infested leaves were collected from a cooperator farm approximately 10 miles southeast of Garden City, Kansas. These leaves were cut into small pieces and attached to the marked corn plants in each plot in order to initiate spider mite populations. A subsample of these leaf pieces (n=10) was determined to contain an average of 92 BGM and two predatory mites per piece. Infestations were somewhat successful in that small mite colonies became established. However, the rapid mite increase that so often occurs during favorable weather did not occur.

A pre-treatment spider mite count was made in each plot on 29 July by visually searching every other leaf (one-half plant) on the flagged plants for large (adult female) spider mites. Heavy rains following irrigation rendered the field too muddy to treat on the target date, 2 August. Because of the rain, the pre-treatment half-plant counts were repeated on 7 August. Treatments were applied on 8 and 9 August. A single post-treatment half-plant count was made on 16 August, 7 days after treatment (DAT). Results of each count were averaged over the four marked plants and analyzed statistically using SAS Proc GLM. Mean number of mites per half plant was multiplied by two, and the results are presented in Table 1 as mites per one whole plant.

On each sample date, samples of spider mites were taken from the four flagged plants in each plot using a vacuum sampler and mounted on glass slides for microscopic determination of species. On 16 August, plots were rated to determine if the sulfur treatments (TD-2322 and Microthiol Special) were phytotoxic.

Harvest yields (bu/acre), were estimated by collecting a 1/1000-acre sample of ears from an 8.7-ft section of each of the two center rows. The corn was shelled mechanically, weighed, and tested for moisture. The gross weight was adjusted to 15.5% moisture and converted to bu/acre. Test weights (lb/bu) of samples were determined electronically using a Dickey John GAC-II. Results are reported in Table 1.

RESULTS AND DISCUSSION

The mite species composition remained above 98% BGM throughout the study period and is treated as a single-species complex in this discussion. The stagnant nature of the mite population, despite general drought conditions for most of the summer, is indicated by the lack of substantial change in mite numbers between the first and second pre-treatment counts (Table 1). No significant differences occurred in corn yield among treatments. None of the treatments were phytotoxic.

Highly significant differences ($p<0.01$) occurred in number of mites among treatment on all sample dates, as well as significant ($p<0.01$) block and block by treatment interactions. As a result, it is difficult to draw any definite conclusions from the data. Even though the number of mites appears to be significantly lower in some treatments, it is not clear whether this is a treatment effect or an artifact of the low and variable spider mite numbers. The percent control for each treatment was calculated using the Henderson & Tilton formula, which adjusts the amount of control based on an increase or decrease in number of mites in the untreated check. These data may not be truly representative of product performance under heavy mite pressure. In reality, much of the decrease in mite numbers was probably due to the activity of predatory mites and insects. Data on predator numbers were collected but have not yet been analyzed. Our overall conclusion is that treatment for mites would not have been necessary if these conditions had occurred in a commercial field.

Table 1. Efficacy of miticides against Banks grass mites and twospotted spider (as a species complex) in field corn (DAT = Days after Treatment).

Treatment	Rate lb [AI] /acre	MEAN NO. MITES[1] Pre-Treat. First	Pre-Treat. Second	Post-Treat. 7 DAT	% CONTROL[2]	Adj. yield bu/A[1]
Capture 2EC[3]	0.04	2.2 d	5.6 fg	4.0 cd	64	171 a
Capture 2EC[3]	0.08	3.9 cd	2.4 g	0.2 d	96	168 a
Capture 2EC[3]	0.06					
+ Cygon 400	0.50	8.4 b-d	4.6 fg	0.3 d	97	158 a
Capture 2EC[3]	0.06					
+ Furadan 4F	0.75	4.2 cd	4.6 fg	0.0 d	100	187 a
Capture 2EC[3]	0.08					
+ Furadan 4F	0.75	7.4 b-d	6.0 fg	0.4 d	97	171 a
Comite 6.55EC	1.64	5.2 b-d	7.6 e-g	7.4 cd	51	154 a
Comite 6.55EC	2.40	4.6 c-d	4.2 fg	0.2 d	98	128 a
Comite 6.55EC	1.64					
+ Capture 2EC[3]	0.04	10.0 a-d	18.2 bc	20.2 bc	44	136 a
Comite 6.55 EC	1.64					
Cygon 400	0.50	6.2 b-d	8.2 d-g	1.6 cd	90	105 a
Cygon 400	0.50	9.2 b-d	12.0 c-f	3.2 cd	87	135 a
Furadan 4F	0.75	4.8 cd	2.8 g	0.2 d	96	143 a
Furadan 4F	0.50					
+ Disyston 8E	1.00	5.0 cd	12.6 c-e	2.2 cd	91	174 a
Metasystox-R 2SC	0.50	6.9 b-d	5.0 fg	0.3 d	97	147 a
Microthiol 80 DF	4.80 lb	17.0 a	21.6 ab	4.1 cd	90	120 a
Microthiol 80 DF	8.00 lb	10.4 a-c	10.2 c-g	5.0 cd	75	121 a
Penncap-M 2FM	0.75	11.4 a-c	27.8 a	56.2 a	-2	150 a
TD-2322 25 WP[3]	0.50	10.6 a-c	10.0 c-g	1.2 cd	94	141 a
TD-2322 25 WP[3]	1.00	12.8 ab	16.0 b-d	19.4 b-d	39	139 a
TD-2322 25 WP[3]	1.50	6.5 b-d	2.4 g	1.0 cd	79	150 a
Supracide 2EC[3]	0.50	6.6 b-d	11.4 c-f	4.6 cd	80	169 a
UNTREATED						
Check	—	11.4 a-c	16.2 b-d	32.0 b	—	174 a
ANOVA TABLE						
F-Value		2.5	7.27	6.09		0.51
F-Test Prob.		0.0001	0.0001	0.0001		0.95
C.V.		299%	262%	723%		40%

[1]Means in the same column followed by the same letter do not differ significantly (DMRT).
[2]Percent control was calculated using the Henderson and Tilton formula from the mean of the two untreated checks.
[3]**These products not labeled for use on field corn.**

GREENBUG UPDATE

by

Phil Sloderbeck, Roxanne Shufran, Tom Harvey**, Gerald Wilde* and Leroy Brooks**

Biotype E has been the most abundant greenbug biotype in Kansas since 1981. However, significant changes have been noted recently. During the last 4 years, two new pesticide-resistant types and a new biotype of the greenbug have been discovered in Kansas. The former are showing high levels of resistance to the organophosphate insecticides, including parathion and Lorsban. The new Biotype I greenbugs have overcome the resistance used in most of the Biotype E-resistant sorghums. These changes will make management decisions more complex, as the new biotype spreads throughout the High Plains.

The greenbug is a native of Europe and was first detected in the United States in 1882. Originally, it was described as a pest of wheat and other small grains. Over the years, several different types of greenbugs have been described based on their response to different host plants or pesticides (see Table 1).

It is now generally accepted that the term biotype should be reserved to describe an insect's response to its host plant. Therefore, we will not define the new pesticide-resistant greenbugs as being a new biotype. Currently, we are still unsure what, if any, significance to give to the Type 1 vs. Type 2 pesticide resistance. These names are based on the fact that we observe dark bands at two different locations on a gel electrophoresis plate. Work is currently underway to determine any real biological differences exist between these two types of banding patterns. These data may be available in the near future.

So far, all of the pesticide-resistant greenbugs we have sent to Dr. Tom Harvey at Hays and Dr. Gerald Wilde at Manhattan have been identified as Biotype E based on their response to host plants. However, greenbugs collected from Stevens County during 1990 were found to be a new biotype based on their ability to damage most Biotype E-resistant sorghums and were named Biotype I. It is too early to tell what this discovery will mean to Kansas sorghum producers, but if it spreads as rapidly as Biotype E, it may become the predominant type within a few years.

Thus currently, four different types of greenbugs are known to be present in Kansas:

Biotype E that are susceptible to pesticides.
Biotype E that have Type 1 pesticide resistance.
Biotype E that have Type 2 pesticide resistance.
Biotype I that are susceptible to pesticides.

Table 1. Greenbug biotypes.

Biotype	Change Observed
B	Overcame resistance developed for wheat
C	Became a serious pest of sorghum
D	Developed resistance to Di-syston
E	Overcame resistance of Amigo wheat and several lines of Biotype C-resistant sorghum.
F	Found to damage Canada bluegrass
G	Found to damage all known wheat varieties, but not Wintermalt barley.
H	Damages Post barley
I	Overcame the resistance in most Biotype E-resistant sorghum lines

The results of surveys conducted to determine the distribution of these different types of greenbugs are shown on the following maps. Basically, pesticide-resistant Biotype E greenbugs have been reported from five states (Kansas, Nebraska, New Mexico, Colorado, and Texas (Fig. 1)). The new Biotype I greenbugs have been found in four states (Kansas, Nebraska, Colorado, and Texas (Fig. 2)).

Pesticide-resistant greenbugs and Biotype I greenbugs were easy to find in Southwest Kansas during 1991(Figs. 3 and 4). However, luckily the weather did not seem to be just right for a greenbug outbreak, and very little insecticide was applied. Where treatments were used, parasites and predators were able to quickly eliminate the remaining greenbugs. Thus, growers didn't really notice that the resistant greenbugs were present. This is in contrast with 1990, when parasites and predators were scarce, the resistant greenbugs left after the initial insecticide application soon rebounded to damaging levels, and additional sprays were ineffective.

Figure 1. Counties in which pesticide-resistant greenbugs were detected during 1991.

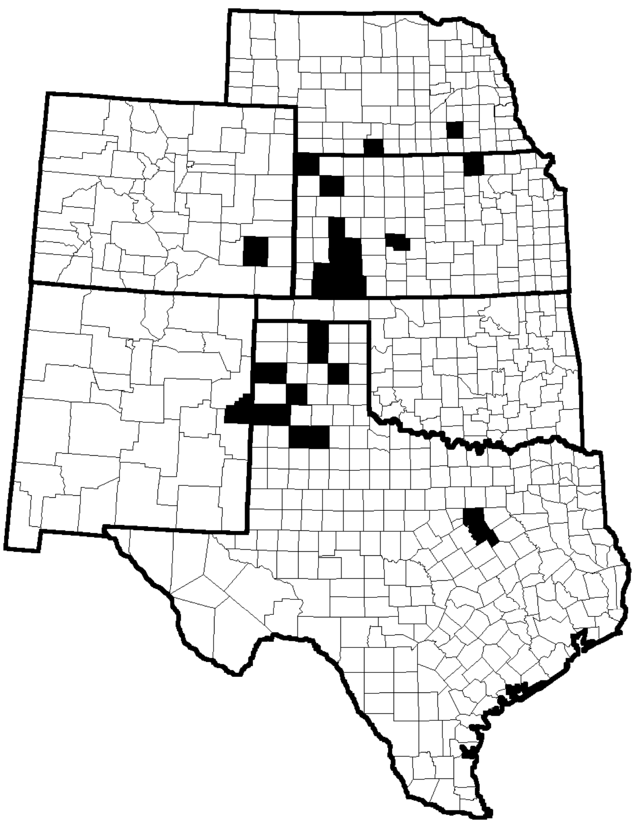
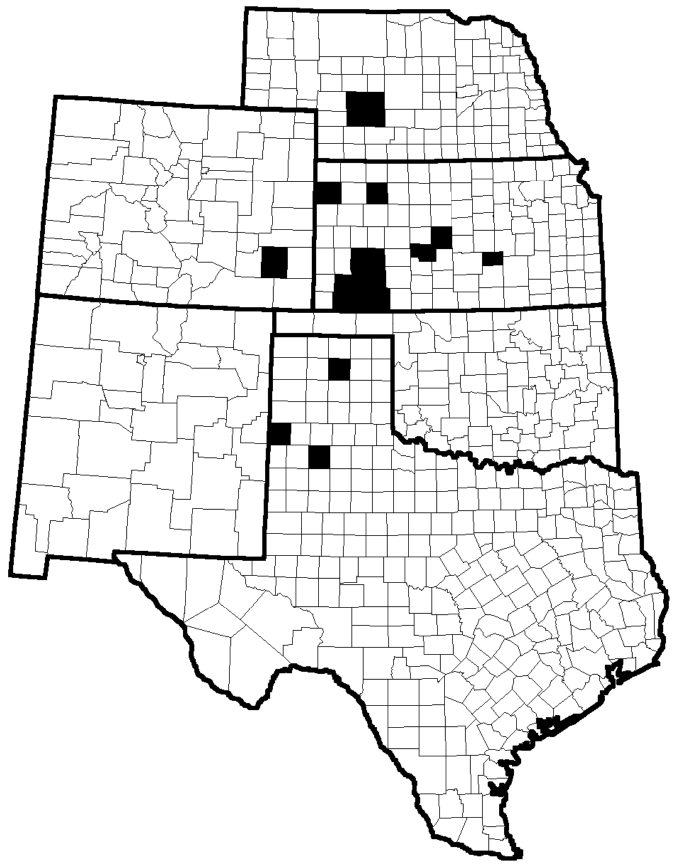


Figure 2. Counties in which Biotype I greenbugs were detected during 1991



o date, we are still working to determine if :ide resistance is present in the new Biotype I bugs. As mentioned earlier, all of the pesticide-ant greenbugs appear to be Biotype E. How-we have not tested a large enough number of pe I greenbugs to be sure they aren't occasion-lso pesticide-resistant. Biotype I is suspected esticide-resistant based on the similarity of its bution patterns to those of pesticide-resistant bugs. The worst case scenario would be for the Biotype I greenbug to have pesticide resistance. ecause this is a rapidly changing and confusing , please feel free to call Leroy Brooks or Phil rbeck if you have any questions about the s of greenbug biotypes or pesticide resistance. ill continue to monitor the greenbug popula-and hope to have more data on the pesticide-ant greenbugs soon.

Figure 3. Results of pesticide resistance enzyme tests - 1991.

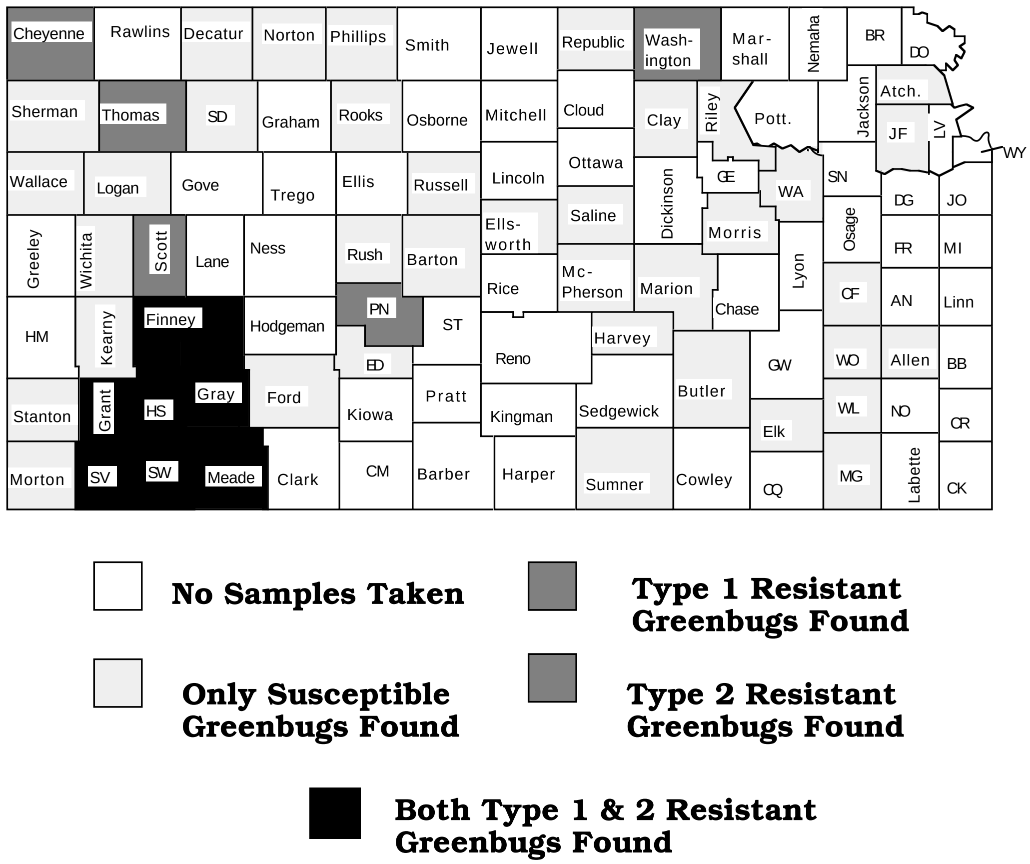
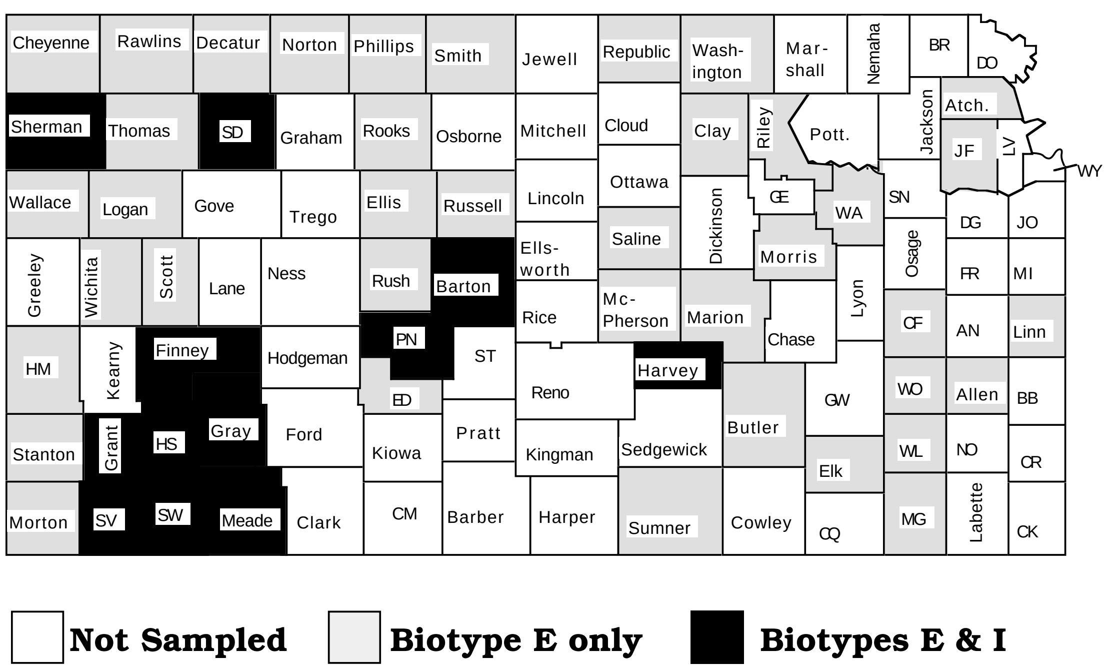


Figure 4. Biotype determination of greenbug collections - 1991.



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COMPARISONS OF 4 PREEMERGENCE HERBICIDE COMBINATIONS TO 21 POST-EMERGENCE HERBICIDE COMBINATIONS FOR WEED CONTROL IN CORN.[1]

by
Randall Currie and Dave Rust

SUMMARY

Many treatments provided good kochia and pigweed control. However, only the experimental compound San 582 + atrazine at 1 + 1 lbs ai/A, San 582 + Marksman at 1 + 1 1/4 lbs ai/A, and Lasso + atrazine at 2 + 1 lbs ai/A provided season-long control of kochia, pigweed, and foxtail. Analysis of pigweed and foxtail control was complicated by intense kochia competition. In general, preemergence herbicide programs outperformed total postemergence herbicide tank mixes.

Table 1. Cropping information.

Crop Name:	Corn
Variety:	4673B Delta Pine
Planting Date:	5-1-91
Planting Method:	JD Max Emerge 2
Rate, Unit:	28,000/A
Depth, Unit:	1 1/2 Inch
Row Spacing, Unit:	30 Inch
Soil Temp., Unit:	55°
Emergence Date:	Approximately 5/5/91 received rainfall within 30 hours of planting

INTRODUCTION

More than 32 herbicides and many more combinations of these herbicides are commonly used in field corn. This test compares many, but certainly not all postemergence herbicides, to three effective preemergence herbicide programs.

[1] This study is based on only one year's data. Management decisions should not be made solely on the information provided here. Always remember to read and follow all label instructions when using any pesticide and be advised that it is a violation of federal law to use any pesticide inconsistent with its labeling.

PROCEDURES

Furrow-irrigated corn was planted as described in Table 1., and herbicide treatments were applied pre- post-, and late post-emergance with a tractor-mounted CO2-pressurized sprayer as described in Tables 2,3, and 4.

Table 2. Pre-emergence spraying information.

Application Date:	5-2-91
Application Timing:	Pre-emergence
Appl. Equipment:	Tractor mounted windshield sprayer
Pressure, Unit:	30#
Nozzle Type:	Flat fan
Nozzle Size:	XR8004
Ground Speed, Unit:	4 MPH
Spray volume, Unit	16.7 GPA

Table 3. Post-emergence spraying information.

Application Date:	5-28-91
Appl. Equipment:	Windshield sprayer
Pressure, Unit:	30#
Nozzle Type:	Flat fan
Nozzle Size:	XR8004
Ground Speed, Unit:	4 MPH
Spray volume, Unit	16.7 GPA

Table 4. Late post-emergence spraying information.

Application Date:	6-11-91
Wind Velocity, Unit:	0-2 MPH
Appl. Equipment:	Bicycle sprayer
Pressure, Unit:	30#
Nozzle Type:	Flat fan
Nozzle Size:	XR8004
Ground Speed, Unit:	4 MPH
Spray volume, Unit	16.7 GPA

Treatments were arranged in a randomized complete block design with four replications. The percent weed control was calculated by dividing the number of a specific weed species per unit area in the treated plots by its corresponding control plot, subtracting this from 1, and multiplying the difference by 100.

RESULTS AND DISCUSSION

No herbicide treatment caused commercially significant injury to corn. However, all Buctril treatments caused statistically significant, albeit minor leaf speckling, which equated to 9.25 to 9.5% visual injury. In general, only those treatments containing atrazine provided good kochia control (Table 5. Treatments 4, 8, 9, 23, 26.). Treatments 1, 21, 22, and 24 provided poor kochia control although they contained atrazine. This poorer kochia control might be attributed to reduced efficacy of postemergence applications.

Although most treatments provided excellent pigweed control, in many instances, kochia competition was a significant component of pigweed control (Table 6). For example, treatments 5, 12, and 22 provided very poor kochia control, which, in turn, produced higher levels of pigweed control than expected. This additional control was probably due to kochia competition. Therefore, only those treatments that produced excellent kochia control should be used to compare pigweed control. For example, only treatments 1, 2 3, 4, 7, 8, 9, 17, 19, 20, 23, and 25 produced kochia control sufficient to allow the reader to conclude that subsequent pigweed control was due to herbicide treatment not kochia competition.

Kochia control also confounds the analysis of foxtail control (Table 7). Only in this instance, kochia control lead to dramatic increase in foxtail numbers. Once again, the reader is advised to consider the level of kochia pressure in this test when comparing foxtail control.

Table 5. Percent kochia control.

Trt No.	Treatment Name	Lbs/A	Growth Stage	Days After Planting 27	39	54	69	75
1	Buctril + Beacon + X-77	1/4 + .036 + 1/4% V/V	Post	48	80	90	75	78
2	Buctril + Beacon + X-77 + Beacon + X-77	1/4+.018+1/4%+.018+1/4% V.V	Post + Later Post	54	91	86	75	88
3	Buctril + Accent + X-77	1/4+.031+1/4% V/V	Post	16	94	79	88	68
4	Buctril + Accent + Atrazine 4L + X-77	1/4+.031+1/2+1/4% V/V	Post	*-2	91	91	83	98
5	SAN 582	1	Pre	9.8	*-27	*-90	*-50	5
6	SAN 582	1 1/4	Pre	33	37	*-34	13	38
7	SAN 582 + Atrazine	1+1	Pre	85	84	95	38	73
8	SAN 582 + Marksman	1 1/4+1.4	Pre + Post	18	90	81	83	93
9	SAN 582 + Marksman	1+1.4	Pre + Post	18	75	83	83	90
10	Laddok + Agridex	1+2 pts/A	Post	*-57	58	31	*-13	40
11	Sencor + Basagran	0.089+1/2	Post	*-37	62	7	13	48
12	Sencor + Basagan +X-77	0.089+1/2+1/4% V/V	Post	*-75	7	3	*-113	0
13	Sencor + Basagran + UAN	0.089+1/2+1 gal/A	Post	13	39	16	*-20	25
14	Sencor + 2.4-D Weedone LV4 Ester	0.089+.16	Post	*-24	32	47	*-42	33
15	Sencor + 2.4-D Weedone LV4 Ester	0.089+.25	Post	*-20	7	29	*-25	13
16	DPX 79406 + X - 77	0.0156+1/4% V/V	Post	*-22	28	*-60	21	40
17	DPX 79406 + Buctril + X - 77	0.0156+1/4+1/4% V/V	Post	*-56	69	93	29	80
18	DPX 79406 + Buctril + Atrazine + X-77	0.0156 +0.07 + 0.14 +1/4% V/V	Post	*-54	31	25	*-21	48
19	DPX 79406 + Banvel + X-77	0.0156+1/2+1/4% V/V	Post	*-136	14	75	70	90
20	DPX 79406 + Marksman + X-77	0.0156+1.4+1/4% V/V	Post	*-28	31	43	50	90
21	DPX 79406 + Atrazine +X-77	0.0156+1+1/4% V/V	Post	*-17	65	48	16	65
22	Laddok + UAN	1.04+1 gal/A	Post	*-46	65	26	4	63
23	Laddok + COC	1.04+12 qt./A	Post	13	88	90	67	90
24	Laddok + AMS	1.04+2.5#	Post	*-120	45	66	29	73
25	Lasso + Atrazine	2.0+1.0	Pre	60	98	95	92	100
26	Check			0	0	0	0	0
	LSD 0.05 =			nsd	44	11	10	56

* More present than in the control.

Table 6. Percent pigweed control.

Trt No.	Treatment Name	Lbs/A	Growth Stage	Days After Planting 27	39	54	69	75
1	Buctril + Beacon + X-77	1/4 + .036 + 1/4% V/V	Post	50	100	100	100	100
2	Buctril + Beacon + X-77 + Beacon + X-77	1/4+.018+1/4%+.018+1/4% V/V	Post + Later Post	*-10	100	100	100	100
3	Buctril + Accent + X-77	1/4+.031+1/4% V/V	Post	*-80	100	100	100	100
4	Buctril + Accent + Atrazine 4L + X-77	1/4+.031+1/2+1/4% V/V	Post	*-10	100	100	100	100
5	SAN 582	1	Pre	33	100	100	100	77
6	SAN 582	1 1/4	Pre	82	100	85	60	88
7	SAN 582 + Atrazine	1+1	Pre	93	0	100	80	88
8	SAN 582 + Marksman	1 1/4+1.4	Pre + Post	50	100	100	80	100
9	SAN 582 + Marksman	1+1.4	Pre + Post	60	100	92	80	100
10	Laddok + Agridex	1+2 pts/A	Post	*-180	67	100	60	100
11	Sencor + Basagran	0.089+1/2	Post	*-13	*-66	89	100	100
12	Sencor + Basagan +X-77	0.089+1/2+1/4% V/V	Post	43	*-33	94	-	55
13	Sencor + Basagran + UAN	0.089+1/2+1 gal/A	Post	*-58	33	95	80	77
14	Sencor + 2.4-D Weedone LV4 Ester	0.089+.16	Post	39	33	100	80	88
15	Sencor + 2.4-D Weedone LV4 Ester	0.089+.25	Post	54	100	100	100	88
16	DPX 79406 + X - 77	0.0156+1/4% V/V	Post	65	67	100	100	100
17	DPX 79406 + Buctril + X - 77	0.0156+1/4+1/4% V/V	Post	28	100	100	60	100
18	DPX 79406 + Buctril + Atrazine + X-77	0.0156 +0.07 + 0.14 +1/4% V/V	Post	67	100	100	100	100
19	DPX 79406 + Banvel + X-77	0.0156+1/2+1/4% V/V	Post	59	100	100	100	100
20	DPX 79406 + Marksman + X-77	0.0156+1.4+1/4% V/V	Post	17	100	100	100	100
21	DPX 79406 + Atrazine +X-77	0.0156+1+1/4% V/V	Post	*-15	100	100	100	100
22	Laddok + UAN	1.04+1 gal/A	Post	*-50	100	89	60	77
23	Laddok + COC	1.04+12 qt./A	Post	65	67	100	80	100
24	Laddok + AMS	1.04+2.5#	Post	*-100	33	95	100	100
26	Lasso + Atrazine	2.0+1.0	Pre	50	0	92	100	100
25	Check			0	0	0	0	0
	LSD 0.05 =			nsd	nsd	67	nsd	68

* More present than in the control.

Table 7. Percent foxtail control.

Trt No.	Treatment Name	Lbs/A	Growth Stage	Days After Planting 27	39	54	69	75
1	Buctril + Beacon + X-77	1/4 + .036 + 1/4% V/V	Post	*-65	*-111	*-22	*-100	*-67
2	Buctril + Beacon + X-77 + Beacon + X-77	1/4+.018+1/4%+.018+1/4% V/V	Post + Later Post	*-124	*-155	*-22	*-246	*-158
3	Buctril + Accent + X-77	1/4+.031+1/4% V/V	Post	*-70	*-33	*-55	*-262	*-100
4	Buctril + Accent + Atrazine 4L + X-77	1/4+.031+1/2+1/4% V/V	Post	*-74	*-100	*-5	*-115	*-108
5	SAN 582	1	Pre	41	85	100	100	92
6	SAN 582	1 1/4	Pre	88	81	92	53	92
7	SAN 582 + Atrazine	1+1	Pre	91	77	69	85	83
8	SAN 582 + Marksman	1 1/4+1.4	Pre + Post	41	96	97	100	83
9	SAN 582 + Marksman	1+1.4	Pre + Post	41	70	89	69	42
10	Laddok + Agridex	1+2 pts/A	Post	68	63	64	*-138	16
11	Sencor + Basagran	0.089+1/2	Post	*-20	48	11	*-130	*-100
12	Sencor + Basagan +X-77	0.089+1/2+1/4% V/V	Post	*-6	70	39	69	33
13	Sencor + Basagran + UAN	0.089+1/2+1 gal/A	Post	76	44	8	*-115	*-83
14	Sencor + 2.4-D Weedone LV4 Ester	0.089+.16	Post	32	26	42	38	*-8
15	Sencor + 2.4-D Weedone LV4 Ester	0.089+.25	Post	32	*-33	31	0	17
16	DPX 79406 + X - 77	0.0156+1/4% V/V	Post	47	55	47	46	42
17	DPX 79406 + Buctril + X - 77	0.0156+1/4+1/4% V/V	Post	*-12	*-22	*-81	*-23	*-25
18	DPX 79406 + Buctril + Atrazine + X-77	0.0156 +0.07 + 0.14 +1/4% V/V	Post	0	48	28	*-8	8
19	DPX 79406 + Banvel + X-77	0.0156+1/2+1/4% V/V	Post	73	55	*-11	*-8	*-16
20	DPX 79406 + Marksman + X-77	0.0156+1.4+1/4% V/V	Post	38	*-77	*-16	*-138	*-225
21	DPX 79406 + Atrazine +X-77	0.0156+1+1/4% V/V	Post	50	44	22	*-85	*-83
22	Laddok + UAN	1.04+1 gal/A	Post	56	*-15	0	*-54	*-75
23	Laddok + COC	1.04+12 qt./A	Post	*-35	*-215	*-158	*-254	*-167
24	Laddok + AMS	1.04+2.5#	Post	*-3	*-41	*-47	*-38	*-100
25	Lasso + Atrazine	2.0+1.0	Pre	94	77	78	92	75
26	Check			0	0	0	0	0
	LSD 0.05 =			nsd	nsd	nsd	nsd	52

* More present than in the control.

EFFECTS OF TIME OF APPLICATION OF 8 HERBICIDE COMBINATIONS FOR WOOLYLEAF BURSAGE (BUR RAGWEED) CONTROL

by

*Randall Currie, Dave Rust, and Peg Steward**

SUMMARY

Several herbicides were compared for woolyleaf bursage control in fallow. Tordon + 2,4-D at 0.25 + 1.0 lb ai/A and Tordon + Banvel at 0.25 + 0.50 lb ai/A applied at flowering controlled wooly leaf bursage 99.5% and 81.5%, respectively, 350 days after treatment, as compared to 88.5% and 80.8% control, respectively, for these two treatments applied after a light frost. XRM 5084 + Banvel at 0.375 + 0.5 lbs ai/A provided 86.4% control. All other treatments provided less than 77.4% control.

INTRODUCTION

Woolyleaf bursage, also known as bur ragweed, is a noxious perennial weed found most frequently in low lying areas of fields. It is also found in the higher areas of fields because of movement of root stocks and seeds by tillage equipment. Once established, this weed is difficult to control. The objective of this study was to compare several herbicides applied at flowering and after frost for control of woolyleaf bursage.

PROCEDURES

The study was established in August, 1990. The experimental design was a two factorial randomized complete block with two levels of application timing, nine levels of herbicide treatment, and three replications. Herbicides were applied with a CO_2-pressurized, hand-held sprayer equipped with a six-nozzle boom. Application volume was 20 gallons per acre. Herbicides were applied on August 15, 1990 at flowering and on September 13, 1990, after a light frost.

On April 25, 1992, a tank mix of Surflan, Bladex, and atrazine at 2, 4, and 2 lb ai/A was applied to the entire plot area to control all weed species but bur bagweed. The treatments were evaluated for weed control 255 and 350 days after treatments. The percent weed control was calculated by dividing the number of a specific weed species per unit area in the treated plots by it's corresponding control plot, subtracting this from 1, and multiplying the difference by 100.

RESULTS AND DISCUSSION

No late fall treatment outperformed herbicide applications at flowering 350 days after application. In only one instance, Stinger at 0.67 pt/A, did a late fall application outperform an at-flowering treatment 255 days after treatment (Table 1).

Only those treatments that produced greater than 37.8% control 350 days after treatment had any statistically significant impact on bur ragweed growth. Any treatment producing at least 61.7% control was not statistically significantly better than the best treatment, Tordon 22K + 2,4-D at 1 + 2 pts/A, which produced 99.5% control 350 days after treatment. This treatment was also rated as the most effective by Morishita under similar conditions near the S.W.R.E.C. in 1988.

Although labeled, Tordon can severely injure wheat under dry conditions that do not facilitate its breakdown. Tordon can also eliminate all weed cover during the fallow period, greatly enhancing the risk of severe wind and water erosion if very careful residue management is not practiced.

*Personal Consultant, Diamond Ag Research, Garden City.

Table 1. Bur ragweed control with 8 herbicide combinations applied at flowering (8/15/90) and in fall after light frost (9/13/90).[1]

		% Control[2] 255 Days after Trt.		% Control[2] 350 Days after Trt.	
Herbicide	Rate	Flwr	Fall	Flwr	Fall
	(pt/A)				
Stinger	0.33	- 34.4[3]	- 21.2	2.4	- 5.2
Stinger	0.67	33.6	75.5	28.3	36.5
XRM 5084 + Banvel	3 + 1	87.5	13.3	49.3	2.1
XRM 5084 + 2,4 D(LV4)	3 + 2	94.2	- 11.8	86.4	- 7.5
Tordon 22K + Banvel	1 + 1	98.3	98.9	81.5	88.5
Tordon 22K + 2,4 D(LV4)	1 + 2	100.0	96.0	99.5	80.8
Roundup +Banvel + Surfactant	4 + 1 + 1/4% V/V	39.6	30.1	19.4	19.2
Roundup + 2,4 D(LV4)+ Surfactant	4 + 2 + 1/4% V/V	96.3	- 20.5	77.4	13.2
Untreated		0		0	
LSD 0.05 =		41.2		37.8	

[1] This study is based on only one year's data. Management decisions should not be made solely on the information provided here. Always remember to read and follow all label instructions when using any pesticide and be advised that it is a violation of federal law to use any pesticide inconsistent with its labeling.
[2] Control is based on aboveground growth as a percentage of the untreated check. Aboveground growth was estimated by multiplying the average height times the average number of stems per unit area.
[3] A negative number indicates that more bur ragweed was found in these treatments than in the untreated control. In no case was this increase statistically significant.

COMPARISONS OF PREEMERGENCE HERBICIDE TREATMENTS PRECEDING APPLICATION OF ACCENT OR BEACON

by
Randall Currie and Dave Rust

SUMMARY

All Accent or Beacon treatments at full labeled rate preceded by any preemergence treatment provided excellent shattercane, pigweed, and kochia control. Although 1/2 X rates of Accent and Beacon used in combination with preemergence herbicides frequently provided very good control of these weed species, control was more variable.

INTRODUCTION

Shattercane is a weed that causes serious problems for corn growers. It is highly competitive and difficult to control. Accent and Beacon are sulfonyl urea herbicides for controlling shattercane in corn. The objective of this study was to compare these two compounds at 1 X and 1/2 X rates with and without several preemergent herbicide treatments for shattercane control in corn.

PROCEDURES

Furrow-irrigated corn was planted as described in Table 1., and herbicide treatments were applied pre- and postemergence with a tractor-mounted CO_2-pressurized sprayer as described in Tables 2. and 3. Treatments were arranged in a randomized complete block design. The percent weed control was calculated by dividing the number of a specific weed species per unit area in the treated plots by it's corresponding control plot, subtracting this from 1, and multiplying the difference by 100. The original intent of this experiment was to apply only full label rates of Accent or Beacon in two split 1/2 X rate applications. Weather did not permit the second application of Accent or Beacon; therefore, evaluations of a total postemergence weed control program are not possible.

Table 1. Crop information.

Crop Name:	Corn
Crop Variety:	D.P. 4673 B
Planting Date:	4-18-91
Planting Method:	JD Max Emerge
Rate, Unit:	28,400/A
Depth, Unit:	1.5”
Row spacing, Unit:	30”
Soil Temp., Unit:	55°F
Soil Moisture:	Fair
Emergence Date:	circa 4-22-91

Table 2. Preemergence application information.

Application Date:	4-17-91
Application Method:	Lilliston - (2 passes)
Hours to Incorp:	1-2
Incorp. Depth, Unit:	3”
Appl. Equipment:	Windshield Sprayer
Pressure, Unit:	30#
Nozzle Type:	Flat Fan
Nozzle Size:	XR8004
Ground speed, Unit	4 mph
Spray Volume, Unit:	16.7 GPA

RESULTS AND DISCUSSION

Although the data show several strong trends, these are based on only one years’ data and the distribution of weed species varied across the test. Therefore, the reader should use these data only as a very loose guide.

In general, any preemergence product followed by a full rate of Accent or Beacon provided good

Table 3. Postemergence application information.

Application Date:	6-5-91
Appl. Equipment:	Windshield Sprayer
Pressure, Unit:	30#
Nozzle Type:	Flat fan
Nozzle Size:	XR8004
Ground speed, Unit:	4 mph
Spray Volume, Unit:	16.7 GPA

control of shattercane, pigweed, and kochia (Tables 4, 5, 6.). Although many preemergence treatments followed by a half rate of Accent or Beacon performed well, these combination were more variable. Unfortunately, weather did not allow the second application of Accent or Beacon to treatments 16 or 17, so comparisons of full rates of these compounds by themselves could be made. Also, we should point out that a low level of Bicep ($13.05/A) is being compared to a higher rate of Eradicane + Atrazine or Sutan + Atrazine ($29.24 and $23.49, respectively). Although there are some exceptions, increases in herbicide cost generally equated to increased weed control which in turn translated into higher yield.

Table 4. Percent shattercane control.

Trt No.	Treatment	Lbs/A	GrowthH Stage	Days after planting 22	35	48	62	83
				Days after Post-Treatment		0	14	35
1	Sutan + Atrazine	6 + 1.5	PPI	78	79	83	31	74
2	Sutan + Atrazine + Accent + Surfactant	6 + 1.5 + 0.03125 + 1/4% V/V	PPI,post	90	87	72	67	87
3	Sutan + Atrazine + Accent + Surfactant	6 +1.5 + .0156 + 1/4% V/V	PPI,post	90	85	75	90	97
4	Sutan + Atrazine + Beacon (75 WG) + Surfactant	6 + 1.5 + .0356 + 1/4% V/V	PPI,post	96	87	71	92	100
5	Sutan + Atrazine + Beacon + Surfactant	6 + 1.5 + .0178 + 1/4% V/V	PRE,post	91	90	84	82	100
6	Eradicane Extra + Atrazine	6 + 1.5	PPI	100	97	92	78	69
7	Eradicane Extra + Atrazine + Accent + Surfactant	6 + 1.5 + 0.03125 + 1/4% V/V	PPI,post	100	95	75	87	95
8	Eradicane Extra + Atrazine + Accent + Surfactant	6 + 1.5 + .0156 + 1/4% V/V	PPI,post	100	95	88	92	97
9	Eradicane Extra + Atrazine + Beacon + Surfactant	6 + 1.5 + .0356 + 1/4% V/V	PRE,post	100	97	83	90	100
10	Eradicane Extra + Atrazine + Beacon + Surfactant	6 + 1.5 + .0178 + 1/4% V/V	PPI,post	100	100	83	92	87
11	Bicep	2.5 QT/A	PRE	61	3	48	15	44
12	Bicep + Accent + Surfactant	2.5 QT/A + .03125 + 1/4% V/V	PRE,post	43	21	73	72	97
13	Bicep + Accent + Surfactant	2.5 QT/A + .0156 + 1/4% V/V	PRE,post	52	23	68	21	54
14	Bicep + Beacon + Surfactant	2.5 QT/A + .0356 + 1/4% V/V	PRE,post	96	33	72	69	100
15	Bicep + Beacon + Surfactant	2.5 QT/A + .0178 + 1/4% V/V	PRE,post	100	69	66	64	82
16	Accent + Surfactant	.01563 + 1/4% V/V	post	70	**-54	10	51	59
17	Beacon + Surfactant	.0178 + 1/4% V/V	post	**-22	26	60	41	82
18	Check	***	***	0	0	0	0	0
	LSD = 0.05			28	44	59	49	65

** More shattercane was present than in the check.

Table 5. Percent pigweed control.

Trt No.	Treatment	Lbs/A	Growth Stage	Days after Planting 35	0	14	35
					Days after Post-Treatment 0	14	35
1	Sutan + Atrazine	6 + 1.5	PPI	100.0	98.2	100.0	100.0
2	Sutan + Atrazine + Accent + Surfactant	6 + 1.5 + 0.03125 + 1/4% V/V	PPI,post	100.0	91.1	100.0	100.0
3	Sutan + Atrazine + Accent + Surfactant	6 +1.5 + .0156 + 1/4% V/V	PPI,post	95.3	94.6	66.7	90.9
4	Sutan + Atrazine + Beacon (75 WG) + Surfactant	6 + 1.5 + .0356 + 1/4% V/V	PPI,post	100.0	100.0	100.0	100.0
5	Sutan + Atrazine + Beacon + Surfactant	6 + 1.5 + .0178 + 1/4% V/V	PRE,post	95.3	100.0	100.0	100.0
6	Eradicane Extra + Atrazine	6 + 1.5	PPI	100.0	100.0	100.0	100.0
7	Eradicane Extra + Atrazine + Accent + Surfactant	6 + 1.5 + 0.03125 + 1/4% V/V	PPI,post	97.7	100.0	100.0	100.0
8	Eradicane Extra + Atrazine + Accent + Surfactant	6 + 1.5 + .0156 + 1/4% V/V	PPI,post	100.0	100.0	100.0	100.0
9	Eradicane Extra + Atrazine + Beacon + Surfactant	6 + 1.5 + .0356 + 1/4% V/V	PRE,post	97.7	100.0	100.0	90.9
10	Eradicane Extra + Atrazine + Beacon + Surfactant	6 + 1.5 + .0178 + 1/4% V/V	PPI,post	97.7	94.6	100.0	100.0
11	Bicep	2.5 QT/A	PRE	100.0	100.0	100.0	100.0
12	Bicep + Accent + Surfactant	2.5 QT/A + .03125 + 1/4% V/V	PRE,post	76.7	91.1	66.7	100.0
13	Bicep + Accent + Surfactant	2.5 QT/A + .0156 + 1/4% V/V	PRE,post	97.7	100.0	0.0	90.9
14	Bicep + Beacon + Surfactant	2.5 QT/A + .0356 + 1/4% V/V	PRE,post	100.0	96.4	33.3	100.0
15	Bicep + Beacon + Surfactant	2.5 QT/A + .0178 + 1/4% V/V	PRE,post	97.7	46.4	66.7	54.5
16	Accent + Surfactant	.01563 + 1/4% V/V	POST	0.0	**-30.0	**-200.0	45.5
17	Beacon + Surfactant	.0178 + 1/4% V/V	POST	56.0	**-57.1	66.7	**-18.0
18	Check	***	***	0	0	0	0
LSD = 0.05				39.2	55.0	nsd	50.0

** More pigweed was present than in the check.

Table 6. Percent kochia control.

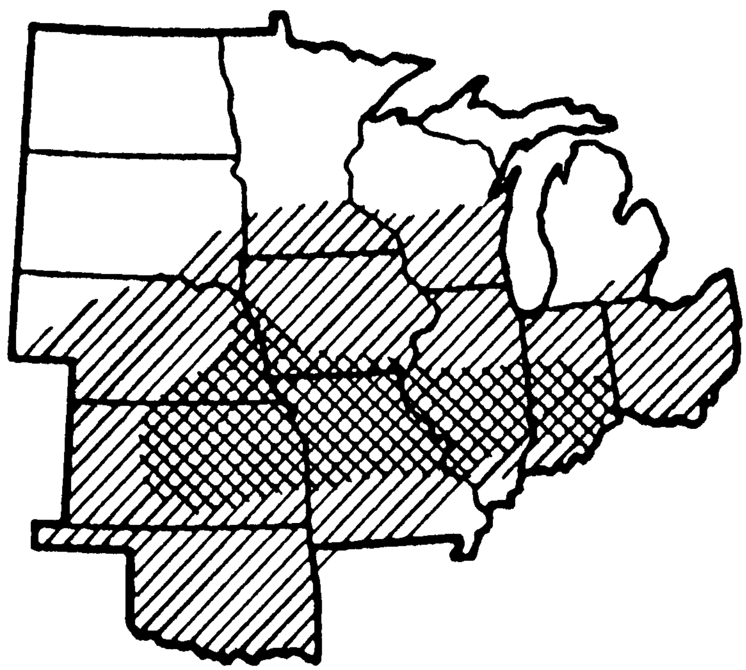
Trt No.	Treatment	Lbs/A	Growth Stage	Days after Planting 35	48	62	83
				Days after Post-Treatment	0	14	35
1	Sutan + Atrazine	6 + 1.5	PPI	100.0	100.0	100.0	100.0
2	Sutan + Atrazine + Accent + Surfactant	6 + 1.5 + 0.03125 + 1/4% V/V	PPI,post	100.0	75.0	100.0	100.0
3	Sutan + Atrazine + Accent + Surfactant	6 +1.5 + .0156 + 1/4% V/V	PPI,post	100.0	50.0	100.0	100.0
4	Sutan + Atrazine + Beacon (75 WG) + Surfactant	6 + 1.5 + .0356 + 1/4% V/V	PPI,post	100.0	75.0	100.0	100.0
5	Sutan + Atrazine + Beacon + Surfactant	6 + 1.5 + .0178 + 1/4% V/V	PRE,post	100.0	75.0	100.0	87.5
6	Eradicane Extra + Atrazine	6 + 1.5	PPI	100.0	100.0	100.0	100.0
7	Eradicane Extra + Atrazine + Accent + Surfactant	6 + 1.5 + 0.03125 + 1/4% V/V	PPI,post	100.0	100.0	100.0	100.0
8	Eradicane Extra + Atrazine + Accent + Surfactant	6 + 1.5 + .0156 + 1/4% V/V	PPI,post	100.0	100.0	100.0	100.0
9	Eradicane Extra + Atrazine + Beacon + Surfactant	6 + 1.5 + .0356 + 1/4% V/V	PRE,post	100.0	25.0	100.0	87.5
10	Eradicane Extra + Atrazine + Beacon + Surfactant	6 + 1.5 + .0178 + 1/4% V/V	PPI,post	100.0	100.0	100.0	100.0
11	Bicep	2.5 QT/A	PRE	75.0	75.0	75.0	87.5
12	Bicep + Accent + Surfactant	2.5 QT/A + .03125 + 1/4% V/V	PRE,post	75.0	**-50.0	75.0	50.0
13	Bicep + Accent + Surfactant	2.5 QT/A + .0156 + 1/4% V/V	PRE,post	**-50.0	25.0	**-50.0	87.5
14	Bicep + Beacon + Surfactant	2.5 QT/A + .0356 + 1/4% V/V	PRE,post	12.5	**-50.0	12.5	75.0
15	Bicep + Beacon + Surfactant	2.5 QT/A + .0178 + 1/4% V/V	PRE,post	100.0	75.0	100.0	87.5
16	Accent + Surfactant	.01563 + 1/4% V/V	post	25.0	**175.0	25.0	**-125.0
17	Beacon + Surfactant	.0178 + 1/4% V/V	post	37.5	**-75.0	37.5	12.5
18	Check	***	***	0	0	0	0
	LSD = 0.05			23.0	100.0	23.0	nsd

** More kochia was present than in the check.

Table 7. Economic analysis of shattercane control - SWREC (1991)

#	Treatment	Cost/Acre	Bu/A	Yield Bu/A	Extra Yield[1] Net Returns[2]
1	Sutan + Atrazine	$23.49	177	44	$163.61
2	Sutan + Atrazine + Accent	$36.39	177	44	$150.71
3	Sutan + Atrazine + l/2 Accent	$29.94	187	54	$180.16
4	Sutan + Atrazine + Beacon	$36.89	184	51	$166.31
5	Sutan + Atrazine + l/2 Beacon	$30.19	180	47	$163.81
6	Eradicane + Atrazine	$29.24	194	61	$196.96
7	Eradicane + Atrazine + Accent	$42.14	168	35	$124.26
8	Eradicane + Atrazine + l/2 Accent	$35.69	188	55	$176.71
9	Eradicane + Atrazine + Beacon	$42.64	200	67	$197.36
10	Eradicane + Atrazine + l/2 Beacon	$35.94	193	60	$187.96
11	Bicep ($10.00 Dual + $3.05 Atrazine)	$13.05	159	26	$132.65
12	Bicep + Accent	$25.95	171	38	$147.35
13	Bicep + l/2 Accent	$19.50	170	37	$151.50
14	Bicep + Beacon	$26.45	186	53	$181.35
15	Bicep + l/2 Beacon	$19.75	173	40	$158.15
16	l/2 Accent	$6.45	160	27	$141.55
17	l/2 Beacon	$6.70	179	46	$185.00
18	Control	$0.00	133	0	$85.90

[1] Additional yield attributed to herbicide treatment only.
[2] Assumes $2.50/bu corn price, harvest cost of $0.20/bu, and all non-herbicide costs of $220/A.



Distribution of shattercane in the 13 North Central States.

LEPA IRRIGATION REPORT

by
William Spurgeon and Thomas Makens

SUMMARY

Irrigation frequency did not affect yields. Therefore, switching to an LEPA system and applying smaller amounts to minimize runoff should not affect yields adversely. Yield was significantly reduced by underirrigation and was not significantly increased by overirrigation.

LEPA is easier to justify when purchasing a new sprinkler because the cost difference is smaller (approximately $5,000). Converting an existing system to LEPA is much harder to justify, unless water costs are high and the producer is currently underirrigating the crop.

INTRODUCTION

A Low Energy Precision Application (LEPA) sprinkler system was installed at the Southwest Research-Extension Center in 1989. This report summarizes the frequency and amount results and procedures for 1989, 90, and 91.

PROCEDURES

Corn was planted in a circle. The system was run around once to establish the tower tracks, which were used as markers. The corn was planted in a circle from the even towers (i.e., towers 2, 4, and 6) out to the odd towers.

Aluminum access tubes were installed for use with a neutron probe to determine soil water. Measurements were taken weekly to verify crop water use estimates and were used to calculate the change in soil water over the season.

The field was furrow diked to help prevent runoff. Dikes or deep ripping are used with LEPA systems to store water for infiltration and prevent excessive runoff.

Irrigation treatments of 0.4, 0.7, 1.0, and 1.3 times the base irrigation (BI) amount were used. The rated flow was changed for the nozzles by the respective percentage. Irrigation frequencies of 3, 6, and 9 days were also used. Each treatment was replicated four times. Plots were then irrigated every 3, 6, or 9 days with the bubble mode and the desired fraction of BI. We replenished the amount of water used during each time interval at the end of that interval.

Irrigation amounts for each plot varied by treatment and frequency. Application amounts ranged from 0.2 to 3.8 inches per irrigation event. The 3-day frequency was used to study the effects of high frequency applications. LEPA systems (bubble mode) will probably require amounts less than 1 inch because of high runoff potential. The 9-day frequency resulted in very high water applications for LEPA but the plots were bordered to contain the water. Thus, the 9-day treatment resembled low frequency irrigation like furrow irrigation.

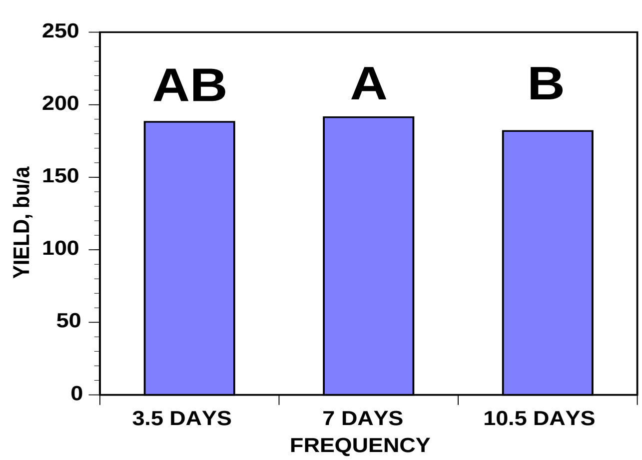
Forty feet of row were hand harvested from each plot. Yields were adjusted to 15.5 percent moisture and are reported in bushels per acre.

DISCUSSION

This study was patterned after a study at Texas A & M conducted by Dr. Bill Lyle. The Texas study used the same amount and frequency treatments but added a 12-day frequency.

These data (Figure 1) and the Texas data show that irrigation frequencies of 3, 6, and 9 days are not

Figure 1. Three-year average corn yield for frequency treatments.



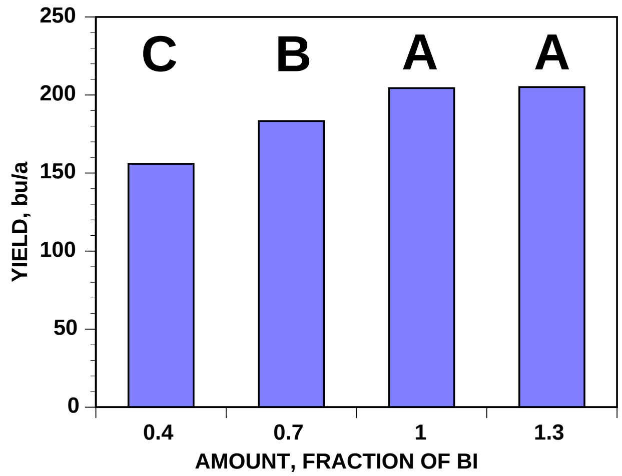
significantly different. Because of scheduling conflicts, our "3-day" treatment was actually 3.5 days and our "9-day" treatment was actually every 10.5 days. Therefore, our "9-day" frequency tended to have lower yield. The 12-day yields (Texas) were significantly lower than those for the 3-, 6-, and 9-day treatments. Yields for all treatments are given in Table 1. These data indicate no yield losses when high frequency irrigation is required, such as for an LEPA system.

Table 1. Effect of irrigation frequency and amount on corn yield (bu/a), Southwest Research-Extension Center.

Fraction of BI	Irrig. Inches	Irrigation Frequency, Days 3.5	7	10.5	AVG
1989					
0.4	4.7	151.5	153.8	155.3	153.5
0.7	8.3	161.0	168.8	156.3	162.0
1.0	11.9	180.8	174.0	182.8	179.2
1.3	15.5	177.5	183.3	174.5	178.4
AVG		167.7	169.9	167.2	
1990					
0.4	11.0	149.1	155.4	162.0	155.5
0.7	16.6	185.6	204.3	185.3	191.7
1.0	22.2	220.5	217.0	200.3	212.6
1.3	27.8	222.6	231.4	204.0	219.3
AVG		194.5	202.0	187.9	
1991					
0.0		85.7	127.7	105.8	106.4
0.4		166.6	153.3	155.8	158.6
0.7		194.5	209.7	184.4	196.2
1.0		228.1	218.2	217.8	221.4
1.3		219.9	228.5	204.5	217.7
AVG		179.0	187.5	173.7	
3-year average					
0.4		155.7	154.2	157.7	155.9
0.7		180.4	194.3	175.3	183.3
1.0		209.8	203.1	200.3	204.4
1.3		206.7	214.4	194.4	205.2
AVG		188.1	191.5	181.9	

Figure 2 shows that yields level off for amounts greater than 1.0 BI. This presents a case for using irrigation scheduling to help the producer obtain optimum yield without wasting water. As expected, corn yields increase significantly with irrigation amounts up to 1.0 BI. A significant difference occurred between yields for each of the two low BI treatments but not between the two high BI treatments.

Figure 2. Three-year average yield for amount treatments.



The seasonal soil water change is given in Table 2. A negative value shows that water was extracted from a 5 ft. profile between June 30 and September 22

Table 2. Change in soil water content, in inches, for a 5 ft. profile.

Fraction of BI	Irrig. Inches	Irrigation Frequency, Days 3.5	7	10.5	AVG
1989					
0.4	4.8	-2.0	-2.1	-1.9	-2.0
0.7	8.4	-0.5	-0.6	0.0	-0.3
1.0	11.9	0.4	-0.4	0.6	0.5
1.3	15.5	0.6	1.1	0.6	0.6
AVG		-0.4	-0.5	-0.2	
1990					
0.4	11.0	-4.8	-	-3.4	-4.1
0.7	16.6	-1.8	-	-2.5	-2.2
1.0	22.2	-0.8	-	-1.0	-0.9
1.3	27.8	-0.4	-	-0.8	-0.6
AVG		-2.0	-	-1.9	
1991					
0.0		-5.5	-	-6.3	-5.9
0.4		-4.7	-	-4.9	-4.8
0.7		-2.7	-	-2.8	-2.8
1.0		-0.9	-	-1.8	-1.3
1.3		-0.3	-	-0.2	-0.2
AVG		-2.2	-	-2.4	
3-year average					
0.4		-3.8	-	-3.4	-3.6
0.7		-1.7	-	-1.8	-1.7
1.0		-0.4	-	-0.7	-0.6
1.3		-0.0	-	-0.1	-0.1
AVG		-1.5	-	-1.5	
-5					

(1989), June 27 and October 3 (1990), and June 3 and September 19, 1991. Soil water was monitored in the 3.5- and 10.5-day treatments for each replication in 1991. In 1989, only one replication was monitored. In the underwatered irrigation treatments, water was generally extracted from the soil profile to help meet the crop's water needs.

Similar results were obtained for each year, despite the difference in rainfall. We received 11.5 inches of rainfall during the 1989 growing season, 3.8 inches in 1990, and 8.0 inches in 1991. The irrigation amounts applied were 11.9 inches in 1989 and 22.2 in 1990 for the 1.0 BI treatment. Irrigation amounts were evened up among frequency treatments in 1989 with the last irrigation. The amounts were the same for 1990. Irrigation amounts for each treatment for 1991 are given in Table 3.

Table 3. Irrigation amounts, in inches, for 1991.

Fraction of BI	Irrigation Frequency, Days 3.5	7	10.5
0.0*	2.5	2.5	2.5
0.4	9.5	8.9	8.0
0.7	14.8	13.6	12.2
1.0	20.0	18.4	16.3
1.3	25.3	23.1	20.5

*All plots received a small amount of irrigation until modifications were made to the irrigation system.

Total water use is shown in Table 4, which includes seasonal soil water change, irrigation, and rainfall amounts. The long-frequency plots required less irrigation water because they had more opportunity to capture rainfall. If plots had been managed at some value less that "field capacity", similar irrigation amounts would have resulted.

The total water use and irrigation water applied were used to calculate total water use efficiencies (TWUE) and irrigation water use efficiencies (IWUE). Both are shown in Table 5. Water use efficiency is defined as the corn yield divided by the appropriate water quantity (bu/a-in).

The LEPA concept is to keep every other row dry to reduce evaporation losses. Slopes greater than 0.5 to 1.0 percent will produce significant runoff and reduced yield. Therefore, furrow diking is recommended for all LEPA systems. The plots were not furrow diked in 1989 because fields were too wet from excessive rainfall during June, which may be why yield was lower. Improved corn yields might have resulted from using the flat spray mode rather than the bubble mode.

Table 4. Total water use (soil water extracted + irrigation + rainfall) in inches.

Fraction of BI	Irrig. Inches	Irrigation Frequency, Days 3.5	7	10.5	AVG
1989					
0.4	4.8	18.3	18.4	18.2	18.3
0.7	8.4	20.4	20.5	19.9	20.2
1.0	11.9	23.0	23.8	22.8	22.9
1.3	15.5	26.4	25.9	26.4	26.4
AVG		22.0	22.2	21.8	
1990					
0.4	11.0	19.6		18.2	18.9
0.7	16.6	22.2		22.9	22.6
1.0	22.2	26.8		27.0	26.9
1.3	27.8	32.0		32.4	32.2
AVG		25.2		25.1	
1991					
0.0		16.0		16.7	16.4
0.4		22.2		20.9	21.6
0.7		25.5		23.0	24.2
1.0		29.0		26.1	27.5
1.3		33.6		28.7	31.1
AVG		27.6		24.7	
3-year average					
0.4		20.0		19.1	19.6
0.7		22.7		21.9	22.3
1.0		26.3		25.3	25.8
1.3		30.7		29.2	29.9
AVG		24.9		23.9	

The current cost to convert an existing system to LEPA is approximately $10,000. It is hard to justify conversion unless fuel costs are high and water is limiting (i.e., the producer is currently underirrigating). However, the difference in cost between spray heads and LEPA heads (approximately $5,000) for new installations can be paid off in a 3- to 5-year period, depending on fuel costs and corn prices.

Table 5. Irrigation water use efficiency (IWUE) and (total water use efficiency, (TWUE)), bu/a-in.

Fraction of BI	Irrigation Frequency, Days 3.5	7	10.5	AVG
1989				
0.4	31.6	32.0	32.4	32.0
	(8.3)	(8.4)	(8.5)	(8.4)
0.7	19.2	20.1	18.6	19.3
	(7.9)	(8.2)	(7.9)	(8.0)
1.0	15.2	14.6	15.4	15.1
	(7.9)	(7.3)	(8.0)	(7.7)
1.3	11.5	11.8	11.3	11.5
	(6.7)	(7.1)	(6.6)	(6.8)
AVG	19.3	19.6	19.4	
	(7.7)	(7.7)	(7.8)	
1990				
0.4	13.6	14.1	14.7	14.1
	(7.6)		(8.9)	(8.3)
0.7	11.2	12.3	11.2	11.6
	(8.4)		(8.1)	(8.2)
1.0	9.9	9.8	9.0	9.6
	(8.2)		(7.4)	(7.8)
1.3	8.0	8.3	7.3	7.9
	(7.0)		(6.3)	(6.6)
AVG	10.7	11.1	10.6	
	(7.8)		(7.7)	
1991				
0.0	34.7	51.7	42.8	43.1
	(5.4)		(6.3)	(5.8)
0.4	17.5	17.4	19.5	18.1
	(7.5)		(7.4)	(7.5)
0.7	13.2	15.4	15.2	14.6
	(7.6)		(8.0)	(7.8)
1.0	11.4	11.9	13.4	12.2
	(7.9)		(8.4)	(8.1)
1.3	8.7	9.9	10.0	9.5
	(6.6)		(7.1)	(6.8)
AVG	12.7	13.6	14.5	
	(7.4)		(7.7)	
3-year average				
0.4	16.4	16.5	17.3	16.7
	(5.3)		(5.3)	(5.3)
0.7	15.3	16.5	16.2	16.0
	(7.7)		(8.3)	(8.0)
1.0	12.6	12.9	13.3	12.9
	(8.0)		(8.2)	(8.1)
1.3	10.0	10.5	10.1	10.2
	(7.2)		(7.1)	(7.1)
AVG	13.6	14.1	14.2	
	(7.0)		(7.2)	

LEPA IRRIGATION MANAGEMENT FOR SOYBEANS

by
William Spurgeon, Alan Schlegel, and Thomas Makens

SUMMARY

Soybean yields were good and increased with increasing water applied. Yield was 60 bu/a for beans watered at 40 percent of the base irrigation (BI) requirement. Past research has shown that the water use curve is usually flat and may decrease with overwatering. This did not happen in 1991 for our conditions. Therefore, additional years of data will be collected to determine the response of soybeans to irrigation water applied using the LEPA bubble mode.

INTRODUCTION

A Low Energy Precision Application (LEPA) water requirement study for soybeans was initiated in 1991. LEPA irrigation should deliver 95 percent or more of the water to the soil. This highly efficient method of irrigation coupled with keeping every other row dry should produce good to excellent soybean yields.

The objectives of the study are: 1) to determine the water requirement of soybeans irrigated with a LEPA system in the bubble mode and 2) to establish management criteria for irrigating soybeans with a LEPA system.

PROCEDURES

Soybeans were planted in a circular pattern. The center pivot was run around the field once to establish tower tracks, which were used as markers for the planter to follow. The soybeans were planted on May 15 from the even towers out to the odd towers. The field was furrow diked to prevent runoff.

Aluminum access tubes were installed to measure soil water with the use of a neutron probe. Measurements were taken weekly to a depth of 5 feet to calculate the change in soil water over the season.

Treatments of no irrigation, 0.4, 0.7, 1.0, and 1.3 times the base irrigation (BI) were used. Each treatment was replicated five times. One irrigation (0.60 inches) was applied at 100 percent for all treatments early in the season on June 18. This occurred before the system was modified to put on fractional amounts of water for the various treatments. Irrigations were generally 1 inch, except for the first and second irrigations. The second irrigation was 2.75 inches because it was delayed while modifications were still being made the the system.

Twenty feet of row were harvested from each plot. Yields were reported in bu/a and adjusted to 13 percent moisture.

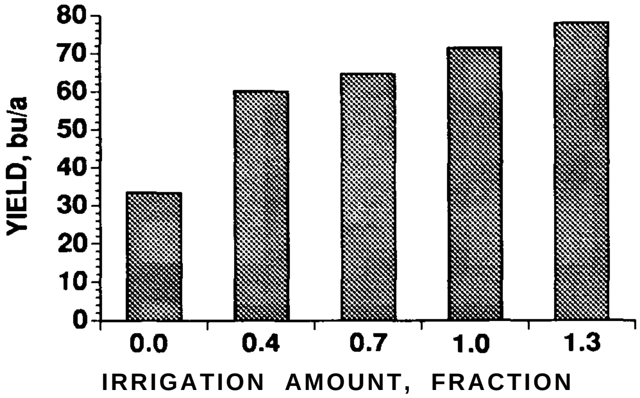
RESULTS AND DISCUSSION

The yield and water use data are given in Table 1. Yield by treatment is also shown in Figure 1. Yields increased with increasing water applied. Past research has shown yield response to water applied for soybeans to be relatively flat. Yield can decrease

Table 1. Soybean yield, irrigation, and total water use for LEPA irrigation.

Irrigation Treatment	Irrigation inches	Yield bu/a	Change in Soil Water inches	Total Water Use inches	TWUE bu/a-in	IWUE bu/a-in
1.3 BI	17.2	78.0	-1.4	27.1	5.1	4.5
1.0 BI	13.4	71.6	-1.6	23.5	5.9	5.3
0.7 BI	9.5	64.7	-3.7	21.7	6.6	6.8
0.4 BI	5.7	60.2	-3.9	18.1	8.2	10.6
0.0 BI	0	33.4	-3.2	11.7	8.9	-

Figure 1. Soybean yield for the various LEPA irrigation treatments.

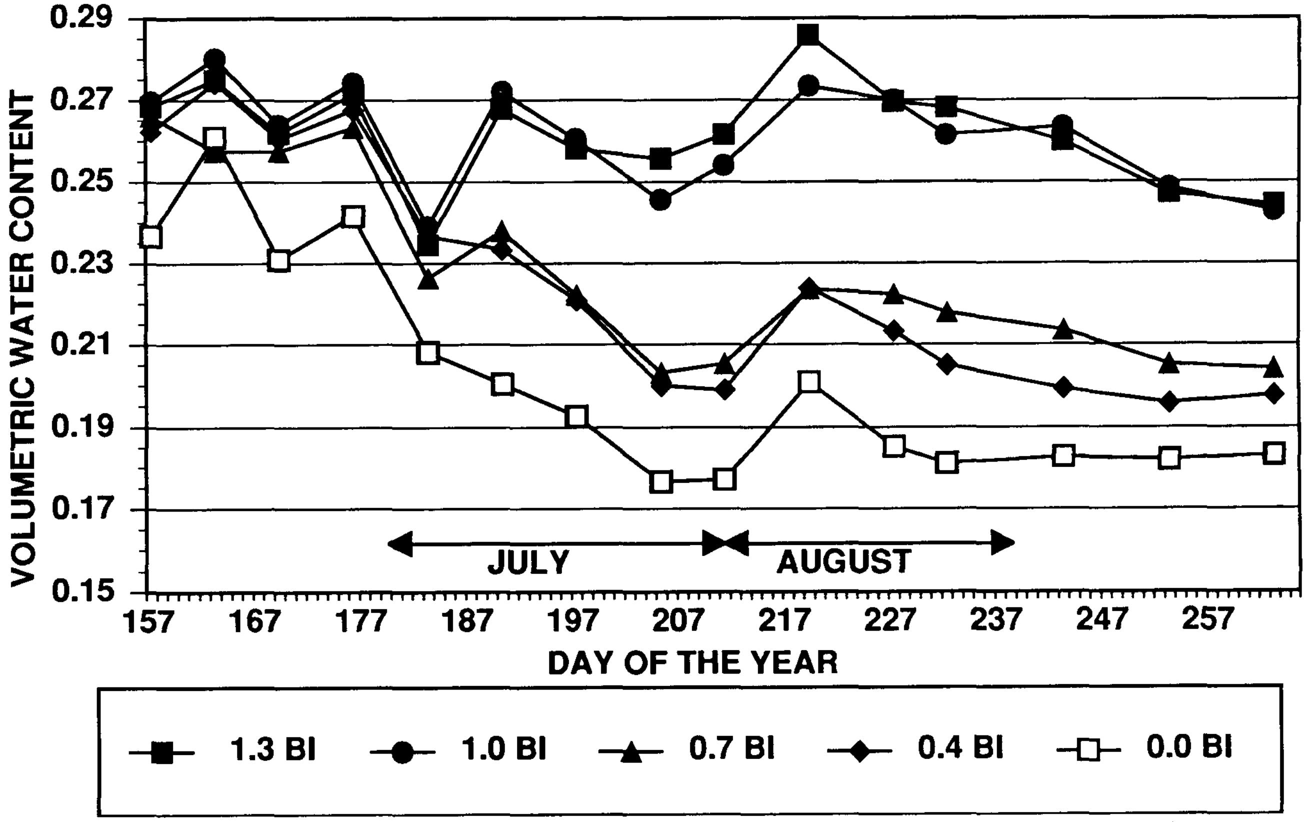


with overwatering in some years.

Although we felt we did not stress the fully watered plots, the yield continued to increase with increasing depths of applied water. Figure 2 shows the average volumetric soil water content for the 5 ft. profile by water treatment throughout the season. Soil water contents were very similar for the 1.3 and 1.0 BI treatments. Soil water content did decrease with time for the underwatered treatments.

These are data for only one year, and additional climatic years are required to draw any useful conclusions. For the conditions encountered, LEPA in the bubble mode with furrow diking performed well.

Figure 2. Average soil water content for the top 5 ft. by Irrigation treatment for the growing season.



LEPA SPRAY MODE / TILLAGE STUDY

by
William Spurgeon and Thomas Makens

SUMMARY

The LEPA bubble mode would work well under conditions in which the reservoirs can hold all the water applied. Reservoir tillage is effective in reducing runoff and holding water where it was applied. The study area had slopes ranging up to 6 percent. Irrrigations were between 0.75 and 1.0 inches. The flat spray mode was more effective in maintaining yield and soil water than reservoir tillage. The combination of flat spray and reservoir tillage produced the highest yield.

INTRODUCTION

Low Energy Precision Application (LEPA) sprinkler systems produce high application rates because of the small wetted diameters of the nozzles. On sloping ground, this can cause considerable runoff. A study was initiated in 1990 to provide producers with effective guidelines for managing LEPA systems on slopes greater than 1 percent.

PROCEDURES

Corn was planted in a circlular pattern. Various tillage treatments and spray modes were used to determine which combination reduced runoff the most. Slopes ranged from 1 to 6 percent and averaged 3 percent. Bubble-mode plots had a higher average slope than did the flat-spray plots.

Tillage treatments included furrow diking (forming basin reservoirs between rows), in-furrow ripping, and implanted reservoirs in combination with ripping. Dikes and small reservoirs dug into the soil surface are used to hold water until it can infiltrate into the soil. Ripping is used to increase the intake rate of the soil.

All treatments were irrigated by the bubble and flat spray modes. The bubble mode concentrates the water into a small area directly beneath the nozzle (approximately 1.3 ft. in diameter). The flat spray spreads the water out over a greater area (approximately 10 ft.).

Aluminum access tubes were installed for use with a neutron probe to determine soil water content. Soil water measurements were taken weekly to calculate the change in soil water over the season.

The first irrigation was on June 17, and plots were irrigated approximately once a week thereafter. The irrigation application amount was kept at or below one inch, the current recommendation for flat slopes. Borders were installed across the field to prevent water from one treatment from running onto any treatment further downhill.

Forty feet of row were hand harvested from each plot. Yields were adjusted to 15.5 percent moisture and are reported in bushels per acre.

RESULTS AND DISCUSSION

Runoff rates were so high in the bubble mode that corn yields were reduced (Figure 1). Ripping and furrow diking increased yields slightly (Table 1). Diking with ripping increased yields the most (Figure 2).

Figure 1. Two-year average yield for spray treatment.

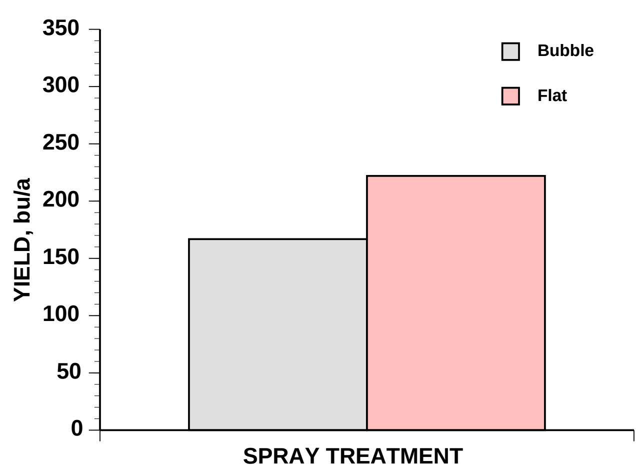
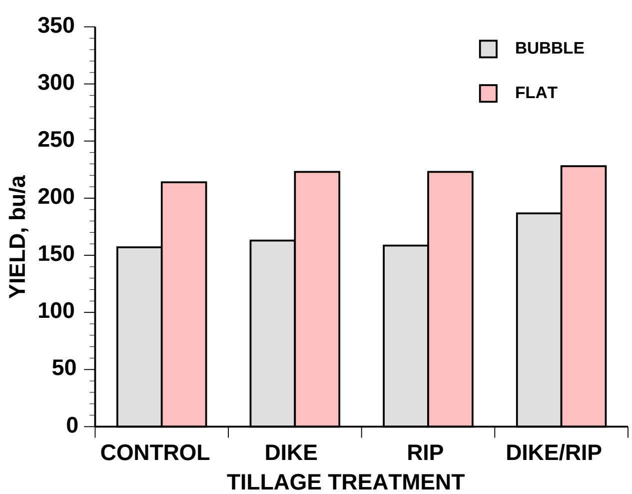


Table 1. Effect of spray mode and tillage treatment on corn yield (bu/a).

Tillage Treatment	Spray Mode: Bubble	Flat Spray	Average
1990			
Control	168.1	210.8	189.5
Dike	174.7	214.0	194.3
Rip	176.0	224.6	200.3
Dike/Rip	204.4	225.9	215.1
Average	180.8	218.8	
1991			
Control	145.9	217.1	181.5
Dike	150.8	231.8	191.3
Rip	141.5	221.8	181.7
Dike/Rip	169.4	230.5	200.0
Average	151.6	225.3	
2-year average			
Control	157.0	213.9	185.5
Dike	162.9	223.0	192.9
Rip	158.5	223.0	191.0
Dike/Rip	186.7	228.0	207.6
Average	166.8	222.0	

Figure 2. Two-year average yield for tillage and spray mode treatments.



Diking with ripping had the greatest effect on yields when the bubble mode was used. This could be because of the increased intake rate with ripping and because this treatment had the best reservoirs. The flat spray mode showed less sensitivity to tillage treatment because of the larger area wetted as compared to the bubble mode.

The seasonal soil water change for the period between June 3 and September 19 is given in Table 2.

Table 2. Change in soil water content, in inches, for 5 ft of profile from June 3 to September 19.

Tillage Treatment	Spray Mode: Bubble	Flat	AVG
1990			
Control	-5.3	-4.4	-4.9
Dike	-5.3	-2.1	-3.7
Rip	-4.7	-2.8	-3.8
Dike/Rip	-3.1	-2.4	-2.8
AVG	-4.6	-2.9	
1991			
Control	-1.9	-3.1	-2.5
Dike	-2.1	-2.9	-2.5
Rip	-1.9	-3.5	-2.7
Dike/Rip	-2.5	-2.8	-2.7
AVG	-2.1	-3.1	

Total water applied is shown in Table 3. This includes the seasonal soil water change, irrigation, and rainfall amounts. Rainfall amounts were 3.8" and 8.0" for 1990 and 1991, respectively. Irrigation amounts were 21.1 and 16.7 inches for 1990 and 1991, respectively. Not all of the water applied was available for use by the crop because of runoff from the plot area.

Table 3. Total water applied (soil water extracted + irrigation + rainfall) in inches.

Tillage Treatment	Spray Mode: Bubble	Flat	AVG
1990			
Control	30.2	29.3	29.8
Dike	30.2	27.0	28.6
Rip	29.6	27.7	28.7
Dike/Rip	28.0	27.3	27.7
AVG	29.5	27.8	
1991			
Control	26.6	27.8	27.2
Dike	26.8	27.6	27.2
Rip	26.6	28.2	27.4
Dike/Rip	27.2	27.5	27.4
AVG	26.8	27.8	

The total water and irrigation water applied were used to calculate total water use efficiency (TWUE) and irrigation water use efficiency (IWUE). Both are shown in Table 4. Water use efficiency is defined as the corn yield divided by the appropriate water quantity.

The bubble mode would work well under conditions where the reservoirs can hold all the water applied. Reservoir tillage was effective in reducing runoff and holding water where it was applied. Diking with ripping worked best on the slopes studied (1 to 6 percent). The flat spray mode was more effective in minimizing runoff than reservoir tillage. The combination of flat spray mode and reservoir tillage produced the highest yields.

Table 4. Irrigation water use efficiency (IWUE) and total water use efficiency (TWUE) in bushels per acre-inch.

Tillage	Spray Mode		
Treatment	Bubble	Flat	AVG
1990			
Control	8.0	10.0	9.0
	(5.6)	(7.2)	(6.4)
Dike	8.3	10.1	9.2
	(5.8)	(7.9)	(6.9)
Rip	8.3	10.6	9.5
	(5.9)	(8.1)	(7.0)
Dike/Rip	9.7	10.7	10.2
	(7.3)	(8.3)	(7.8)
AVG	8.6	10.4	
	(6.1)	(7.9)	
1991			
Control	8.7	13.0	10.9
	(5.5)	(7.5)	(6.5)
Dike	9.0	13.9	11.5
	(5.6)	(8.4)	(7.0)
Rip	8.5	13.3	10.9
	(5.3)	(7.9)	(6.6)
Dike/Rip	10.1	13.8	12.0
	(6.2)	(8.4)	(7.3)
AVG	9.1	13.5	
	(5.7)	(8.1)	
2-year average			
Control	8.4	11.5	9.9
	(5.5)	(7.5)	(6.5)
Dike	8.7	12.0	10.3
	(5.7)	(8.2)	(6.9)
Rip	8.4	12.0	10.2
	(5.6)	(8.0)	(6.8)
Dike/Rip	9.9	12.3	11.1
	(6.8)	(8.3)	(7.5)
AVG	8.8	11.9	
	(5.9)	(8.0)	

KSU Southwest Research-Extension Center

SPACING FOR IN-CANOPY, LOW PRESSURE, SPRAY NOZZLES

by
William Spurgeon and Thomas Makens

SUMMARY

Low pressure spray nozzles were placed 2 ft off the ground on 5 and 10 ft spacings. Plots were on low sloping (0 to 1 percent), deep silt loam soil and were furrow diked. Little difference occurred in corn yield for either spacing treatment. Yield was slightly higher for samples taken from rows next to the nozzles in the 10-ft spacing treatment as compared to the rows between nozzles.

INTRODUCTION

Interest in low pressure spray devices has increased greatly in recent years. Greater management is necessary because of the increased potential for runoff. In some cases, the nozzles have been placed just above the ground surface. This introduces an additional problem of interception of the spray by the crop for nozzle spacings that do not provide every row with an equal opportunity for water (i.e., spacings greater than 5 ft-every other row for circular rows). The amount of water saved by moving the nozzles from the truss rod height to 2 ft off the ground may not justify the additional cost, especially if runoff (nonuniformity within the field) becomes a problem.

Most systems do not fit the definition for LEPA (Low Energy Precision Application). LEPA systems by design must use reservoir tillage to maximize capture of rainfall in and out of season. Reservoir tillage is used on all slopes to maximize uniformity of rain and irrigation water. LEPA systems should also keep every other row dry (i.e., use the bubble mode or double-ended socks) to minimize evaporation of water from the soil surface. Another requirement for LEPA is keeping all traffic out of the row that receives water so that compaction is minimized and intake rates are maximized. Very little LEPA irrigation is being done in Southwest Kansas. However, we can improve the efficiency of the water delivered to the soil, but it may take several years to pay for the additional hardware with water and energy savings.

The objective of this study was to determine the effect of in-canopy flat spray nozzle spacing on corn yield. This study was mainly a reconnaissance mission to determine the potential for further investigation.

PROCEDURES

Corn was planted in circular rows in a deep silt loam soil. The nozzles tracked well between corn rows. Soil slope was generally 0 to 1 percent. The field was furrow diked to minimize runoff.

Treatments consisted of LEPA nozzles (6 psi) operated in the flat spray mode placed in every other row (5 ft spacing) and Low Drift Nozzles (LDN) (10 psi) placed in every 4th row (10 ft spacing). All nozzles were 2 to 3 ft from the ground surface.

No soil water data was taken. This study will be expanded for 1992 and include soil water measurements and a 15-ft spacing treatment.

Irrigation depth was generally kept at 1 inch. The soil water was depleted slightly more than planned (greater than 25 percent) during the third week of August because of scheduling conflicts.

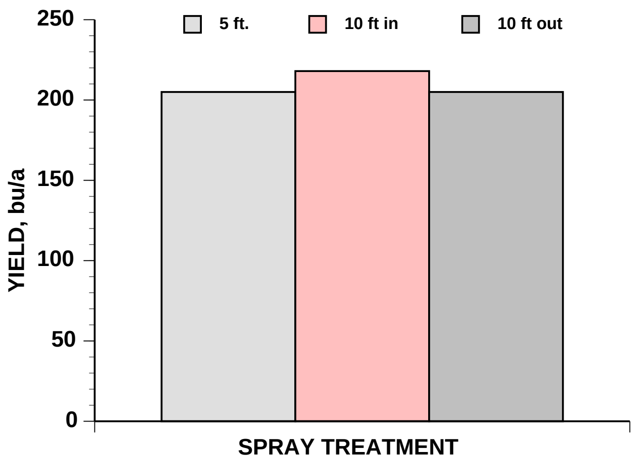
Irrigation for all plots totaled 16.5 inches. Rainfall from June 5 to September 19 was 8.5 inches.

RESULTS AND DISCUSSION

Yield from the study by row position relative to the nozzle position is shown in Figure 1. Yield for the 5 ft spacing was 205 bu/a. Samples taken next to the nozzles spaced at 10 ft yielded 218 bu/a and samples taken between the nozzles yielded 205 bu/a. No statistics were run on the data because of the small difference in yield and small number of treatments. However, the data indicate that we should continue investigation of effects of in-canopy nozzle spacing on yield and include soil water measurements.

We should be concerned about fields with slopes greater than one percent. Steeper slopes will cause more runoff, especially for the 10-ft. nozzle spacing as the spray gets intercepted by the growing crop.

Figure 1. Corn yield by position for 5-ft. nozzle spacing and 10 ft nozzle spacing. "In" represents samples taken next to the 10-ft nozzles, and "out" represents samples taken in the rows furthest from the 10 ft. nozzle.



DRIP-LINE SPACING AND PLANT POPULATION FOR CORN

by
*William Spurgeon, Thomas Makens, and Harry Manges**

SUMMARY

A drip-line spacing and plant population study for corn was conducted in 1989, 90, and 91. Three-year average yields ranged from 187 to 216 bu/a for line spacings of 10 to 2.5 ft, respectively. Yields were lower from the 7.5 and 10 ft. spacings than from the 2.5 ft. and 5.0 ft. spacing. The soil water content decreased in the upper 2 to 3 ft as close as 15 inches from the drip line. Yields from population treatments were different and peaked at 212 bu/a for the 32,000 plants/a treatment.

INTRODUCTION

Water tables in southwest Kansas are declining; therefore, producers want to use their water efficiently to allow the resource to last as long as possible. Producers might consider drip irrigation to save water, if production were profitable.

A drip irrigation study was initiated at the Southwest Research-Extension Center in 1989. Objectives of the study are: to determine (1) optimum plant population, (2) the effect of drip line spacing on yield, and (3) the effect of drip line spacing on water movement.

PROCEDURES

Plot Layout

The field was fertilized with 240 lbs of nitrogen and 40 lbs of phosphorous. Drip lines were buried 16 inches below the ground surface and spaced 2.5, 5.0, 7.5, and 10 ft apart in a silt loam soil. Corn was planted in 30-inch rows perpendicular to the drip lines and thinned to populations of 38,000, 32,000, 26,000, and 20,000 plants/a. Each plot consisted of four crop rows. Populations were replicated four times.

Soil-Water Monitoring Method

Aluminum access tubes were installed in increments of 7.5 inches from a drip line in each spacing replication. The access tubes were installed in the 32,000 plants/a population treatment. A neutron probe was used weekly to determine the soil water status.

Irrigation Method

All spacing treatments were irrigated to apply 100 percent of evapotranspiration (ET - crop water use). Therefore, each plot received the same gross average depth. The wide spacing treatments received enough water to cause deep percolation. This was done so that maximum horizontal water movement was not hindered. The drip lines were 195 ft long and were rated at 0.3 gpm per 100 ft.

Set times for the various spacings needed to apply an average depth of 0.5 inch over the plot area were: 4.3 hr for 2.5 ft, 8.6 hr for 5.0 ft, 13 hr for 7.5 ft, and 17.3 hr for 10 ft. Set times were reduced slightly by operating the system at 15 psi rather than the suggested pressure of 10 psi. A measurable plant height decrease, about 18 inches, occurred between drip lines for the wide spacings.

The first irrigation was applied on June 7. Plots were irrigated by replenishing ET after the soil water deficit reached at least 0.5 inches. Irrigation was applied when the soil water deficit was between 1.00 and 1.75 inches to allow for the beneficial use of rainfall. Totals of 13.0, 21.9, and 17.2 inches of irrigation water were applied in 1989, 1990, and 1991, respectively. Rainfall amounts were 11.5, 3.8, and 8.0 inches, respectively. About 2 inches of water were lost to deep percolation in both 1990 and 1991 because of rainfall events following irrigations.

Harvest Samples

Each plot consisted of four corn rows and four drip lines. The two middle corn rows were used for yield samples. One row was used for bulk yield samples and the other row for individual plant yield. Because the drip lines were perpendicular to the corn rows, the length of row harvested was equal to two times the drip line spacing. The sample began halfway between the first and second drip lines and spanned across the two middle drip lines.

Data Analysis

Both bulk yield and individual plant yield samples were taken. An analysis of variance was performed on the bulk yield samples for population and drip-line spacing treatments. Individual plant yield (mass of grain per plant) was collected but has not been analyzed.

RESULTS AND DISCUSSION

Plant Population

Figure 1 shows the 3-year average yield for the various populations for each spacing treatment. Also, the 3-year average population treatment yields are shown in Figure 2.

Yields for 1989, 90, and 91 are given in Table 1. Yield differences were statistically significant and peaked for 32,000 plants/ac.

Figure 1. Three-year average yield by population and spacing.

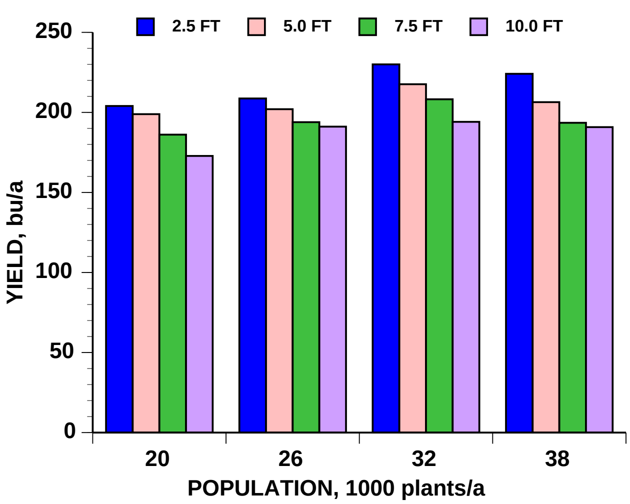


Figure 2. Three-year average yield for population treatments. Different letters indicate values are significantly different at the 0.05 level.

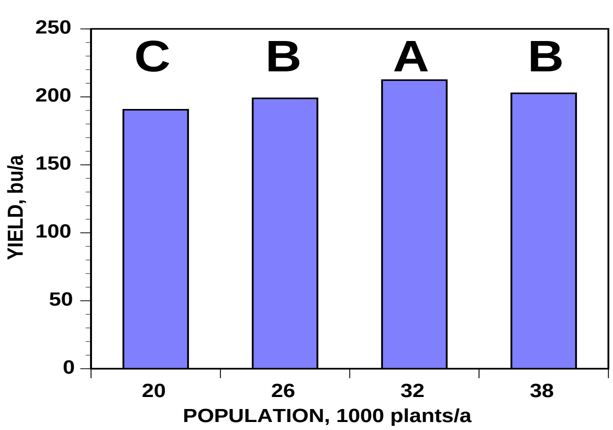


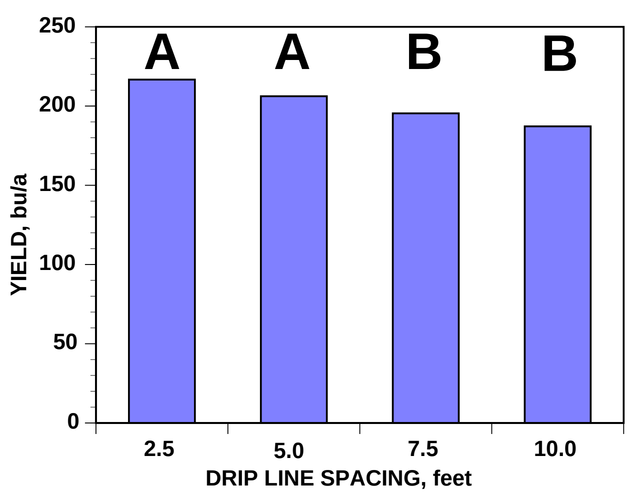
Table 1. The effect of line spacing and population on corn.

Line Spacing ft.	Population, 1000 plants/a 20	26	32	38	Avg.
1989					
2.5	190.1	197.1	217.4	220.8	206.4
5.0	193.4	190.1	204.6	209.6	199.4
7.5	176.4	174.6	201.4	189.9	185.6
10.0	178.1	198.8	192.9	195.0	191.2
Avg.	184.5	190.2	204.1	203.8	
1990					
2.5	182.9	196.3	215.0	190.8	196.3
5.0	180.2	178.5	193.7	163.0	178.9
7.5	173.4	180.3	186.0	158.7	174.6
10.0	162.5	178.9	180.5	168.7	172.7
Avg.	174.8	183.5	193.8	170.3	
1991					
2.5	239.1	232.7	257.7	260.7	247.6
5.0	223.0	237.5	254.4	246.4	240.3
7.5	208.6	226.7	237.2	232.0	226.1
10.0	177.9	195.5	208.8	208.6	197.7
Avg.	212.2	223.1	239.5	236.9	
3-year average					
2.5	204.0	208.7	230.0	224.1	216.7
5.0	198.9	202.0	217.6	206.3	206.2
7.5	186.1	193.9	208.2	193.5	195.4
10.0	172.8	191.1	194.1	190.8	187.2
Avg.	190.5	198.9	212.5	203.7	

Drip-Line Spacing

Three-year average yields for the spacing treatments are shown in Figure 3. Yields were higher for narrow drip-line spacing, although they stayed relatively high for the wider spacing.

Figure 3. Three-year average yield for spacing treatments. Different letters indicate values are significantly different at the 0.05 level.



Soil Water Movement

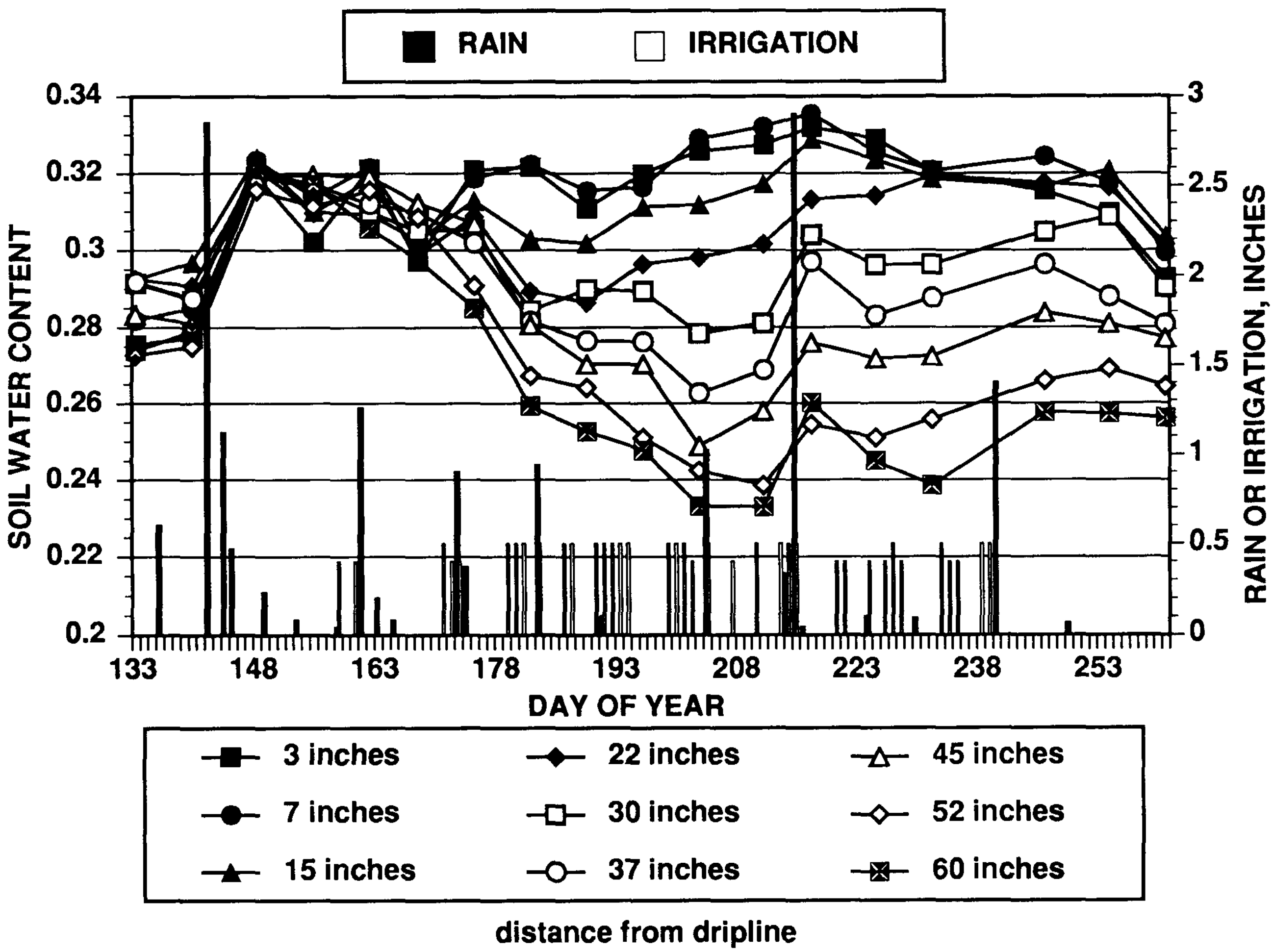
Soil water content was monitored weekly to a depth of 8 ft. Access tubes were placed at 15-inch increments away from the drip lines in 1989, and 7.5 inches in 1990 and 91. This was done for all of the spacing treatments in the 32,000 plants/a population treatment.

The average volumetric soil water contents for the upper 5 ft at 3, 15, 30, 45, and 60 inches from the drip line for one of the 10-ft spacing treatments are shown in Figure 4 for 1991.

Also, rainfall and irrigation events are shown. We were able to maintain high soil water contents 15 inches from the drip line. Soil water content decreased as the distance away from the drip line increased and approached a value dependent on rainfall rather than irrigation.

Our data show that volumetric soil water content approached 50 percent depletion at 45 and 60 in. from the drip line. This dry region extended 2 to 3 ft below the soil surface for both the 7.5 and 10 ft spacing treatments. Corn height was about 1.5 ft shorter between drip lines for the 7.5 and 10 ft spacings.

Figure 4. Soil water status by distance away from the dripline for the 10 ft spacing for the 1991 growing season.



*Professor, Agricultural Engineering Dept., Kansas State University, Manhattan.

DRIP-LINE LENGTH STUDY

by

William Spurgeon, Thomas Makens, and Harry Manges

SUMMARY

A drip-line length study was initiated in 1990. Subsurface dripline lengths of 330 and 660 ft. were used to irrigate corn on a 0.15% slope. The study area had a deep silt loam soil with high water holding capacity. Small yield variation under these conditions indicates that line length can be increased without reducing yield. Increasing line length could reduce installation costs of drip irrigation by 10-20 percent.

INTRODUCTION

Drip irrigation is expensive to install, i.e., $500/ acre, depending on field slope. Flat slopes of 0-0.5 percent require short driplines, approximately 330 ft., because of the pressure drop in the small diameter lines. However, fields generally have 1/4 and 1/2 mile row lengths. Therefore, 1/8 mile, 660 ft. lengths, were studied.

Objectives of the study are to determine: (1) the effect of length of drip lines on corn yield and (2) the effect of water flow upgrade and downgrade on corn yield.

PROCEDURES

Plot Layout

Drip lines were buried 16 inches below the ground surface and spaced 60 inches apart in a silt loam soil. Four drip lines were used per length treatment, and lengths were 330 ft. and 660 ft.. For each length, the water flowed from the up or downslope end. Also, one of the 660 ft. treatments had water pumped in from both ends. The slope was about 0.15 percent. Corn was planted on April 23, 1991 in 30-inch rows parallel to the drip lines. Each plot consisted of eight crop rows.

Soil-Water Monitoring Method

Aluminum access tubes were installed in the corn rows and were 15 inches from the drip line. They were read to a depth of 8 ft. A neutron probe was used weekly to determine the soil water content.

Irrigation Method

All treatments were irrigated to apply 100 percent of the Base Irrigation (BI) requirement in 1990 and 75 percent in 1991. We thought that the reduction in irrigation level in 1991 might impose greater stress on the corn for the longer length plots. This was done so that any existing differences would be more evident. Plots were irrigated when the depletion reached 1 inch. The first irrigation occurred on June 16. Plots were irrigated by replenishing the appropriate fraction of BI. A total of 15.7 inches of irrigation water was applied in 1991 (19.3 inches in 1990). Rainfall was 7.5 inches during the season (9.2 inches in 1990).

The drip lines were rated at 0.25 gpm per 100 ft. A pressure of 10 psi was maintained on all plots.

Harvest Samples

Each plot consisted of eight corn rows and four drip lines. The two middle corn rows were used for yield samples, 20 ft. of row was harvested in each. The 660 ft. length was harvested at both ends and two places along its length. The 330 ft. length was harvested at both ends.

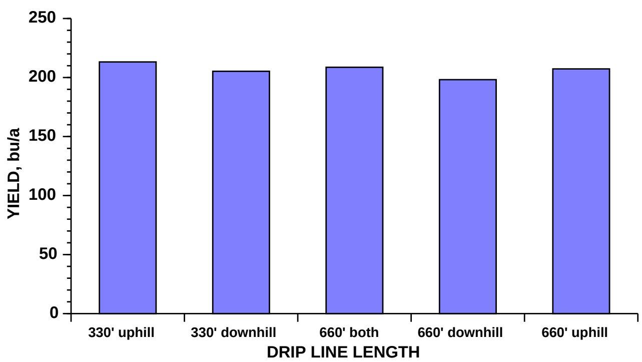
Data Analysis

Corn yield per acre was calculated from each of the sample areas. The yields were adjusted to a 15.5 percent moisture content. An analysis of variance showed no difference among corn yields.

RESULTS AND DISCUSSION

Two seasons (1990 and 91) of data have been collected. Figure 1 shows differences in average yield for the 2 years. However, the differences were not significant nor consistent with the differences expected. We would have expected the 330 ft. downslope flow to have the highest yield and the 660 ft. uphill flow to have the lowest.

Figure 1. Two-year average corn yield as affected by drip line length and direction of water flow.



A hail storm on July 19, 1990 affected yield at various locations in the field. Lower yields occurred on the west end of the field (the uphill end), causing the 330 ft. downhill treatment to have lower than expected yield. Yield by position is given in Table 1.

Table 2 shows total water use by position for each treatment for 1990 and 1991. These data show little change in water use by position for all treatments, indicating that the long lengths (660 ft.) performed quite well.

A portion of the cost of drip installation is in feeder lines that supply water to the drip lines. Therefore, assuming less yield difference when hail damage is not present, longer lengths of drip line may be used to reduce installation costs.

Table 1. Two-year corn yield average by field position for the various line length treatments.

	Yield bu/a				
Treatment	50 ft. from upslope end	280 ft. from upslope end	280 ft. from downslope end	50 ft. from downslope end	Avg.
1990					
330 ft. upslope	-	-	193.9	211.6	202.7
330 ft. downslope	185.1	193.5	-	-	189.3
660 ft. upslope	173.0	188.6	200.0	207.4	192.2
660 ft. downslope	172.0	181.8	184.1	191.1	182.2
660 ft. both	176.2	191.5	194.1	198.6	190.1
1991					
330 ft. upslope	-	-	219.4	223.1	221.3
330 ft. downslope	226.6	220.5	-	-	223.6
660 ft. upslope	223.2	218.6	222.0	225.2	222.3
660 ft. downslope	214.9	214.0	205.8	221.8	214.1
660 ft. both	226.9	229.5	220.5	231.9	227.2
2-year average					
330 ft. upslope	-	-	206.7	217.4	212.0
330 ft. downslope	205.9	207.0	-	-	206.5
660 ft. upslope	198.1	203.6	211.0	216.3	207.3
660 ft. downslope	193.5	202.8	200.0	210.2	201.6
660 ft. both	201.6	210.5	207.3	215.3	208.7

Table 2. Total water use by position for the various lengths. Plots were watered at 100% of BI in 1990 and 75% of BI in 1991.

	Total Water Use, inches				
Treatment	50 ft. from upslope end	280 ft. from upslope end	280 ft. from downslope end	50 ft. from downslope end	Avg.
1990					
330 ft. upslope	-	-	31.3	30.9	31.1
330 ft. downslope	31.2	31.0	-	-	31.1
660 ft. upslope	31.5	30.9	31.0	31.2	31.2
660 ft. downslope	31.5	31.1	30.9	30.9	31.1
660 ft. both	31.5	31.1	31.1	31.0	31.2
1991					
330 ft. upslope	-	-	25.2	25.4	25.3
330 ft. downslope	25.0	24.9	-	-	25.0
660 ft. upslope	24.4	24.7	25.1	25.3	24.9
660 ft. downslope	24.6	24.2	24.0	24.0	24.2
660 ft. both	25.5	24.9	24.8	25.0	25.1

IRRIGATION FREQUENCIES WITH DRIP LINES

by

Doug Caldwell, William Spurgeon, Thomas Makens, and Harry Manges*

SUMMARY

An irrigation frequency study was initiated in 1990. Corn yields ranged from 162-181 bu/a for the various treatments in 1990 and from 205-224 bu/a in 1991. No statistical differences were found between the yields for the frequency treatments studied for either year. Watering every 1, 3, 5, or 7 days did not affect corn yield. Also, watering when the depletion reached 0.5, 1.0, 1.5, or 2.0 inches did not affect corn yields. The longer frequency treatments did have higher water use efficiencies than the shorter frequency treatments. A reduction of 3 to 4 inches (15-20 %) of irrigation water was realized with the longer frequencies.

The best management would be to leave the soil drier, so rainfall could be absorbed anytime, and irrigate frequently to maintain soil water at an acceptable and moderately high level.

INTRODUCTION

Subsurface drip was used to irrigate corn in Holcomb, Kansas. This is a method of supplying low volumes of water to the root zone, thus minimizing evaporation losses and potentially reducing deep percolation losses. Eight different frequencies of irrigation were used, and the yields were compared.

The objectives of this study are to determine: 1) the effect of frequency and amount of irrigation on crop yield and 2) soil water content.

PROCEDURES

Drip lines were buried 16 inches deep in the center of each bed and ran parallel to the crop rows. Therefore, each drip line supplied water to two corn rows 15 inches away. The corn was planted on 60-inch beds. The study consisted of eight watering treatments. The treatments were 1-, 3-, 5-, and 7-day watering intervals and 0.5-, 1-, 1.5-, and 2-inch depletion levels. The evapotranspiration (ET) was calculated to determine the amounts to be watered for each treatment. The depletion level treatments were watered when depletion reached the stated amount, and frequency plots received the amount of water used during the specified interval.

Access tubes were installed in every plot in the corn row, 15 inches from the drip line, for use with a neutron probe. The neutron probe was used to determine soil water to a depth of 8 ft. The soil water was monitored weekly. The larger amount and less frequent irrigation treatments generally dried out more between irrigations.

RESULTS AND DISCUSSION

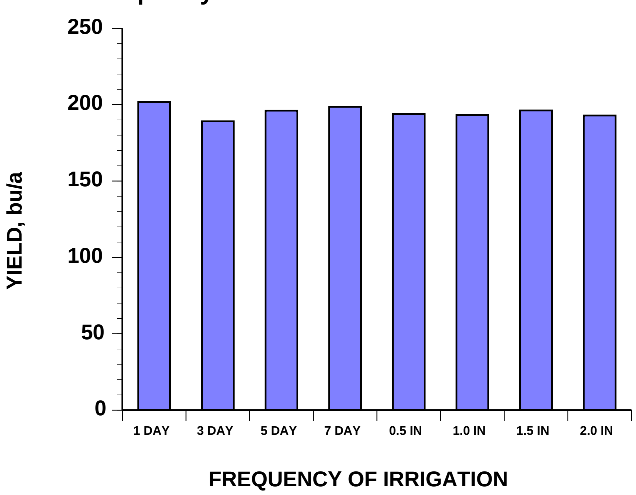
Statistically, no differences occurred among the yields of the different treatments (Table 1).
In 1990, the highest yielding plot was the 7-day treatment with 181 bu/a and the lowest was the 3-day treatment with 162 bu/a. In the second year, the highest was the 1-day treatment with 225 bu/a, and the 5-day treatment was lowest with 205 bu/a. Because of this lack of statistical difference and the uneven damage caused by a July 19, 1990 hail storm, it is difficult to draw any conclusions. Figure 1 shows the 2-year average yield by treatment and indicates very few differences.

The total water applied differed between treatments (Table 2). Rainfall was 9.2 inches in 1990 (June 6-September 24) and 7.5 inches in 1991 (June 1-September 17). The less frequent treatments with larger amounts allowed the soil to dry out between irrigations; thus, it had the ability to store rainfall. Because irrigating 1 inch takes 21 hours, the frequency of applying this amount is limited. All treatments were brought back to field capacity at each irrigation. Also, we continued to irrigate during rain storms to stay consistent and to avoid the error that would be caused by variations in the irrigation amounts. However, practical management, i.e., leaving a deficit for the storage of rainfall, could reduce irrigation amounts .

Table 1. Corn yield and irrigation for frequency treatments.

Frequency Treatment	Irrigation Inches	Yield bu/a
1990		
1 day	21.0	178.9
3 day	19.3	161.9
5 day	18.1	177.8
7 day	18.1	180.5
0.5 inches	20.5	170.8
1.0 inches	18.3	165.4
1.5 inches	17.4	176.7
2.0 inches	16.7	171.3
1991		
1 day	23.5	224.7
3 day	21.5	216.3
5 day	20.9	205.4
7 day	19.4	216.7
0.5 inches	21.4	217.0
1.0 inches	20.4	220.9
1.5 inches	19.4	216.3
2.0 inches	19.4	214.5
2-year avg.		
1 day	22.3	201.8
3 day	20.4	189.1
5 day	19.5	196.1
7 day	18.8	198.6
0.5 inches	21.0	193.9
1.0 inches	19.4	193.2
1.5 inches	18.4	196.5
2.0 inches	18.1	192.9

Figure 1. Two-year average corn yield for the various amount/frequency treatments.



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WATER REQUIREMENT FOR CORN WITH DRIP IRRIGATION

by

Todd Weis, William Spurgeon, Thomas Makens, and Harry Manges*

SUMMARY

A corn water requirement study using buried drip lines was done in 1990 and 91. The 2-year average corn yields were 197 bu/a for the full BI irrigations and 133 bu/a for the dryland plots. The horizontal movement of water was adequate to supply water to corn rows 15 inches away, yet provided little water for weed growth in the furrows.

INTRODUCTION

This study was designed to evaluate the use of buried drip line irrigation for corn in Holcomb, Kansas. The corn was irrigated at various fractions of the Base Irrigation (BI) required.

The objectives of this study are: 1) to determine the water requirement of corn grown with drip irrigation and 2) examine the feasibility of large-scale adoption of drip irrigation for row crops in Southwest Kansas.

PROCEDURES

Corn was planted in 30-inch rows on 60-inch beds. Each bed was irrigated by a drip line running through the center of the bed, 16 inches deep. Each drip line watered two corn rows, 15 inches to either side of the line. There were six irrigation treatments. They were no irrigation, irrigation at 0.25, 0.5, 0.75, 1.0, and 1.25 times BI.

Access tubes were installed in every plot in the corn row, 15 inches from the drip line, for use with a neutron probe. A neutron probe was used to determine soil water to a depth of 8 ft. Also, access tubes were placed at 3, 15, and 30 inches from the drip lines in the 1.25, 1.0, 0.75 and 0.5 BI plots. This enabled us to study the horizontal movement of water away from the drip line.

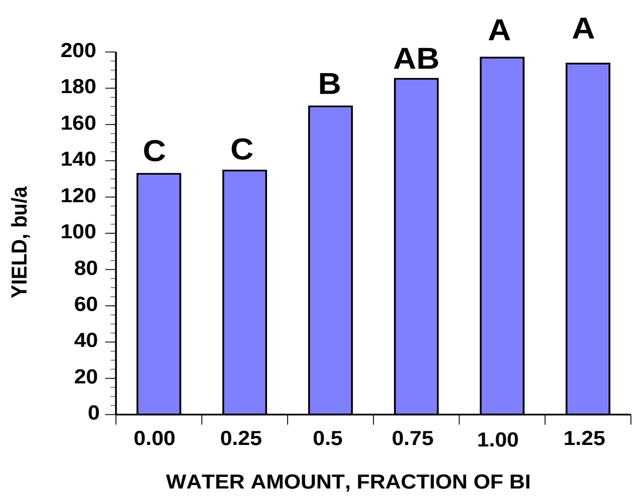
RESULTS AND DISCUSSION

Differences in yields were observed for the harvest (Table 1 and Figure 1). A hail storm in July 1990

Table 1. The effect of irrigation level on corn yield (bu/a).

	Water Treatment	Irrigation Inches	Yield bu/a
1990			
	1.25 BI	23.8	174.3
	1.00 BI	19.3	176.3
	0.75 BI	13.4	162.5
	0.50 BI	6.8	159.3
	0.25 BI	1.8	140.3
	0.00 BI	0	134.3
1991			
	1.25 BI	23.7	213.0
	1.00 BI	20.1	217.8
	0.75 BI	15.7	207.8
	0.50 BI	8.8	180.5
	0.25 BI	1.8	129.0
	0.00 BI	0	131.8
2-year average			
	1.25 BI	23.8	193.6
	1.00 BI	19.7	197.0
	0.75 BI	14.6	185.2
	0.50 BI	7.8	169.9
	0.25 BI	1.8	134.6
	0.00 BI	0	133.0

Figure 1. Two-year average (1990-1991) corn yield for the different water treatments.

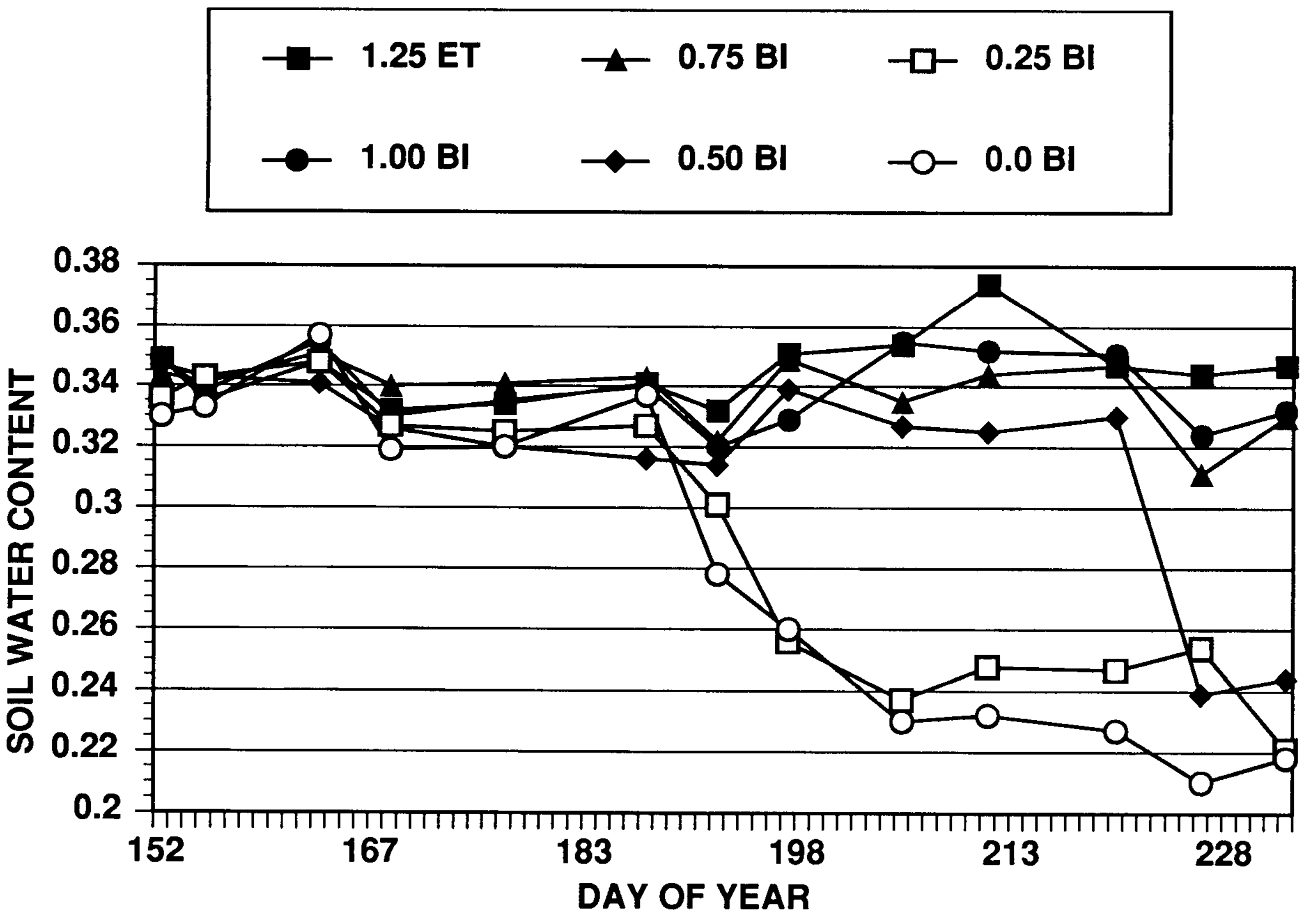


reduced yields. The 1.0 BI treatment received 20.1 inches of irrigation water in 1991.

Rainfall was 7.5 inches for the season. The 1.0 BI treatment had the highest 2-year average yield, 197.0 bu/a. The 1.25 BI treatment yielded 193.6 bu/a. The increased amount of water did not increase yields. This may have been due to loss of aeration.

Irrigations were frequent, and small amounts were used. Soil water status by BI level throughout the season is shown in Figure 2. Analysis of a similar drip water requirement study at Colby indicated that the 0.75 BI level had slightly reduced yield (6% reduction from 1.0 BI). The best management for drip would be to maintain the soil water at some level less than field capacity. This should be done to help capture more rainfall and minimize drainage losses. Irrigations should be frequent enough to prevent stress. At least a 15 to 20% savings on water is realized by managing a buried drip at values less than field capacity with little or no reduction in corn yield.

Figure 2. Soil water status through the 1991 season for each irrigation treatment.



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CROP VARIETY TESTS - HIGH YIELDERS

by
Merle Witt

Brief lists of the "High 5" or "High 10" yielding crop varieties at three western Kansas locations (Garden City, Tribune, and Colby) are presented as a quick reference to some top performing crop variety or hybrid choices. More complete information on these and other crops is published in Crop Performance Test reports available at your county extension office.

CORN HYBRIDS

GARDEN CITY

High 10 (3-yr av)	Bu/A	% Lodged
Pioneer 3162	238	0
Deltapine G-4673B	227	1
Jacques 8210	226	0
Crow's 682	225	1
Northrup-King N7816	225	1
Northrup-King N8318	225	0
Pioneer 3159	225	0
Northrup-King PX9540 Exp	224	0
Growers GSC 4192	223	1
Asgrow RX908	222	0
Oro 190	222	0

High 10 (2-yr av)	Bu/A	% Lodged
Pioneer 3162	241	0
Germains GC 96008	232	1
Golden Acres T-E 7055	228	0
Growers GSC 4192	228	1
Northrup-King N8318	228	0
Ohlde 300	228	0
Asgrow XP8519 Exp.	227	1
Jacques 8210	227	0
Deltapine G-4673B	226	1
Asgrow RX908	225	0
Crows 682	225	1
Northrup-King PX9540 Exp	225	0

COLBY

High 10 (3-yr av)	Bu/A	% Lodged
Northrup-King N7816	225	2
Ohlde 230	224	2
Cargill 6227	222	5
Garst 8388	222	4
Oro 120	222	4
Deltapine G-4513	220	7
Garst 8492	219	4
Garst 8344	219	5
Bo-jac 602	218	1
Cargill 7993	218	2
Dekalb DK636	217	3
Horizon 77	217	4
Golden Acres T-E 6951	216	2
Northrup-King PX9540 Exp	216	1
Oro 180	216	1

High 10 (2-yr av)	Bu/A	% Lodged
Asgrow XP8519 Exp	259	11
Hyperformer HS 9773	253	2
NC+ 6414	253	1
Northrup-King N7816	253	2
Oro 180	252	1
Pioneer 3162	251	2
Ohlde 230	250	2
Garst 8344	249	5
Cargill 6227	248	5
Crow's 670	248	3
Deltapine G-4513	248	7
Oro 150	248	3
Garst 8388	246	4

CORN HYBRIDS (cont.)

TRIBUNE

High 10 (3-yr av)	Bu/A	% Lodged	High 10 (2-yr av)	Bu/A	% Lodged
Oro 150	219	6	Oro 150	221	6
Bo-jac 603	218	1	Horizon 7113	217	2
Deltapine G-4513	217	3	Triumph 1265	217	2
Horizon 7113	217	2	Bo-jac 603	216	1
Golden-Acres T-E 6994	215	7	Golden Acres T-E 6994	216	7
Triumph 1595	214	4	Deltapine G-4513	215	3
Northrup-King N6873	213	4	Northrup-King N6330	215	2
Cargill 8027	212	3	Garst 8492	213	1
Oro 190	212	3	Hyperformer HS 9773	212	6
Pioneer 3162	211	1	Crow's 488	211	5

GRAIN SORGHUM—IRRIGATED

GARDEN CITY

High 10	2-yr av	Days to Bloom
Casterline SR 324E	128	70
Dekalb DK-56	126	72
DekalbDK-66	124	75
Groagri GSC1313	123	68
Jacques 60E	123	69
Casterline X15343EXP	121	76
Groagri GSC3146	121	70
Deltapine G-1616	120	69
Garst 5319	119	70
Hyperformer HSC Cherokee	119	71

High 5	3-yr av	Days to Bloom
Dekalb DK 66	127	75
Casterline SR324E	126	70
Oro G Extra	120	70
Garst 5319	118	70
Deltapine G1616	117	69

COLBY

High 10	2-yr av	Days to Bloom
Dekalb DK-66	201	79
Golden Acres T-E77-E	186	73
Dekalb DK-56	184	75
Oro GXTRA	184	74
Groagri GSC1313	183	73
TX2752 X TX430	183	73
Triumph Two 80-D	182	74
Oro Baron	181	73
Cargill 847	180	72
Dekalb DK-48	179	71
AgriPro STD701G	179	74

High 5	3-yr av	Days to Bloom
Golden Acres T-E77-E	155	73
Oro Baron	153	73
Triumph Two 80-D	153	74
Asgrow Osage	152	73
Cargill 847	152	72
Groagri GSC1313	152	73

TRIBUNE

High 10	2-yr av	Days to Bloom
Dekalb DK-66	168	85
Dekalb DK-48	163	78
Cargill 83	163	78
Casterline SR319E	161	79
Dekalb DK-56	160	80
Oro Amigo	160	80
Oro GXTRA	158	81
Groagri GSC1313	158	81
Cargill 847	157	80
Golden Acres T-E77-E	152	78
Oro Baron	152	82

High 5	3-yr av	Days to Bloom
Cargill 837	149	78
Dekalb DK-66	145	85
Dekalb DK-48	143	78
Groagri GSC1313	143	81
Northrup King KS-714Y	141	82
Oro GXTRA	141	81
Oro Amigo	141	80

GRAIN SORGHUM—DRYLAND

GARDEN CITY

High 10	2-yr av	Days to Bloom
Northrup-King KS-710	72	85
Northrup-King KS-714Y	70	85
Casterline SR-319E	69	85
DekalbDK-41Y	65	79
Asgrow Sneca	64	75
Groagri GSC1214	64	88
Garst 5511	63	87
TX2752 X TX430	62	86
Pioneer 8500	61	78
Cargill 618Y	60	74
Cargill 575	60	85

High 5	3-yr av	Days to Bloom
Northrup-King KS714Y	62	85
Dekalb DK-41Y	60	79
Garst 5511	59	87
Pioneer 8500	58	78
Asgrow Seneca	56	75
TX 2752 X TX430	56	86

TRIBUNE

High 10	2-yr av	Days to Bloom
TX2752 X TX430	57	86
Asgrow Seneca	56	81
Casterline SR319E	55	85
Groagri GSC1214	55	78
Oro Ivory	55	78
Asgrow A504	53	88
Groagri GSC3159	53	78
Golden Acres T-EY-60	51	79
Triumph TR58Y	51	83
Asgrow Madera	50	75
TX399 X TX430	50	87
Wheatland X TX2536	50	85

High 5	3-yr av	Days to Bloom
Asgrow Seneca	58	81
Oro Ivory	56	78
TX2752 X TX430	55	86
Triumph TR58Y	53	83
Pioneer 8500	52	79
Golden Acres T-EY-60	52	79

COLBY

High 10	2-yr av	Days to Bloom
Cargill 630	103	66
NC+ Y363	101	68
Triumph TR60-G	101	70
Golden Acres T-EY-66	100	68
Pioneer 8771	100	62
Asgrow A504	99	77
Casterline SR319E	99	70
Dekalb DK-41Y	99	67
TX2752 X TX430	99	73
TX399 X TX430	98	72
Golden Harvest H-388W	98	66
Groagri GSC3159	98	65
Asgrow Seneca	98	67

High 5	3-yr av	Days to Bloom
Cargill 630	95	66
NC+ Y363	95	68
Golden Acres T-FY-60	94	68
Triumph TR60-G	93	70
Pioneer 8500	92	67
Asgrow MADERA	92	62

SUNFLOWERS

GARDEN CITY

High 5 (3-yr av)	Lbs/A	% Oil	High 5 (2-yr av)	Lbs/A	% Oil
Triumph 565	2271	46.9	Triumph 565	2474	46.9
Triumph 560A	2136	47.1	Genetic Resources GRI881	2261	43.8
Garst Hysun 33	1941	43.2	Triumph 560A	2126	46.7
Triumph 548A	1729	46.3	Garst Hysun 33	1969	42.9
Garst Hysun 354	1693	45.3	Triumph 548A	1689	46.4

COLBY—IRRIGATED

High 5 (3-yr av)	Lbs/A	% Oil	High 5 (2-yr av)	Lbs/A	% Oil
Cargill SF187	2633	43.3	Kaystar 9101	2990	42.3
Genetic Resources GRI881	2628	44.6	Genetic Resources GRI881	2864	45.8
Jacques Commando	2522	44.8	Kaystar 8806	2848	46.0
Triumph 565	2486	46.7	Cargill SF187	2705	44.1
Cargill SF100	2465	43.6	Jacques Commando	2690	45.9

COLBY—FALLOW

High 5 (3-yr av)	Lbs/A	% Oil	High 5 (2-yr av)	Lbs/A	% Oil
Genetic Resources GRI881	1939	41.5	Genetic Resources GRI881	2041	42.0
Cargill SF100	1914	39.6	Dahlgren DO838	2038	42.0
Cargill SF187	1891	39.4	Cargill SF100	1978	39.3
Interstate 3311	1850	41.9	Cargill SF187	1961	39.4
Jacques Commando	1830	40.0	Pioneer 6440	1952	41.8

ALFALFA

GARDEN CITY

High 5 (1-yr av)	Tons/A
MBS Seeds MS 2041	12.04
Dairyland Research DS 901 Exp	11.55
W-L Research 86-20 Exp	11.41
Dairyland Research Magnum III	11.25
Garst 630	11.21

WHEAT—IRRIGATED

GARDEN CITY

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
AgriProThunderbird	58	AgriPro Sierra	53
TAM107	55	AGSECO 7846	50
AGSECO7853	55	Karl	47
Karl	54	TAM 107	46
2163	53	Quantum 589	46

COLBY

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
TAM 200	69	AgriPro Mesa	72
AgriPro Mesa	69	Quantum 589	72
Colt	67	Karl	72
Karl	66	TAM 200	72
Quantum 578	65	2180	71
AgriPro Abilene	65		

TRIBUNE

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Karl	72	Colt	77
Colt	72	AgriPro Abilene	77
AgriPro Abilene	72	AgriPro Sierra	76
TAM 107	71	Karl	76
TAM 200	71	AGSECO 7853	74

WHEAT—DRYLAND

GARDEN CITY

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Tam 107	39	Quantum 562	48
AgriPro Abilene	38	AgriPro Abilene	45
Karl	35	Karl	45
2172	34	AgriPro Sierra	44
AgriPro Thunderbird	33	AGSECO 7805	43
AGSECO 7846	33	MBS 8905	43

COLBY

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
TAM 200	60	TAM 200	73
AgriPro Abilene	60	Arapahoe	73
Quantum 562	59	MBS 8905 Exp	73
TAM 107	58	AgriPro Abilene	73
AGSECO 7846	58	AgriPro Sierra	72
AgriPro Bronco	58	Quantum 562	72
		TAM 107	7

TRIBUNE

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Quantum 562	36	AGSECO 7805	41
Scout 66	36	Karl	39
TAM 107	35	AGSECO 7846	38
Pharoah Tut	35	Quantum 562	38
Arapahoe	34	Newton	38
Larned	34	Tam 200	38
Tam 200	34		

ACKNOWLEDGMENTS

The staff of the Southwest Kansas Research-Extension Center and Kansas State University appreciate and acknowledge the following companies, foundations, and individuals for their support of the research that has been conducted during the past year.

Donations:

Abbott Laboratories
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Rhone Poulenc Ag Co.
Spink County Equipment
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Grant Support:

American Cyanamid
Atochem North America
BASF Corp
CIBA-GEIGY
E.I. duPont de Nemours and Co., Inc.
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Kansas Agriculture Experiment Station
Miles, Inc. (Mobay Chemical Corp.)
Monsanto Agricultural Products Co.
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KKG Farms
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Tom Miller & Ingalls Aerial Sprayers
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Charles Norwood- Agronomist - Dryland Soil Management. Charles has M.S. and Ph.D. degrees from Oklahoma State University. He joined the staff in 1972. Charles' primary research responsibilities include dryland soil and crop management, with emphasis on reduced and no-tillage cropping systems.

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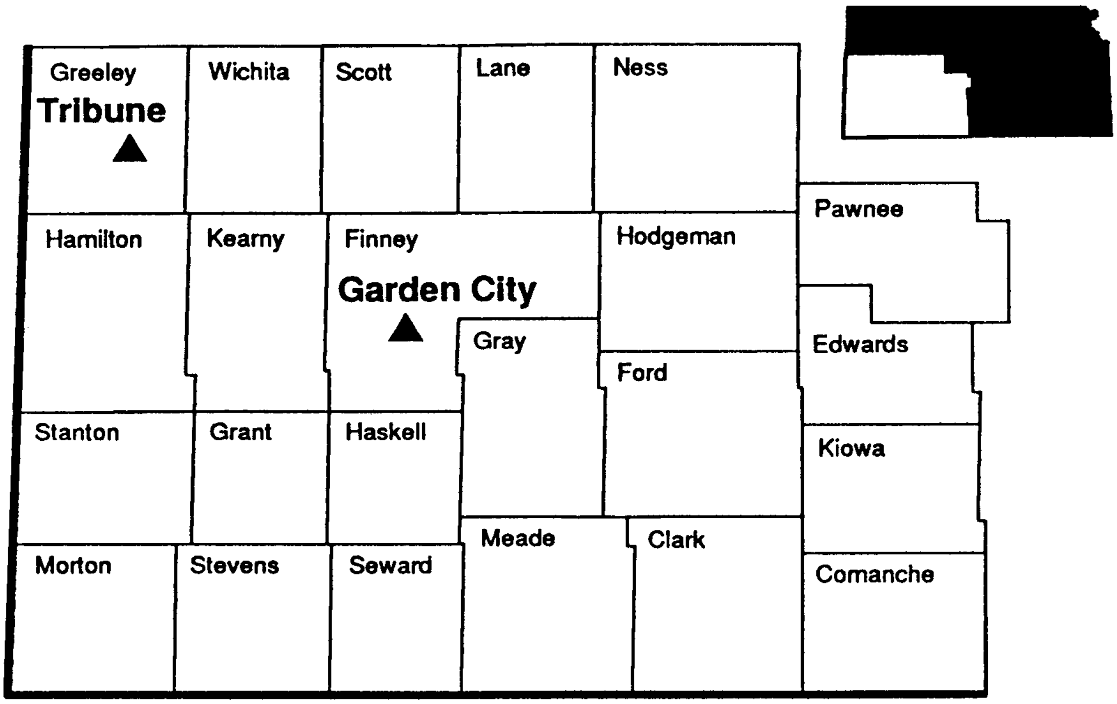
SERVICE AREA — SWK RESEARCH-EXTENSION CENTER



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