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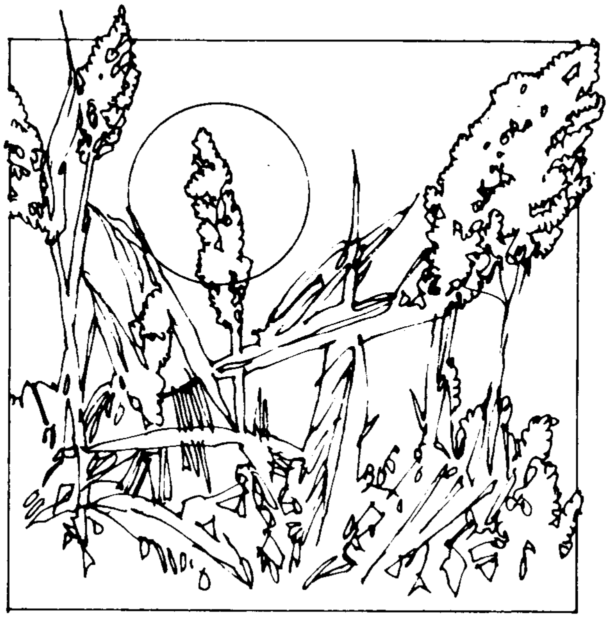
Field Day 1991

Abstract

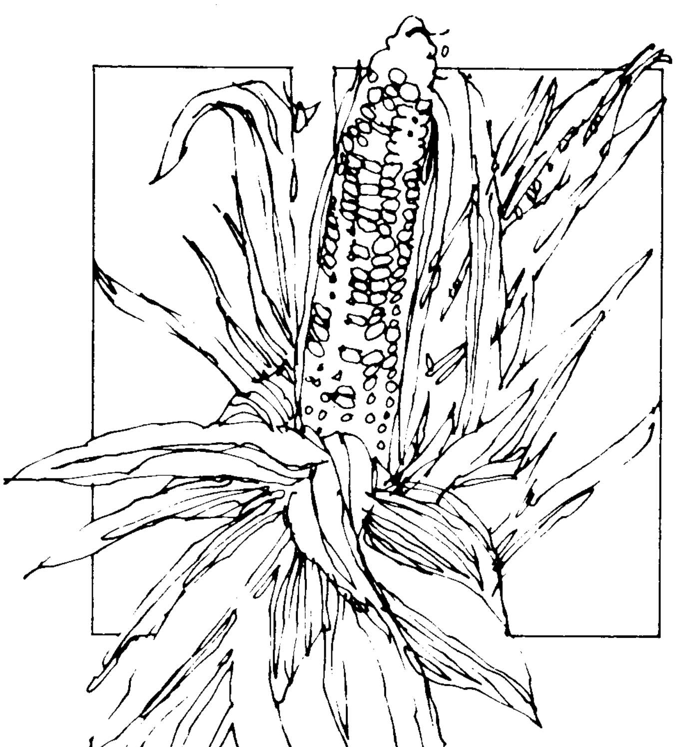
Each Field Day report consists of individual research reports on topics specific to the region, including cultural methods for most of the major crops grown in Kansas, mitigating the effects of weeds, insects, and disease associated with those crops, and irrigation. Research is conducted and reports written by staff of the K-State Research and Extension Southwest Research Extension Center.

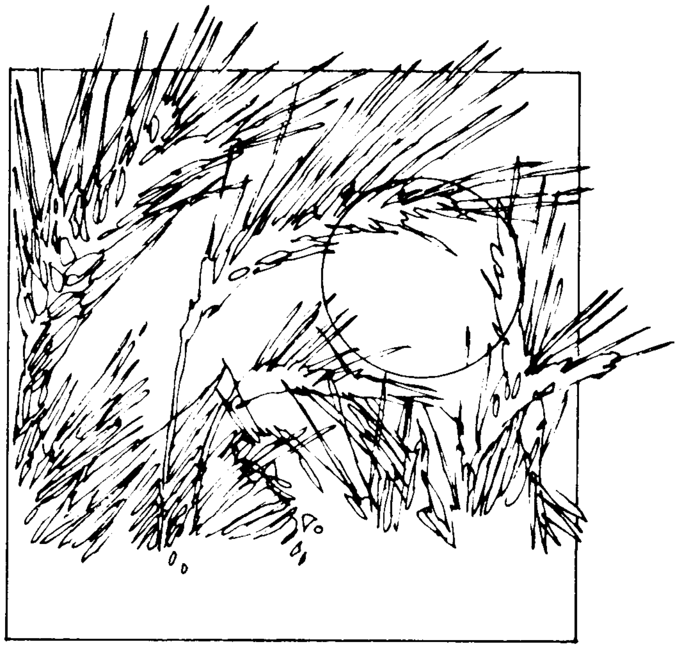
Keywords

Report of progress (Kansas State University. Agricultural Experiment Station); 630; Kansas Agricultural Experiment Station contribution; no. 91-460-S; Kansas; Weather; Crops; Tillage systems; Water management; Weeds; Insect biology and control



1991 FIELD DAY REPORT





SOUTHWEST KANSAS RESEARCH-EXTENSION CENTER

Report of Progress 630 Agricultural Experiment Station
Kansas State University Walter R. Woods

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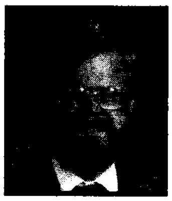

Randall Currie - Weed Scientist. Randall began his agriculture studies at Kansas State University, where he received his B.S. degree. He then went onto receive his M.S. from Oklahoma State University and his Ph.D. from Texas State University.

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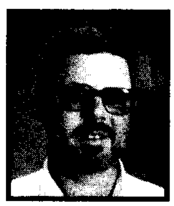

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Gerald Greene - Entomologist. He received his M.S. from Kansas State and his Ph.D. from Oregon State University. He was Station Head from 1976-1982. His research is on livestock entomology, with emphasis on control of stable flies by predators and parasites in feedlots of western Kansas.

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Southwest Research-Extension Center

WEATHER INFORMATION AT GARDEN CITY

by

Charles Norwood

Climatic conditions were very favorable for crop growth in 1990, particularly from January through late summer. Above normal precipitation from January through May resulted in excellent wheat yields. June and August had below normal rainfall, but above normal rainfall in July contributed to good yields from the summer crops.

Precipitation totaled 18.76 inches or 0.90 inches above normal. Snowfall was above normal, with nearly 15 inches in January and over 16 inches in February. One-half inch fell in March, then 1 inch in November and nearly 5 inches in December.

With the exception of November, precipitation during the last 5 months of the year was below normal. A lack of topsoil moisture in September resulted in some problems in obtaining good stands of wheat.

Temperatures were warmer than normal in January, March, June, September, and November. May, July, and December were cooler than normal. Record high temperatures occurred on 5 days during the year, and record lows on 6 days. The high for the year was 105° on June 30, and the low was -10° on December 22 and 23. There were 16 days of 100° or higher temperatures, and 10 days when the low reached 0° or below. The coldest day was December 22, with a low of -10° and a high of 0°. Single-digit high temperatures of 4°, 2°, and 2° occurred on December 21, 23, and 30, respectively.

Average wind speed was 5.1 mph or 1.0 mph below normal. Open pan evaporation was 70.88 inches or 7.44 inches below normal. The frost-free period was from May 10 to October 9, or 152 days, 18 days below normal.

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

Table 1. Climatic data. Southwest Kansas Research-Extension Center, Garden City. 1990.

	Precipitation inches		Temperature (°F)						Wind MPH		Evaporation inches	
			Average		Mean		Extreme					
Month	1990	Avg.	Max	Min	1990	Avg.	Max	Min	1990	Avg.	1990	Avg.
January	1.52	.35	45.0	17.6	31.8	27.7	69	2	4.0	5.1		
February	1.69	.45	43.0	21.3	32.2	33.1	67	0	6.1	6.0		
March	1.26	1.15	55.6	30.1	42.8	40.0	79	13	7.4	7.4		
April	2.09	1.42	66.1	39.5	52.8	52.5	84	27	7.0	7.7	8.10	8.79
May	5.68	3.26	70.7	47.0	58.9	62.5	94	31	4.9	7.1	7.96	10.96
June	0.51	2.87	90.9	61.6	76.3	73.2	105	48	5.8	7.3	14.07	13.90
July	3.29	2.51	89.8	61.9	75.9	78.4	103	45	4.6	6.2	13.01	14.96
August	0.94	2.19	90.3	60.8	75.9	76.0	102	53	3.4	5.5	10.98	12.78
September	0.54	1.52	85.9	55.7	70.8	67.4	100	39	3.6	5.7	9.54	9.80
October	0.06	1.07	70.9	37.0	54.0	55.0	92	23	5.0	5.3	7.22	7.13
November	0.79	.75	62.6	29.4	46.0	40.3	83	13	4.7	5.1		
December	0.39	.32	40.6	12.2	26.4	31.7	69	-10	5.1	4.9		
Annual	**18.76**	**17.86**	**67.6**	**39.5**	**53.6**	**53.2**				**6.1**	**70.88**	**78.32**

Average earliest freeze in fall	Oct. 13	1990:	Oct. 17
Average latest freeze in spring	April 25	1990:	May 10
Frost-free period	170 days	1990:	168 days

All averages are for the 30-year period 1951-1980, except for the October evaporation, which is the 1962-82 average.

WEATHER INFORMATION AT TRIBUNE

by

Dale Bremer and David Frickel

Precipitation for 1990 totaled 16.48 inches, which was slightly above normal (Table 1). Precipitation was above normal in 6 months. The wettest months were May, with 2.49 inches, and July, with 3.72 inches of precipitation. The largest single amount of precipitation was 1.30 inches on May 30. Snowfall for the year totaled 29.4 inches. The largest single amount of snowfall was 10.0 inches on January 19 and 20.

Air temperatures were above normal for 6 months and below normal for 6 months. The warmest month was July, with an average temperature of 74.8° and an average high temperature of 90.1°. The coldest month was December, with an average temperature of 24.5°, an average high of 39.1°, and an average low of 9.8°. Deviations from the normal were greatest in December, when the average temperature was 10.7° lower than normal.

The highest temperature was 107° on June 29 and 30. A total of 16 days reached 100° or above. The lowest temperature was -21° on December 30. There were 8 days with sub-zero temperatures. The last frost (30°) in spring was on May 10 (29°), which was 9 days later than normal. The first frost (30°) in the fall was on October 9 (25°), which was the same date as the 78-year average. The frost-free period was 152 days or 9 days less than normal. Record high temperatures were set on 12 days; June 19 (105°), June 29 (107°), June 30 (107°), July 4 (105°), August 28 (103°), August 29 (103°), September 16 (99°), October 6 (91°), October 27 (85°), November 1 (82°), November 25 (79°), and November 26 (79°). Record low temperatures were set on 8 days; June 22 (45°), July 13 (43°), July 14 (42°), July 21 (48°), July 23 (50°), October 18 (21°), December 23 (-13°), and December 30 (-21°).

Open pan evaporation from April through September totaled 80.41 inches or 14.27 inches above normal. Wind speed for the same period averaged 5.56 mph; normal speed is 5.63 mph.

Table 1. Climatic data. Southwest Kansas Research-Extension Center, Tribune. 1990.

	Precipitation inches		Temperature (°F)						Wind MPH		Evaporation inches	
			Average[2]		Mean		Extreme					
Month	1990	Avg.[1]	Max	Min	1990	Avg.	Max	Min	1990	Avg.[3]	1990	Avg.[4]
January	1.16	.35	45.7	16.0	30.9	28.9	71	1	4.6			
February	1.67	.42	43.5	18.8	31.2	34.1	67	4	4.8			
March	1.46	0.96	54.5	27.8	41.2	39.9	76	14	5.3			
April	1.07	1.36	66.2	35.6	50.9	41.0	86	24	6.4	6.8	8.74	7.86
May	2.49	2.69	71.1	42.5	56.8	60.9	91	29	6.0	6.3	12.20	9.96
June	1.53	2.72	91.2	58.1	74.7	71.5	107	45	6.0	5.7	19.00	12.55
July	3.72	2.52	90.1	59.5	74.8	78.5	105	42	5.7	5.1	16.76	14.28
August	0.81	2.15	90.6	57.7	74.2	76.3	104	49	4.7	4.8	12.84	12.18
September	0.78	1.37	85.0	52.5	68.8	67.6	102	37	4.7	5.2	10.87	9.20
October	0.21	0.90	70.3	35.1	52.7	54.5	91	21	4.6			
November	1.04	0.51	60.8	27.5	44.2	39.7	82	10	4.6			
December	0.54	0.40	39.1	9.8	24.5	35.2	68	-21	5.0			
Annual	**16.48**	**16.35**	**67.3**	**36.7**	**52.1**	**52.3**			**5.2**	**5.7**	**80.41**	**66.14**

Average earliest freeze in fall[5]	Oct. 9	1990:	Oct. 9
Average latest freeze in spring	May 1	1990:	May 10
Frost-free period	161 days	1990:	152 days

[1] 78-year average [2] 1990 average [3] 67-year average [4] 70-year average [5] 78-year 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. Wheat yields from the WF and WSF systems usually did not differ, nor did sorghum yields from the SF and WSF systems. An economic comparison between WF and WSF indicated that the greatest return occurred from reduced-till wheat, no-till sorghum in the WSF system.

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 1990.

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.

<u>WF</u>

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. Blade once - 1.0 lb atrazine after wheat harvest + 2.4 lbs Bladex the following spring. Blade once in the spring or early summer, then postemergent herbicides as needed.
5. No-till (NT) - 1.0 lb atrazine after wheat harvest + 2.4 lbs Bladex the following spring + postemergent herbicides as needed.

<u>WSF (prior to wheat)</u>

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.

<u>WSF (prior to sorghum)</u>

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.

<u>SS</u>

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.

<u>SF</u>

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

<u>WW</u>

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 amounts did not differ between tillage treatments in the WF system. In the WSF system, there was more soil water in the NT plots only in 1989. There was more soil water in the WF-CT and NT plots than in 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 in 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
Avg.	7.6ab	8.3a	6.4b	7.2ab	4.9c

[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, there was more soil water in RT and NT than in CT in 1987 and 1988; in 1989, the amount in RT, but not NT, exceeded that in CT. No significant differences occurred in WSF in 1986. There were no significant differences between RT and NT in any year. Soil water in SS was less than that in all WSF treatments in 1986 and 1988, and less than in WSF-RT and NT in 1990, but more than in WSF-CT in 1987. No difference occurred between any WSF treatment and SS in 1989. The longer fallow period of SF never resulted in more soil water than in WSF-RT or NT but did result in more than in WSF-CT in 1987 and 1989.

Table 3 . Effect of cropping system and tillage on the amount of available soil water at sorghum planting. Garden City, KS. 1986-90.

	Cropping System				
Year	WSF-CT	WSF-RT	WSF-NT	SS	SF
	Inches available water in a 5-ft. profile				
1986	3.2a[1]	3.8a	4.5a	0.2b	4.2a
1987	5.3b	8.4a	7.3a	7.9a	8.0a
1988	6.7c	8.5ab	9.3a	4.7d	7.3bc
1989	6.6b	8.7a	8.3ab	8.1ab	8.8a
1990	7.7ab	8.2a	9.1a	6.0b	8.8a
Avg.	5.9b	7.5a	7.7a	5.4b	7.4a

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

Wheat yields

Tillage caused no differences in the WF system in 1987, 1988, and 1990 (Table 4). In 1989, NT yielded more than the CT and blade-once treatments but yielded the same as RT and MT.

Table 4. Effect of reduced and no tillage on the yield of winter wheat in a wheat-fallow system. Garden City, KS. 1987-90.

Tillage system	1987	1988	1989	1990	Avg.
	Bu/A				
Conventional	24a[1]	19a	37bc	49a	32a
Reduced	27a	22a	38ab	54a	35a
Minimum	26a	22a	41ab	52a	35a
Blade once	26a	22a	32c	52a	33a
No till	27a	19a	43a	50a	35a

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

The blade-once treatment was included because NT has resulted in hard, dry soil in previous studies. Blading tends to prevent a hard surface layer and makes planting easier. However, in the current study, this has not been a problem. There is no explanation, thus far, for the significantly lower yield of the blade-once treatment in 1989.

In the WSF system (Table 5), RT yielded more than CT in 1989. In December, 1990, several days of extremely cold temperatures reaching -17° F. occurred before the wheat entered dormancy. This caused abortion of some tillers, and WSF-NT yielded less than WSF-RT or CT. The NT plants were exposed more to the cold because of shallower planting and lost more tillers than the other treatments. Under these same conditions, the yield of WF-NT (Table 4) was not reduced because of insulation from wheat straw remaining from the previous crop. Tillage had no effect on continuous wheat (Table 6).

Table 5. Effect of reduced and no tillage on the yield of winter wheat in a wheat-sorghum-fallow system. Garden City, KS. 1987- 90.

Tillage system	1987	1988	1989	1990	Avg.
	Bu/A				
Conventional	24a[1]	26a	12b	57a	30a
Reduced	26a	23a	31a	55a	34a
No till	23a	19a	23ab	46b	28a

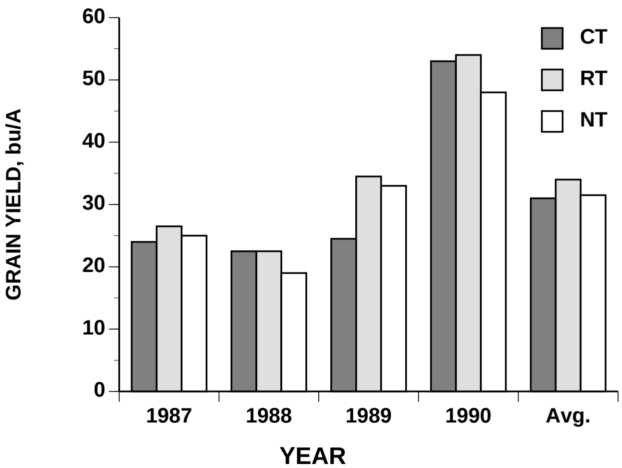
[1] Yields within a column followed by the same letter do not differ (P<0.05).

Table 6. Effect of tillage on the yield of continuous winter wheat. Garden City, KS. 1987-90.

Tillage system	1987	1988	1989	1990	Avg.
	Bu/A				
Conventional	10	17	7	47	20
No-till	13	14	9	41	19
LSD (.05)			NS		

Figure 1 shows a graphic summary of the effects of tillage on wheat yields when averaged over the WF and WSF cropping systems. Although the data vary from year to year, there is a trend toward increased yield with RT. Figure 2 is a summary of the effects of cropping system on yield, averaged over tillage. Yields of WF and WSF are generally similar. The longer fallow period of WF increased yields only in 1989, because of more stored moisture, discussed previously. The WW system yielded the least in each year, although high rainfall in 1990 resulted in yields greater than those of WF and WSF in the preceding 3 years.

Figure 1. Effect of tillage on wheat yield. 1987-90 (averaged over cropping system).



Tillage system	1987	1988	1989	1990	Avg.
	Bu/A				
WSF					
CT	49b[1]	35a	90a	52a	56
RT	61ab	49b	99a	55a	66
NT	69a	53b	99a	58a	70
SS	56ab	---	55b	38b	50
SF	64a	---	71b	53a	63

Table 7. Effect of cropping system and tillage on grain sorghum yield. Garden City, KS. 1987-90.

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

Figure 2. Effect of cropping system on wheat yield (averaged over tillage).

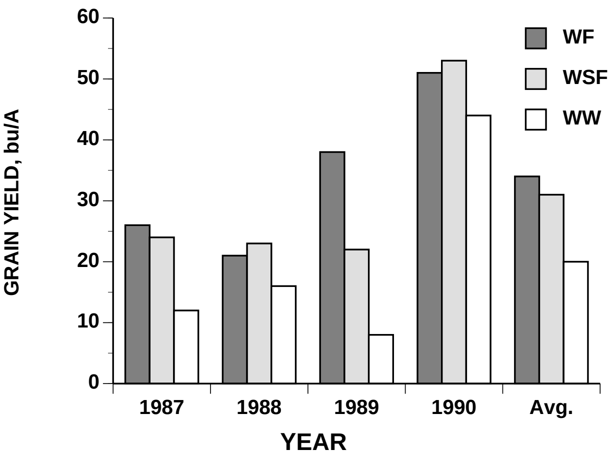
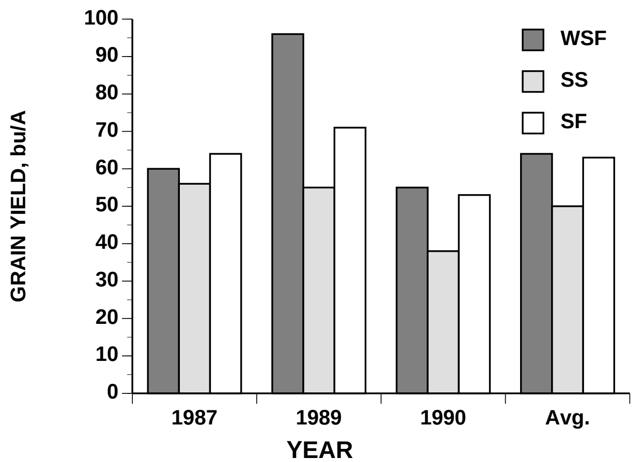


Figure 3. Effect of cropping system on grain sorghum yield. 1987-90.



Grain sorghum yields

Grain sorghum yields, as affected by cropping systems and tillage, are presented in Table 7. Reduced and NT yielded more than CT in 1988, but NT yielded more than CT in 1987. Yield increases were a result of more soil water at planting (Table 3). Figure 3 illustrates the difference between cropping system (WSF is averaged over tillage). Wheat-sorghum-fallow yields were similar to those following the longer fallow period of SF in 2 of the 3 years. In 1989, WSF plots matured earlier than those of SF, which were not yet mature by frost. Continuous sorghum yielded less than WSF or SF in each year.

Southwest Research-Extension Center

ECONOMIC ANALYSIS OF CROPPING AND TILLAGE SYSTEMS

by

Charles Norwood and Kevin Dhuyvetter

SUMMARY

The wheat-sorghum-fallow system, with two crops in 3 years, provided a greater return than did the wheat-fallow system with one crop in 2 years. The greatest return was received from a reduced-till wheat, no-till sorghum system. Returns were higher for wheat-sorghum-fallow even when no government payments were received for the sorghum.

INTRODUCTION

An economic analysis was conducted on the wheat-fallow and wheat-sorghum-fallow systems for the 1987-1990 period. The objective was to determine which cropping and tillage system provided the greatest economic return under several government program scenarios.

PROCEDURES

Cultural practices and treatments used are described on page 5 in the preceding section. For the purpose of this analysis, a 2000-acre, dryland farm was assumed. Wheat-fallow (WF) included 1000 acres of wheat and 1000 acres of fallow each year. Wheat-sorghum-fallow (WSF) included 666.67 acres of wheat, 666.67 acres of sorghum, and 666.67 acres of fallow each year. Conventional tillage (CT), reduced tillage (RT), and no tillage (NT) were compared. All land was owned. Costs were calculated using KSU Farm Management Guides MF 257, MF 903, and MF 904 for the WF and WSF systems. Crop prices used for wheat and sorghum were the averages for southwest Kansas each year. Deficiency payments were based on actual rates in 1987-1989 and an estimated rate for 1990. Payment yields (ASCS yields) used average dryland yields for wheat and grain sorghum in Finney County. Provisions of the 1990 Farm Bill pertaining to cross compliance and building base were used in the calculations. Crop prices, deficiency payment rates, and proven yields are included in Table 1.

RESULTS AND DISCUSSION

Profit or loss from cropping and tillage systems depends on crop yield, price, government payments,

Table 1. Yields, prices, and deficiency payments for wheat and grain sorghum. 1987-1990.

Year	Crop	WF-CT	WF-RT	WF-NT	WSF-CT	WSF-RT	WSF-NT	Price	Deficiency payment[1]
		Bu/A						$/Bu	
1987	Wheat	24	27	27	24	26	23	2.47	1.81
	Sorghum				49	61	69	1.82	1.14
1988	Wheat	19	22	19	26	23	19	3.67	0.69
	Sorghum				35	49	53	2.28	0.48
1989	Wheat	37	38	43	12	31	23	3.61	0.32
	Sorghum				90	99	99	2.07	0.66
1990	Wheat	49	54	50	57	55	46	2.40	1.28
	Sorghum				52	55	58	2.02	0.55[2]
Avg.	Wheat	32	35	35	30	34	28	3.04	1.02
	Sorghum				56	66	70	2.05	0.71

[1]Deficiency payments are paid on proven yields of 28 bu/A wheat and 42 bu/A sorghum.
[2]Estimated payment.

and the costs of herbicides vs tillage. Table 2 is a listing of the number of tillage and spraying operations in the WF and WSF systems and the total costs of production. Costs increase as tillage is decreased, particularly for pure no-till systems. However the WF-RT system is slightly cheaper than WF-CT, and the combination CT wheat,

Table 2. Effect of the number of tillage and spray operations on total costs in cropping systems.

Cropping system	Number of operations: Tillage	Spray	Total Cost
Wheat-fallow			$/A
Conventional till	6	0	105.19
Reduced till	4	1	103.67
No-till	0	3	123.93
Wheat-sorghum-fallow (wheat + sorghum)			
Conventional till	7	0	193.92
Reduced till	3	1	209.29
No-till	0	5	210.34
CT wheat, NT sorghum	4	2	186.25
RT wheat, NT sorghum	2	3	195.84

RT sorghum system in WSF is cheaper than all CT. An explanation for the differences in costs can be seen in Figure 1, which is a comparison of the herbicide vs machinery costs. Herbicide costs increase greatly as tillage is decreased. This cost is countered somewhat by lower machinery costs (in Figure 1 machinery costs consist of depreciation, interest, insurance, and housing). The amount and size of machinery decrease as the need for tillage decreases. Figures 2, 3, and 4 are net returns from each system and reflect the average return from the 1987-1990 period, given different government payment assumptions. The notation CNT for WSF means the wheat was conventional-till, but the sorghum was no-till; RNT means the wheat was reduced-till, and the sorghum, no-till. Otherwise the wheat and sorghum were both CT, RT, or NT. The 1990 Farm Bill allows producers to build base, provided they are not receiving deficiency payments on any program crops. Figure 2 compares the net returns of WF and WSF without any government payments. The 1990 Farm Bill also allows producers with no sorghum base to plant both wheat and sorghum and still receive deficiency payments on wheat (cross compliance has been eliminated). Thus, in Figure 3, deficiency payments were received for wheat but not sorghum. In Figure 4, we assumed that the producer had both a wheat and sorghum base; thus deficiency payments were received for both crops. In all three cases, the average returns were greater from WSF than from WF. Reduced-till wheat, no-till sorghum (RNT) returned slightly more

Figure 1. Herbicide and machinery costs as affected by cropping system and tillage.

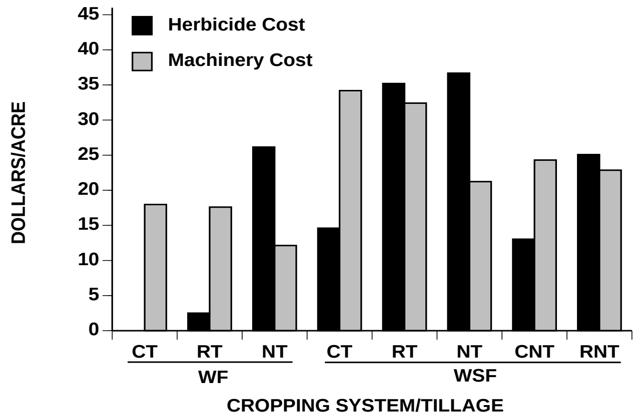


Figure 2. Returns as affected by cropping system and tillage, no government payments. 1987-90 average.

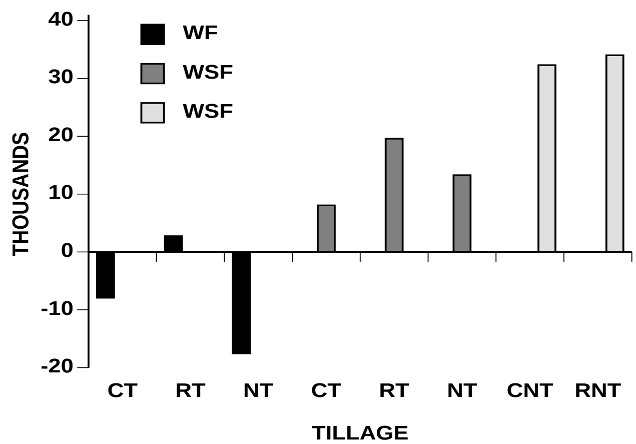


Figure 3. Returns as affected by cropping system and tillage, government payments on wheat only. 1987-90 average.

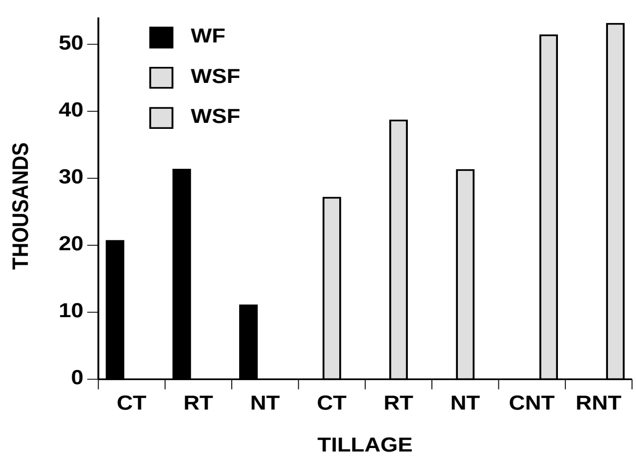


Figure 4. Returns as affected by croppng system and tillage, government payments on wheat and sorghum. 1987-1990 average.

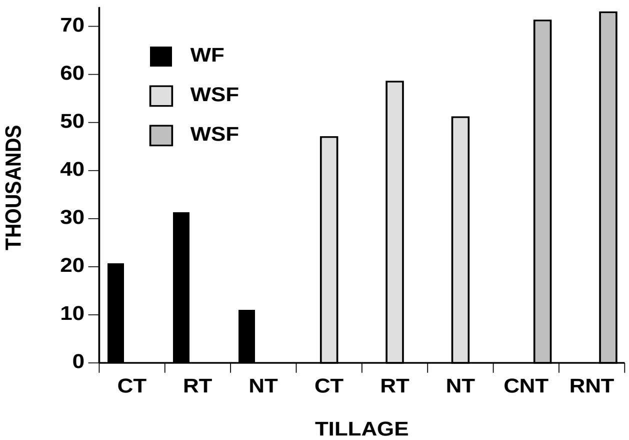
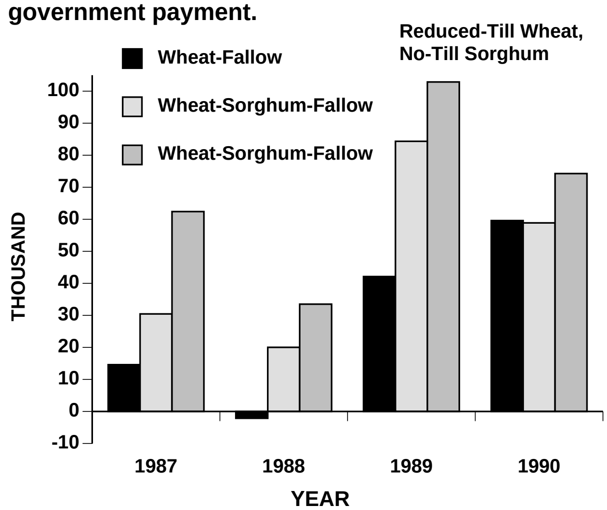


Figure 5. Returns as affected by cropping system and government payment.



than did CNT, and both of these treatments were substantially more profitable than the other treatments.

Figure 5 is a yearly comparison of the returns between the most profitable system WSF system, RNT, and the most profitable WF system, RT. Included are deficiency payments for wheat only or both wheat and sorghum. Although returns varied greatly from year to year (a $100,000 difference between the best and worst system), the profit from WSF exceeded that from WF in each year when deficiency payments were received for both crops. In 1990, the year of the highest wheat yields, the WF return was about the same as the WSF return when only wheat payments were received (no sorghum base). In the event that the producer gets higher than normal wheat yields and lower than normal sorghum yields, the return from WF could exceed that of WSF, particularly if there was no sorghum base. In most years, however, WSF should be more profitable than WF. The 1990 Farm Bill gives dryland wheat-fallow producers the opportunity to make the conversion to a wheat-sorghum-fallow cropping system.

In this study, WF-RT was the most profitable WF tillage system, and WSF-RNT was the most profitable WSF tillage system. This is not surprising, based on results from this and other studies. What is surprising is that the pure WSF-NT system, in which both wheat and sorghum were no-till, returned more than the CT system. No-till wheat is expensive, and this system was profitable only because of high sorghum yields. Note that the no-till wheat-fallow system was the least profitiable. In years of low sorghum yields, WSF-NT will result in a loss. The possibility of high sorghum yields should not be used to compensate for the high number (at least three and possibly four) herbicide applications that are required for no-till wheat. For this reason, no-till wheat should be avoided. Reduced-till wheat, when only one or two herbicide applications are used, has the potential for higher yields and will often return more profit than conventional tillage. Both reduced and no-till sorghum have a good possibility of producing higher yields and more profit than conventionally tilled sorghum and merit serious consideration for the producer with good management skills.

ROW SPACING OF WHEAT

by
Merle Witt

Narrow rows for drill-seeded wheat did not increase grain yields in our study. With 3 years of data, we did not find significant differences between 5”, 10”, or 15” row spacing (see table 1). There appeared to be a slight trend for both varieties, TAM 107 and Larned, to have lower yields at the widest (15”) spacing. However, the variety Larned lodged worst in 1990 with narrow (5”) rows and performed better with the 10” and 15” rows.

The narrow rows possibly could times be helpful in hastening fall ground cover, which might reduce erosion and enhance forage production for grazing. However, we did not find a statistically significant grain yield advantage with narrow rows on dryland or under irrigation.

Table 1. Grain yields of wheat with row spacings of 5”, 10”, and 15” rows with varieties TAM 107 and Larned on dryland and under irrigation.

Variety	Row Spacing	1988 Dry	1988 Irrig	1989 Dry	1989 Irrig	1990 Dry	1990 Irrig	3 yr avg. Dry	3 yr avg. Irrig
TAM 107	5”	33.8	71.3	30.2	70.9	41.6	67.5	34.9	69.9
TAM 107	10”	31.4	71.5	34.0	73.8	40.4	64.1	35.3	69.8
TAM 107	15”	33.9	72.8	31.0	70.0	35.9	60.6	34.4	67.8
LSD (.05)		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Larned	5”	28.7	46.8	35.9	55.9	39.0	39.2	34.5	47.3
Larned	10”	27.7	45.2	38.5	58.6	39.5	48.0	35.2	50.6
Larned	15”	29.4	46.5	37.3	56.0	34.6	44.7	33.0	49.1
LSD (.05)		n.s.	n.s.	n.s.	n.s.	n.s.	5.4	n.s.	n.s.

DRYLAND PRODUCTION OF SOYBEAN

by
Merle Witt

SUMMARY

Dryland soybeans have produced respectable yields, with a 3-year average of 22 bushels per acre. Adjacent, dryland, grain sorghum has had a 3-year average of 52 bushels per acre. Yields averaged 14 bushels per acre in dry 1988, 27 bushels per acre in a wet 1989, and 23 bushels per acre in 1990. Maturity Groups III or IV have produced higher yields than the shorter season Maturity Groups 00, 0, I, or II.

INTRODUCTION

Dryland soybeans were initiated in 1988 to determine production feasibility under moisture-limiting conditions and to compare the relative yield potential of various maturity groups.

PROCEDURES

Soybeans of Maturity Groups 00, 0, I, and III were grown on dryland plots planted on May 8 in 1988. Soybeans of Maturity Groups I, II, III, and IV were seeded on May 5, 1989 and on May 2, 1990. Plots were grown on a Keith Silt loam soil type 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, which had followed a grain sorghum crop.

RESULTS AND DISCUSSION

Yields of dryland soybeans in 1988 ranged from 10 to 19 bushels per acre (Table 1). A nearly full profile of stored subsoil moisture at the start of the season helped overcome a very dry summer. Grain sorghum yields in nearby variety plots averaged 52 bushels per acre by comparison.

Yields of dryland soybeans in 1989 ranged from 20 to 37 bushels per acre (Table 2). This compared with yields from adjacent, grain sorghum, variety plots that averaged 53 bushels per acre.

Yields of dryland soybeans in 1990 ranged from 22 to 26 bushels per acre (Table 2). This compared with yields from adjacent, grain sorghum, variety plots that averaged 50 bushels per acre.

In all 3 years, yields increased with increasing maturity length of the soybeans. Soil core sampling following harvest in 1988 showed greater rooting depth and greater moisture extraction at depth with the soybeans of later maturity groups. Early plantings were utilized each year when adequate surface soil moisture for emergence was present.

Table 1. Dryland soybeans in 1988.

Maturity Group	Variety	Bu/A	Test Weight	Plant Height	Date Mature*
00	McCall	10.2	62.8	11	8-5
0	Dawson	11.8	55.8	14	8-22
I	Hodgson 78	12.9	56.8	17	8-27
III	Ohlde 3431	19.5	56.1	24	9-16
	Avg.	13.6			

* Planted 5-8-88.

Table 2. Dryland soybeans in 1989 and 1990.

Maturity Group	Variety	Bu/A		Test Weight		Plant Height		Date Mature*	
		89	90	89	90	89	90	89	90
I	Weber 84	20.5	22.6	55.3	53.7	16	26	9-4	9-7
II	Ohlde 2193	26.6	26.0	54.0	53.5	19	25	9-14	9-14
III	Resnik	26.3	22.3	54.8	55.8	21	25	9-18	9-18
IV	Sparks	36.7	22.2	55.1	55.5	23	30	9-23	9-21
Avg.		27.5	23.2						
LSD (5%)		2.2	1.0						

* Planted 5-5-89 and 5-2-90.

EFFECT OF HYBRID SELECTION AND NITROGEN RATE ON GRAIN YIELD OF DRYLAND CORN

by

Alan Schlegel, John Havlin, and David Frickel*

SUMMARY

Dryland corn can be successfully grown in western Kansas, but yields are highly variable. Grain yields were affected more by hybrid selection than by N rate. Additional information is needed in identifying hybrids best adapted for dryland corn production.

INTRODUCTION

Traditional dryland cropping systems in western Kansas have been restricted to wheat-fallow and wheat-sorghum-fallow rotations. However, recent studies in other areas have indicated successful corn production in areas of 20 inches or less of annual precipitation. Therefore, this research was conducted to determine the production potential of corn grown under dryland conditions in western Kansas.

PROCEDURES

Six corn hybrids were planted at four sites from 1988 to 1990. The varieties ranged in relative maturity from early (90 to 100 days) to late (110 to 120 days). The sites were located in Greeley, Wallace, Sherman, and Thomas Counties. Nitrogen fertilizer was applied at planting at four rates ranging from 0 to 105 lb N/acre. Corn was planted in late April in a wheat-corn-fallow rotation using reduced or no tillage. After corn emergence, all plots were hand thinned to uniform stands. Residual herbicides were used to control weeds in the wheat stubble prior to planting of corn and for in-season weed control in corn. Soil moisture and residual N determinations were made at corn planting and harvest. All plots were harvested in September of each year, and yields were adjusted to 15.5% moisture. In 1989, the Sherman County site sustained considerable hail damage, so grain yields were not determined.

RESULTS AND DISCUSSION

Grain yields ranged from less than 10 bu/acre to over 90 bu/acre, depending on hybrid, location, and year. Hybrid selection affected grain yields more than N rate (Tables 1, 2, and 3). Hybrid selection significantly affected yields in 7 of the 11 site-years. Nitrogen fertilizer had minimal effect on grain yield, with significant differences in yield observed in only 2 of the 11 site-years. Grain yields increased with increased N rates in Greeley County in 1990, and yields decreased with increased N rate in Wallace County in 1990.

*John Havlin, Department of Agronomy, Kansas State University, Manhattan.

Table 1. Effect of hybrid selection and N rate on grain yield of dryland corn at 4 locations in 1988.

Variety	N Rate	Location			
		Greeley	Wallace	Thomas	Sherman
	lb/A	- - - - - - - - - - - - bu/A - - - - - - - - - - - - -			
DK 498	0	24	30	56	62
	35	31	24	50	53
	70	21	27	39	66
	105	28	17	34	53
DK 572	0	28	13	46	55
	35	21	19	53	51
	70	17	23	47	54
	105	25	20	47	5
DK 656	0	26	16	35	46
	35	23	14	33	45
	70	30	11	24	42
	105	11	10	30	41
Garst 8532	0	29	37	62	65
	35	23	29	59	68
	70	35	30	53	55
	105	29	29	57	67
Garst 8708	0	24	34	53	51
	35	30	31	48	55
	70	27	28	59	53
	105	35	27	60	49
C.V. (%)		31.8	31.4	21.4	14.4
ANOVA (P>F)					
Variety		.066	.001	.001	.001
N Rate		.996	.175	.241	.703
V * N		.025	.366	.210	.472
MEANS					
Variety					
DK 498		26	24	45	58
DK 572		23	19	49	53
DK 656		23	13	30	44
Garst 8532		29	31	58	64
Garst 8708		29	30	55	52
$LSD_{.05}$		6	5	7	6
N Rate (lb/acre)					
0		26	26	50	56
35		26	23	49	54
70		26	24	44	54
105		26	21	46	52
$LSD_{.05}$		5	5	6	6

Table 2. Effect of hybrid selection and N rate on grain yield of dryland corn at 3 locations in 1989*.

Variety	N Rate	Location		
		Greeley	Wallace	Thomas
	lb/A	- - - - - - - - bu/A - - - - - - - - -		
DK 415	0	72	31	28
	35	70	31	24
	52.5	66	27	30
	105	84	36	26
DK 572	0	78	19	26
	35	64	22	30
	52.5	71	14	22
	105	79	24	24
DK 656	0	75	17	29
	35	67	23	19
	52.5	77	22	26
	105	66	21	37
Garst 8532	0	95	36	32
	35	85	24	24
	52.5	86	49	41
	105	82	33	50
Garst 8708	0	75	32	28
	35	77	44	35
	52.5	93	21	33
	105	94	41	26
Garst 8882	0	73	36	39
	35	79	27	34
	52.5	88	45	37
	105	77	34	38
C.V. (%)		18.6	41.5	43.0
ANOVA (P>F)				
Variety		.008	.001	.057
N Rate		.388	.778	.521
V * N		.509	.103	.645
MEANS				
Variety				
DK 415		73	31	27
DK 572		73	20	26
DK 656		71	21	28
Garst 8532 87		36	37	
Garst 8708 85		34	30	
Garst 8882 79		36	37	
$LSD_{.05}$		10	9	9
N Rate (lb/acre)				
0		78	29	30
35		74	28	28
52.5		80	30	32
105		80	32	33
$LSD_{.05}$		8	7	8

* Sherman county hailed out 1989

Table 3. Effect of hybrid selection and N rate on grain yield of dryland corn at 4 locations in 1990.

Variety	N Rate	Location Greeley	Wallace	Thomas	Sherman
	lb/A	- - - - - -	bu/A	- - - - -	
DK 415	0	41	49	19	20
	35	30	44	9	26
	70	46	52	7	20
	105	42	38	14	21
DK 584	0	30	67	22	35
	35	35	78	30	26
	70	50	66	16	41
	105	44	41	19	34
DK 636	0	29	62	10	22
	35	39	61	6	18
	70	45	54	15	23
	105	58	42	7	26
Garst 7777	0	34	40	21	31
	35	40	42	24	41
	70	49	67	28	28
	105	35	37	14	32
Garst 8532	0	32	73	20	37
	35	41	46	31	43
	70	58	37	28	31
	105	50	46	13	35
Garst 8599	0	34	60	34	29
	35	49	53	29	40
	70	42	56	10	41
	105	41	44	29	31
C.V. (%)		31.3	38.3	75.8	34.1
ANOVA (P>F)					
Variety		.777	.173	.044	.001
N Rate		.001	.021	.613	.811
V * N		.413	.443	.731	.726
MEANS					
Variety					
DK 415		40	46	12	22
DK 584		40	63	22	34
DK 636		43	55	9	22
Garst 7777		39	47	22	33
Garst 8532		45	51	23	37
Garst 8599		41	53	26	35
$LSD_{.05}$		9	14	12	9
N Rate (lb/acre)					
0		33	58	21	29
35		39	54	21	32
70		48	55	17	31
105		45	41	16	30
$LSD_{.05}$		7	12	10	7

Southwest Research-Extension Center

CORN AND GRAIN SORGHUM RESPONSE TO TILLAGE, PREPLANT IRRIGATION, AND PHOSPHORUS PLACEMENT

by
Alan Schlegel, Dale Bremer, and David Frickel

SUMMARY

Ridge tillage and conventional tillage produced equal grain yields of irrigated corn and grain sorghum. Preplant irrigation was generally ineffective in increasing grain yields of corn and grain sorghum. Phosphorus fertilizer increased corn and sorghum yields, but P placement had no effect on yield. Soil water at planting, soil water accumulation during fallow, and fallow efficiency were greater with ridge rather than conventional tillage.

INTRODUCTION

This research was conducted to determine the feasibility of ridge tillage for flood-irrigated corn and grain sorghum in western Kansas. Additional objectives were to 1.) determine the benefit from preplant irrigation for ridge and conventional tillage and 2.) determine whether phosphorus placement was affected by tillage practices.

PROCEDURES

Corn and grain sorghum have been grown continuously since 1988 under conventional and ridge tillage. Phosphorus fertilizer has been applied since 1989. Conventional tillage consists of stalk shredding and discing in the fall, followed by spring discing and furrowing prior to planting. With ridge tillage, the only operation between harvest and planting is shredding stalks. Tillage (two cultivations) during the growing season was the same for both systems. Preplant irrigation treatments were applied 2 to 4 weeks prior to planting and averaged 4.3 inches for corn and 5 inches for sorghum. In-season irrigations were applied uniformly to all plots when needed. Phosphorus was broadcast and band applied at planting at a rate of 40 lb P_2O_5/acre, and a zero P check was included. All plots were machine harvested, and grain yields adjusted to 15.5% moisture for corn and 12.5% moisture for sorghum.

RESULTS AND DISCUSSION

With corn, ridge rather than conventional tillage increased soil water accumulation during the period from harvest to planting by 1 inch (Fig. 1), thereby, increasing fallow efficiency from 24 to 45% (Fig. 2) and soil water at planting by over 1 inch (Fig. 3). Preplant irrigation increased soil water accumulation during fallow by 2 inches for conventional tillage and 2.7 inches for ridge tillage. Soil water at harvest was not affected by tillage or preplant irrigation (Fig. 4).

Figure 1. Soil water accumulation during fallow period before planting corn at Tribune, 1988-90.

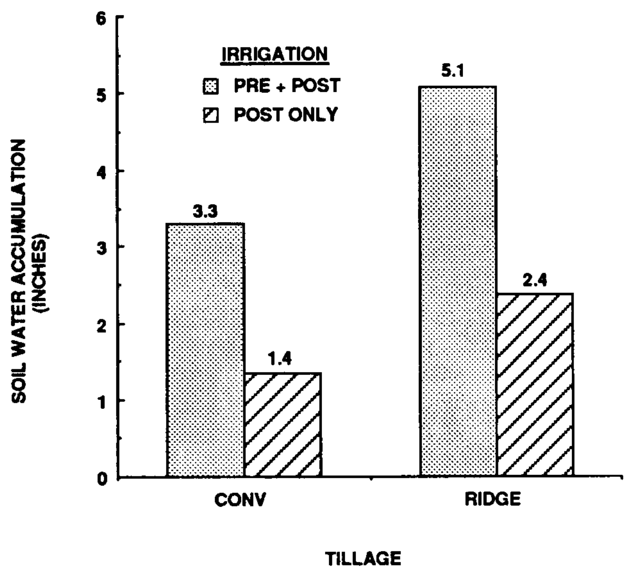


Figure 2. Percent of precipitation and irrigation during fallow that was stored prior to planting corn at Tribune, 1988-90.

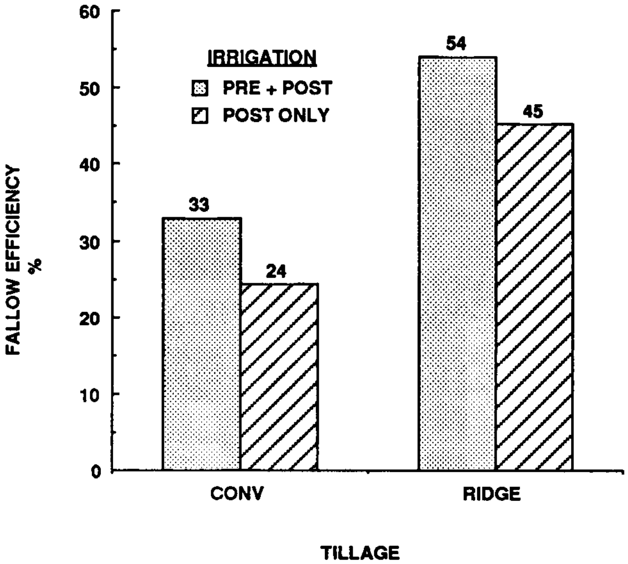


Figure 3. Available soil water at planting for irrigated corn at Tribune, 1988-90.

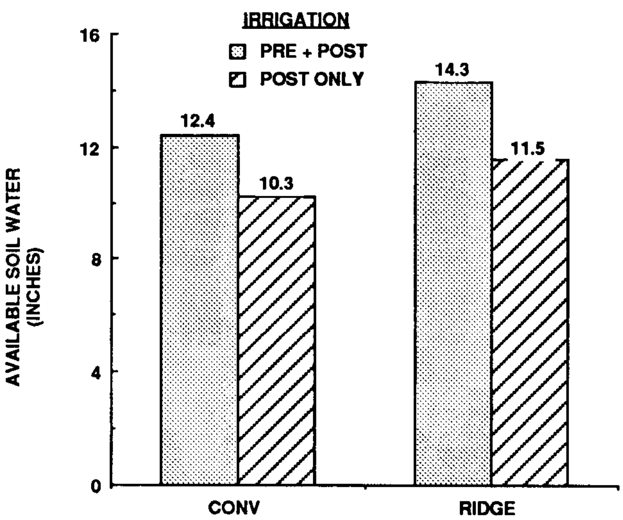
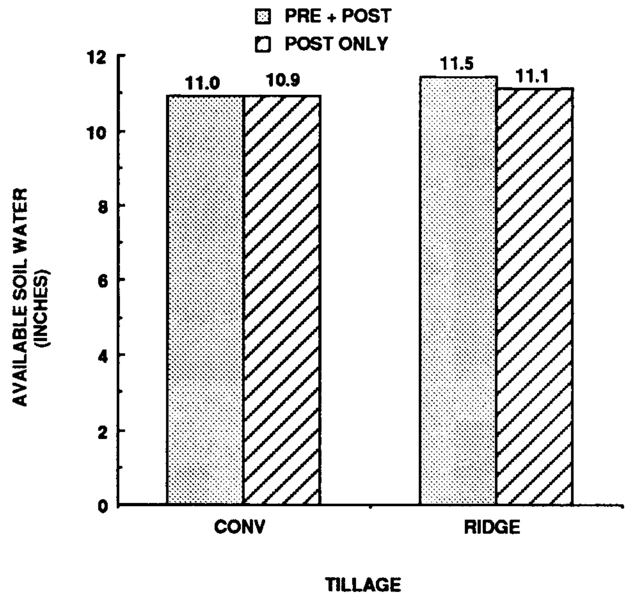


Figure 4. Available soil water at harvest for irrigated corn at Tribune, 1988-80.



With sorghum, accumulation of soil water during fallow was 0.5 inch greater with ridge than with conventional tillage (Fig. 5). Fallow efficiency was 26% with conventional tillage without preplant irrigation and 32% with ridge tillage (Fig. 6). Soil water at planting and harvest was about 1 inch greater with ridge than with conventional tillage (Fig. 7 and 8).

Figure 5. Soil water accumulation during fallow before planting grain sorghum at Tribune, 1988-90.

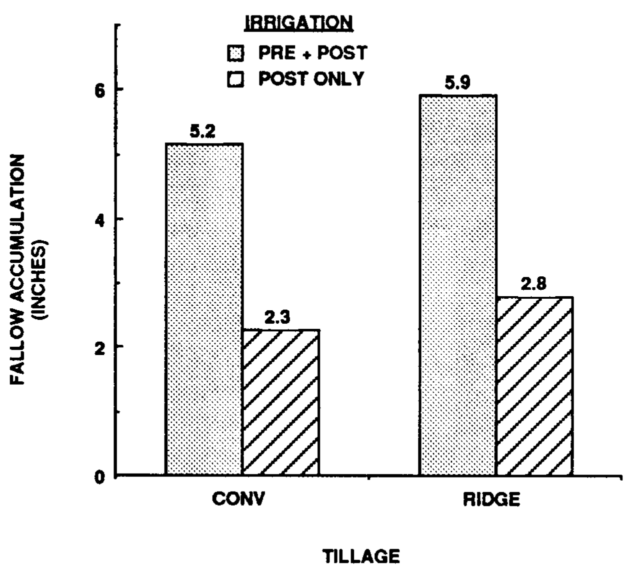


Figure 6. Percent of precipitation and Irrigation received during fallow stored prior to planting grain sorghum at Tribune, 1988-90.

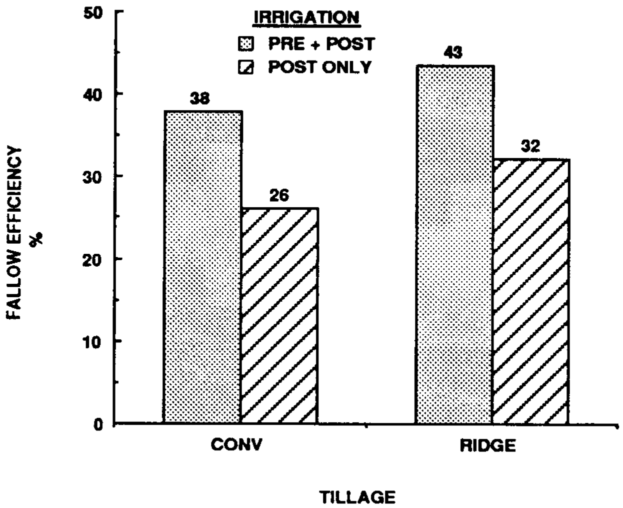


Figure 7. Available soil water at planting for Irrigated grain sorghum at Tribune, 1988-90.

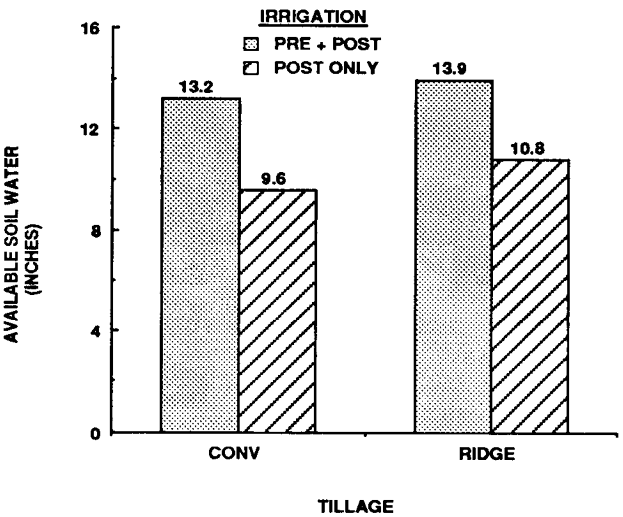
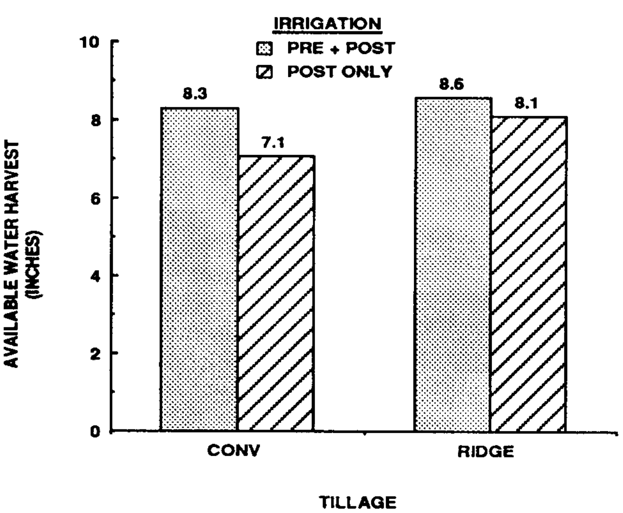


Figure 8. Available soil water at harvest for irrigated grain sorghum at Tribune, 1988-90.



Similar corn yields have been obtained with ridge and conventional tillage (Table 1). Preplant irrigation did not significantly increase corn yields. Grain sorghum yields in 1989 were extremely low because of an earlier than normal frost. Sorghum yields in 1990 were not affected by tillage but were increased slightly by preplant irrigation. Both corn and grain sorghum yields were increased by P fertilization; however, placement had no effect on yields.

Table 1. Effect of tillage, preplant irrigation, and phosphorus placement on grain yield of corn and grain sorghum. Tribune, KS, 1989-1990.

Tillage	Preplant Irrigation	Phosphorus Placement	Corn 1989	Corn 1990	Sorghum 1989	Sorghum 1990
			-------	bu/A	-------	
Conv	Yes	None	162	148	41	97
		Bdct	170	165	45	100
		Band	176	167	46	106
	No	None	163	143	52	89
		Bdct	166	163	50	100
		Band	173	165	33	101
Ridge	Yes	None	161	140	40	99
		Bdct	170	164	53	107
		Band	166	159	44	103
	No	None	155	141	34	92
		Bdct	179	169	38	101
		Band	172	158	59	100
ANOVA[1]						
Tillage			ns	ns	ns	ns
Irrigation			ns	ns	ns	*
P Placement			**	**	ns	**
Tillage * Irrigation			ns	ns	ns	ns
Tillage * P placement			ns	ns	ns	*
Irrigation * P placement			ns	ns	ns	ns
MEANS						
Tillage		Conv	169a	159a	47a	99a
		Ridge	164a	155a	47a	100a
		$LSD_{.05}$	5	4	9	4
Preplant irr.		Yes	168a	157a	49a	102a
		No	165a	157a	45a	97b
		$LSD_{.05}$	4	4	9	4
P placement		None	158b	143b	43b	94b
		Bdct	170a	165a	51a	102a
		Band	173a	163a	47ab	102a
		$LSD_{.05}$	6	6	8	3

[1]*, ** Significant at the .05 and .01 levels of probability.

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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, 1990

by

Gary Dick, Phil Sloderbeck, and Steven Posler

SUMMARY

Several insecticides were evaluated for control of European corn borers and for their effect on spider mites in furrow-irrigated field corn. Interpretation of the results is complicated by the combined effects of corn borers and spider mites on yield and the differential effect of insecticides on corn borers and spider mites. Numerically, more live corn borer larvae and corn borer-infested plants and significantly more corn borer tunneling were observed in the reduced-mite check plots than in the untreated check plots. All corn borer treatments resulted in a significant reduction in length of stalk tunneling compared to the reduced-mite check. All treatments, except Asana XL, resulted in a significant reduction in the number of live larvae and number of plants infested compared to the reduced-mite check. Capture resulted in the highest level of control of any of the insecticides in this test, with >95% reduction in live larvae, number of tunnels, and length of tunneling compared to the reduced-mite check.

The spider mite species composition was 94% Banks grass mites before treatment and 86% Banks grass mites 19 days after treatment (DAT). The effects of corn borer insecticides on spider mites were highly variable and generally not significantly different from the untreated checks.

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* (Hubner), on field corn in southwest Kansas. This test historically includes an evaluation of the southwestern corn borer (SWCB), *Diatraea grandiosella* (Dyar), but natural populations were absent from our 1990 plots. A mixed population of Banks grass mite (BGM), *Oligonychus pratensis* (Banks), and twospotted spider mite (TSM), *Tetranychus urticae* Koch, was observed to determine if any of the insecticides were miticidal 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. Simulated chemigation applications 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 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). The sprayer was calibrated to deliver 20 gal/a at 2.3 mph and 30 psi.

Ample first generation ECB larvae were collected between 27 June and 9 July for use with Kansas State University's European Corn Borer Software model, which predicts the second generation egg laying period. The model predicted 25-50% oviposition to occur during a 10-day period from 19 July to 29 July, which is earlier than normal. The predicted oviposition period coincided with peak light trap catches of European corn borer moths at the SWREC (see report page 32). During this period, we examined local corn fields visually to fine-tune the insecticide application date. All treatments, except the simulated chemigation application of Dipel, were applied on 27 July. Capture was applied at the 0.04 lb[AI]/acre corn borer rate in this test. Treatments were interrupted on 27 July by a 0.88-in rainfall. Another 0.44-in rainfall occurred on the morning of 28 July. The simulated chemigation application of Dipel was completed on 30-31 July. Although our results suggest no statistically significant (and very little numerical) difference between the late, "chemigated", Dipel treatment and the properly timed, standard, Dipel treatment, the lateness of application of Dipel should be considered when interpreting the results of this test. In past tests, simulated chemigation applications of Dipel performed numerically (but generally not statistically) somewhat better than standard spray applications. Comite was applied to one set of plots on 6 Aug 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. The mite-free check plots were purposely treated late in an attempt to avoid a direct effect on corn borer larvae.

Corn borer counts were made between 29 Aug and 10 Sep 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). This was approximately 2-3 weeks earlier than in 1989 because of unusually high temperatures and rapid maturity of the crop in late August. The number of live corn borer larvae, the number of plants with tunneling (number of plants infested), and the total length (cm) of tunneling were recorded for each plant, and the 15-plant totals were data analyzed using SAS Proc ANOVA (Proc GLM, if data were missing).

Spider Mites

To determine the effect of corn borer insecticides on spider mite populations, two plants were selected from each of the two center rows of each plot and flagged. Naturally occurring populations of BGM were relatively evenly distributed and reached numbers such that artificial infestation was not necessary. Spider mite counts were made before treatment on 26 July by visually searching one-half of every other leaf (one-quarter plant) on the flagged plants for large (adult female) spider mites. One-quarter plant, spider mite counts were repeated on 2 and 15 August (6 and 19 DAT, respectively). Results were converted to mean number of spider mites per one whole plant (n = 4) and analyzed statistically using SAS Proc ANOVA (SAS Proc GLM for analyses with missing data). On each sample date, samples of spider mites were taken from the four flagged plants using a vacuum sampler and mounted on glass slides for microscopic determination of species. There were no significant differences in proportion of BGM (arcsine-square root-transformed) among treatment plots (Table 3). Because the proportion of BGM remained relatively high during the study, the spider mite population was treated as a single-species complex rather than as separate species. Percent control of mites was calculated using the Henderson & Tilton formula, which adjusts the percent control for increases or decreases in mite numbers that occur in the untreated check.

Harvest yields (bu/acre), adjusted to 15.5% moisture, were estimated by collecting a 1/1000-acre sample of ears (8.7-ft sections of row from each of the two center rows, 30-in rows). Test weights (lb/bu) of samples were determined electronically.

RESULTS AND DISCUSSION

European Corn Borer

The light- trap catch of the European corn borer, reached a 4-year high on the night of 24-25 July (see page 32). Corresponding oviposition was moderate and occurred over a relatively short period of time.

In interpreting the results of this test, the interactive effects of the high spider mite populations and moderate corn borer larval infestations should be considered. Relatively mediocre but statistically significant ($p<0.01$) spider mite control in the reduced-mite check plot may have contributed to numerically more corn borer larvae and greater number of corn borer-infested plants and significantly more ($p<0.01$) corn borer tunneling than in either untreated check plot (Table 1). Plants protected from high spider mite numbers may be more suitable for corn borer development.

All treatments significantly reduced ($p<0.01$) the length of stalk tunneling compared to the reduced-mite check (Table 1). All treatments, except Asana XL, significantly reduced ($p<0.01$) the number of live larvae and number of plants infested compared to the reduced-mite check. Capture resulted in the highest level of control ($p<0.01$) in this test, giving 100%, 96%, and 99% reduction of live larvae, number of tunnels, and length of tunneling, respectively, when compared to the reduced-mite check. Furadan resulted in significant ($p < 0.01$) and generally acceptable (>70%) control in all three damage categories. All but one Dipel and MVP treatment resulted in generally less than acceptable (34-68%) control. The standard application, high rate treatment of MVP resulted in acceptable (75%) reduction of length of tunneling. There is lack of evidence for an MVP rate response.

Capture-treated plots yielded significantly ($p=0.05$) higher than either untreated check but were not significantly different from the reduced-mite check. The level of spider mite suppression achieved in the mite-free check plots did not by itself prevent of yield reduction. Both spider mite suppression and corn borer control seemed to be necessary to prevent yield reduction in this test. There was no significant difference (p=0.45) in test weight (lb/bu) among treatments.

Mite Species Complex

Unlike the situation in 1989, the spider mite species composition remained predominantly Banks grass mites (94% before treatment and 86% at 19 DAT) throughout the test period (Table 3). The spider mite species composition in other area fields ranged from high percentages of BGM to high percentages of TSM. Capture (remember-at the corn borer rate) did not result in significant (p=0.17) spider mite control at 6 DAT, even though it resulted in considerable numerical suppression of spider mites (Table 2). At 6 DAT, Capture was the only treatment resulting in reasonable suppression (<300 mites per plant). By 19 DAT (10 DAT for the Comite application), the only treatment that significantly (p<0.01) reduced mites was the reduced-mite check, but remaining numbers of mites were unacceptably high (>1000/plant). At 19 DAT, the Capture plots had significantly higher spider mite numbers than the mite-free check.

Asana did not appear to “flare” mites as sometimes occurs. In 1989, some treatments of MVP (MYX 7275) resulted in significant control of BGM; in 1990, MVP and Dipel generally had a neutral effect compared to the untreated checks.

Table 1. Efficacy of standard and simulated chemigation applications of insecticides for second generation corn borer control, Southwest Research-Extension Center, 1990. Percent control calculated using the value obtained in the "reduced-mite" check plot.

		Average per 15 Plants						
Treatment	Rate lb [AI] /acre[1]	# Larvae	% control	# Plants Infest.	% control	Tunnel Length (cm)	% control	Yield bu/A
STANDARD APPLICATION (20 gal/acre)								
Asana XL	0.04	6.0 ab	39	9.8 a-c	23	108.3 b-d	44	99 ab
Capture 2EC[2]	0.04	0.0 d	100	0.5 e	96	1.0 f	99	109 a
Dipel ES	2.5 pt	4.8 bc	51	7.0 c	45	75.0 b-e	61	98 a-c
Furadan 4F	1.0	1.8 cd	82	3.3 de	74	25.9 ef	86	89 bc
MVP (low)[2]	2.0 qt	3.8 b-d	62	7.8 bc	39	61.1 c-f	68	96 a-c
MVP (high)[2]	3.0 qt	4.0 bc	59	6.3 cd	51	47.5 d-f	75	100 ab
SIMULATED CHEMIGATION (5227 gal/acre)								
Dipel ES	2.5 pt	4.8 bc	51	8.5 bc	34	72.1 b-e	63	80 c
MVP (low)[2]	2.0 qt	3.8 b-d	62	8.3 bc	35	65.8 b-e	66	101 ab
MVP (high)[2]	3.0 qt	5.0 bc	49	8.3 bc	35	67.7 b-e	65	97 a-c
UNTREATED OR REDUCED-MITE CHECKS								
Untreated A	0.0	6.0 ab	39	11.3 ab	12	131.0 b	32	85 bc
Untreated B	0.0	6.3 ab	36	11.0 ab	14	125.1 bc	35	88 bc
Reduced Mite Ck. (Comite 6.55EC)	2.8[3]	9.8 a	—	12.8 a	—	192.0 a	—	97 a-c
ANOVA TABLE								
F-Value		3.86		9.03		6.41		2.05
F-Test Prob.		0.0013		0.0001		0.0001		0.0554
Experiment C.V.		53.1		28.9		50.1		11.8

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

[1] Except Dipel ES, which is given in pints/acre, and MVP, which is listed in quarts/acre.

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

[3] Applied on 6 Aug, much later than other treatments in an attempt to prevent severe spider mite damage, which makes corn plants less suitable hosts for corn borer larvae. **Note: This rate is intentionally higher than the label rate.**

Table 2. Effect of corn borer insecticides on spider mite numbers (DAT = Days after Treatment). Percent control calculated (Henderson & Tilton formula) using the average of the two untreated check plots.

Treatment	Rate lb [AI] /acre[1]	Pre-treat # mites	6 DAT[4] # mites	6 DAT[4] % control	19 DAT[4] # mites	19 DAT[4] % control	Adj. yield bu/A
STANDARD APPLICATION (20 gal/acre)							
Asana XL	0.04	1685	1012	-1	1670 ab	13	98 ab
Capture 2EC[2]	0.04	1185	202	71	1200 c	11	109 a
Dipel ES	2.5 pt	1015	393	35	1464 bc	-27	98 a-c
Furadan 4F	1.0	1272	310	59	1536 bc	-6	89 bc
MVP (low)[2]	2.0 qt	1850	1364	-24	1608 a-c	24	96 a-c
MVP (high)[2]	3.0 qt	1613	1255	-30	1765 ab	4	100 ab
SIMULATED CHEMIGATION (5227 gal/acre)							
Dipel ES	2.5 pt	1258	730	3	1835 ab	-28	80 c
MVP (low)[2]	2.0 qt	1297	690	11	2065 a	-40	101 ab
MVP (high)[2]	3.0 qt	1563	705	24	1579 bc	11	97 a-c
UNTREATED OR REDUCED-MITE CHECKS							
Untreated A	0.0	1834	1241	-13	1732 ab	17	85 bc
Untreated B	0.0	1112	517	22	1490 bc	-18	88 bc
Reduced-Mite Ck. (Comite 6.55EC)	2.8[3]	1075	566	12	640 d	48	97 a-c
ANOVA TABLE							
F-Value		1.54	1.53		6.32		2.05
F-Test Prob.		0.16	0.17		0.0001		0.0554
Experiment C.V.		34.4	84.0		18.4		11.8

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

[1] Except Dipel ES, which is given in pints/acre, and MVP, which is listed in quarts/acre.

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

[3] Applied on 6 Aug, much later than other treatments in an attempt to prevent severe spider mite damage, which makes corn plants less suitable hosts for corn borer larvae. **Note: This rate is intentionally higher than the label rate.**

[4] Because of the late simulated chemigation application of Dipel ES, the corresponding DAT should be 3 and 16.

Table 3. Spider mite species composition in corn borer insecticide plots, Southwest Kansas Research-Extension Center, 1990.

Treatment	Rate lb [AI] /acre[1]	Proportion of Banks Grass Mites (%) Pre-Treat	6 DAT[4]	19 DAT[4]
STANDARD APPLICATION (20 gal/acre)				
Asana XL	0.04	99	89	86
Capture 2EC[2]	0.04	81	75	76
Dipel ES	2.5 pt	95	81	90
Furadan 4F	1.0	88	93	84
MVP (low)[2]	2.0 qt	96	95	88
MVP (high)[2]	3.0 qt	84	80	93
SIMULATED CHEMIGATION (5227 gal/acre)				
Dipel ES	2.5 pt	98	84	94
MVP (low)[2]	2.0 qt	91	85	78
MVP (high)[2]	3.0 qt	98	83	97
UNTREATED OR REDUCED-MITE CHECKS				
Untreated A	0.0	96	93	80
Untreated B	0.0	100	86	83
Reduced Mite Ck. (Comite 6.55EC)	2.8[3]	100	90	82
Overall % BGM		94	86	86
ANOVA TABLE				
F-Value		1.84	0.24	0.54
F-Test Prob.		0.09	0.99	0.86
Experiment C.V.		12.8	26.1	19.3

No significant difference in percent BGM composition among plots for any sample date.
[1] Except Dipel ES, which is given in pints/acre, and MVP, which is listed in quarts/acre.
[2] **This product not currently registered for use on field corn.**
[3] Applied on 6 Aug, much later than other treatments in an attempt to prevent severe spider mite damage, which makes corn plants less suitable hosts for corn borer larvae. **Note: This rate is intentionally higher than the label rate.**
[4] Because of late simulated chemigation of Dipel ES, the corresponding DAT should be 3 and 16.

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We would like to acknowledge the very able assistance of Todd Staats, Steve Sandoval, Mike Sandoval, and Mary Belland. Their patience, persistence, and attention to detail resulted in a very useable, complete, and reliable data sets for all 8 tests we conducted this year. We would also like to express our appreciation to Bill Spurgeon for allowing Janet Baier and Thom Makens to assist us with two of our tests. Don Dick and Randy Dick were kind enough to contribute some of their vacation time to help with our plot harvest. The SWREC Farm Crew contributed greatly to the success of all our tests this year.

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EFFICACY OF MITICIDES AGAINST SPIDER MITES IN CORN

by
Gary Dick, Phil Sloderbeck, and Steven Posler

SUMMARY

Hot and dry weather during the last half of the growing season contributed to a heavy infestation of spider mites in our miticide plots. Several miticides resulted in both a significant reduction in numbers of spider mites and generally acceptable control at 6 days after treatment (DAT). None of the miticides resulted in acceptable control at 18 DAT.

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. The proportion of BGM remained relatively high throughout the test, so the species complex is treated as a single unit in the following discussion.

PROCEDURES

This experiment was conducted in a furrow-irrigated corn field at the 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. Thio-Sul, an ammonium thiosulfate fertilizer solution often applied to the growing corn crop through center pivot irrigation systems, was included in this test in order to attempt to substantiate popular press reports (The High Plains Journal, March 12, 1990, pp. 1A-2A) that it had miticidal properties. Simulated chemigation applications of Thio-Sul were made on 27 July 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). All standard-volume treatments, except the experimental insecticidal soap (applied 31 July), were applied on 27 July 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 20 gal/a at 2.3 mph and 30 psi.

Two plants were selected from each of the two center rows of each plot and flagged. Prior to the test, we determined that a naturally occurring population of predominantly BGM was fairly evenly distributed and had reached numbers such that artificial infestation was unnecessary. Spider mite counts were made before treatment on 26 July by visually searching one-half of every other leaf (one-quarter plant) on the flagged plants for large (adult female) spider mites. One-quarter plant, spider mite counts were repeated on 2 and 14 August (6 and 18 DAT, respectively). Results were converted to mean number of spider mites (n=4) per one whole plant and analyzed statistically using SAS Proc ANOVA (SAS Proc GLM for analyses with missing data). 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. The percent BGM values were transformed using the arcsine-square root transformation before analysis and back-transformed for presentation. Percent control of mites was calculated using the Henderson & Tilton formula, which adjusts the percent control for increases or decreases in mite numbers that occur in the untreated check plots. The value used for the untreated check in the Henderson & Tilton formula was the mean of the two untreated checks. Examination of the numerical differences in number of mites and yield between the two untreated checks (Table 1) shows why seemingly large differences in resulting numbers of mites in treatment plots are often not statistically different.

Harvest yields (bu/acre), adjusted to 15.5% moisture, were estimated by collecting a 1/1000-acre sample of ears from an 8.7-ft section of each of the two center rows, 30-in rows. Test weights (lb/bu) of samples were determined electronically.

Unlike the situation in 1989, the spider mite species composition remained predominantly Banks grass mites (95% before treatment and 77% at 18

DAT) throughout the test period (Table 2). The spider mite species composition in other local fields ranged from high percentages of BGM to high percentages of TSM.

RESULTS AND DISCUSSION

There was no significant difference (p=0.40) among treatments in numbers of mites per plant before treatment (Table 2). There was no significant difference (p=0.4, 0.3, and 0.13 for respective sample dates) among treatments in proportion of BGM (Table 2). At 6 DAT, 8 of the 14 miticide treatments resulted in a significant reduction (p<0.01) in number of spider mites to generally acceptable levels (<300 per plant) (Table 1). Although there was no significant difference in spider mite numbers among the eight treatments, Capture and Supracide resulted in >80% control. At 18 DAT, only Avid, Capture, and Kelthane resulted in significant reduction (p=0.01) of mite numbers (depending on which check plot used for comparision), but the level of control acheived was generally unacceptable.

Despite failure to acheive acceptable spider mite control for more than a few days, there were significant differences (p = 0.01) in yield among treatments. Capture resulted in a significantly higher yield than either untreated check plot. Cygon, Asana plus Cygon, and Furadan plus Disyston resulted in significantly higher yields than one, but not both, of the untreated check plots. Higher yields with these four treatments may be attributable to their combined effect on spider mites and corn borers. Unfortunately, none of the materials used in this test was specific for corn borers. Future miticide tests should include a specific corn borer insecticide, such as one of the *Bacillus thuringiensis* products.

Asana did not "flare" mites in this test. The addition of Asana to Cygon did not significantly improve the performance of Cygon in this test. Furadan did not perform as well in 1990 as it has in the past, but the combination of Furadan and Disyston performed reasonably well at 6 DAT. Thio-Sul did not have a significant effect on spider mite numbers in this test.

Table 1. Efficacy of miticides against Banks grass mites and twospotted spider (as a species complex) in field corn, Southwest Kansas Research-Extension Center, 1990.

Treatment	Rate lb [AI] /acre[1]	Pre-treat # mites	6 DAT # mites	6 DAT % control[2]	18 DAT # mites	18 DAT % control[2]	Adj. yield bu/A
STANDARD APPLICATION (20 gal/acre)							
Asana 0.66EC	0.04	1767	528 bc	26	1880 a-d	19	118 cd
Asana 0.66EC	0.04						
+ Cygon 400	0.5	1648	261 e	61	1542 c-f	28	142 a-c
Avid 0.15EC**	0.02	1785	242 e	66	846 ef	64	135 a-d
Capture 2EC**	0.08	1679	114 e	83	864 ef	61	153 a
Cygon 400	0.5	1828	259 e	65	1425 d-f	40	147 ab
Disyston 8EC	1.0	1719	371 c-e	46	1974 a-d	12	120 b-d
Exp. Soap[3]**	1.0%	1127	583 a-c	-19	2586 a	-76	126 a-d
Furadan 4F	1.0	1833	515 b-d	30	2491 ab	-4	117 cd
Furadan 4F	0.5						
+ Disyston 8EC	1.0	1688	187 e	72	1759 a-e	20	141 a-c
Kelthane MF**	1.0	1569	277 de	56	756 f	63	134 a-d
Metasystox-R 2SC	0.5	1475	212 e	64	1438 d-f	25	136 a-d
Sunspray	2.0%	1367	791 a	-44	2390 a-c	-34	114 cd
Supracide 2EC**	0.5	1884	149 e	80	1581 b-f	36	122 b-d
SIMULATED CHEMIGATION (5227 gal/acre)							
Thio-Sul	18.0 gal	1793	652 ab	10	2084 a-d	11	111 d
UNTREATED							
Untreated A	0.0	1361	538 a-c	—	2068 a-d	—	108 d
Untreated B	0.0	1465	597 a-c	—	1623 b-f	—	122 b-d
ANOVA TABLE							
F-Value		0.69	6.33		4.02		2.50
F-Test Prob.		0.79	0.0001		0.0001		0.009
Experiment C.V.		36.0	45.3		33.0		13.42

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

[1] Except Sunspray, which was applied as a 2% (vol:vol) solution; the experimental soap, which was applied as a 1% (wt:vol) solution; and Thio-Sul, which is an ammonium thiosulfate fertilizer solution (12-0-0-26) and was applied at 18 gallons of product per acre.

[2] Percent control was calculated using the Henderson and Tilton formula from the mean of the two untreated checks.

[3] This treatment was not applied until 31 July, so counts are at 2 and 5 DAT.

** **These products not labeled for use on field corn.**

Table 2. Proportion of BGM (%) in spider mite population.

Treatment	Rate lb [AI] /acre[1]	Proportion of Banks Grass Mites (%) Pre-Treat	6 DAT	18 DAT
STANDARD APPLICATION (20 gal/acre)				
Asana 0.66EC	0.04	83	79	57
Asana 0.66EC	0.04			
+ Cygon 400	0.5	99	68	65
Avid 0.15EC**	0.02	100	91	96
Capture 2EC**	0.08	90	88	81
Cygon 400	0.5	96	66	57
Disyston 8EC	1.0	99	90	71
Exp. Soap[2]**	1.0%	100	96	92
Furadan 4F	1.0	100	91	67
Furadan 4F	0.5			
+ Disyston 8EC	1.0	100	90	67
Kelthane MF**	1.0	100	94	88
Metasystox-R 2SC	0.5	93	70	68
Sunspray	2.0%	99	86	79
Supracide 2EC**	0.5	99	91	89
SIMULATED CHEMIGATION (5227 gal/acre)				
Thio-Sul	18.0 gal	100	99	94
UNTREATED				
Untreated A	—	100	92	89
Untreated B	—	71	86	84
Overall BGM proportion		95.4%	86.1%	77.3%
ANOVA TABLE				
F-Value		1.08	1.20	1.54
F-Test Prob.		0.4025	0.3093	0.133
Experiment C.V.		14.94	20.288	23.88

[1] Except Sunspray, which was applied as a 2% (vol:vol) solution; the experimental soap, which was applied as a 1% (wt:vol) solution; and Thio-Sul, which is an ammonium thiosulfate fertilizer solution (12-0-0-26) and was applied at 18 gallons of product per acre.

[2] This treatment was not applied until 31 July, so species determinations are at 2 and 5 DAT.

** **These products not labeled for use on field corn.**

CORN BORER MOTH FLIGHTS IN FINNEY COUNTY, KANSAS

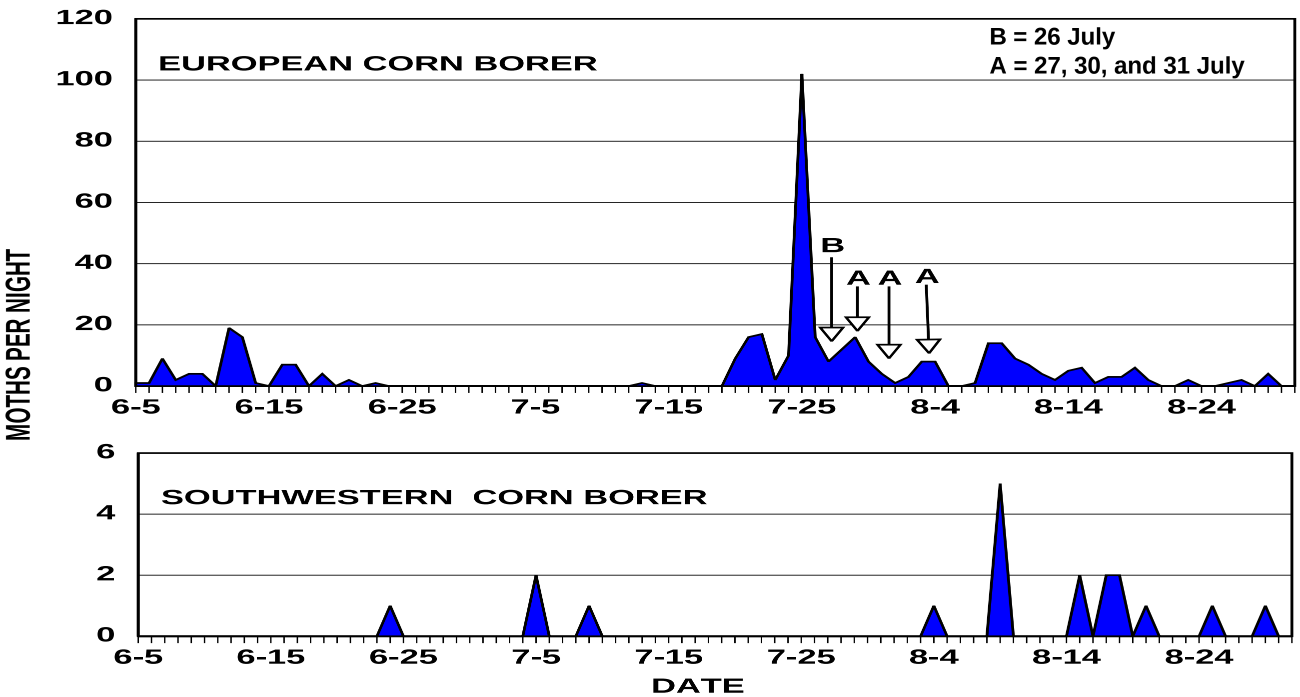
by

Steven Posler, Mike Sandoval, and Gary Dick

Corn borer moth flight was monitored from 1 June to 30 August using a standard black light trap located at the Southwest Research-Extension Center, Finney County, Kansas (Figure 1). Both European corn borer (ECB), *Ostrinia nubilalis* (Hubner), and southwestern corn borer (SWCB), *Diatraea grandiosella* (Dyar), were recorded in light trap catches. Although a few southwestern corn borer moths were caught in the light trap, we detected no natural southwestern corn borer oviposition or tunneling in plants we sampled in the Garden City area in 1990. European corn borer moths reached a 4-year high of 102 (36 male, 66 female) on the night of 24 to 25 July. In contrast to 1989, there were ample first generation European corn borer larvae in 1990 to use the Kansas State University European Corn Borer Phenology and Management Model (developed by Higgins et al.) to predict second generation oviposition.

Infestations of first generation European corn borer larvae ranged from 0 to 61% of plants. There appeared to be an inverse visual correlation between level of first generation European corn borer infestation and planting date (later planting = lighter first generation corn borer infestation). Based on samples of first generation larvae collected on 12 and 27 June and 7 July, the model predicted second generation oviposition to occur from 19 to 29 July. Field scouting was begun on 19 July just prior to the estimated oviposition period and was used to verify second generation oviposition and to fine-tune insecticide applications on experimental plots and bulk corn at the Southwest Research-Extension Center. Bulk corn fields were treated for a combination of heavy spider mites and moderate second generation corn borers on 26 July (uppercase b, Figure 1). Experimental plots were treated on 27, 30, and 31 July (uppercase a, Figure 1).

Figure 1. Black light trap catches of European corn borer and southwestern corn borer moths at the Southwest Research-Extension Center.



LEPA IRRIGATION PROJECT REPORT

by
William Spurgeon and Thomas Makens

SUMMARY

Irrigation frequency did not affect yields. Therefore, switching to a LEPA system and applying smaller amounts to minimize runoff should not affect yields adversely. Yield is significantly reduced by underirrigation and is 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 results and procedures for 1989 and 1990.

PROCEDURES

Corn was planted in a circle on May 19. The late planting was due to a wet spring and high residue cover. The system was run around once to establish the tower tracks, used as a marker. The corn was planted from the even towers (i.e. towers 2, 4, and 6) out to the odd towers. A total of 200 lbs of nitrogen was applied in 50 lb increments through the system four different times during the growing season.

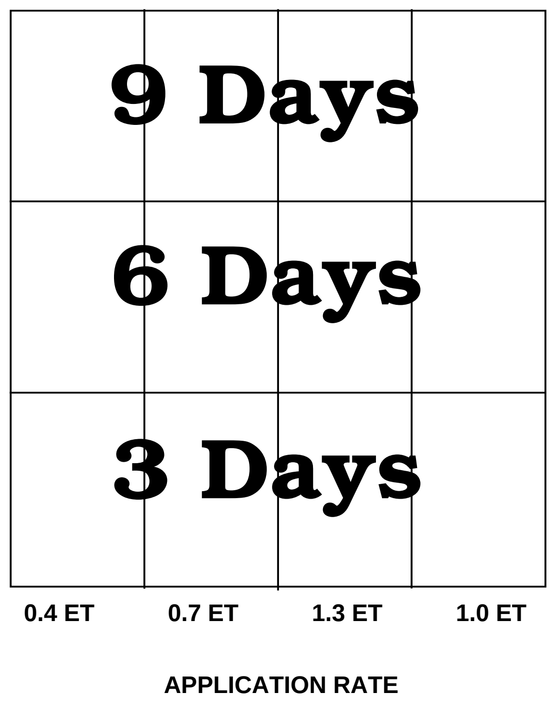
The flexible drop hose initially installed was replaced with PVC pipe in late June, 1990. Dual nozzles also were installed in some locations at this time. The dual nozzles allowed the amount of water applied to the research plots to be varied. Once the center pivot was out of the plots, the desired rate for the bulk corn could be applied.

Aluminum access tubes were installed for use with a neutron probe to determine soil moisture. Measurements were taken weekly to verify estimates of crop water use 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 evapotranspiration (ET-estimated crop water use) 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. A typical replication is shown in Figure 1.

Figure 1. Amount and frequency plot for a typical replication.



Each of the first three irrigations (June 15, 23, and 25) was used to apply 50 lbs of nitrogen. Each plot received the same total amount of water. Plots were then irrigated every 3, 6, or 9 days with the desired fraction of ET. At the end of each time interval, we replenished the amount of water used during that interval. A final 50 lbs of nitrogen was applied on July 25 during corn pollination.

Irrigation amounts for each plot varied by treatment and frequency. Application amounts ranged from 0.4 to 3.8 inches per irrigation event. The 3-day frequency was used to study the effects of high frequency applications. LEPA systems 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 on October 9. Yields were adjusted to 15.5% moisture and reported in bushels per acre.

RESULTS AND 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 2) and the Texas data show that irrigation frequencies of 3, 6, and 9 days are not significantly different. The yields for 12-day frequency were significantly lower than yields 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 a LEPA system.

Figure 2. Average yield for frequency treatments.

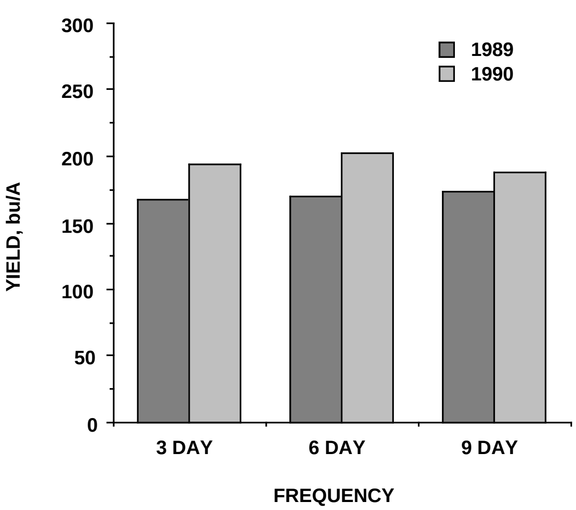


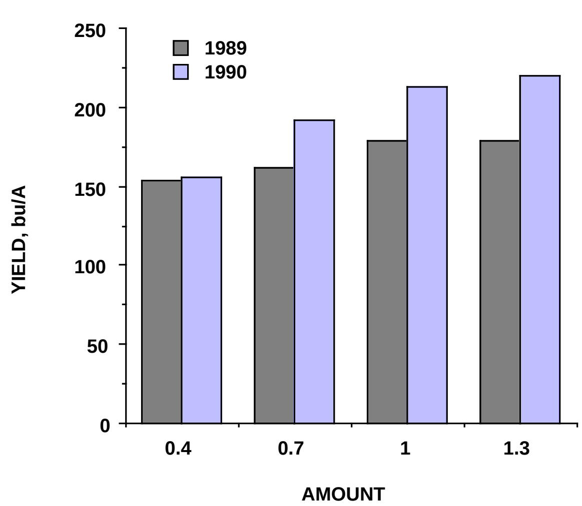
Table1. Effect of irrigation frequency and amount on corn yield (bu/a), Southwest Research-Extension Center.

Fraction of ET	Irrig Inches	Irrigation Frequency Days 3	6	9	Avg.*
1989					
0.4	4.8	151.5	153.8	155.3	153.5b
0.7	8.4	161.0	168.8	156.3	162.0b
1.0	11.9	180.8	174.0	182.8	179.2a
1.3	15.5	177.5	183.3	174.5	178.4a
Avg.		167.7a	169.9a	167.2a	
1990					
0.4	11.0	149.1	155.4	162.0	155.5b
0.7	16.6	185.6	204.3	185.3	191.7a
1.0	22.2	220.5	217.0	200.3	212.6a
1.3	27.8	222.6	231.4	204.0	219.3a
Avg.		194.5a	202.0a	187.9a	

*Different letters indicate values are significantly different at the 0.05 level.

Figure 3 shows that yields level off for amounts greater than 1.0 ET. This presents a case for using irrigation scheduling to help the producer obtain optimum yield without wasting water. As expected, yields increase significantly with irrigation amounts up to 1.0 ET. The combined data from 1989 and 1990 showed significant differences among all amount treatments, except 1.0 and 1.3 ET.

Figure 3. 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 (1989) and June 27 and October 3 (1990). Soil water was monitored in the 3-, and 9-day treatments for each replication in 1990. 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.

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

Fraction of ET	Irrig. Inches	Irrigation Frequency Days 3	6	9	Avg.
1989					
0.4	4.8	-2.0*	-2.1	-1.9	-2.0
0.7	8.4	-0.5	-0.6	0.0	-0.4
1.0	11.9	0.4	-0.4	0.6	0.2
1.3	15.5	0.6	1.1	0.6	0.8
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	

*A negative value shows soil water was extracted from the profile by the crop.

Similar results were obtained for each year, despite the difference in rainfall. We received 15.4 inches of rainfall during the 1989 growing season and 7.2 inches in 1990. The irrigation amounts applied were 11.9 inches in 1989 and 22.2 in 1990 for the 1.0 ET treatment. This results in a total of 27.3 and 29.4 inches, respectively, for the 1.0 ET treatment.

Total water use is shown in Table 3, including seasonal soil water change, irrigation, and rainfall amounts.

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 4. 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

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

Fraction of ET	Irrig. Inches	Irrigation Frequency Days 3	6	9	Avg.
1989					
0.4	4.8	22.2	22.3	22.1	22.2
0.7	8.4	24.3	24.4	23.8	24.2
1.0	11.9	26.9	27.7	26.7	27.1
1.3	15.5	30.3	29.8	30.3	30.1
Avg.		25.9	26.1	25.7	
1990					
0.4	11.0	23.0	-	21.6	22.3
0.7	16.6	25.6	-	26.3	26.0
1.0	22.2	30.2	-	30.4	30.3
1.3	27.8	35.4	-	35.8	35.6
Avg.		28.6		28.5	

Table 4. Irrigation water use efficiency (IWUE) and (total water use efficiency) (TWUE),bu/a-in.

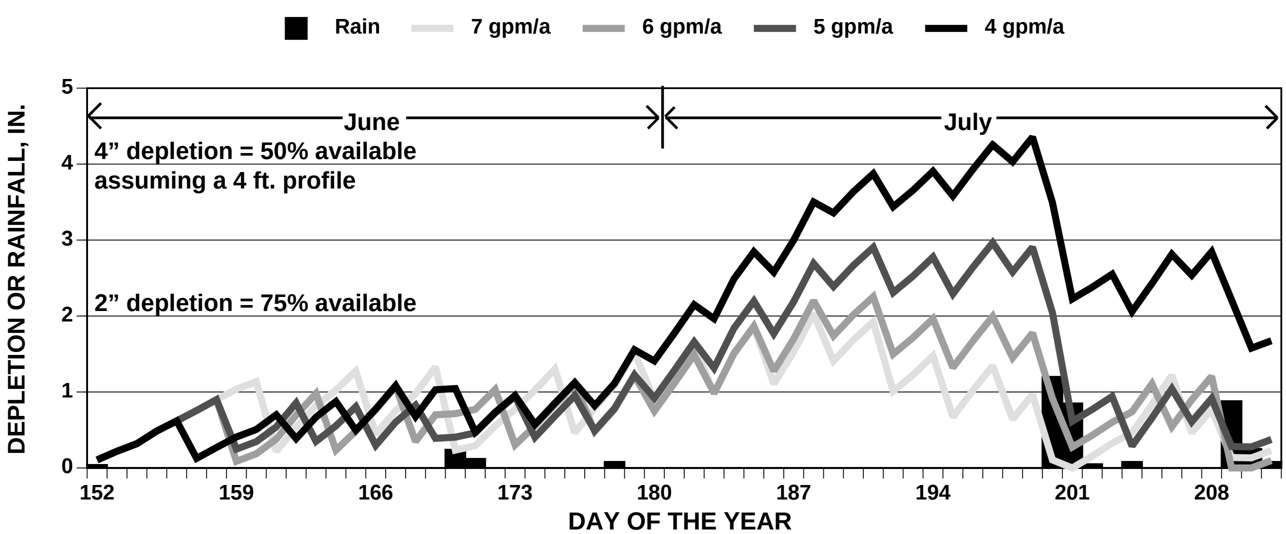
Fraction of ET	Irrigation Frequency Days 3	6	9	Avg.
1989				
0.4	31.6	32.0	32.4	32.0
	(6.8)	(6.9)	(7.0)	(6.9)
0.7	19.2	20.1	18.6	19.3
	(6.6)	(6.9)	(6.6)	(6.7)
1.0	15.2	14.6	15.4	15.1
	(6.7)	(6.3)	(6.8)	(6.6)
1.3	11.5	11.8	11.3	11.5
	(5.9)	(6.2)	(5.8)	(6.0)
Avg.	19.4	19.6	19.4	
	(6.5)	(6.6)	(6.6)	
1990				
0.4	13.6	14.1	14.7	14.1
	(6.5)	-	(7.5)	(7.0)
0.7	11.2	12.3	11.2	11.6
	(7.3)	-	(7.0)	(7.2)
1.0	9.9	9.8	9.0	9.6
	(7.3)	-	(6.6)	(7.0)
1.3	8.0	8.3	7.3	7.9
	(6.3)	-	(5.7)	(6.0)
Avg.	10.7	11.1	10.6	
	(6.9)	-	(6.7)	

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. This may be the reason yield was lower in 1989. Improved corn yields might have resulted from using the flat spray mode rather than the bubble mode.

Only 0.42 inch of rainfall fell between June 1 and July 19 (1990), but 3.06 inches of rain fell between July 19 and August 2. During a hot dry year like 1990 and using the above rainfall amounts, the soil profile (4 ft) would have approached 3 inches depletion for a system capacity of 5 gpm/ac at 100 percent efficiency (Figure 4). Over 4 inches would have been depleted in a 4-ft profile with a capacity of 4 gpm/A. Both maximum depletion levels would have occurred around July 19, near or after pollination, the most critical growth stage. Assuming that LEPA is 98 percent efficient and the soil holds at least 2 inches per ft in a 5-ft soil profile, fully irrigated corn may be possible with 5 gpm/ac or less. However, that would not leave any extra capacity for system repair, and the grower would assume more risk in meeting the crop's water needs.

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). It is possible, however, to pay off the difference in cost between spray heads and LEPA heads (approximately $5,000) for new installations in a 3-to 5-year period, depending on fuel costs and corn prices.

Figure 4. Simulated soil water depletion levels for irrigation capacities of 4, 5, 6, and 7 gpm/A assuming 100% effeciency of applied water. This figure was generated using the actual weather data for 1990, which was warmer and drier than normal. Simulated for corn planted May 1.



LEPA SPRAY MODE/TILLAGE PROJECT REPORT

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. Diking with ripping worked best on the slopes studied (1 to 6 percent). The flat spray mode was more effective than reservoir tillage. The combination of flat spray mode and reservoir tillage produced the highest yields.

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 the producer with effective guidelines for managing LEPA systems on slopes greater than 1 percent.

PROCEDURES

Corn was planted on May 19 in a circle. Various tillage treatments and spray modes were used to determine which combination reduces runoff the most. Slopes ranged from 1 to 6 percent and averaged 3 percent.

Tillage treatments included furrow diking (forming basin reservoirs between rows), in-furrow ripping, and a combination of ripping and furrow diking (Figure 1). Dikes, small reservoirs dug into the soil surface, and deep ripping are used to hold water until it can infiltrate into 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.

Figure 1. Tillage treatment and spray mode plot for a typical replication.

TILLAGE TREATMENT	BUBBLE SPRAY	FLAT SPRAY
	Rip	Control
	Dike	Dike/Rip
	Dike/Rip	Rip
	Control	Dike

The first irrigation was on June 15, and plots were irrigated approximately once a week thereafter. The irrigation application amount was kept below 1 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 on October 8. Yields were adjusted to 15.5% moisture and reported in bushels per acre.

RESULTS AND DISCUSSION

Runoff rates were so high in the "bubble" mode that corn yields were reduced (Figure 2). Ripping and furrow diking increased yields slightly (Table 1). Diking with ripping increased yields the most (Figure 3). Furrow diking by itself did little to increase corn production on these slopes. The furrow dikes may have been too shallow (not properly installed) to hold the water applied and washed out early in the season.

Figure 2. Average yield for spray treatment.

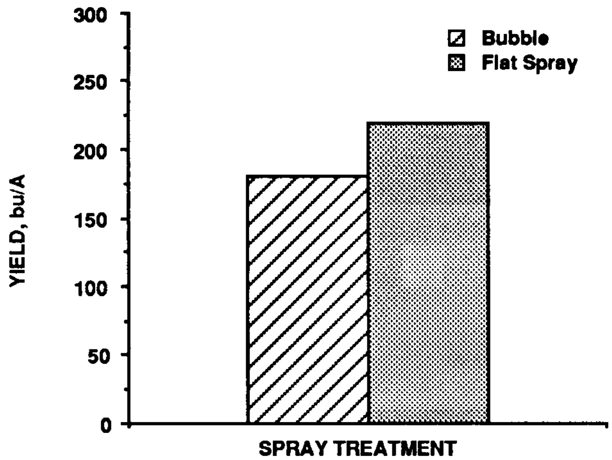
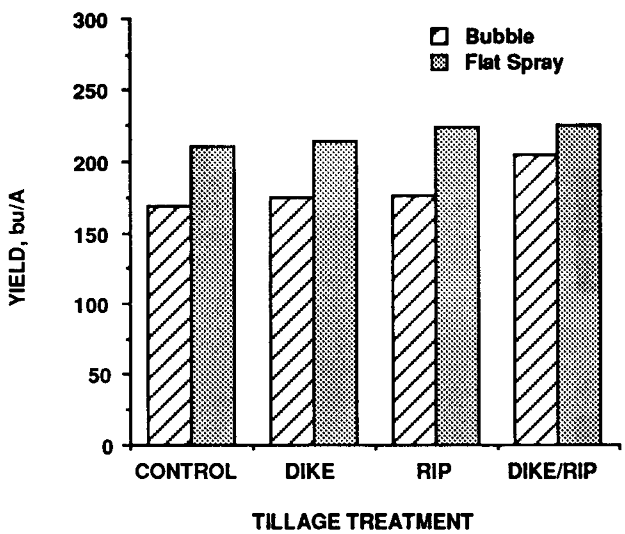


Table 1. Effect of spray mode and tillage treatment on corn yield (bu/a).			
	Spray Mode		
Tillage Treatment	Bubble	Flat Spray	Avg.
Control	168.1	210.8	189.5 b*
Dike	174.7	214.0	194.4 a b
Rip	176.0	224.6	200.3 a b
Dike/Rip	204.4	225.9	215.2 a
Average	180.8b	218.8a	

*Different letters indicate values are significantly different at the 0.05 level.

Figure 3. Average yields for tillage treatment and spray mode.



Diking with ripping had the greatest effect on yields when the "bubble" mode was used. This could be because of the increased intake rate from 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 27 and October 10 is given in Table 2.

Table 2. Change in soil water content, in inches, for 5 ft. of profile from June 27 to October 10.			
	Spray Mode		
Tillage Treatment	Bubble	Flat	Avg.
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	

* A negative value shows soil water was extracted from the profile by the crop.

Total water applied is shown in Table 3, including the seasonal soil water change, irrigation (21. 1 inches), and rainfall (7.2 inches) amounts. 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.			
	Spray Mode		
Tillage Treatment	Bubble	Flat	Avg.
Control	33.6	32.7	33.2
Dike	33.6	30.4	32.0
Rip	33.0	31.1	32.1
Dike/Rip	31.4	30.7	31.1
Avg.	32.9	31.2	

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.

Table 4. Irrigation water use efficiency (IWUE) and (total water use efficiency) (TWUE) in bushels per acre-inch.			
	Spray Mode		
Tillage Treatment	Bubble	Flat	Avg.
Control	8.0	10.0	9.0
	(5.0)	(6.5)	(5.8)
Dike	8.3	10.1	9.2
	(5.2)	(7.0)	(6.1)
Rip	8.3	10.6	9.5
	(5.3)	(7.2)	(6.3)
Dike/Rip	9.7	10.7	10.2
	(6.5)	(7.4)	(7.0)
Avg.	8.6	10.4	
	(5.5)	(7.0)	

DRIP-LINE SPACING AND PLANT POPULATION FOR CORN

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

SUMMARY

A study of drip-line spacing and plant population for corn was conducted in 1989 and 90. Two-year corn yield averages were180 and 201 bu/a for line spacings of 7.5 ft and 2.5 ft, respectively. Yields from the 7.5 and 10 ft. spacings were lower than that from the 2.5 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 199 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: (1) to determine optimum plant population, (2) to determine the effect of drip line spacing on yield, and (3) to determine the effect of drip line spacing on water movement.

PROCEDURES

Plot Layout

The field was fertilized with 200 lbs of nitrogen and 60 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 on May 1 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.

June 1990 was hot and dry, which enhanced spacing effects. There was a measurable decrease in plant height, about 15 inches, between drip lines for the wide spacings.

The first irrigation occurred on June 16. Plots were irrigated by replenishing ET when the soil water deficit reached 0.5 inches. A total of 21.9 inches of irrigation water was applied.

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 2-year average yield for the various populations for each spacing treatment. Also, the 2-year average population treatment yields are shown in Figure 2. Yields for 1989 and 90 are given in Table 1. Yield differences were statistically significant and peaked for 32,000 plants/a.

Figure 1. Two-year average yield, 1989 and 90, by population and spacing.

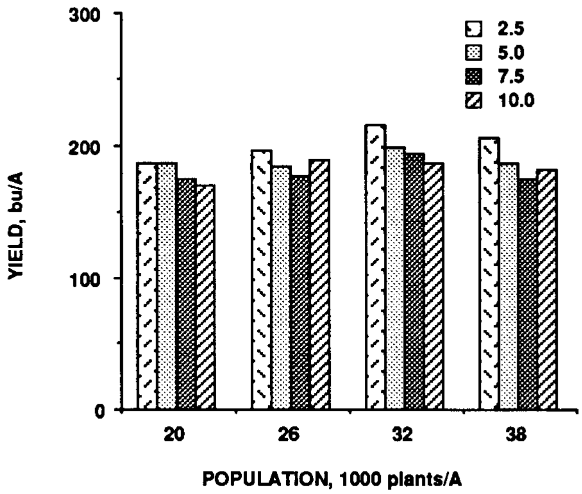


Figure 2. Two- year (1989, 90) average yield for population treatments. Different letters indicate values are significantly different at the 0.05 level.

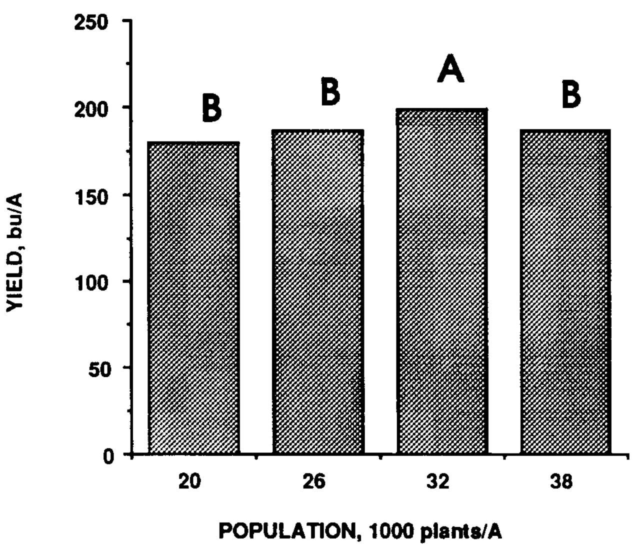


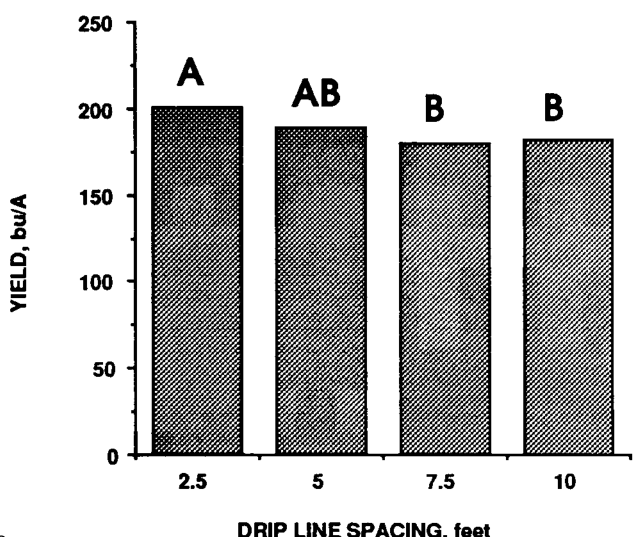
Table 1. The effect of line spacing and population on corn yield.

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	
Avg. for 1989 and 1990					
2.5	186.5	196.5	216.2	205.8	201.3
5.0	186.8	184.3	199.2	186.3	189.2
7.5	174.9	177.5	193.7	174.3	180.1
10.0	170.3	188.9	186.7	181.9	182.0
Avg.	179.6	186.9	199.0	187.1	

Drip-Line Spacing

Two-year average yields for the spacing treatments are shown in Fig. 3. Yields were higher for narrow drip line spacing, although they stayed relatively high for the wider spacing. We received 10.2 inches of rainfall, with 2 in. on July 19, during the 1990 growing season.

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



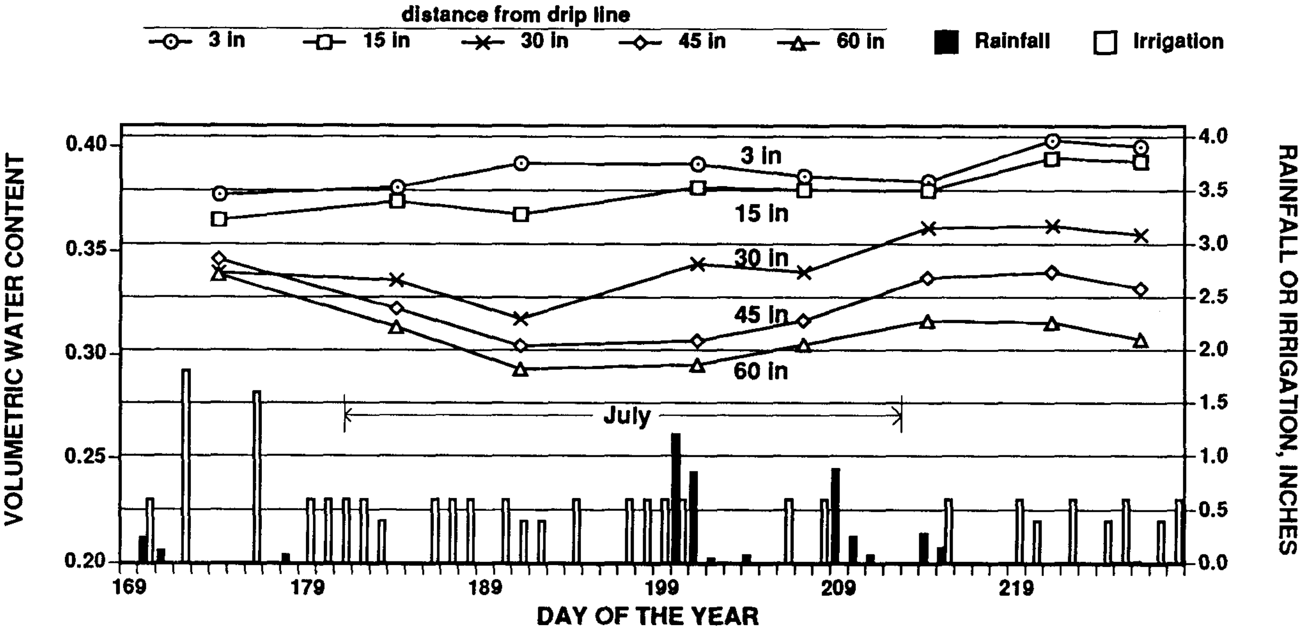
Soil Water Movement

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. This was done for all of the spacing treatments in the 32,000 plants/a population treatment.

The average volumetric soil water content for the upper 4 ft at 3, 15, 30, 45, and 60 inches from the drip line for one of the 10 ft spacing treatments is shown in Figure 4. Also, rainfall and irrigation events are shown. This figure shows that 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 the volumetric soil water content approached 60 percent of the available water content at 45 and 60 in. from the drip line. This dry region extends 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 in-between drip lines for the 7.5 and 10 ft spacings.

Figure 4. Average soil water content of the upper 4 feet of soil for 10 feet line spacing.



*H.L. Manges, Professor, Agricultural Engineering Dept., Kansas State University, Manhattan.

WATER REQUIREMENT FOR CORN WITH DRIP IRRIGATION

by

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

SUMMARY

A study of water requirement for corn using buried drip lines was initiated in 1990. Corn yielded 176 bu/A for the full ET irrigations and 134 bu/A for the dryland plots. Yields were reduced by a hail storm on July 19. 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 evapotranspiration (ET).

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 on May 9 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 2 corn rows, 15 inches to either side of the line. There were 6 irrigation treatments. They were 0, 0.25, 0.5, 0.75, 1.0, and 1.25 times ET.

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. Also, access tubes were placed at 3, 7.5, 15, 22.5, and 30 inches from the drip line in the 1.0 ET treatment only. This enabled us to study the horizontal movement of water away from the drip line.

RESULTS AND DISCUSSION

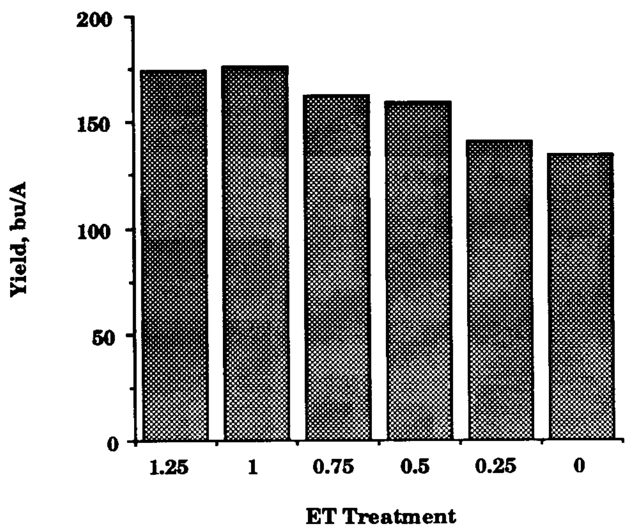
Differences in yields were observed for the 1990 harvest (Table 1 and Figure 1). Timely rains contributed to high yields for the low water-amount treatments. A hail on July 19 reduced yields for the high water-amount treatments.

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

Irrigation Treatment	Yield bu/A	
1.25 ET	174.1	ab*
1.00 ET	176.1	a
0.75 ET	162.6	ab
0.50 ET	159.1	b
0.25 ET	140.2	c
0.00 ET	133.9	c

* LSD=16.4 bu/A at the 0.05 level.
Similar letters denote statistically similar yields.

Figure 1. Corn yield for the different ET treatments.



The 1.0 ET treatment received 19.3 inches of irrigation water (Table 2). The rainfall was 9.2 inches between June 7 and September 24. The 1.0 ET treatment had the highest yields, 176.1 bu/A. The 1.25 ET treatment yielded 174.1 bu/A. The increased amount of water did not increase yields. This may have been due to loss of aeration and/or the leaching of fertilizer below the crop root zone.

Irrigations were frequent, using small amounts (0.75-1.25 inches). Soil water status by ET level throughout the season is shown in Figure 2.

The lateral movement of water did not appear to be hampered by the subsurface drip system (Figure 3). The soil water was maintained at 15 inches from the drip line. However, the soil water level dropped off beyond 15 inches. As expected, 30 inches from the drip line, the soil water was lowest. Of course, this is the furthest point from the drip line and has the advantage of keeping the furrow dry and suppressing weed growth.

Table 2. Water use of corn for different ET treatments.

Irrigation Treatment	Irrigation inches	Change in* Soil Water inches	Total Water Use inches	Water** Use Efficiency bu/A-in
1.25 ET	23.8	-1.1	34.1	5.1
1.00 ET	19.3	-1.2	29.7	5.9
0.75 ET	13.4	-2.1	24.7	6.6
0.50 ET	6.8	-3.5	19.5	8.2
0.25 ET	1.8	-4.8	15.8	8.9
0.00 ET	0.0	-4.4	13.6	9.8

* The change in soil water content is for 4 ft. of soil profile, from June 7 to September 24. A negative value means soil water was extracted from the profile by the crop.

** The water use efficiency = yield + total water use.

Figure 2. Seasonal soil water status through the season for each ET treatment.

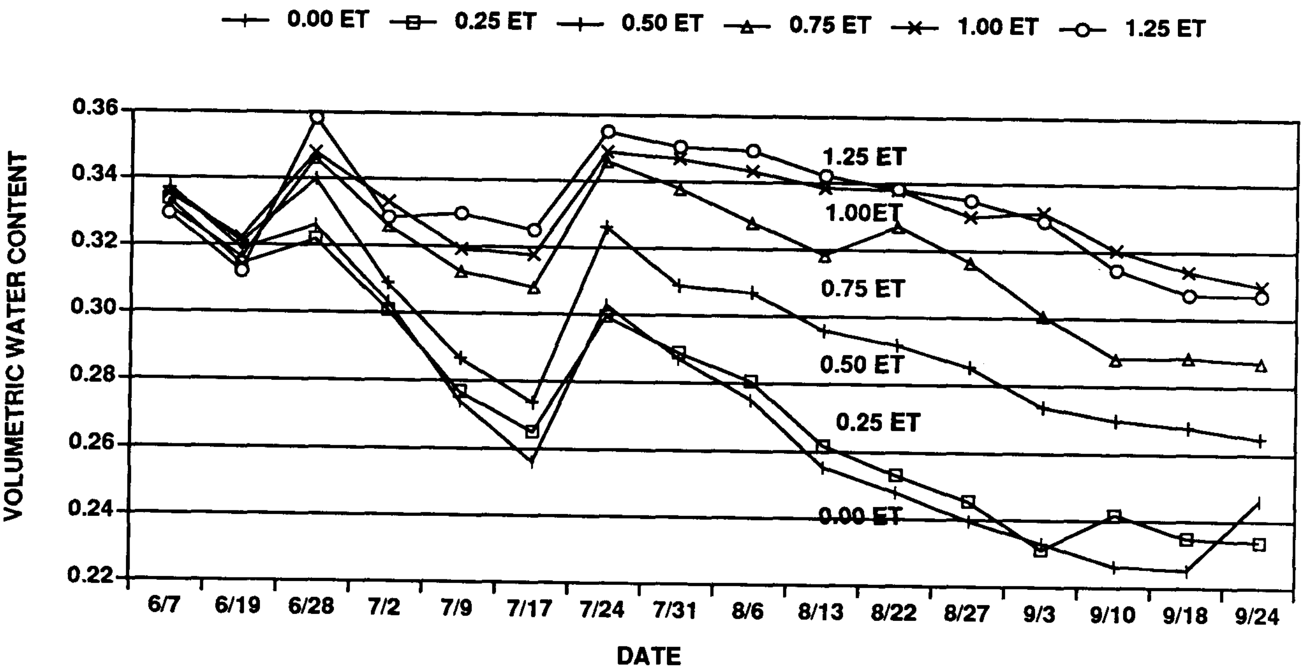
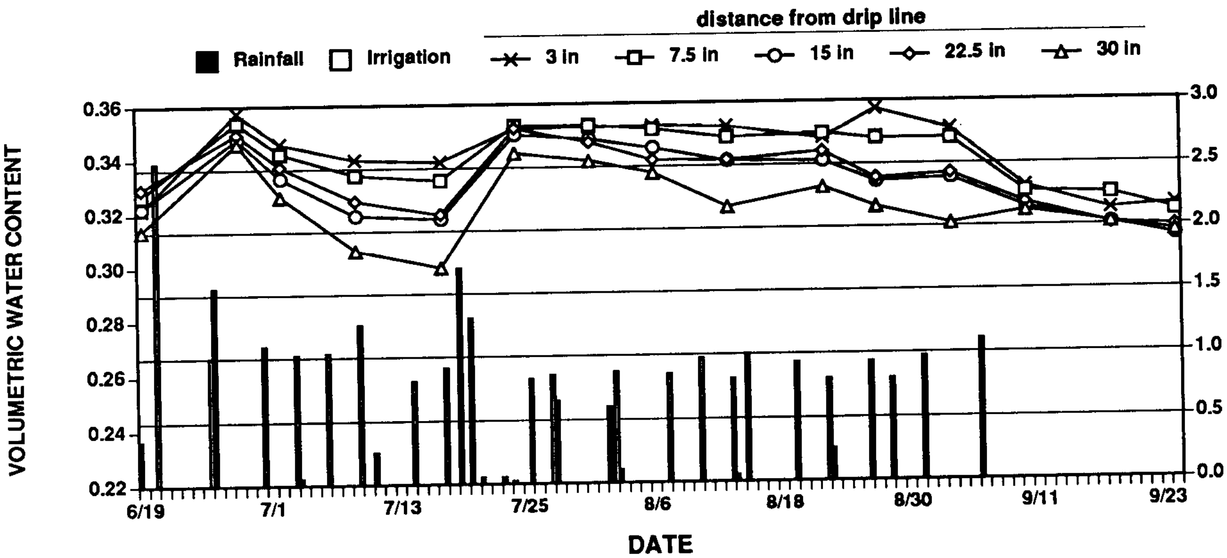
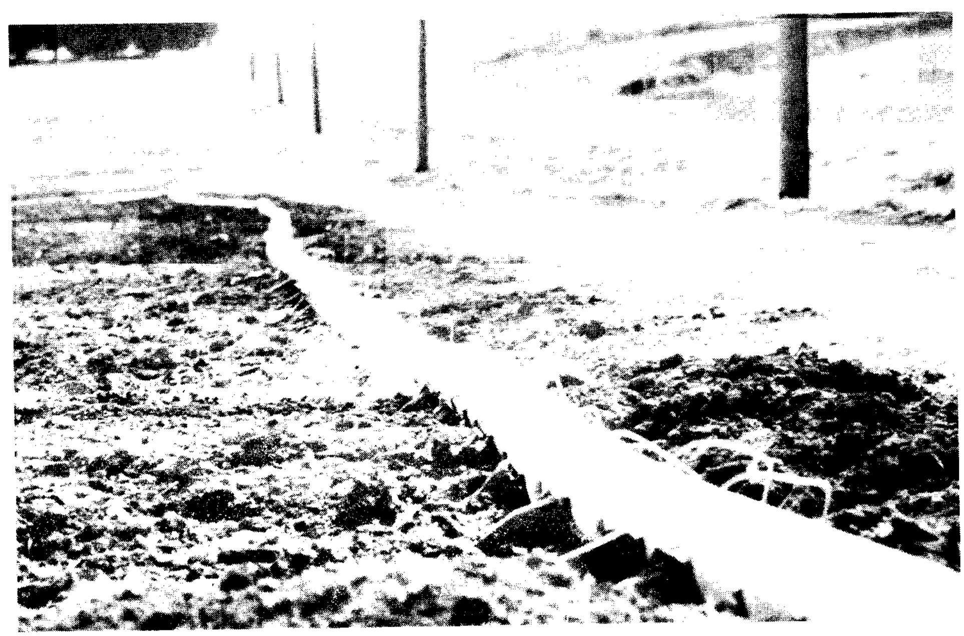


Figure 3. Soil water status through the season for the 1.0 ET treatment at various distances from the drip line.





*Todd Weis, Graduate Student, Kansas State University, Manhattan.

IRRIGATION FREQUENCIES WITH DRIPLINES

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. No statistical difference was found among the yields for the frequency treatments studied. 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. Although the 2-inch treatment used 4.4 inches less water than the every-day treatment, a hail storm on July 19 reduced yield and may have affected yield uniformity.

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 objective of this study is to determine the effect of frequency and amount of irrigation on crop yield and soil water content.

PROCEDURES

Drip lines were buried 16 inches deep in the center of each bed, running parallel to the crop rows. Therefore, each drip line supplied water to 2 corn rows 15 inches away. The corn was planted on May 9, 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 the 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.

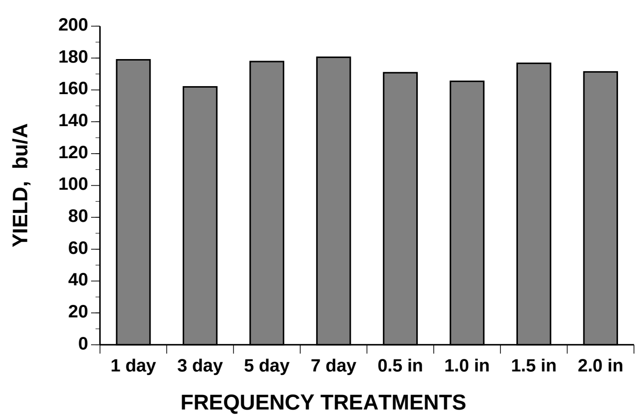
RESULTS AND DISCUSSION

Statistically, there were no differences among the yields of the different treatments (Table 1). The highest yielding plot was the 7-day study, with 181 bu/A. The lowest was the 3-day treatment, with 162 bu/A. Therefore, it is difficult to draw any conclusions because of the lack of statistical difference and the uneven damage caused by the July 19 hail storm (Figure 1).

Table 1. Corn yield for frequency treatments.

Frequency Treatment	Yield bu/A
1 Day	178.9
3 Day	161.9
5 Day	177.8
7 Day	180.5
0.5 inches	170.8
1.0 inches	165.4
1.5 inches	176.7
2.0 inches	171.3

Figure 1. Corn yield for the various amount/frequency treatments.



The total water applied showed differences among treatments (Table 2). Rainfall was 9.2 inches between June 6 and September 24. The less frequent and the larger amount treatments allowed the soil to dry out in between irrigations and thus have the ability to store rainfall. Because irrigating 1 inch takes 21 hours, there is a limit to how frequently 1 inch may be applied. 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.

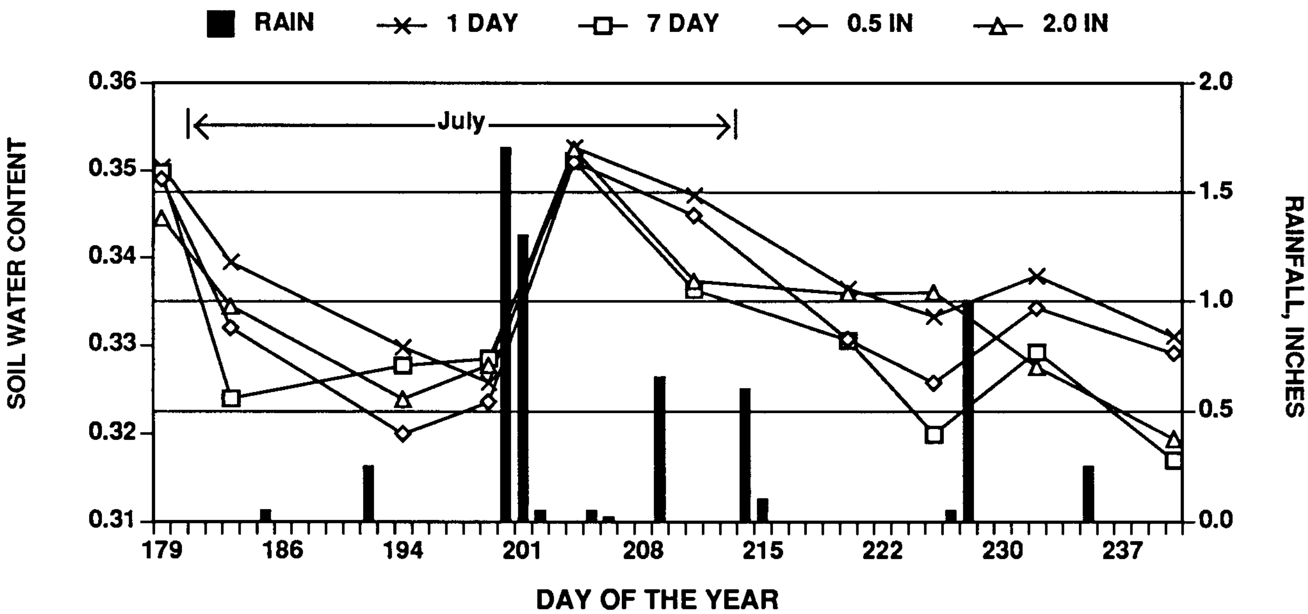
The soil water was monitored weekly. Access tubes were usually read just prior to irrigation. The larger amounts and less frequent irrigation treatments generally dried out more between irrigations (Figure 2). However, treatments did not fall below 75% of available water content.

Table 2. Water use and water use efficiency for corn by frequency and amount treatments. Total water use = irrigation + rainfall + change in soil water for season.

Treatment	Irrigation inches	Change in* Soil Water inches	Total Water Use inches	Water Use Efficiency bu/a-in
1 Day	21.0	-1.4	31.6	5.7
3 Day	19.3	-1.1	29.6	5.5
5 Day	18.1	-1.7	29.0	6.1
7 Day	18.1	-1.5	28.8	6.3
0.5 inches	20.4	-1.2	30.8	5.5
1.0 inches	18.3	-1.2	28.7	5.8
1.5 inches	17.4	-1.6	28.2	6.3
2.0 inches	16.7	-1.3	27.2	6.3

* Average change in soil water content in a 4-ft. profile from June 6 to September 24. A negative value means soil water was extracted from the profile by the crop. Water use efficiency = yield+ irrigation + rainfall + change in soil water for season.

Figure 2. Soil water content for selected treatments.



*Doug Caldwell, Graduate Student, 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. Preliminary results reveal inconsistent variation in corn yield with respect to line lengths of 330 and 660 ft. and irrigating up- or downgrade. This inconsistency might have occurred because of variable hail damage. Smaller variation is expected under normal conditions, indicating that line length can be increased without reducing yield. Increasing line length will reduce installation costs of drip irrigation by 10-20 percent.

INTRODUCTION

Drip irrigation is expensive to install, $400-500/acre, depending on field slope. Flat slopes, 0-0.5 percent, require short drip lines, 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: (1) to determine the effect of length of drip lines on corn yield and (2) to determine 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. There were four drip lines per length treatment. Lengths of 330 ft. and 660 ft. were used, and 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 May 9 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 evapotranspiration (ET - crop water use). Plots were irrigated when the depletion reached 0.75 to 1.25 inches. The first irrigation occurred on June 16. Plots were irrigated by replenishing ET. A total of 19.3 inches of irrigation water was applied. Rainfall was 9.2 inches from June 6 to September 24.

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, and 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 on 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

One season (1990) of data has been collected. Figure 1 shows differences in yield, but they were not consistent with our expectations. Furthermore, we would have expected the 330-ft. downslope flow to have the highest yield and the 660-ft. upslope flow to have the lowest.

A hail storm on July 19 affected yield by location in the field. Lower yields occurred on the west end of the field (the upslope end), causing the 330-ft. downslope treatment to have lower than expected yield. Yield by position is given in Table 1.

A portion of the cost of drip installation is in feeder lines, which 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.

Figure 1. Drip irrigated corn yields as affected by line length and direction of water flow.

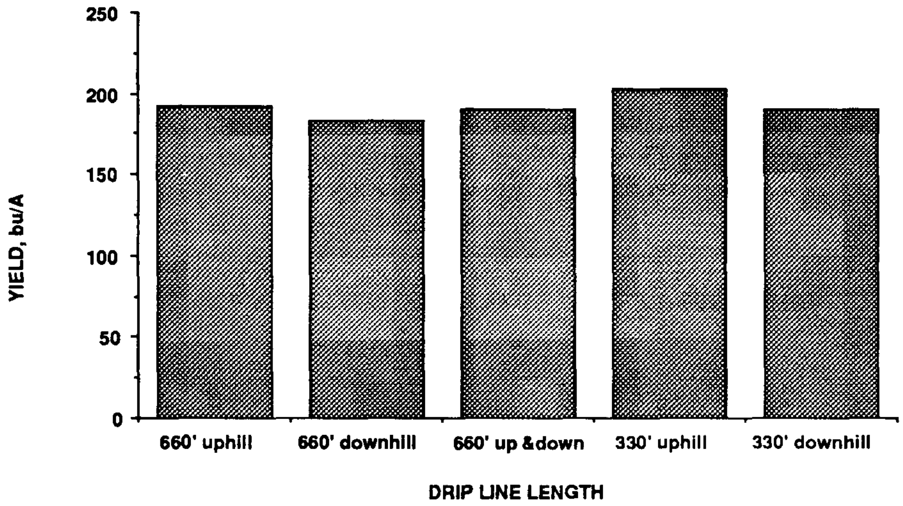


Table 1. Corn yield by field position for line length treatments.*

Treatment	Yield bu/A 50 ft. from upslope end	280 ft. from upslope end	280 ft. from downslope end	50 ft. from downslope end	Avg.
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	182.3
660 ft. both	176.2	191.5	194.1	198.6	190.1

*A hail storm on July 19 affected yield from the west side (upslope end) of the field.

Southwest Research-Extension Center

CROP VARIETY TESTS - HIGH YIELDERS

by

Merle Witt

A brief list of the "High 5" or "High 10" yielding crop varieties at three western Kansas locations (Garden City, Tribune, & Colby) are compiled 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
Deltapine G-4673-B	231	0
Atlas S-Brand SS62B	222	2
Crow's 488	222	3
Jacques 8210	222	T
Crow's 682	220	2
Oro 190	218	3
Garst 8388	217	2
Cargill 7990	216	2
Garst 8345	216	1
Supercrost 5460	215	0
Pioneer 3168	215	0
Northrup-King PX9540	215	0
Cargill 8027	215	1
Asgrow RX788	215	1

High 10 (2-yr av)	Bu/A	% Lodged
Pioneer 3162	238	1
Deltapine G-4673-B	233	0
Atlas S-Brand SS62B	231	2
Pioneer 3180	231	2
Jacques 8210	230	T
Pioneer 3159	230	1
Germain's GC86040	225	3
Asgrow RX908	224	0
Crow's 682	224	1
Northrup-King N7816	224	0
Northrup-King N8318	224	T

COLBY

High 10 (3-yr av)	Bu/A	% Lodged
Bo-Jac 602	217	6
Ohlde 230	216	7
Deltapine G-4513	212	3
Garst 8388	212	4
Cargill 7993	210	4
Golden Acres T-E 6951	210	5
Northrup-King PX9540	210	3
Cargill 7990	209	8
Garst 8344	206	2
Triumph 1270	206	5
Triumph 1595	206	6

High 10 (2-yr av)	Bu/A	% Lodged
Ohlde 230	215	7
Horizon 717	213	5
Oro 120	212	4
Bo-Jac 602	210	6
Northrup-King N7816	209	5
Deltapine G-4513	208	T
Golden Acres T-E 6951	208	0
Cargill 7993	206	1
Cargill 6227	205	1
Great Lakes GL611	204	T

CORN HYBRIDS (cont.)

TRIBUNE

High 10 (3-yr av)	Bu/A	% Lodged
Cargill 7990	221	4
Deltapine G-4513	219	0
Oro 190	219	3
Triumph 1595	219	T
Golden Acres T-E 6994	217	1
Cargill 8027	216	1
Bo-Jac 603	215	2
Oro 150	215	1
Oro 180	211	2
Golden Acres T-E 6951	210	1

High 10 (2-yr av)	Bu/A	% Lodged
Ohlde 230	231	3
Triumph 1595	222	0
Deltapine G-4513	221	0
Bo-Jac 603	219	2
Northrup-King N7816	218	1
Northrup-King N6873	217	1
Crow's 488	217	3
Golden Acres T-E 6994	215	1
Horizon 7113	215	1
Cargill 7990	213	4

GRAIN SORGHUMIRRIGA   TED

GARDEN CITY

High 10 (3-yr av)	Bu/A	(Days to Bloom)
DeKalb DK66	130	80
Garrison SG944	122	76
Oro Baron	120	76
Oro G Xtra	118	75
Triumph Two 80-D	115	75
Garrison SG 922	113	73
Pioneer 8358	112	76
Asgrow Osage	111	75
Casterline SR323 Plus	111	76
Warner W-844-E	111	76
TX2752 x TX430	111	75

High 10 (2-yr av)	Bu/A	(Days to Bloom)
Golden Harvest H514	117	76
DeKalb DK66	116	80
Garrison SG922	114	73
Oro G Xtra	113	75
Casterline SR 324 E	111	76
Garrison SG 942	110	77
Asgrow GS 712	107	76
Garrison SG-944	107	76
Oro Baron	107	76
Triumph Two 80-D	107	75
TX2752 x TX430	107	75

COLBY

High 10 (3-yr av)	Bu/A	(Days to Bloom)
Northrup-King KS 737	158	80
Oro Baron	153	78
Asgrow GS 712	152	80
Asgrow Osage	151	79
TX2752 x TX430	151	80
DeKalb DK-48	150	76
Garrison SG 932	150	79
Triumph Two 80-D	150	81
Agripro ST D701G	149	81
Golden Acres T-E Y-75	149	79

High 10 (2-yr av)	Bu/A	(Days to Bloom)
Golden Acres T-E 77-E	141	79
Northrup-King KS 737	139	80
Asgrow GS 712	138	80
Oro Baron	138	78
Groagri GSC 1313	137	79
Asgrow Osage	136	79
DeKalb DK-48	135	76
Golden Acres T-E Y-75	134	79
Golden Harvest H-444W	134	78
Oro Amigo	134	80
Triumph Two 80-D	134	81

GRAIN SORGHUMIRRIGA TED (cont.)

TRIBUNE

High 10 (3-yr av)	Bu/A	(Days to Bloom)
Golden Acres T-E Y-75	138	84
TX399 x TX430	137	83
Cargill 6670	136	82
Asgrow Osage	135	85
Garrison SG 932	133	85
Asgrow GS 712	132	86
Triumph Two 80-D	132	83
Garrison SG 922	131	84
Northrup-King KS737	130	87
Oro Baron	130	86

High 10 (2-yr av)	Bu/A	(Days to Bloom)
DeKalb DK-48	135	84
TX399 x TX430	133	83
Groagri 1313	132	87
DeKalb DK-66	132	90
Cargill X15277 Exp	130	83
Golden Acres T-E Y-75	129	84
Oro Amigo	126	85
Garrison SG-922	125	84
Golden Acres T-E 77-E	125	83
Pioneer 8358	125	86

GRAIN SORGHUMDR YLAND

GARDEN CITY

High 10 (3-yr av)	Bu/A	(Days to Bloom)
Agripro ST 686	63	92
Cargill 70	62	96
Northrup-King KS-714Y	62	95
DeKalb DK-41Y	60	87
Garst 5511	59	96
Oro G Xtra	59	95
Pioneer 8500	58	87
Garrison SG 932	57	96
Asgrow Seneca	56	86
TX2752 x TX430	56	94

High 10 (2-yr av)	Bu/A	(Days to Bloom)
Northrup-King KS 710	72	94
Agripro ST 686	71	92
Northrup-King KS 714Y	70	95
Casterline SR 319E	69	94
Cargill 70	65	96
DeKalb DK-41Y	65	87
Oro G Xtra	65	95
Asgrow Seneca	64	86
Groagri GSC 1214	64	86
Garst 5511	63	96

COLBY

High 10 (3-yr av)	Bu/A	(Days to Bloom)
Golden Acres T-E Y-60	106	74
Groagri GSC 1214	102	73
Oro G Xtra	101	75
Triumph TR 60-G	99	73
Oro Baron	99	75
Garst 5613	97	71
TX3042 x TX2737	97	72
Cargill 630	96	68
Deltapine G-1492	96	70
Garrison SG 932	96	76
TX399 x TX430	96	74

High 10 (2-yr av)	Bu/A	(Days to Bloom)
Golden Acres T-E Y-60	94	74
Northrup-King KS-555 Y	94	73
Triumph TR 65-G	93	76
NC+ Y363	92	72
Pioneer 8500	92	70
Triumph TR 60-G	92	73
Groagri GSC 1214	90	73
Asgrow Seneca	89	69
Cargill 630	89	68
Oro Baron	89	75

GRAIN SORGHUM—DRYLAND (cont.)

TRIBUNE

High 10 (3-yr av)	Bu/A	(Days to Bloom)
Asgrow Seneca	58	82
Pioneer 8500	58	84
Cargill 630	56	81
Golden Acres T-E Y-60	55	84
Triumph TR 58-Y	55	89
Deltapine G-1492	54	82
Garst 5517	54	83
Oro Baron	54	87
Asgrow Madera	53	77
Garst 5613	53	82
Oro G Xtra	53	87

High 10 (2-yr av)	Bu/A	(Days to Bloom)
Oro Ivory	59	82
Asgrow Seneca	58	82
Northrup-King KS-555Y	58	83
Pioneer 8500	57	84
Golden Acres T-E 35	56	85
Oro G Xtra	56	87
Cargill 630	55	81
Deltapine G-1492	55	82
Asgrow Madera	54	77
DeKalb DK-39Y	54	77
Oro Baron	54	87
Triumph TR 58Y	54	89
TX399 x TX430	54	86

SOYBEANS

GARDEN CITY

High 5 (3-yr av)	Bu/A	Maturity Group
Atlas S-Brand S67	65.3	III
Stine 4915	63.4	IV
Northrup-King 36-36	61.3	III
DeKalb-Pfizer CX 415	61.0	IV
DeKalb CX 366	60.9	III
High 5 (2-yr av)		
Atlas S-Brand S67	66.3	III
Ohlde 3431A	66.1	III
Stine 4915	62.5	IV
Golden Harvest H-1355	61.7	III
DeKalb-Pfizer CX415	61.7	IV

COLBY

High 5 (3-yr av)	Bu/A	Maturity Group
Spencer	65.0	III
ZANE	64.5	III
DeKalb CX366	64.3	III
Sparks	62.9	III
Sherman	61.5	III
High 5 (2-yr av)		
Ohlde 3000	68.1	III
Wilson Blend 3165	67.9	III
Atlas S-Brand S57A	65.3	III
Northrup-King 36-36	64.1	III
ZANE	62.6	III

ALFALFA

GARDEN CITY

High 5 (3-yr av)	tons/A
Great Plains Res. Cimarron	11.33
Agripro Arrow	11.09
Agripro Dart	11.04
Anderson Emerald	11.04
W-L Research Pro-cut	11.04

High 5 (2-yr av)	tons/A
Great Plains Res. Cimarron	11.47
W-L Research Pro-cut	11.33
Agripro Arrow	11.28
Casterline Super 55	11.27
W-L Research Acclaim	11.21

WHEAT IRRIGATED

GARDEN CITY

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Tam 107	72	Tam 107	83
Agripro Mesa	67	Agripro Mesa	74
Tam 200	65	Tam 200	74
Agripro Thunderbird	58	2157	70
Century	58	Century	70
Karl	58		

COLBY

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Agripro Mesa	78	Agripro Mesa	76
Agripro Abilene	73	Agripro Abilene	74
Colt	73	Tam 107	74
Tam 107	73	Tam 200	74
Karl	71	Colt	73
		Karl	73

TRIBUNE

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Agripro Mesa	66	Agripro Mesa	68
Agripro Abilene	62	Colt	68
Karl	62	Agripro Abilene	67
Tam 107	62	Quantum 578	67
Colt	61	Agripro Rio Blanco (W)	65
KS84HW196 Exp	61	Karl	65
		Tam 107	65

WHEAT DRYLAND

GARDEN CITY

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Tam 107	40	Tam 107	47
Redland	35	Agripro Abilene	44
AGSECO 7837	34	Redland	40
Larned	34	Karl	39
Newton	34	AGSECO 7837	38
		AGSECO 7846	38
		Newton	38
		Siouxland	38
		2172	38

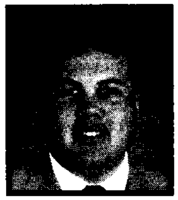
COLBY

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Tam 107	66	Agripro Abilene	64
Agripro Abilene	63	Tam 200	63
AGSECO 7846	62	Quantum 562	61
Quantum 562	61	Agripro Rio Blanco (W)	60
KS84HW196 Exp (W)	60	KS84HW196 Exp	60
Norkan	60	Tam 107	60

TRIBUNE

High 5 (3-yr av)	Bu/A	High 5 (2-yr av)	Bu/A
Tam 107	43	Tam 107	44
Century	41	Agripro Bronco	43
Quantum 562	41	Newton	43
Newton	40	Larned	41
Agripro Abilene	39	Quamtum 562	41
Larned	39	Tam 200	41

Charles Norwood - Agronomist - Dryland Soil Management. He 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.



Steve Posler - Research Assistant, Entomology. Steve received his B.S. in Agriculture-Crop Protection from Kansas State University. He joined the staff in 1990.

Alan Schlegel - Agronomist-in-Charge, Tribune. Alan received his M.S. and Ph.D. degrees at Purdue University. He joined the staff in 1986. His research involves fertilizer and water management in reduced tillage systems.

Phil Sloderbeck - Extension Entomologist. Phil received his M.S. from Purdue University and his Ph.D. from the University of Kentucky. He joined the staff in 1981. His extension emphasis is on insect pests of field crops.

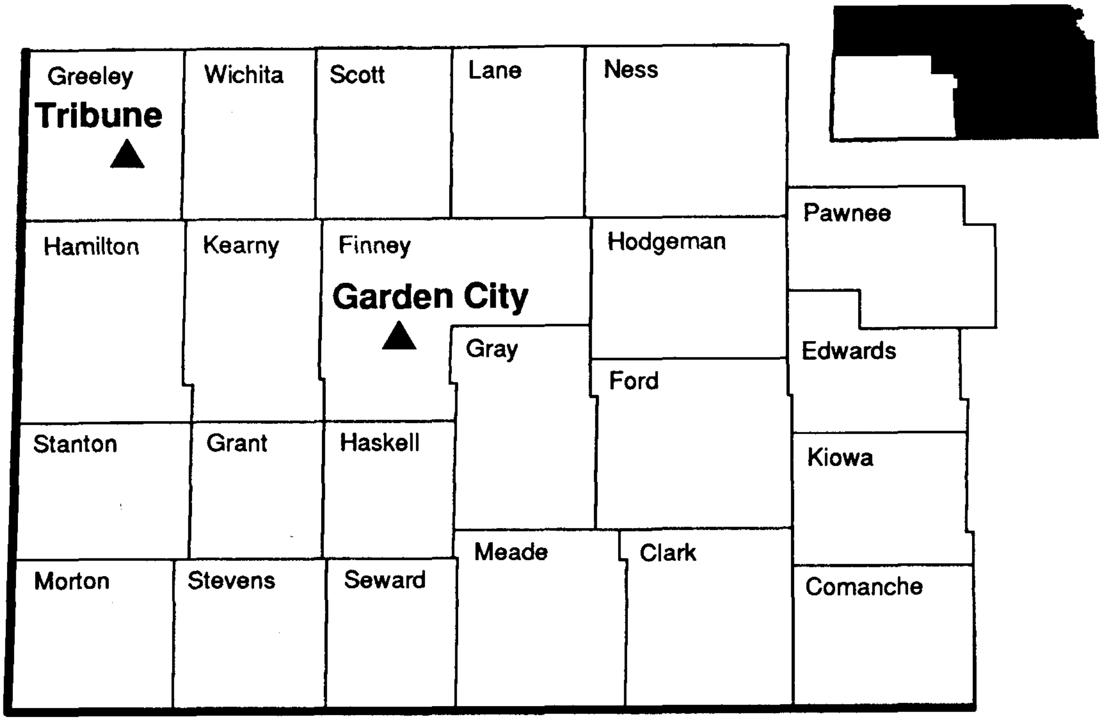
Bill Spurgeon - Agricultural Engineer. Bill received his M.S. from the University of Nebraska and his Ph.D. from Colorado State. He joined the staff in 1988. His research interests include surface irrigation, drip irrigation, and LEPA (Low Energy Precision Application) with center pivots.

Merle Witt - Agronomist - Crop Specialist. He received an M.S. at Kansas State University and joined the staff in 1969. He received his Ph.D. from the University of Nebraska in 1981. Merle's research has included varietal and cultural testing of established crops and potential crops for Southwest Kansas.

Carol Young - Extension Home Economist. Carol received her M.S. degree from Wichita State University. She joined the staff in 1982 after serving as County Extension Home Economist in Osage, Sumner, and Edwards Counties. She is responsible for Home Economics program development in Southwest Kansas.

Kirk Zoellner - Community/Economic Development Specialist. Kirk received his B.S. from Kansas State University in agronomy and his M.B.A from Arizona State University in finance and marketing. He joined the staff in 1989. Kirk's interests focus on economic development strategic planning, local government, community economic analysis, and banking.

SERVICE AREA — SWK RESEARCH-EXTENSION CENTER



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