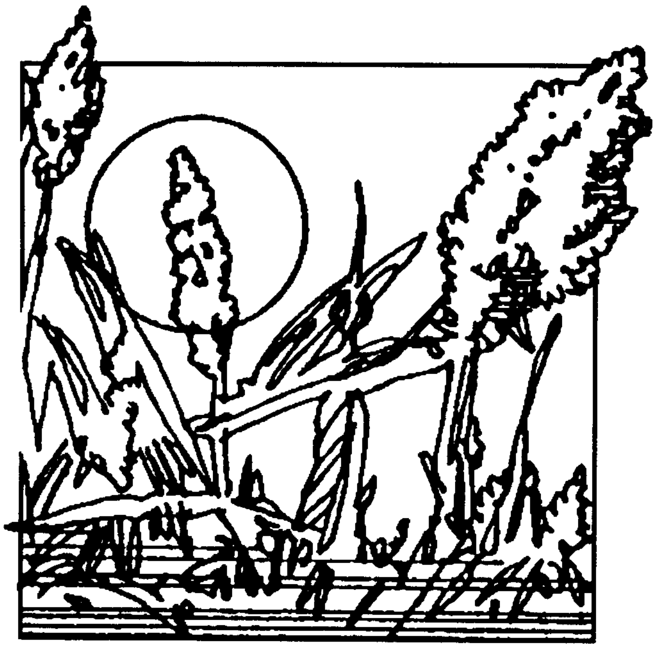

# 1993 FIELD DAY REPORT

## SOUTHWEST KANSAS RESEARCH-EXTENSION CENTER

**Report of Progress 689 • Agricultural Experiment Station**
**Kansas State University • Marc A. Johnson, Director**

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Contribution 94-23-S from the Kansas Agricultural Experiment Station.

KSU Southwest Research-Extension Center

# WEATHER INFORMATION AT GARDEN CITY

*by*
*William Spurgeon*

Precipitation totaled 20.58 inches or 2.67 inches above normal. However, an unusually dry spring occurred with only 0.12 inches of precipitation during April. Twenty-seven inches of snow fell during the year, 7.66 inches more than the average. Record breaking amounts of 14.50 and 11.50 inches occurred in November and December, respectively. There was snow cover on the ground from November 24 through the end of the year.

Temperatures were moderate with generally warmer than normal conditions for the first 5 months and cooler than normal conditions for the latter 7 months. The weather was good for the wheat crop, and record yields were reported. Only two record low temperatures occurred (36° on May 29 and 47° on August 27). Record high temperatures also occurred on 2 days (78° on March 2 and 95° on May 2). The high for the year was 101° on July 8. There were only 2 days with temperatures of 100° or higher. The temperature reached 0° only once, on December 17.

Average wind speed was 4.7 mph or 1.4 mph below normal. Open pan evaporation was 60.60 inches or 17.72 inches below normal and much below average in June, July, and August The frost-free period was from April 27 through October 7, or 164 days, 6 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. 1992**

| | Precipitation inches | | Temperature (°F) Average[2] | | Mean | | Extreme | | Wind MPH | | Evaporation[3] inches | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | 1992 | Avg.[1] | Max. | Min. | 1992 | Avg. | Max. | Min. | 1992 | Avg.[1] | 1992 | Avg.[1] |
| January | 0.97 | 0.33 | 48.0 | 22.2 | 35.1 | 27.7 | 58 | 7 | 4.77 | 5.1 | | |
| February | 0.57 | 0.45 | 54.6 | 25.6 | 40.1 | 33.1 | 74 | 18 | 4.98 | 6.0 | | |
| March | 0.75 | 1.15 | 61.6 | 31.3 | 46.5 | 40.0 | 78 | 12 | 5.95 | 7.4 | | |
| April | 0.12 | 1.56 | 69.0 | 39.3 | 54.2 | 52.5 | 76 | 16 | 5.26 | 7.7 | 7.38 | 8.79 |
| May | 1.58 | 3.11 | 76.5 | 49.5 | 63.0 | 62.5 | 95 | 33 | 5.3 | 7.1 | 10.34 | 10.96 |
| June | 5.42 | 2.87 | 78.8 | 56.7 | 67.7 | 73.2 | 95 | 47 | 3.81 | 7.3 | 8.17 | 13.90 |
| July | 3.38 | 2.60 | 87.3 | 61.8 | 74.6 | 78.4 | 101 | 56 | 4.36 | 6.2 | 10.44 | 14.96 |
| August | 4.70 | 2.16 | 82.4 | 58.3 | 70.4 | 76.0 | 95 | 52 | 3.8 | 5.5 | 8.97 | 12.78 |
| September | 0.24 | 1.59 | 81.3 | 52.0 | 67.4 | 67.4 | 96 | 47 | 4.74 | 5.7 | 9.10 | 9.80 |
| October | 0.29 | 0.98 | 72.0 | 38.9 | 55.4 | 55.0 | 92 | 38 | 4.04 | 5.3 | 6.20 | 7.13 |
| November | 1.43 | 0.76 | 45.9 | 23.8 | 34.9 | 40.3 | 71 | 26 | 4.3 | 5.1 | | |
| December | 1.13 | 0.35 | 36.3 | 13.3 | 24.8 | 31.7 | 46 | 0 | 4.58 | 4.9 | | |
| **Annual** | **20.58** | **17.91** | **66.3** | **39.4** | **52.9** | **53.2** | | | **4.7** | **6.1** | **60.6** | **78.32** |

| | | | |
|---|---|---|---|
| Average earliest freeze in fall | Oct. 13 | 1992 | Oct. 8 |
| Average latest freeze in spring | April 25 | 1992: | April 26 |
| Frost-free period | 170 days 1992: | 164 days | |

[1] 1961-1990 Average
[2] 1951-1980 Average
[3] October evaporation, 1962-1982 Average

# WEATHER INFORMATION AT TRIBUNE

*by*
*Dale Bremer and David Frickel*

Precipitation for 1992 totaled 19.82 inches or 3.91 inches above normal. Precipitation was above normal in 8 months, but a record dry spring of 77 days from March 10 to May 26 with only 0.02 inches of precipitation was recorded. The wettest months were June, July, and August, with 5.05 inches, 3.80 inches, and 3.45 inches, respectively. The largest single amount of precipitation was 1.59 inches on July 13. Snowfall for the year totaled 21.8 inches, and the greatest single amount of snowfall of 3.8 inches was reported on January 1. A total of 47 days of snow cover was recorded in 1992, with 7 days in January and 40 consecutive days at the end of the year from November 21 through December 30.

The air temperature was above normal for the first 4 months of the year and below normal for the last 8 months. The warmest month was July, with a mean temperature of 72° and an average high temperature of 87°. The coldest month was December, with a mean temperature of 24°, an average high of 36°, and an average low of 12°.

Deviation from the normal was greatest in December when the mean temperature was 7° below normal. On only 1 day, July 8, did the maximum temperature reach 100° compared to a 30-year average of 10 days of 100° and above. Temperatures of 90° and above were recorded on only 31 days compared to the 30-year average of 63 days. The lowest temperature for the year was 0° on January 15. Record highs were recorded on May 1 (95°), May 2 (95°), and October 22 (85°) with only 1 day, April 1, having a record low of 13°. The last freeze (30°) on May 26 was 25 days later than the normal of May 1, with only two dates, May 27, 1950 (29°) and June 2, 1917 (30°) being later. The first freeze (27°) in the fall was October 8 which was only 1 day later than normal. However, because of the late spring freeze, there were only 135 frost-free days, which was 24 days less than the normal of 159 days.

Open pan evaporation from April through September totaled 64.43 inches, which was 9.69 inches below the normal of 74.12 inches. Wind speed for the same period averaged 5.2 mph compared to the normal of 5.5 mph.

**Table 1. Climatic data. Southwest Kansas Research-Extension Center, Tribune. 1992.**

| | Precipitation inches | | Temperature (°F) | | | | | | Wind MPH | | Evaporation inches | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Average[2] | | Mean | | Extreme | | | | | |
| Month | 1992 | Avg.[1] | Max. | Min. | 1992 | Avg. | Max. | Min. | 1992 | Avg.[1] | 1992 | Avg.[1] |
| January | 0.76 | 0.36 | 45.5 | 19.2 | 43.4 | 14.2 | 63 | 0 | | | | |
| February | 0.58 | 0.40 | 53.8 | 24.6 | 48.7 | 18.7 | 73 | 17 | | | | |
| March | 1.28 | 0.99 | 60.5 | 28.9 | 56.6 | 25.4 | 77 | 14 | | | | |
| April | T | 1.13 | 69.5 | 36.0 | 67.5 | 35.1 | 86 | 13 | 5.1 | 6.6 | 8.05[2] | 9.14 |
| May | 1.64 | 2.68 | 76.1 | 44.9 | 76.0 | 45.3 | 95 | 30 | 5.6 | 6.1 | 13.59 | 11.31 |
| June | 5.05 | 2.68 | 78.3 | 53.6 | 86.9 | 55.3 | 94 | 45 | 4.3 | 5.6 | 9.80[2] | 14.10 |
| July | 3.80 | 2.60 | 87.1 | 57.3 | 92.7 | 61.3 | 100 | 49 | 5.0 | 4.9 | 12.53[2] | 16.10 |
| August | 3.45 | 1.98 | 81.7 | 55.0 | 89.9 | 59.2 | 97 | 44 | 4.6 | 4.8 | 9.29 | 13.55 |
| September | 0.29 | 1.54 | 82.5 | 48.0 | 81.3 | 49.9 | 98 | 35 | 6.3 | 5.2 | 11.17 | 9..92 |
| October | 0.72 | 0.74 | 70.9 | 35.2 | 70.4 | 37.3 | 89 | 22 | | | | |
| November | 1.76 | 0.48 | 43.9 | 22.2 | 54.7 | 25.3 | 68 | 2 | | | | |
| December | 0.49 | 0.33 | 35.7 | 11.9 | 44.9 | 16.6 | 49 | 3 | | | | |
| Annual | 19.82 | 15.91 | 65.5 | 36.4 | 67.7 | 52.5 | | | 5.2 | 5.5 | 64.43 | 74.12 |

| | | |
|---|---|---|
| Average earliest freeze in fall[3] | Oct.7 | 1992: Oct. 8 |
| Average latest freeze in spring | May 1 | 1992: May 26 |
| Frost-free period | 159 days | 1992: 135 days |

[1]30-year average(1961-1990) [2]Corrected by National Weather Service. [3]Killing frost is 30°F in this table.

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

*by*
*Charles Norwood*

## SUMMARY

Increases in available soil water and yield from a reduction in tillage occurred more often in the WSF system than in the WF system and more often for sorghum than for wheat. Yields with reduced or no tillage were higher in 2 of 6 years for wheat in WSF and in all years for sorghum in WSF but were higher in only 1 year in WF. Wheat yields from the WF and WSF systems usually did not differ.

## 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 1992.

## PROCEDURES

The wheat-fallow (WF), wheat-sorghum-fallow (WSF), sorghum-fallow (SF), and continuous sorghum (SS) 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. 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. Conventional tillage (CT) - Tillage (blade or rodweed only.

<u>SF</u>
1. Conventional tillage (CT) - Tillage (blade or rodweed) only.

Preemergent herbicides (usually 3 lbs Ramrod + 1.0 lb atrazine) were used in the WSF-CT, SF and SS 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). The SS plots required spring tillage similar to WSF-CT.

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

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

### Soil Water

The amount of available soil water (hereafter referred to as soil water) at wheat planting is presented in Table 2. The amount differed between tillage treatments in the WF system in 1989 and 1990. In the WSF system, the NT plots had more soil water in 1989 and 1992. The WF-CT and NT plots had more soil water than WSF-CT and NT in 1989 and 1992, also. The advantage for WF occurred because of the longer fallow period; much of the storage occurred early in fallow, before the beginning of the WSF fallow period.

The amount of soil water at sorghum planting is presented in Table 3. In the WSF system, the NT plots had more soil water in 4 of 6 years. Soil water in SS was less than in WSF-NT in 3 years and more than in WSF-CT in 2 years. Conversely, soil water in WSF-CT exceeded that in SS in 2 years. The longer fallow period of SF never resulted in more water than in WSF-NT.

**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 |
| | Inches available water in a 5-ft. profile | | | |
| 1987 | 7.9a[1] | 7.5a | 6.8a | 7.1a |
| 1988 | 7.0ab | 7.8a | 6.3b | 6.6b |
| 1989 | 7.1b | 8.5a | 3.2d | 5.3c |
| 1990 | 8.2b | 9.6a | 9.0ab | 9.7a |
| 1991 | 7.7a | 7.6a | 7.1a | 7.0a |
| 1992 | 8.0ab | 9.1a | 5.7c | 7.2b |
| Avg. | 7.6ab | 8.3a | 6.3c | 7.1bc |

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

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

| Year | Cropping System | | | |
|---|---|---|---|---|
| | WSF-CT | WSF-NT | SS | SF |
| | Inches available water in a 5-ft. profile | | | |
| 1987 | 5.3b[1] | 7.3a | 7.9a | 8.0a |
| 1988 | 6.7b | 9.3a | 4.7c | 7.3b |
| 1989 | 6.6b | 8.3a | 8.1a | 8.8a |
| 1990 | 7.7b | 8.9a | 7.4b | 8.8a |
| 1991 | 8.0b | 8.9ab | 6.6c | 9.7a |
| 1992 | 7.6a | 8.6a | 7.8a | 8.1a |
| Avg. | 7.0b | 8.4a | 7.1b | 8.49 |

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

Wheat Yield

Wheat yields are presented in Table 4. No tillage caused a difference in yield in the WF system only in 1 year. In the WSF system, RT and NT yielded more than CT in 1989, and NT yielded more than CT in 1991. Although an increase in soil water caused the increase in 1989, no difference occurred in soil water in 1991 (Table 2). A yield reduction occurred in WSF-NT in 1990, because extremely cold temperature in December 1989 caused some tillers to abort. The NT plants were exposed more to the cold because of shallower planting. Under the same conditions, the yield of WF-NT was not reduced, because it was insulated from the cold by the wheat straw remaining from the previous crop.

A comparison of the WF and WSF systems indicates that their yields were similar, except in 1989, when more soil water at planting resulted in higher WF yields. Above average rainfall in 1990 resulted in high yields from all systems, whereas low rainfall reduced yields in 1988.

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

| Year | Cropping System | | | | | |
|---|---|---|---|---|---|---|
| | WF-CT | WF-RT | WF-NT | WSF-CT | WSF-RT | WSF-NT |
| | – bu/a – | | | | | |
| 1987 | 23.7a[1] | 26.7a | 26.7a | 24.2a | 25.6a | 23.1a |
| 1988 | 19.3ab | 22.0ab | 19.2b | 25.5a | 22.8ab | 19.4ab |
| 1989 | 36.7ab | 38.4ab | 42.9a | 12.0d | 31.2b | 22.7c |
| 1990 | 49.1bc | 54.2ab | 50.3bc | 56.8a | 55.2ab | 46.2c |
| 1991 | 41.8bc | 47.5ab | 51.6a | 41.3b | 45.6ab | 50.3a |
| 1992 | 26.4ab | 31.1a | 29.9ab | 23.9b | 27.9ab | 29.2ab |
| Avg. | 32.8a | 36.7a | 36.8a | 30.6a | 34.7a | 31.8a |

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

Grain Sorghum Yield

Grain sorghum yields are presented in Table 5. The yield of WSF-NT exceeded that of WSF-CT in all years. The yield of WSF- NT exceeded that of WSF-RT in 3 of 6 years. Continuous sorghum and SF yields could not be statistically compared with WSF yields because of bird damage in 1988. However, SS yields were generally lower than WSF yields, whereas SF yields never exceeded and were somemtimes lower than WSF-NT yields.

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

| Year | Cropping System | | | | |
|---|---|---|---|---|---|
| | WSF-CT | WSF-RT | WSF-NT | SS | SF |
| | — bu/a — | | | | |
| 1987 | 49.2c | 61.5b | 69.2a | 56.2 | 64.2 |
| 1988 | 35.3b | 49.0a | 53.3a | --[2] | --[2] |
| 1989 | 90.2b | 99.4a | 98.7a | 55.4 | 70.8 |
| 1990 | 51.9b | 55.4ab | 58.1a | 38.1 | 53.1 |
| 1991 | 43.6c | 54.4b | 70.6a | 33.4 | 70.8 |
| 1992 | 96.9b | 100.6b | 110.4a | 71.4 | 97.5 |
| Avg. | 61.1c | 70.1b | 76.7a | -- | -- |

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

# IRRIGATED VERSUS DRYLAND CROPPING SYSTEMS

*by*

*Charles Norwood*

## SUMMARY

A comparison of dryland WSF and WCF cropping systems with similar systems receiving a single irrigation indicate that substantial yield increases can occur in the irrigated systems. However, timely rains can result in dryland yields as high as irrigated yields. Consistent yield increases from irrigation occurred in 2 of 3 years for wheat and 1 of 4 years for sorghum and corn. More data are needed before conclusions can be made regarding the feasibility of these very limited irrigated systems in comparison to dryland.

## INTRODUCTION

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

## PROCEDURES

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

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

## RESULTS AND DISCUSSION

### Wheat Yield

Wheat yields are presented in Table 1. Rainfall well above normal and ideal conditions during grain fill produced very high (also unrealistic) yields in 1990. Irrigation did not significantly improve yields. Conditions were more normal in 1991 and 1992, when a response to irrigation occurred in the irrigated plots following sorghum or corn. However, irrigated continuous wheat did not yield more than dryland wheat. The yield of the irrigated phase of the AID system was similar to that of the other irrigated systems, and the yield of the dryland phase was similar to that of dryland systems.

### Sorghum Yield

Grain sorghum (Table 2) was generally unaffected by cropping system or irrigation in 1989 and 1990, because of timely rains. Rainfall was below normal in 1991, resulting in irrigated WSF yields of 91 bu/a, or 57 bu/a higher than the dryland WSF yield. Dryland sorghum following irrigated wheat yielded 61 bu/a, whereas the all dryland WSF system yielded 34 bu/a, perhaps indicating carryover soil water from the irrigated wheat. Dryland continuous sorghum yielded only 6 bu/a in 1991. There was no response to irrigation in 1992, because of damage from hail and lack of maturity before frost, after a cool, wet growing season.

Corn Yield

Corn yields (Table 3) were higher than sorghum yields in 3 of 4 years. Corn yields were lower than sorghum yields in 1992 because of hail damage at tassel stage. Because of rainfall, irrigated corn did not yield more than dryland corn in 1989. In 1990 no differences occurred, except that ICC yielded less than the other systems, indicating that corn grown in rotation can yield more than continuous corn. A trend toward this occurred in 1989, also. No response to irrigation occurred, in 1992 in any of the treatments because of the hail and above- normal rainfall. Substantially less rainfall occurred in 1991 than in the other 3 years, and yields of the irrigated treatment exceeded those of dryland by more than 50 bu/a. As with sorghum, dryland corn following irrigated wheat yielded substantially more than corn in the all dryland system in 1991, indicating carryover water.

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

| Cropping System [1] | 1990 | 1991 | 1992 | Avg. |
|---|---|---|---|---|
| | | - bu/a - | | |
| Dryland sorghum (corn)-fallow -irrigated wheat | 90.1bc[1] | 70.9a | 56.5ab | 72.5a |
| Irrigated sorghum (corn)-fallow -dryland wheat | 86.0bc | 46.8c | 34.9d | 55.9c |
| Irrigated sorghum (corn)-fallow -irrigated wheat | 100.1a | 65.4ab | 61.9a | 75.8a |
| Dryland sorghum (corn)-fallow -dryland wheat | 86.3bc | 49.8c | 43.2cd | 59.8bc |
| Irrigated continuous wheat | 75.5cd | 56.5bc | 47.6bc | 59.9bc |
| Dryland continuous wheat | 72.2d | 22.9d | 12.6e | 35.9d |
| Irrigated wheat-fallow -dryland wheat | 75.2cd | 51.0c | 45.2bcd | 57.2c |
| Dryland wheat-continuous -irrigated wheat | 85.8bc | 65.9ab | 56.4ab | 69.4ab |

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

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

| Cropping System | 1989 | 1990 | 1991 | 1992 | Avg. |
|---|---|---|---|---|---|
| | | | - bu/a - | | |
| Irrigated wheat-fallow -dryland sorghum | 87.1a[1] | 92.8a | 60.8b | 65.9a | 76.7ab |
| Dryland wheat-fallow -irrigated sorghum | 78.7a | 91.9a | 90.8a | 66.3a | 81.9ab |
| Irrigated wheat-fallow -irrigated sorghum | 78.1a | 99.0a | 91.8a | 73.2a | 85.5a |
| Dryland wheat-fallow -dryland sorghum | 80.0a | 91.4a | 34.1c | 69.2a | 68.7ab |
| Irrigated continuous -sorghum | 81.1a | 84.9a | 86.3a | 60.5a | 78.2ab |
| Dryland continuous -sorghum | 75.3a | 90.7a | 6.4d | 55.5a | 57.0b |

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

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

| Cropping System | 1989 | 1990 | 1991 | 1992 | Avg. |
|---|---|---|---|---|---|
| | | | - bu/a - | | |
| Irrigated wheat-fallow -dryland corn | 101.8ab[1] | 115.3a | 61.2a | 48.8a | 81.8a |
| Dryland wheat-fallow -irrigated corn | 112.4a | 114.7a | 92.9ab | 62.1a | 95.5a |
| Irrigated wheat-fallow -irrigated corn | 104.8ab | 109.7a | 98.3a | 52.8a | 91.4a |
| Dryland wheat-fallow -dryland corn | 97.1ab | 114.3a | 41.9d | 56.9a | 77.5a |
| Irrigated continuous -corn | 84.9b | 84.6b | 84.2b | 47.1a | 75.2a |

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

# NITROGEN MANAGEMENT OF IRRIGATED TRITICALE

*By*
*Dave Frickel and Alan Schlegel*

SUMMARY

Grain yields of irrigated triticale were variable between site-years ranging from about 50 to over 100 bu/acre and generally were not increased by application of N fertilizer. Residual soil N status prior to planting, as indicated by a profile soil N test, was not a reliable indicator of N fertilizer requirement. Grain protein was consistently increased by increased N rates but largely unaffected by time of N application. When lodging occurred, it was greater at higher N rates.

## INTRODUCTION

Nitrogen fertilizer management for irrigated triticale was evaluated over 5 site-years on cooperators' farms south of Garden City. The objectives were to determine the optimum rate and time of N application for irrigated triticale and the effect of N management on residual soil N content.

## PROCEDURES

Field studies were conducted in 1991 and 1992 to evaluate N management practices for irrigated winter triticale (a cross between wheat and rye). Study sites were selected based upon residual soil nitrate status, and soils ranged from silt loam to fine sands. In 1991, experiments were located on low, medium, and high residual-N soils. In 1992, only low and medium residual-N sites were used. Four rates of N fertilizer (40, 80, 120, and 160 lb N/acre) were broadcast at four application timings; all fall, all spring (Feeke's growth stage 3[GS3]), a 2-way split of 1/3 fall+2/3 GS3, and a 3-way split of 1/3 fall+1/3 GS3+1/3 GS8 (early boot), and a zero N control was included. Plant tillers, plant heights, and lodging were measured at physiological maturity. The center of each plot was machine harvested, and grain yields were adjusted to 12.5% moisture. Grain samples taken at harvest were analyzed for kernel weight and N content. Soil samples were collected to a depth of 8 ft in 1-ft increments after harvest and analyzed for residual nitrate-N content.

## RESULTS AND DISCUSSION

Soil tests for residual soil N taken prior to planting indicated that four out of the five sites were low to medium in residual N (less than 20 ppm N as nitrate plus ammonia in 2-foot profile). The lower the residual soil N content, the greater the probability of crop response to N additions. However, triticale grain yield was increased by N fertilizer in only one of the 5 site-years (Table 1-5). The N responsive site (TH92) had residual soil N in the medium range and yield increases of 14 bu/acre (Table 2). At the 2 site-years with low residual soil N content (WG91 and WG92) and the other site-year with medium residual soil N (EG91), grain yields were depressed by the highest N rate (Tables 3-5). Grain yields in these site-years ranged from about 50 to over 100 bu/acre. When averaged over all site-years, the highest N rate of 160 lb N/acre tended to decrease yields (Table 6). Spring or split N applications tended to produce greater yields than applying all of the N in the fall in the one N responsive site (TH92). However, when yields were not increased by N fertilizer, then time of N application had no effect on grain yield.

**Table 1. Effect of N management on selected plant parameters (TH91).**

| N rate lb/a | Yield bu/a | Test Weight lb/bu | Grain N % | Tillers $10^{-6}$/a | Plants Lodged % | Height inch |
|---|---|---|---|---|---|---|
| | | | - Means- | | | |
| 0 | 54a | 49.7a | 2.02c | 2.1a | 43c | 47a |
| 40 | 51a | 48.3b | 2.20b | 1.8a | 62b | 47a |
| 80 | 41b | 47.8bc | 2.24ab | 2.0a | 77ab | 47a |
| 120 | 41b | 47.5bc | 2.31a | 2.0a | 71ab | 46a |
| 160 | 37b | 47.2c | 2.33a | 2.0a | 80a | 46a |
| $LSD_{.05}$ | 5 | 1 | 0.11 | 0.4 | 17 | 2 |
| N timing | | | | | | |
| Fall | 43a | 47.9a | 2.27a | 1.8a | 64a | 47a |
| Fall+GS3 | 47a | 48.2a | 2.20a | 2.1a | 69a | 47a |
| Fall+GS3 +GS8 | 46a | 48.1a | 2.20a | 2.0a | 65a | 47a |
| GS3 | 45a | 48.2a | 2.19a | 2.1a | 67a | 46a |
| $LSD_{.05}$ | 4 | 0.8 | 0.09 | 0.4 | 16 | 2 |

**Table 2. Effect of N management on selected plant parameters (TH92).**

| N rate lb/a | Yield bu/a | Test Weight lb/bu | Grain N % | Plants Tillers $10^{-6}$/a | Lodged % | Height inch |
|---|---|---|---|---|---|---|
| | | | - Means- | | | |
| 0 | 62c | 52.5c | 1.61c | 2.2b | 0 | 40c |
| 40 | 67b | 52.6bc | 1.65c | 2.6a | 0 | 41bc |
| 80 | 71a | 52.9b | 1.75b | 2.8a | 0 | 42b |
| 120 | 75a | 53.2a | 1.88a | 3.0a | 0 | 43a |
| 160 | 76a | 53.4a | 1.91a | 2.9a | 0 | 43a |
| $LSD_{.05}$ | 5 | 0.3 | 0.07 | 0.4 | 0 | 1 |
| N timing | | | | | | |
| Fall | 67b | 52.9a | 1.72b | 2.6b | 0 | 42a |
| Fall+GS3 | 72a | 53.1a | 1.76b | 2.8ab | 0 | 42a |
| Fall+GS3 +GS8 | 70ab | 53.0a | 1.82a | 2.5b | 0 | 42a |
| GS3 | 72a | 52.6b | 1.74b | 3.0a | 0 | 42a |
| $LSD_{.05}$ | 5 | 0.3 | 0.06 | 0.4 | 0 | 1 |

**Table 3. Effect of N management on selected plant parameters (WG91).**

| N rate lb/a | Yield bu/a | Test Weight lb/bu | Grain N % | Tillers $10^{-6}$/a | Plants Lodged % | Height inch |
|---|---|---|---|---|---|---|
| | | | | - Means- | | |
| 0 | 51ab | 46.4a | 2.30c | 2.2c | 6c | 46c |
| 40 | 49ab | 46.1ab | 2.37c | 2.4bc | 56b | 48b |
| 80 | 50ab | 45.9b | 2.46b | 2.6ab | 69b | 48b |
| 120 | 55a | 45.4b | 2.52ab | 2.7ab | 88a | 50a |
| 160 | 45b | 44.0c | 2.59a | 2.8a | 97a | 51a |
| LSD.05 | 8 | 0.8 | 0.07 | 0.3 | 16 | 1 |
| N timing | | | | | | |
| Fall | 49a | 45.2a | 2.47a | 2.5a | 73a | 49ab |
| Fall+GS3 | 54a | 45.2a | 2.47a | 2.5a | 73a | 49ab |
| Fall+GS3 +GS8 | 49a | 45.7a | 2.45a | 2.6a | 65ab | 48aba |
| GS3 | 48a | 45.7 | 2.44a | 2.5a | 45.7a | 49b |
| $LSD_{.05}$ | 7 | 0.7 | 0.06 | 0.3 | 14 | 1 |

**Table 4. Effect of N management on selected plant parameters (WG92).**

| N rate lb/a | Yield bu/a | Test Weight lb/bu | Grain N % | Plants Tillers $10^{-6}$/a | Lodged % | Height inch |
|---|---|---|---|---|---|---|
| | | | - Means- | | | |
| 0 | 100ab | 54.1a | 1.69d | 2.2c | 0 | 44d |
| 40 | 106a | 53.9a | 1.78c | 2.7b | 0 | 46c |
| 80 | 105a | 53.1b | 1.86b | 2.7b | 0 | 47b |
| 120 | 96bc | 52.3c | 1.95a | 2.9ab | 0 | 47b |
| 160 | 93c | 51.5d | 1.99a | 3.2a | 0 | 49a |
| $LSD_{.05}$ | 6 | 0.2 | 0.05 | 0.4 | 0 | |
| N timing | | | | | | |
| Fall | 102a | 53.6a | 1.80a | 2.7a | 0 | 47ab |
| Fall+GS3 | 100a | 53.1ab | 1.80a | 2.9a | 0 | 46b |
| Fall+GS3 +GS8 | 99a | 52.3c | 1.90a | 2.6a | 0 | 47b |
| GS3 | 99a | 52.9b | 1.90a | 2.8a | 0 | 46ab |
| $LSD_{.05}$ | 6 | 0.6 | 0.05 | 0.4 | 0 | 1 |

**Table 5. Effect of N management on selected plant parameters (EG91).**

| N rate lb/a | Yield bu/a | Test Weight lb/bu | Grain N % | Plants Tillers $10^{-6}$/a | Lodged % | Height inch |
|---|---|---|---|---|---|---|
| | | | - Means- | | | |
| 0 | 61ab | 49.4a | 1.93d | — | 9b | 43c |
| 40 | 65a | 48.5a | 2.03c | — | 19b | 45b |
| 80 | 58bc | 47.1b | 2.21b | — | 41a | 47ab |
| 120 | 56bc | 45.7c | 2.40a | — | 50a | 47a |
| 160 | 52c | 44.9c | 2.42a | — | 54a | 47ab |
| $LSD_{05}$ | 7 | 1.1 | 0.09 | — | 18 | 2 |
| N timing | | | | | | |
| Fall | 61a | 47.8a | 2.13b | — | 25b | 45b |
| Fall+GS3 | 57a | 47.4ab | 2.20ab | — | 30ab | 45b |
| Fall+GS3 +GS | 58a | 46.8b | 2.20ab | — | 46a | 45b |
| GS3 | 58a | 46.8b | 2.20ab | — | 39ab | 47a |
| $LSD_{05}$ | 6 | 0.1 | 0.08 | — | 16 | 1 |

**Table 6. Effect of N management on selected plant parameters (average of five-site years).**

| N rate lb/a | Yield bu/a | Test Weight lb/bu | Grain N % | Plants Tillers $10^{-6}$/a | Lodged % | Height inch |
|---|---|---|---|---|---|---|
| | | | - Means- | | | |
| 0 | 66a | 50.4a | 1.91e | 2.2d | 10d | 44d |
| 40 | 69a | 50.0b | 1.99d | 2.4c | 26c | 45c |
| 80 | 66a | 49.4c | 2.10c | 2.5bc | 35b | 46b |
| 120 | 66a | 48.9d | 2.20b | 2.7ab | 40ab | 47ab |
| 160 | 62b | 48.2e | 2.24a | 2.8a | 44a | 47a |
| $LSD_{05}$ | 3 | 0.4 | 0.03 | 0.2 | 6 | 1 |
| N timing | | | | | | |
| Fall | 65a | 49.6a | 2.07b | 2.4b | 31a | 46a |
| Fall+GS3 | 67a | 49.6a | 2.07b | 2.6a | 30a | 46a |
| Fall+GS3 +GS8 | 66a | 49.2a | 2.11a | 2.5ab | 34a | 46a |
| GS3 | 66a | 49.2a | 2.09ab | 2.6a | 30a | 46a |
| $LSD_{05}$ | 3 | 0.4 | 0.03 | 0.2 | 5 | 1 |

The addition of N fertilizer was consistent in increasing grain protein in all site-years. Averaged over all site-years, grain N increased from 1.91% without N up to 2.24% with 160 lb N/acre. On average, the highest grain N content was obtained with the 3-way split N application, but this increase was minimal (less than 0.05%).

Tiller population increased with increased N rate from 2.2 without N to 2.8 million tillers/acre at the highest N rate averaged over all site-years. Applying at least some of the N in the spring tended to increase tiller population over an all-fall application.

A negative effect of increased N rates was an increased amount of lodging in 1991. However, in 1992, although yields were considerably greater than 1991, no lodging occurred at either site. Averaged over the 2 years, lodging increased from 10% without N to over 40% at the higher N rates. The effect of time of N application on lodging was inconsistent. Lodging was greater with fall applications at 1 site-year (WG91) and greater for spring applications at another site-year (EG91). Averaged over the years, the time of N application had little effect on lodging.

Soil N measurements taken after harvest showed that higher N rates left more residual nitrate-N in the soil profile (Figs. 1-5). This residual N was not lost, because the majority of it was in the top 2 feet of soil (Figs. 6-8) where it could be readily utilized by subsequent crops. Although there were slight differences occurred between site-years, in general, the time of N application had little effect on the amount of residual N in the soil after harvest.

**Figure 1. Residual soil nitrate after harvest TH91.**

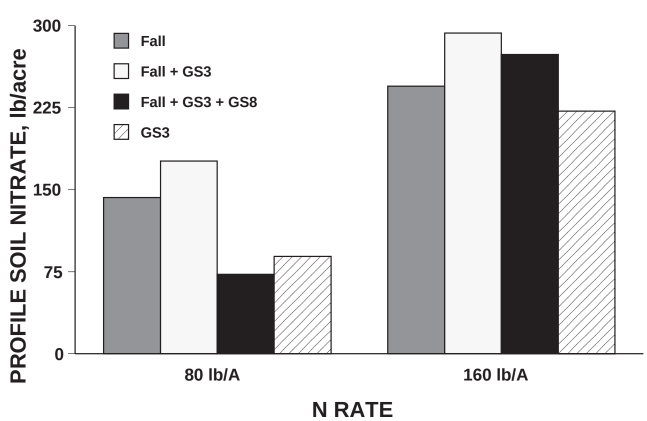


Figure 2. Residual soil nitrate after harvest TH92.

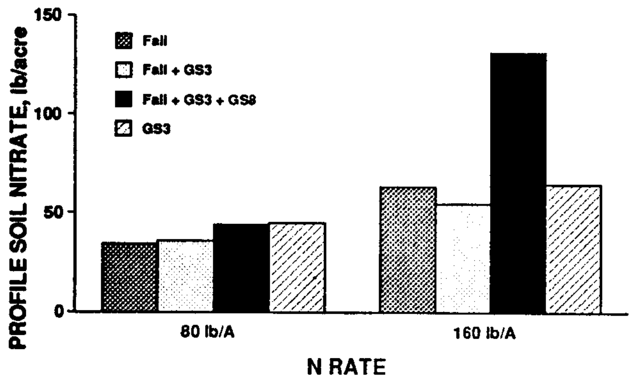



Figure 3. Residual soil nitrate after harvest WG91.

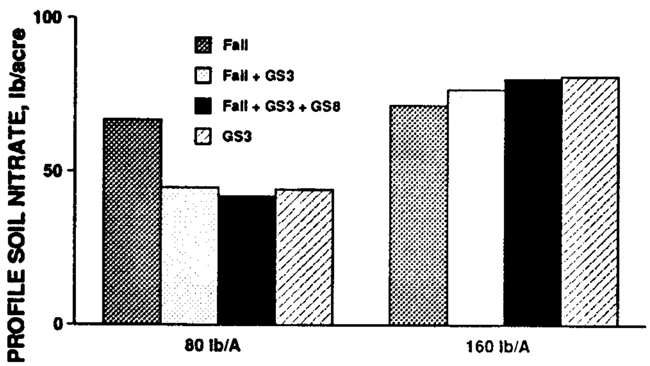



Figure 4. Residual soil nitrate after harvest WG92.

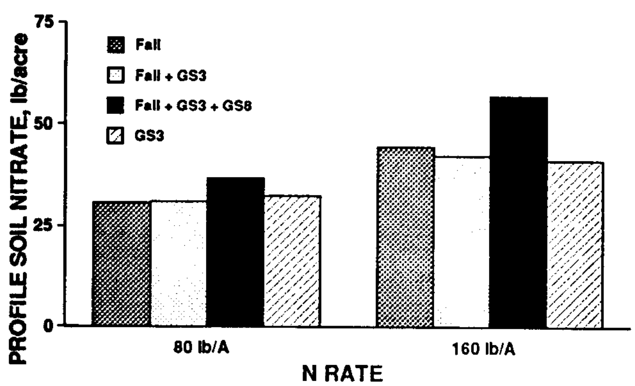



Figure 5. Residual soil nitrate after harvest EG91.

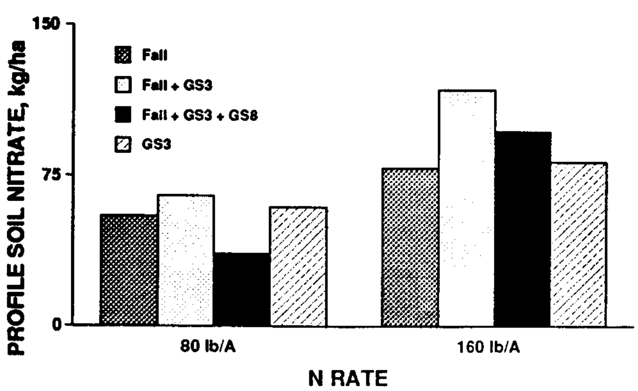



Figure 6. Soil nitrate distribution by depth TH91 (N rate of 160 lb N/acre).

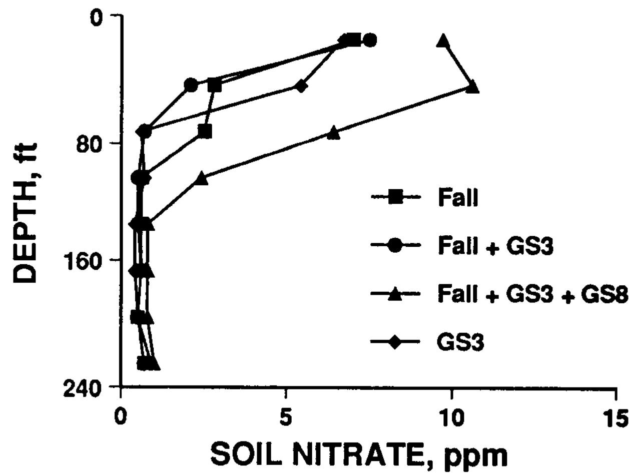



Figure 7. Soil nitrate distribution by depth TH92 (N rate of 160 lb N/acre).

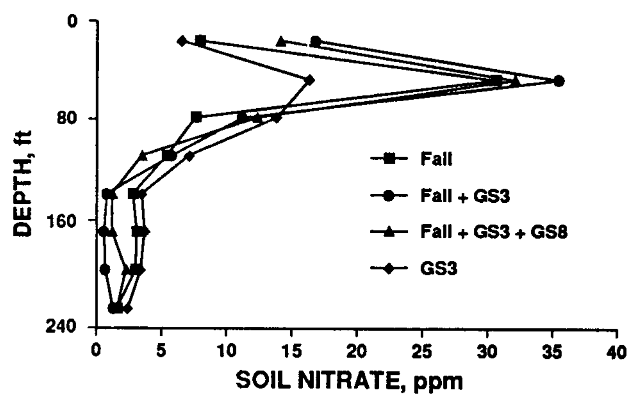
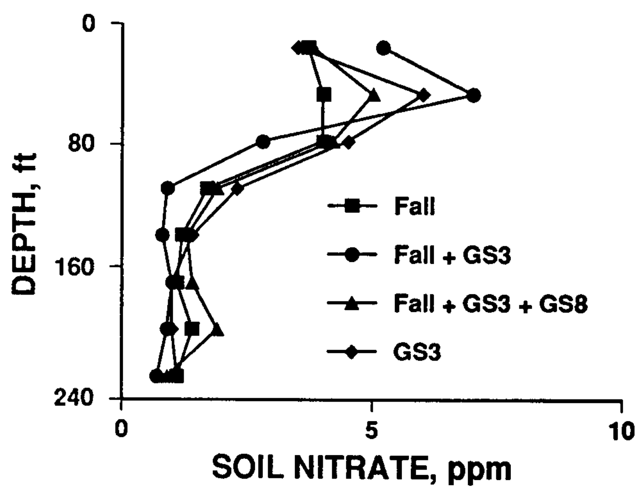



Figure 8. Soil nitrate distribution by depth WG91. (N rate of 160 lb/Nacre).



# EFFECTS OF A NITRIFICATION INHIBITOR, NITROGEN RATE, AND METHOD OF APPLICATION ON IRRIGATED RIDGE-TILL CORN

*by*
*Alan Schlegel and Dave Frickel*

## SUMMARY

Ridge-till corn was grown on N-depleted sites for 2 years under irrigation. Nitrogen uptake and grain yields increased with increased N rates. A nitrification inhibitor, DCD, was effective in reducing nitrification in the soil for several weeks after application of UAN fertilizer, but it was not effective in increasing grain yield. Grain yields were greater from dribble than broadcast N application in 1991 but lower in 1992.

## INTRODUCTION

A nitrification inhibitor, dicyandiamide (DCD), was evaluated for its ability to retard nitrification and improve grain yield of irrigated ridge-till corn when surface applied with urea-ammonium nitrate (UAN) fertilizer. Nitrification is the naturally occuring microbial process that transforms $NH_4$-N into $NO_3$-N in the soil. Maintaining fertilizer N as $NH_4$-N rather than $NO_3$-N reduces the potential of N loss from leaching and may result in greater plant N uptake and grain yield.

## PROCEDURE

This research was conducted at the SWREC near Tribune. A split plot experimental design was used with combinations of method of nitrogen (N) application (broadcast or dribble banded) and rates of UAN solution (0, 80, 120, and 160 lb N/acre) as main plots. Subplots were rates of DCD (0, 1.5, and 3% of total N as DCD N). All treatments were applied on 5/7/91 and 5/8/92 shortly after planting of corn (DeKalb DK636 at 33,000 seeds/acre on 4/23/91 and 4/17/92).

The study sites used in each year had corn grown on them in the previous year without fertilizer N to deplete residual soil N and increase the likelihood of response to N fertilizer. Corn stalks were shredded after harvest but no tillage was done between harvest and planting of corn.

Soil samples (0-6") were taken 23 and 44 days after fertilizer application in 1991. In 1992, soil samples (0-3" and 3-6") were taken 38 days after treatment application. All soil samples were analyzed for nitrate and ammonia. Leaf samples (leaf opposite and below ear) were taken at silking and analyzed for N content.

All plots were machine harvested (9/30/91 and 10/22/92) after physiological maturity, and grain yields adjusted to 15.5% moisture. Grain samples were collected at harvest and analyzed for N content.

## RESULTS

The addition of DCD to UAN fertilizer tended to reduce the level of soil $NO_3$ and increase the ratio of $NH_4$ to $NO_3$ for 3 weeks after fertilizer application in 1991 (Table 1) and 5 weeks in 1992 (Table 2). Application of UAN in a dribble band rather than broadcast also tended to increase the ratio of $NH_4$ to $NO_3$, ,but this was caused by increased levels of $NH_4$ rather than reduced levels of $NO_3$.

Corn grown on the N-depleted sites responded well to N fertilization. Grain yields were increased by increased N rates in both years (Tables 3 and 4). In 1991, grain yields and N uptake tended to be greater with dribble rather than broadcast N application. However in 1992, grain yield and plant N uptake were higher from broadcast than dribble N application. Plant N uptake was reduced by the high rate of DCD in 1992, as shown by lower leaf and grain N content, which resulted in reduced grain yields, particularly with dribble application of fertilizer.

**Table 1. Effect of N and DCD on $NO_3$ and $NH_4$ levels in the soil (0-6 inch) after 3 and 6 weeks, Tribune, KS 1991.**

| Application Method | N Rate | DCD Rate | Time after Application: 3 Weeks $NO_3$ | $NH_4$ | $\%NH_4$ | 6 Weeks $NO_3$ | $NH_4$ | $\%NH_4$ |
|---|---|---|---|---|---|---|---|---|
| | lb/a | % | - - ppm - - | | % | - - ppm - - | | % |
| Broadcast | 80 | 0 | 41.4 | 3.4 | 8 | 23.5 | 4.4 | 16 |
| | | 1.5 | 38.2 | 3.0 | 8 | 27.6 | 4.3 | 14 |
| | | 3.0 | 41.1 | 3.6 | 8 | 28.8 | 4.6 | 14 |
| | 120 | 0 | 54.0 | 3.5 | 6 | 17.9 | 4.4 | 21 |
| | | 1.5 | 45.9 | 4.3 | 8 | 22.3 | 4.0 | 16 |
| | | 3.0 | 45.9 | 5.8 | 11 | 32.7 | 3.8 | 12 |
| | 160 | 0 | 56.0 | 3.8 | 7 | 41.0 | 4.4 | 10 |
| | | 1.5 | 62.3 | 6.1 | 9 | 38.4 | 5.0 | 12 |
| | | 3.0 | 50.3 | 11.0 | 18 | 43.2 | 4.6 | 10 |
| Dribble | 80 | 0 | 48.2 | 6.4 | 11 | 35.3 | 4.2 | 13 |
| | | 1.5 | 35.9 | 3.0 | 8 | 17.7 | 4.5 | 22 |
| | | 3.0 | 29.1 | 5.8 | 17 | 14.8 | 4.2 | 26 |
| | 120 | 0 | 46.6 | 5.1 | 10 | 23.7 | 4.3 | 19 |
| | | 1.5 | 31.9 | 3.3 | 10 | 36.7 | 4.9 | 13 |
| | | 3.0 | 43.5 | 13.5 | 20 | 37.1 | 4.6 | 11 |
| | 160 | 0 | 75.5 | 8.8 | 11 | 48.0 | 4.5 | 11 |
| | | 1.5 | 61.0 | 11.6 | 14 | 49.3 | 5.6 | 11 |
| | | 3.0 | 52.2 | 15.2 | 22 | 36.1 | 6.2 | 15 |
| Control | | 0 | 18.2 | 3.0 | 15 | 10.0 | 4.1 | 32 |
| Main Effect Means | | | | | | | | |
| Application method | | | | | | | | |
| Broadcast | | | 40.4 | 4.4 | 11 | 25.2 | 4.3 | 19 |
| Dribble | | | 40.3 | 6.8 | 14 | 27.6 | 4.6 | 19 |
| | $LSD_{.05}$ | | 6.3 | 1.9 | 2 | 4.4 | 0.4 | 3 |
| N rate | | | | | | | | |
| 0 lb/a | | | 18.2 | 3.0 | 15 | 10.0 | 4.1 | 32 |
| 80 | | | 39.0 | 4.2 | 10 | 24.6 | 4.4 | 18 |
| 120 | | | 44.6 | 5.9 | 11 | 28.4 | 4.3 | 15 |
| 160 | | | 59.6 | 9.4 | 13 | 42.6 | 5.0 | 11 |
| | $LSD_{.05}$ | | 8.9 | 2.7 | 3 | 6.3 | 0.5 | 4 |
| DCD rate | | | | | | | | |
| 0 % | | | 44.6 | 4.6 | 10 | 25.8 | 4.3 | 20 |
| 1.5 | | | 38.9 | 4.6 | 11 | 26.6 | 4.5 | 18 |
| 3.0 | | | 37.5 | 7.6 | 16 | 26.8 | 4.6 | 19 |
| | $LSD_{.05}$ | | 7.1 | 2.2 | 2 | 5.5 | 0.4 | 4 |

Calculated as [NH4/(NO3 + NH4)] * 100.

**Table 2. Effect of N and DCD on soil NO3 and NH4 content 5 weeks after application to irrigated ridge-till corn, Tribune, KS 1992.**

| Application Method | N Rate | DCD Rate | 0-3" Depth $NO_3$ | 0-3" Depth $NH_4$ | 0-3" Depth $\%NH_4$ | 3-6" Depth $NO_3$ | 3-6" Depth $NH_4$ | 3-6" Depth $\%NH_4$ |
|---|---|---|---|---|---|---|---|---|
| | lb/a | % | - - ppm - - | | % | - - ppm - - | | % |
| Broadcast | 80 | 0 | 25.6 | 7.6 | 23 | 19.6 | 6.3 | 24 |
| | | 1.5 | 29.9 | 6.1 | 18 | 20.0 | 6.7 | 26 |
| | | 3.0 | 30.9 | 6.9 | 18 | 17.1 | 7.5 | 30 |
| | 120 | 0 | 60.2 | 8.3 | 14 | 32.9 | 6.7 | 17 |
| | | 1.5 | 36.6 | 9.0 | 20 | 22.4 | 6.5 | 23 |
| | | 3.0 | 29.6 | 6.3 | 18 | 20.6 | 6.8 | 25 |
| | 160 | 0 | 48.9 | 6.6 | 12 | 27.6 | 6.1 | 18 |
| | | 1.5 | 41.0 | 7.5 | 15 | 23.8 | 7.3 | 23 |
| | | 3.0 | 44.7 | 11.4 | 21 | 26.1 | 8.3 | 24 |
| Dribble | 80 | 0 | 41.5 | 12.9 | 25 | 23.0 | 6.9 | 24 |
| | | 1.5 | 35.3 | 10.9 | 22 | 19.9 | 7.3 | 27 |
| | | 3.0 | 15.2 | 8.2 | 36 | 11.3 | 7.4 | 40 |
| | 120 | 0 | 61.8 | 13.5 | 17 | 43.1 | 9.3 | 18 |
| | | 1.5 | 35.1 | 10.6 | 21 | 26.2 | 6.3 | 19 |
| | | 3.0 | 32.5 | 13.2 | 29 | 16.9 | 6.8 | 30 |
| | 160 | 0 | 94.3 | 13.6 | 12 | 51.5 | 8.2 | 14 |
| | | 1.5 | 81.9 | 48.3 | 36 | 49.5 | 12.0 | 19 |
| | | 3.0 | 27.0 | 11.8 | 31 | 11.5 | 7.2 | 39 |
| Control | 0 | 0 | 6.8 | 6.2 | 47 | 6.5 | 6.7 | 51 |
| <u>Main Effect Means</u> | | | | | | | | |
| Application method | | | | | | | | |
| Broadcast | | | 30.6 | 7.4 | 26 | 19.2 | 6.9 | 30 |
| Dribble | | | 37.2 | 13.4 | 30 | 22.6 | 7.6 | 32 |
| $LSD_{05}$ | | | 4.3 | 3.0 | 3 | 2.0 | 0.7 | 2 |
| N rate | | | | | | | | |
| 0 lb/a | | | 6.8 | 6.2 | 47 | 6.5 | 6.7 | 51 |
| 80 | | | 29.7 | 8.8 | 24 | 18.5 | 7.0 | 28 |
| 120 | | | 42.6 | 10.1 | 20 | 27.0 | 7.0 | 22 |
| 160 | | | 56.3 | 16.5 | 21 | 31.7 | 8.2 | 23 |
| $LSD_{05}$ | | | 6.1 | 4.2 | 5 | 2.8 | 1.0 | 3 |
| DCD rate | | | | | | | | |
| 0 % | | | 43.0 | 9.5 | 26 | 26.4 | 7.1 | 27 |
| 1.5 | | | 34.3 | 13.1 | 28 | 21.8 | 7.4 | 30 |
| 3.0 | | | 24.3 | 8.6 | 30 | 14.6 | 7.2 | 36 |
| $LSD_{05}$ | | | 7.0 | 3.4 | 3 | 3.8 | 1.0 | 3 |

Calculated as [NH4/(NO3 + NH4)] * 100.

**Table 3. Effect of N and DCD on grain yield and N status of irrigated ridge-till corn, Tribune, KS 1991.**

| Application Method | N Rate | DCD Rate | Leaf N | Grain Yield | Grain N | N Removal |
|---|---|---|---|---|---|---|
| | lb/a | % | % | bu/a | % | lb/a |
| Broadcast | 80 | 0 | 1.72 | 147 | 1.15 | 80.7 |
| | | 1.5 | 1.68 | 127 | 1.09 | 65.5 |
| | | 3.0 | 1.65 | 150 | 1.12 | 80.3 |
| | 120 | 0 | 1.94 | 155 | 1.18 | 87.0 |
| | | 1.5 | 2.30 | 174 | 1.31 | 107.9 |
| | | 3.0 | 1.90 | 163 | 1.27 | 98.7 |
| | 160 | 0 | 1.90 | 177 | 1.29 | 109.0 |
| | | 1.5 | 2.15 | 181 | 1.33 | 113.5 |
| | | 3.0 | 1.98 | 166 | 1.26 | 100.2 |
| Dribble | 80 | 0 | 2.03 | 132 | 1.24 | 78.5 |
| | | 1.5 | 2.03 | 140 | 1.26 | 84.9 |
| | | 3.0 | 1.87 | 144 | 1.30 | 88.7 |
| | 120 | 0 | 1.80 | 161 | 1.20 | 91.3 |
| | | 1.5 | 1.76 | 167 | 1.22 | 97.0 |
| | | 3.0 | 2.13 | 161 | 1.22 | 92.5 |
| | 160 | 0 | 2.22 | 168 | 1.24 | 98.5 |
| | | 1.5 | 1.93 | 157 | 1.31 | 97.3 |
| | | 3.0 | 1.98 | 149 | 1.25 | 88.5 |
| Control | 0 | 0 | 1.71 | 132 | 1.21 | 76.9 |
| Main Effect Means | | | | | | |
| Application method | | | | | | |
| Broadcast | | | 1.83 | 147 | 1.21 | 85.0 |
| Dribble | | | 1.94 | 155 | 1.25 | 91.8 |
| $LSD_{05}$ | | | 0.12 | 14 | 0.06 | 10.6 |
| N rate | | | | | | |
| 0 lb/a | | | 1.71 | 132 | 1.21 | 76.9 |
| 80 | | | 1.83 | 140 | 1.19 | 79.8 |
| 120 | | | 1.97 | 164 | 1.23 | 95.7 |
| 160 | | | 2.03 | 166 | 1.28 | 101.2 |
| $LSD_{05}$ | | | 0.17 | 19 | 0.09 | 15.0 |
| DCD rate | | | | | | |
| 0 % | | | 1.88 | 154 | 1.22 | 89.1 |
| 1.5 | | | 1.89 | 146 | 1.24 | 86.8 |
| 3.0 | | | 1.88 | 152 | 1.23 | 89.3 |
| $LSD_{05}$ | | | 0.12 | 10 | 0.04 | 7.4 |

**Table 4. Effect of N and DCD on irrigated ridge-till corn, Tribune, KS 1992.**

| Application Method | N Rate | DCD Rate | Leaf N | Yield | Grain N | N Removal |
|---|---|---|---|---|---|---|
| | lb/a | % | % | bu/a | % | lb/a |
| Broadcast | 80 | 0 | 2.13 | 156 | 0.95 | 70.2 |
| | | 1.5 | 2.05 | 164 | 1.01 | 77.4 |
| | | 3.0 | 1.88 | 143 | 0.94 | 63.5 |
| | 120 | 0 | 2.25 | 174 | 1.13 | 92.6 |
| | | 1.5 | 2.05 | 160 | 1.03 | 77.4 |
| | | 3.0 | 2.07 | 158 | 0.93 | 69.6 |
| | 160 | 0 | 2.40 | 189 | 1.16 | 103.4 |
| | | 1.5 | 2.42 | 203 | 1.10 | 105.5 |
| | | 3.0 | 2.31 | 161 | 1.03 | 78.5 |
| Dribble | 80 | 0 | 2.00 | 151 | 1.00 | 71.9 |
| | | 1.5 | 1.83 | 148 | 0.95 | 66.3 |
| | | 3.0 | 1.47 | 107 | 0.95 | 48.5 |
| | 120 | 0 | 2.16 | 168 | 1.04 | 81.8 |
| | | 1.5 | 2.33 | 163 | 1.03 | 79.7 |
| | | 3.0 | 1.89 | 135 | 0.91 | 58.4 |
| | 160 | 0 | 2.15 | 163 | 1.00 | 77.2 |
| | | 1.5 | 2.31 | 176 | 1.05 | 87.1 |
| | | 3.0 | 1.64 | 112 | 0.88 | 47.1 |
| Control | 0 | 0 | 1.43 | 86 | 0.92 | 37.1 |
| <u>Main Effect Means</u> | | | | | | |
| Application method | | | | | | |
| Broadcast | | | 1.98 | 148 | 1.00 | 71.1 |
| Dribble | | | 1.85 | 131 | 0.96 | 60.5 |
| $LSD_{05}$ | | | 0.10 | 9 | 0.03 | 4.5 |
| N rate | | | | | | |
| 0 lb/a | | | 1.43 | 86 | 0.92 | 37.1 |
| 80 | | | 1.89 | 145 | 0.97 | 66.3 |
| 120 | | | 2.12 | 160 | 1.01 | 76.6 |
| 160 | | | 2.21 | 167 | 1.04 | 83.1 |
| $LSD_{05}$ | | | 0.14 | 12 | 0.04 | 6.4 |
| DCD rate | | | | | | |
| 0 % | | | 2.01 | 146 | 1.02 | 71.4 |
| 1.5 | | | 1.97 | 148 | 0.99 | 70.8 |
| 3.0 | | | 1.76 | 124 | 0.93 | 55.1 |
| $LSD_{05}$ | | | 0.11 | 6 | 0.03 | 3.5 |

# EFFICACY OF SELECTED INSECTICIDES AGAINST SECOND GENERATION EUROPEAN CORN BORER, 1992

*by*

*Gary Dick, Lisa Wildman, Larry Buschman, and Phil Sloderbeck*

## SUMMARY

European corn borers averaged about 0.4 larvae per plant in the untreated check. Statistically significant reductions in numbers of corn borers orrurred with Furadan and Karate, whereas reductions with the Penncap-M treatments were variable. No useful observations could be made on Southwestern corn borers or spider mites. The first generation of European corn borer reached a peak of 49 moths per night on 9 May, and the second generation peaked at 114 moths per night on 6 Aug. The Southwestern corn borer moths were uncommon but seemed to peak at 5 per night on 7 Aug.

## PROCEDURES

Field corn, DPG4673B, was planted on 25 May at a rate of 30,000 seeds per acre in a furrow-irrigated field (Finnup #11) 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 (10ft.) wide and 50 ft. long with a 2-row border of untreated corn on each side and a 10-ft alley at each end.

Simulated chemigation applications of insecticides were made using three Delavan 100/140, 3/4 in., raindrop nozzles mounted on a high clearance sprayer at tassel height between rows. This system was calibrated to deliver the equivalent of a 0.2 in. irrigation on the two center rows (5227 gal/A). Standard insecticide treatments were applied with a high clearance sprayer using a 10-ft. boom with three nozzles directed at each row (one nozzle directly over the row and one each side of the row on 18-in. drop hoses) and calibrated to deliver 20 gal/A at 2.4 mph and 30 psi.

The corn borer treatments were made on 4 and 5 August. Treatment timing was based on the Kansas State University European Corn Borer model, which predicted 25-50 % oviposition to occur between 28 July and 5 August. Corn borer moth flight was also monitored using a black light trap.

Natural infestations of spider mites and corn borers were monitored. From September 17-22, 15 plants per plot were dissected to determine the number of corn borer larvae and length of tunneling. Grain yield was determined by hand harvesting 40 row ft per plot and correcting to 15% moisture.

## RESULTS AND DISCUSSION

European corn borer numbers were relatively low, 5.5 larvae per 15 plants, but statistically significant differences occurred among the treatments (Table 1). Furadan and Karate appeared to give good control, but control with Penncap-M treatments was variable. European corn borer numbers were surprisingly low in the Comite treatment (Comite is a miticide). Five Southwestern corn borers were found in 720 plants. Stalk and ear tunneling was low and did not differ significantly among treatments. Grain yields were good; however, they did not differ significantly among treatments. Spider mite populations collapsed soon after treatments were applied because of extended wet, cool weather conditions. These data need to be combined with data from other trials before making conclusions about efficacy.

The first generation of European corn borer reached a peak of 49 moths per night on 9 May, and the second generation moths peaked at 114 per night on 6 Aug. (Fig. 1). Southwestern corn borer moths were uncommon, but second generation moths peaked at 5/night on 7 Aug. (Fig. 2). Application of the corn borer treatments on 4 and 5 August may have been a little early, because the European corn borer flight peaked a few days later.

**Table 1. Efficacy of standard and simulated chemigation applications of insecticides for second generation corn borer control, Southwest Research-Extension Center, 1992.**

| | | | Average per 15 Plants | | | | |
|---|---|---|---|---|---|---|---|
| | | Rate | # | % | Stalk Tunneling | Ear Tunneling | Grain |
| Treatment | Formulation | lb a.i./a[1,2] | Larvae[3] | Control | cm | cm bu/a | Yield |
| Checks | | | | | | | |
| Untreated | - | - | 5.5 ab | - | 25.9 | 16.1 | 1 |
| Comite | 6.55 EC | 2.45 | 2.0 c | 63 | 6.5 | 10.1 | 1 |
| Simulated Chemication (5227 gal/a) | | | | | | | |
| MVP | - | 2 qt. | 3.8 abc | 30 | 16.4 | 18.6 | 187.6 |
| MYX 8018 | - | 2 qt. | 6.3 a | -14 | 37.5 | 21.3 | 202.0 |
| Standard Application (20 gal/a) | | | | | | | |
| Furadan | 4F | 1.00 | 1.3 c | 76 | 12.6 | 5.5 | 204.5 |
| Karate | 1E | 0.015 | 1.0 c | 81 | 13.9 | 0.0 | 207.9 |
| Karate | 1E | 0.025 | 1.3 c | 76 | 6.4 | 8.9 | 211.7 |
| Penncap-M | 2FM | 0.5 | 1.8 c | 67 | 18.6 | 8.9 | 183.4 |
| Penncap-M | 2FM | 0.75 | 3.5 abc | 36 | 21.6 | 14.4 | 192.2 |
| Penncap-M | 2FM | 1.00 | 3.0 bc | 45 | 14.3 | 10.3 | 204.8 |
| Penncap-M | 2FM | 0.5 + 0.5 | 3.8 abc | 31 | 13.1 | 11.0 | 202.3 |
| Penncap-M | 2FM | 0.25 + 0.5 | 2.3 c | 58 | 13.5 | 4.1 | 209.6 |
| F-Test Prob. | | | 0.9% | 29% | 40% | 29% | |
| Experiment C>V. | | | 68% | 92% | 108% | 7.7% | |

[1] Treatments were applied on 4 & 5 August 1992

[2] Except for MVP & MYX8018, which are listed in quarts/a

[3] 4th & 5th instar European corn borer larvae

Figure 1. Black light trap catches of European corn borer moths at the Southwest Research-Extension Center; corn borer treatments made on 4&5 Aug. 1992.

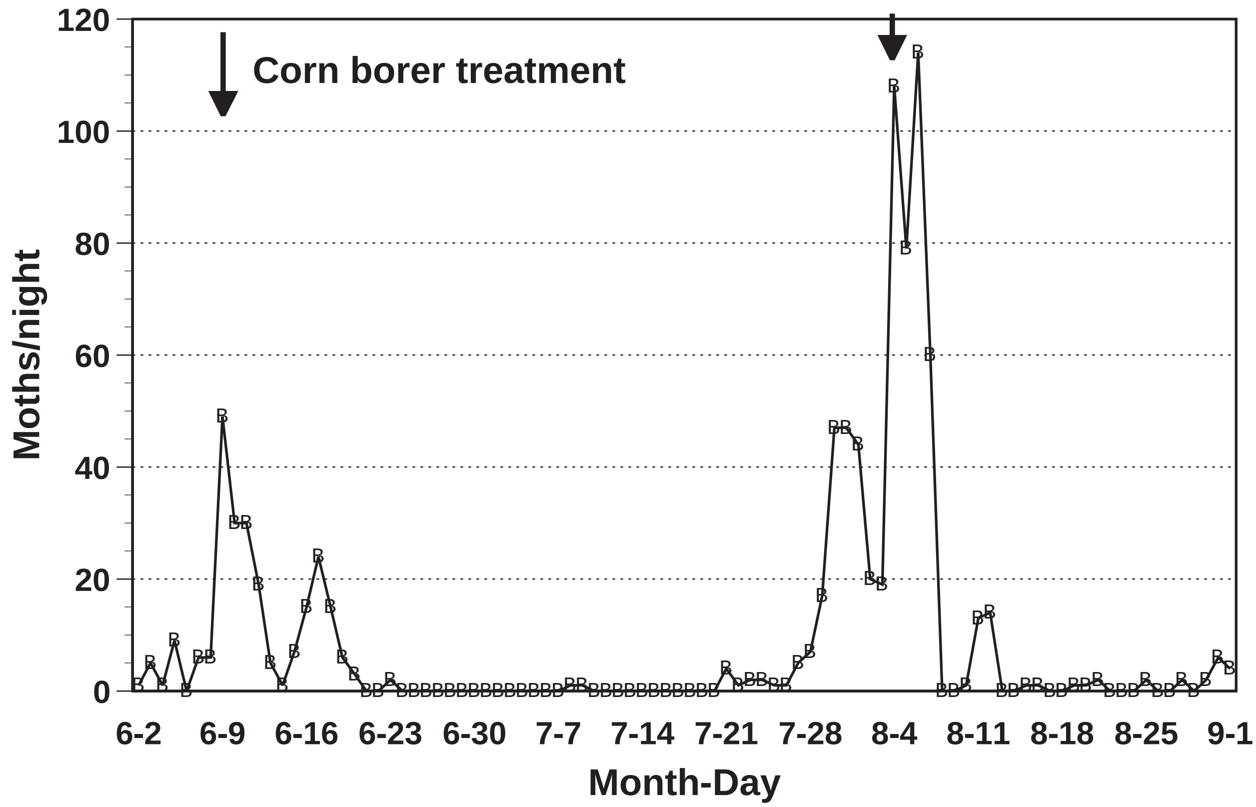
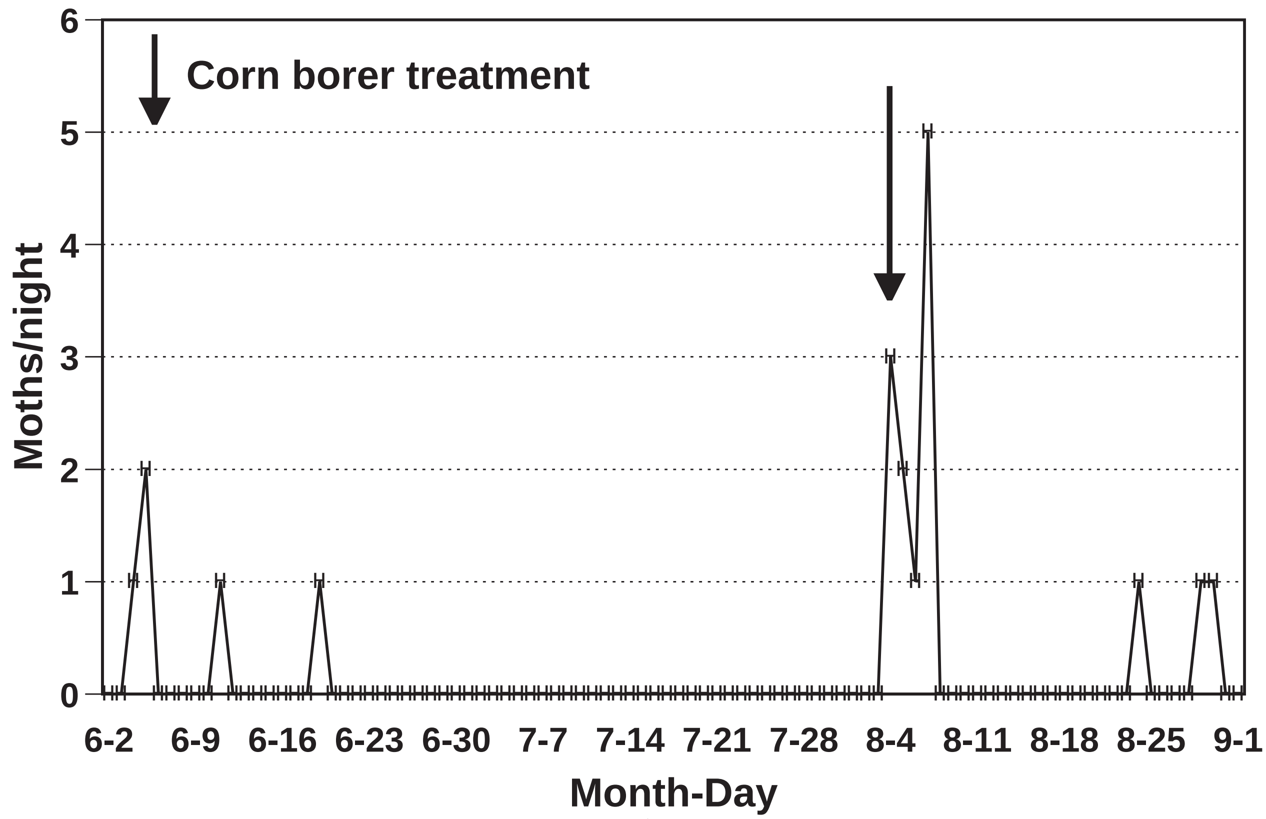



Figure 2. Black light trap catches of Southwestern corn borer moths at the Southwest Research-Extension Center; corn borer treatments made on 4&5 Aug. 1992.



# EFFICACY OF CORN ROOTWORM INSECTICIDES: PLANTING VERSUS POSTPLANTING APPLICATIONS

*by*

*Gary Dick, Lisa Wildman, Phil Sloderbeck, and Larry Buschman*

## SUMMARY

Planting time applications of Counter and Dyfonate II significantly reduced corn rootworm damage ratings. The damage ratings for treatments with lower rates or those applied at cultivation and postcultivation were not reduced significantly.

## PROCEDURES

Field corn, Pioneer 3162, was planted on 1 May 1992 at a rate of 31,000 seeds/a in a furrow-irrigated field (Finnup #3) at the Southwest Research-Extension Center, Finney County, Kansas. Preplant herbicide, Dual, was applied at the rate of 2.25 pt/a and incorporated. The plots, 4 rows by 50 ft, were arranged in a randomized complete block design, replicated 4 times. The insecticide rates, application times, and application methods for the 10 treatments are listed in Table 1. Planting treatments were applied as a 7" band over the open seed furrow (T-band) with planter-mounted granule applicators. Cultivation treatments were applied as 7" bands over the row or broadcast over the plots with a manual Gandy box apparatus prior to cultivation. The plots were cultivated on 24 and 25 June 1992. Postcultivation broadcast treatments were applied using a manual Gandy box apparatus, 7 days after cultivation. These plots were then watered using simulated irrigation (0.2") for incorporation.

Rootworm damage was rated on four plants/plot on 17 July 1992 using the 6 point Iowa scale. The regeneration of these roots was also rated using a 3-point scale, 1=no or little regeneration; 2=some regeneration; 3=good regeneration. Plant lodging from corn rootworm damage was determined by pushing 100 plants over and recording the number of plants that did not return to the upright position. Grain yield was determined by hand harvesting a 40 row ft/plot.

## RESULTS

Rootworm damage ratings differed significantly among treatments (Table 2). Damage was significantly reduced for several treatments that included planting time applications, Counter (treatment #9) and Dyfonate II (treatments #2 and #4). All the treatments with planting time applications of Dyfonate II had somewhat lower damage ratings, but they did not all differ significantly from the untreated check. The low banded rate (treatment #5) and the two broadcast treatments at cultivation and at postcultivation (treatments #7 and #8) had high damage ratings and were clearly not effective in controlling corn rootworm damage. Of the double applications, only the banded application at cultivation (treatment #2) might have improved on the planting time application, but this improvement was not statistically significant

The lodging ratings differed significantly among treatments (Table 2). The trends listed above are generally similar for lodging ratings, except that the lowest lodging was observed in treatment #3. All treatments with planting time applications of Dyfonate II or Counter had lodging ratings significantly lower than that of the untreated check. The low rate cultivation and the postcultivation treatments did not differ significantly from the untreated check.

Root regrowth and grain yield did not differ significantly among treatments. Rootworm damage above 3.0 is usually associated with significant yield reductions. However, the favorable growing conditions in 1992 apparently allowed the plants to recover from the damage.

| Table 1. Insecticide application rates, time of application, and methods of application for the 10 treatments in test. | | | |
|---|---|---|---|
| Insecticide | Rate | Application | |
| | | Time | Method |
| 1 Dyfonate II | 1.2 oz ai/1000 ft | At Planting (AP) | T-Band (TB) |
| 2 Dyfonate II | 1.2 oz ai/1000 ft | AP | TB |
| Dyfonate II | 1.2 oz ai/1000 ft | Cultivation (C) | Banded (B) |
| 3 Dyfonate II | 1.2 oz ai/1000 ft | AP | TB |
| Dyfonate II | 1 lb ai/a | C | Broadcast & cultivated (BC&C) |
| 4 Dyfonate II | 1.2 oz ai/1000 | AP | TB |
| Dyfonate II | 1 lb ai/a | Post-cult. (PC) | BC & watered (BC&W) |
| 5 Dyfonate II | .75 lb ai/a | C | B |
| 6 Dyfonate II | 1.2 oz ai/1000 ft | C | B |
| 7 Dyfonate II | 1 lb ai/a | C | BC&C |
| 8 Dyfonate II | 1 lb ai/a | PC | BC&W |
| 9 Counter | 1.2 oz ai/a | AP | TB |
| 10 Untreated Check | - - | - | |

**Figure 1. Rootworm damage ratings and percent plants lodged for corn rootworm treatments applied at planting, cultivation, and postcultivation**

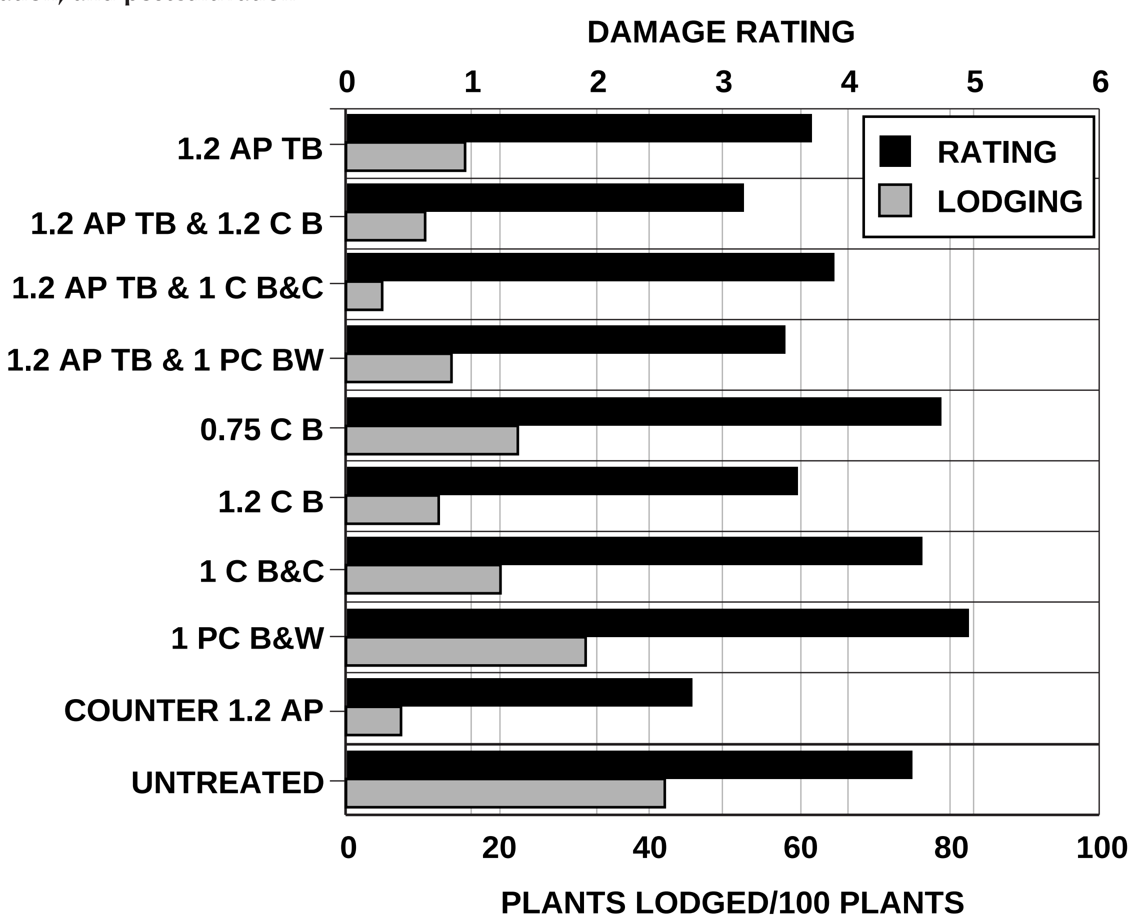


**Table 2. Treatment means for rootworm rating, rootworm lodging, plant regrowth, and grain yield , Garden City, Kansas.**

| Treatment | Rating | Lodging | Regrowth | Yield |
|---|---|---|---|---|
| 1) AP TB | 3.7 cde | 15.8 bc | 1.91 | 199.1 |
| 2) AP TB+C B | 3.16 ef | 10.5 bc | 1.75 | 212.8 |
| 3) AP TB+C BC&C | 3.88 bcde | 4.8 c | 1.34 | 212.6 |
| 4) AP TB+PC BC&W | 3.49 ef | 14.0 bc | 1.38 | 221.2 |
| 5) .75 C B | 4.73 ab | 22.8 abc | 2.25 | 190.5 |
| 6) 1.2 C B | 3.59 def | 12.3 bc | 1.58 | 204.2 |
| 7) C BC&C | 4.58 abc | 20.5 bc | 1.88 | 186.3 |
| 8) PC BC&W | 4.95 a | 31.8 ab | 1.75 | 185.4 |
| 9) Counter AP TB | 2.75 f | 7.3 c | - | 205.6 |
| 10) Untreated | 4.5 abcd | 42.3 a | 1.54 | 203.2 |
| ANOVA F-Test Probabilities | 0.01% | 0.95% | 40% | 7.0% |
| ANOVA C.V. | 15% | 72% | 24% | 8.2% |

[1] AP = At planting
TB = T-band
C = Cultivated
BC = Broadcast
B = Banded
W = Watered

# GREENBUG UPDATE

*by*
*Phil Sloderbeck and Leroy Brooks*

The greenbug continues to evolve and create more potential problems for Kansas sorghum and wheat producers. Although the greenbug did not turn out to be a serious pest during 1992, the populations that were present were found to contain significant levels of both pesticide-resistant greenbugs and the new biotype I greenbugs. The highest levels of both pesticide-resistant and biotype I greenbugs in Kansas occurred in the southwest, especially in Meade, Haskell and Seward Counties (refer to Tables 1 & 2 and Figures 1 and 3). Both of these problems continued to be reported throughout the High Plains region(Figures 2 and 4).

The biggest news during 1992 was the confirmation that some biotype I greenbugs also have the pesticide-resistance enzymes. Thus, some greenbugs are now present that are both pesticide-resistant and a threat to most sorghum varieties grown in the area.

**Table 1. Results of biotype testing on greenbugs from sorghum during 1992.**

| Location | # Samples Tested | # Positive for Biotype I |
|---|---|---|
| Kansas | 60 | 36 (60%) |
| SW Kansas | 31 | 24 (77%) |
| Rest of State | 29 | 12 (41%) |
| ME, HS, SW Counties | 15 | 15 (100%) |

## ACKNOWLEDGEMENTS:

Thanks to the following coworkers for providing the data used in this report: Gerald Wilde, Roxanne Shufran, Bob Bowling, Tom Harvey, and Pat Morrison and to all of the others who helped collect and process the samples.

## GREENBUG CONTROL CONSIDERATIONS

The major question is, what can or should be done after a control failure occurs? Remember that not all failures are necessarily the result of insecticide resistant greenbugs, and even within a specific field where resistance has been confirmed, the infestation is likely to be a mixture of both resistant and susceptible individuals. In some cases, repeating the application with a different product or at the maximum labeled rate achieved satisfactory results, but in other cases, control could not be achieved after reapplication. Based on past experience with insecticide resistance, you now have to assume that the current problem will persist and gradually spread over a larger area of the state. Once insecticide resistance develops, it tends to increase more or less proportionally to the amount of selection pressure that is applied through continued use of the same product(s). Ideally, if a choice were available, it would be best to avoid further use of the currently used insecticides in problem areas. Because this is not possible, we must try to limit use to the

**Table 2. Results of pesticide resistance testing on greenbugs from sorghum during 1992.**

| Location | # of Samples Tested | # Positive for Resistance | # of Greenbugs Tested | # with Pattern 1 | # with Pattern 2 |
|---|---|---|---|---|---|
| Kansas | 72 | 26 (36%) | 1512 | 108 (7%) | 137 (9%) |
| SW Kansas | 44 | 23 (52%) | 1068 | 98 (9%) | 136 (13%) |
| Rest of State | 28 | 3 (11%) | 444 | 10 (2%) | 1 (<1%) |
| ME, HS, SW Counties | 17 | 14 (82%) | 640 | 79 (12%) | 100 (16%) |

**Figure 1. Biotype determinations of greenbug collections from sorghum during 1992.**

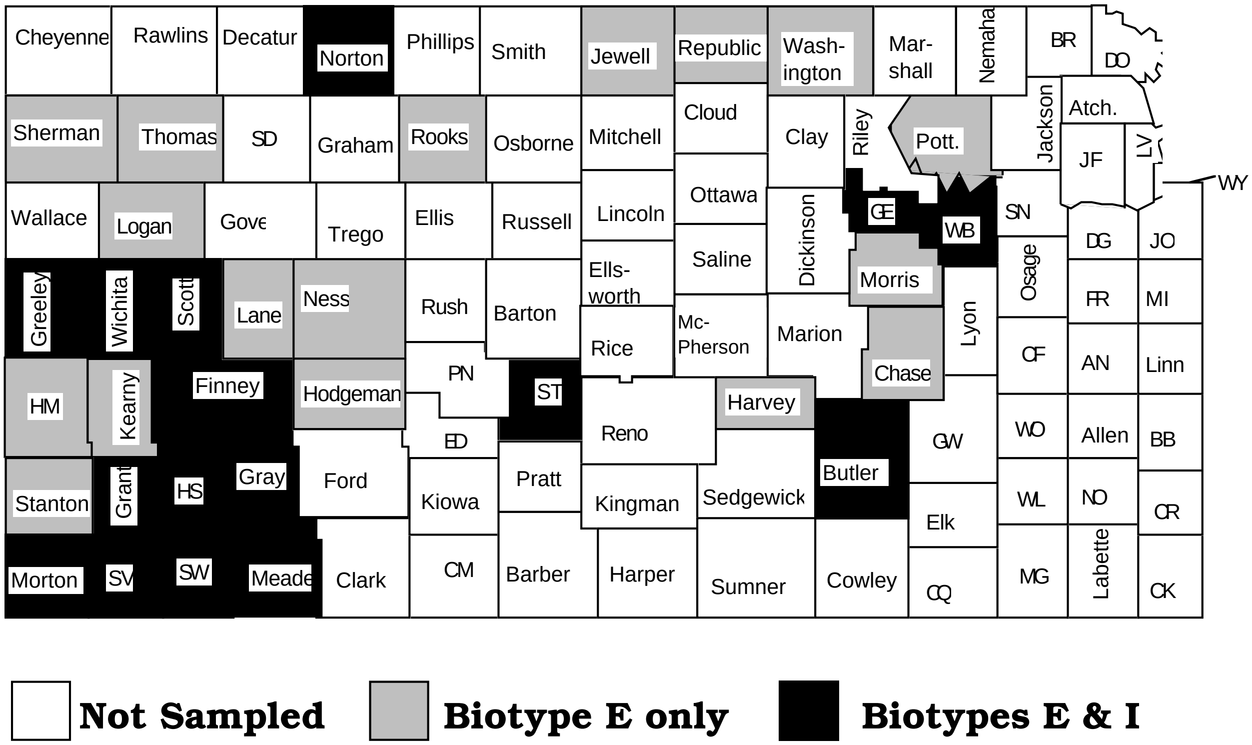
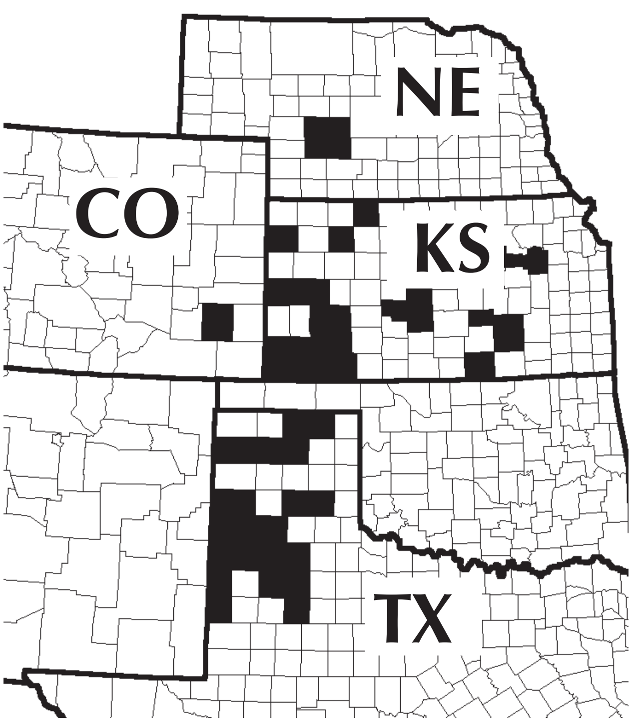



**Figure 2. Counties in which biotype I greenbugs were detected during 1991 or 1992.**




extent that is practical.

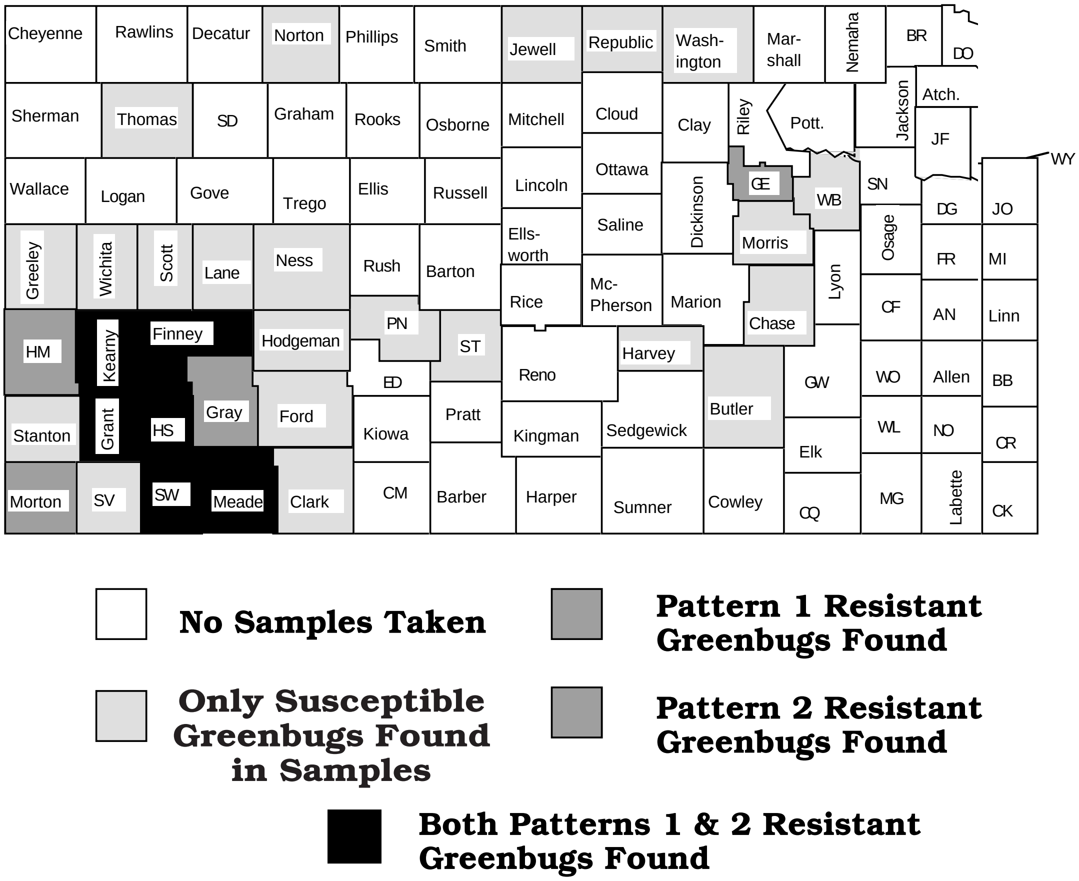
Every effort should be made to limit control attempts to those fields where the treatment guidelines have been met or exceeded and danger of serious crop losses exists unless the greenbug population can be reduced. There is no choice but to begin to settle for a lower degree of control. In many cases, it is now impossible to achieve the high degree of control that producers once took for granted. Continuing to try to achieve a high level of reduction is likely to result only in the elimination of the susceptible individuals, leaving the resistant ones free to survive, reproduce, and expand.

In many situations, the most that one can now accomplish is to lower the infestation pressure until either weather or other natural factors intervene.

## NONCHEMICAL ALTERNATIVES

1. Use of resistant hybrids is an important tool in greenbug management. Even though these hybrids support greenbugs, they suffer less damage at a similar level of infestation, and where infestations are not heavy, the need for control is reduced. The biotype E sorghum hybrids should still be useful in many areas of the state, but their effectiveness will lessen as

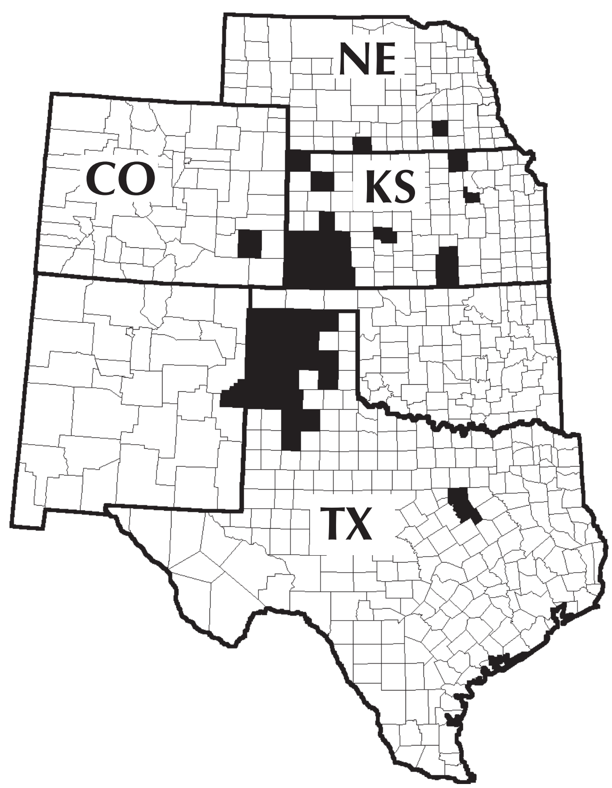
**Figure 3. Results of pesticide resistance enzyme tests from sorghum during 1992.**




biotype I greenbugs become more prevalent. Currently, only two hybrids with biotype I resistance are known , Cargill 607E and 797. Be aware that from a long-term point of view, overuse (that is planting most of the acreage in any one area to resistant hybrids) could speed the development of new biotypes — strains capable of overcoming the resistance contained in current hybrids. Thus, it is probably better in the long run for a grower to use a variety of hybrids with different sources of resistance than to plant all of his acreage to one or two hybrids of similar parentage.

2. Planting dates. Though much discussed, it's difficult to consistently avoid greenbugs by manipulation of planting dates. Historically, the risk of encountering early-season infestations has been greater with both very early and very late planting dates. You can usually expect to see a decline in greenbug flight activity for several days to a few weeks beginning at the onset of wheat maturity. Use of date of planting is probably more helpful in reducing the risk of seedling problems than in avoiding infestations that occur later in the season. In the fall, delaying wheat planting will lessen the likelihood of greenbugs making the switch from sorghum to wheat

**Figure 4. Counties in which pesticide-resistant greenbugs were detected during 1991 and 1992.**



and, thus, should lessen the chance of greenbugs surviving the winter.

3. Some research suggests that the risk of greenbug infestation can be reduced by practicing reduced-till or no-till planting. Repeated observations have indicated that greenbugs in flight appear to land more frequently in bare (little vegetative cover) fields. The benefits might be increased by combining host plant resistance with reduced tillage. This is supported by some USDA research.

4. Utilize natural populations of beneficial insects wherever possible. Lady beetles are important in controlling light, beginning greenbug infestations. Parasitic wasps are usually extremely effective, once they become established, particularly later in the season. However, importing and releasing lady beetles and other beneficial insects to control existing greenbug populations has not met with experimental success and is not presently encouraged. Such an outlook could change if practical mass-rearing techniques could be developed to allow for large-scale releases over wide areas. Seek additional information if confronted by sales people seeking to market biological approaches to greenbug control.

# COMPARISON OF POST-EMERGENCE TANK MIXES WITH EXPERIMENTAL AND COMMERCIALLY AVAILABLE PREPLANT INCORPORATED TANK MIXES FOR WEED CONTROL IN SOYBEANS

*by*
*Randall Currie*


## SUMMARY

Most products and combinations tested provided good to excellent control of kochia, pigweed, shattercane, buffalo bur, yellow foxtail, and devil's claw. Signigicant crop injury was seen with Sencor.


## INTRODUCTION

Introduced over 30 years ago, trifluralin (the active ingredient in Treflan) still provides a significant backbone in many soybean weed control programs. At present, a dozen or more pre-emergence and an equal diversity of postemergence products and numerous combinations of products are labeled or may soon be labeled for weed control in soybeans. Several postemergence combinations, experimental compounds, and trifluralin formulations were compared in this test.

## PROCEDURES

Preplant incorporated (PPI) herbicide treatments were applied on 5/19/92 as described in Table 1. Soybeans were planted 2 days later into an excellent seedbed as described in Table 2. Post- emergence (PE) treatments were applied on 6/25/92 as described in Table 3. Weed control of each species present was determined by counting the number of a given species per unit area and calculating the percent reduction in weed number by dividing the number of a given species in the untreated control into the number in the treated area subtracting them from 1 and multiplying the result by 100.

**Table 1. Application information for preplant treatments, general soybean test, 1992**

| | |
|---|---|
| Application Date: | 5/19/92 |
| Time of Day: | 3:30 - 4:20 PM |
| Application Method: | Tractor Sprayer - Shielded |
| Application Timing: | PPI |
| Air Temp: | 80° |
| Wind Velocity, Unit: | S - 10MPH |
| Dew Presence (Y/N): | N |
| Soil Temp., Unit: | 73° |
| Soil Moisture: | Dry Surface |
| % Cloud Cover: | 0 |
| Appl. Equipment: | Tractor Sprayer - Shielded |
| Pressure, Unit: | 30 PSI |
| Nozzle Type: | XR FF |
| Nozzle Size: | 8004 |
| Nozzle Spacing, Unit: | 20″ |
| Nozzles/Row: | Broadcast |
| Boom Length, Unit: | 10′ |
| Boom Height, Unit: | 19″ |
| Ground Speed, Unit: | 4 MPH |
| Incorporation Equip: | Lilliston - twice |
| Hours to Incorp.: | .5 |
| Incorp. Depth, Unit: | 2″ |
| Carrier: | $H_2O$ |
| Spray volume, Unit: | 17 GPA |
| Propellant: | $CO_2$ |

**Table 2. Planting information for general soybean test, 1992**

| | |
|---|---|
| Crop: | Soybeans |
| Planting Date: | 5/21/92 |
| Planting Method: | JD Max Emerge II |
| Depth, Unit: | 1 1/2 " |
| Row Spacing, Unit: | 30" rows - 60" bed |
| Soil Temp., Unit: | 72° |
| Soil Moisture: | Dry surface, moist below |

**Table 3. Application information for postemergence treatments, general soybean test, 1992**

| | |
|---|---|
| Application Date: | 6/25/92 |
| Time of Day: | 1:45 - 2:00 PM |
| Application Method: | Hand boom - walking |
| Application Timing: | Post Emerge |
| Air Temp: | 80° |
| Wind Velocity, Unit: | n - 5 MPH |
| Dew Presence (Y/N): | N |
| Soil Temp., Unit: | 75° |
| Soil Moisture: | Very wet |
| % Cloud Cover: | 80 |
| | |
| Appl. Equipment: | Hand boom - walking |
| Pressure, Unit: | 30 PSI |
| Nozzle Type: | XR FF |
| Nozzle Size: | 8004 |
| Nozzle Spacing, Unit: | 20" |
| Nozzles/Row: | Broadcast |
| Boom Length, Unit: | 10' |
| Boom Height, Unit: | 19" |
| Ground Speed, Unit: | 4 MPH |
| Carrier: | $H_2O$ |
| Spray volume, Unit: | 17 GPA |
| Propellant: | $CO_2$ |

## RESULTS AND DISCUSSION

Many treatments provided commercially acceptable control of kochia, but Treatments 2,4,5,7 and 14 did not (Table 4). The excellent grass control in these treatments may have removed grass competition from the kochia and allowed it to do well later in the season.

Only Treatments 8 and 14 failed to provide pigweed control equal to that of the best treatments (Table 5). The experimental compounds used in Treatment 8 needed the assistance provided by Command (Treatment 9) or trifluralin (Treatment 10) to provide excellent weed control. Although Treatment 10 provided excellent early-season control of pigweed, it also caused severe injury in the soybeans. This resulted in reduced crop canopy, which impaired the soybeans' ability to compete well with late emerging pigweed.

All compounds provided excellent shattercane control, with the exception of Treatments 8 and 9 (Table 6). Apparently, the experimental compound needs to be used with a grass control product under conditions of severe shattercane pressure.

Treatments 2-9 provided excellent control of buffalo bur (Table 7). Although Treatments 10, 11, and 12 appeared to provide statistically significant buffalo bur control, this is unusual. In general, the other trifluralin treatments are more representative of the typical performance against buffalo bur.

With the exception of Treatments 4 and 8, all treatments provided excellent yellow foxtail control (Table 8). As seen in shattercane evaluation, the experimental compound in Treatment 8 was also weak on foxtail.

All treatments provided some devil's claw control (Table 9). It is somewhat unusual to see commercially acceptable devil's claw control with trifluralin; therefore, Treatments 12 and 14 should be considered typical and Treatment 13 somewhat atypical.

No significant injury was caused by any treatment, with the exception of Treatment 14. It is not unusual for Sencor to injure soybeans in the high pH soils of this region as was clearly seen in that treatment.

Such injury also reduces the competitiveness of crops, and without exception, the Sencor injury diminished control of all weed species.

**Table 4. Kochia % control in soybeans**

| Trt # | Treatment | Rate lbs ai/a | Application Time | 6/18/92 DAP 28 DAPPI 30 | 7/2/92 DAPT7 DAP 42 DAPPI 44 | 7/21/92 DAPT 26 DAP 61 DAPPI 63 | 8/21/92 DAPT 57 DAP 92 DAPPI 94 |
|---|---|---|---|---|---|---|---|
| 1 | CHECK | | | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | Classic + Pinnacle + Fusion | .0039 +.75 +.125 | PE | 63.3 | 65.1 | 90.8 | 51.3 |
| 3 | Blazer + Basagran + Fusion | .375 + .75 + .125 | PE | 43.3 | 99.5 | 97.4 | 81.3 |
| 4 | Pursuit + Fusion | .0625 +.125 | PE | 13.3 | 69.9 | 92.8 | 58.8 |
| 5 | Classic + Pinnacle + Fusion | .0039+ .0039 + .166 | PE | -16.7 | -110.9 | 78.6 | 42.5 |
| 6 | Blazer + Basagran + Fusion | 0.375 +.75 + .166 | PE | -93.3 | 49.0 | 90.3 | 63.8 |
| 7 | Pursuit + Fusion | .0625 +.166 | PE | 20.0 | -7.4 | 93.0 | 60.0 |
| 8 | F 6285 | 0.375 | PPI | 100.0 | 99.4 | 98.1 | 83.8 |
| 9 | F 6285 + Command | .375 + .5 | PPI | 100.0 | 100.0 | 100.0 | 95.8 |
| 10 | F 6285 + Treflan | .375 + .6 | PPI | 66.7 | 75.0 | 100.0 | 99.5 |
| 11 | Trific 60 DF | 1 | PPI | 93.3 | 95.6 | 95.5 | 75.0 |
| 12 | Treflan 4 EC | 1 | PPI | 100.0 | 73.7 | 98.4 | 76.3 |
| 13 | Trifluralin 4 EC | 1 | PPI | 100.0 | 99.6 | 99.3 | 91.3 |
| 14 | Trific 60 DF + Sencor | 1. + .25 | PPI | 73.3 | 97.0 | 95.9 | 63.8 |
| | LSD | | | 30.4 | 55.6 | 10.0 | 30.4 |

DAP= Days after planting
DAPPI= Days after pre plant inc TRT
DAPT= Days after post TRT

**Table 5. Pigweed % control in soybeans**

| Trt # | Treatment | Rate lbs ai/a | Application Time | 6/18/92 DAP 28 DAPPI 30 | 7/2/92 DAPT 7 DAP 42 DAPPI 44 | 7/21/92 DAPT 26 DAP 61 DAPPI 63 | 8/21/92 DAPT 57 DAP 92 DAPPI 94 |
|---|---|---|---|---|---|---|---|
| 1 | CHECK | | | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | Classic + Pinnacle + Fusion | .0039 +.75 +.125 | PE | 43.8 | 100.0 | 100.0 | 98.3 |
| 3 | Blazer + Basagran + Fusion | 0.375 + .75 + .125 | PE | 46.2 | 100.0 | 99.9 | 98.3 |
| 4 | Pursuit + Fusion | .0625 +.125 | PE | -18.8 | 87.5 | 99.2 | 97.5 |
| 5 | Classic + Pinnacle + Fusion | .0039+ .0039 + .166 | PE | 10.0 | 100.0 | 100.0 | 98.8 |
| 6 | Blazer + Basagran + Fusion | 0.375 +.75 + .166 | PE | 26.2 | 100.0 | 99.9 | 100.0 |
| 7 | Pursuit + Fusion | .0625 +.166 | PE | -21.3 | 100.0 | 100.0 | 99.0 |
| 8 | F 6285 | 0.375 | PPI | 100.0 | 85.9 | 99.0 | 73.8 |
| 9 | F 6285 + Command | 0.375 + .5 | PPI | 100.0 | -12.6 | 88.5 | 95.8 |
| 10 | F 6285 + Treflan | 0.375 + .6 | PPI | 100.0 | 87.5 | 100.0 | 99.5 |
| 11 | Trific 60 DF | 1 | PPI | 100.0 | 98.5 | 98.0 | 78.8 |
| 12 | Treflan 4 EC | 1 | PPI | 100.0 | 87.3 | 99.9 | 83.0 |
| 13 | Trifluralin 4 EC | 1 | PPI | 100.0 | 99.2 | 98.2 | 91.3 |
| 14 | Trific 60 DF + Sencor | 1 + .25 | PPI | 95.0 | 83.9 | 92.9 | 71.3 |
| | LSD | | | 78.7 | 84.2 | 5.0 | 22.6 |

DAP= Days after planting
DAPPI= Days after pre plant inc TRT

**Table 6. Shattercane % control in soybeans**

| Trt # | Treatment | Rate lbs ai/a | Application Time | 7/2/92 DAPT 7 DAP 42 DAPPI 44 | 7/21/92 DAPT 26 DAP 61 DAPPI 63 | 8/21/92 DAPT 5 DAP 92 DAPPI 94 |
|---|---|---|---|---|---|---|
| 1 | CHECK | | | 0.0 | 0.0 | 0.0 |
| 2 | Classic + Pinnacle + Fusion | .0039 +.75 +.125 | PE | 100.0 | 100.0 | 100.0 |
| 3 | Blazer + Basagran + Fusion | .375 + .75 + .125 | PE | 100.0 | 99.5 | 98.3 |
| 4 | Pursuit + Fusion | .0625 + 125 | PE | 100.0 | 98.8 | 100.0 |
| 5 | Classic + Pinnacle + Fusion | .0039+ .0039 + .166 | PE | 100.0 | 100.0 | 100.0 |
| 6 | Blazer + Basagran + Fusion | 0.375 +.75 + .166 | PE | 100.0 | 100.0 | 100.0 |
| 7 | Pursuit + Fusion | .0625 +.166 | PE | 100.0 | 100.0 | 99.5 |
| 8 | F 6285 | 0.375 | PPI | 48.0 | 83.5 | 50.0 |
| 9 | F 6285 + Command | .375 + .5 | PPI | -207.5 | 20.6 | 27.5 |
| 10 | F 6285 + Treflan | .375 + .6 | PPI | 87.5 | 92.5 | 92.0 |
| 11 | Trific 60 DF | 1 | PPI | 97.3 | 96.9 | 95.0 |
| 12 | Treflan 4 EC | 1 | PPI | 100.0 | 97.3 | 100.0 |
| 13 | Trifluralin 4 EC | 1 | PPI | 98.7 | 95.3 | 87.5 |
| 14 | Trific 60 DF + Sencor | 1. + .25 | PPI | 95.3 | 95.3 | 89.5 |
| | LSD | | | 214.1 | 24.9 | 22.8 |

DAP= Days after planting
DAPPI= Days after pre plant inc TRT
DAPT= Days after post TRT

**Table 7. Buffalo burr % control in soybeans**

| Trt | Treatment | Rate lbs ai/a | Application Time | 7/2/92 DAPT 7 DAP 42 DAPPI 44 | 7/21/92 DAPT26 DAP 61 DAPPI 63 | 8/21/92 DAPT57 DAP 92 DAPPI94 |
|---|---|---|---|---|---|---|
| 1 | CHECK | | | 0.0 | 0.0 | 0.0 |
| 2 | Classic + Pinnacle + Fusion | .0039 +.75 +.125 | PE | 100.0 | 99.7 | 100.0 |
| 3 | Blazer + Basagran + Fusion | .375 + .75 + .125 | PE | 100.0 | 100.0 | 100.0 |
| 4 | Pursuit + Fusion | .0625 +.125 | PE | 100.0 | 62.7 | 100.0 |
| 5 | Classic + Pinnacle + Fusion | .0039+ .0039 + .166 | PE | 98.7 | 100.0 | 100.0 |
| 6 | Blazer + Basagran + Fusion | 0.375 +.75 + .166 | PE | 100.0 | 100.0 | 100.0 |
| 7 | Pursuit + Fusion | .0625 +.166 | PE | 98.8 | 75.8 | 99.0 |
| 8 | F 6285 | 0.375 | PPI | 66.1 | 100.0 | 97.5 |
| 9 | F 6285 + Command | .375 + .5 | PPI | 98.9 | 100.0 | 97.5 |
| 10 | F 6285 + Treflan | .375 + .6 | PPI | 0.0 | 100.0 | 74.0 |
| 11 | Trific 60 DF | 1 | PPI | 0.0 | 77.8 | 60.0 |
| 12 | Treflan 4 EC | 1 | PPI | 0.0 | 99.5 | 67.5 |
| 13 | Trifluralin 4 EC | 1 | PPI | 99.2 | 88.9 | 75.8 |
| 14 | Trific 60 DF + Sencor | 1. + .25 | PPI | 92.3 | 11.1 | 53.8 |
| | LSD = 0.05 | | | 28.8 | 70.7 | 27.2 |

DAP= Days after planting
DAPPI= Days after pre plant inc TRT
DAPT= Days after post TRT

Table 8. Foxtail % control in soybeans.

| Trt # | Treatment | Rate lbs ai/a | Application Time | 6/18/92 DAPT 26 DAP 28 DAPPI 30 | 7/21/92 DAPT 57 DAP 61 DAPPI 63 | 8/21/92 DAP 92 DAPPI 94 |
|---|---|---|---|---|---|---|
| 1 | CHECK | | | 0.0 | 0.0 | 0.0 |
| 2 | Classic + Pinnacle + Fusion | .0039 +.75 +.125 | PE | 10.0 | 89.6 | 95.8 |
| 3 | Blazer + Basagran + Fusion | .375 + .75 + .125 | PE | 7.5 | 74.3 | 94.5 |
| 4 | Pursuit + Fusion | .0625 +.125 | PE | 0.0 | 92.5 | 92.5 |
| 5 | Classic + Pinnacle + Fusion | .0039+ .0039 + .166 | PE | 0.0 | 86.4 | 97.0 |
| 6 | Blazer + Basagran + Fusion | 0.375 +.75 + .166 | PE | 0.0 | 71.1 | 93.8 |
| 7 | Pursuit + Fusion | .0625 +.166 | PE | 0.0 | 89.5 | 97.0 |
| 8 | F 6285 | 0.375 | PPI | 0.0 | 64.9 | 56.3 |
| 9 | F 6285 + Command | .375 + .5 | PPI | 65.0 | 86.8 | 85.8 |
| 10 | F 6285 + Treflan | .375 + .6 | PPI | 100.0 | 99.0 | 98.5 |
| 11 | Trific 60 DF | 1 | PPI | 100.0 | 96.9 | 97.8 |
| 12 | Treflan 4 EC | 1 | PPI | 100.0 | 99.8 | 97.5 |
| 13 | Trifluralin 4 EC | 1 | PPI | 100.0 | 99.5 | 94.5 |
| 14 | Trific 60 DF + Sencor | 1. + .25 | PPI | 95.0 | 98.8 | 95.8 |
| | LSD = 0.05 | | | nsd | nsd | 14.4 |

DAP= Days after planting
DAPPI= Days after pre plant inc TRT
DAPT= Days after post TRT

Table 9. Devil's claw % control in soybeans

| Trt # | Treatment | Rate lbs ai/a | Application Time | 7/2/92 DAPT 7 DAP 42 DAPPI 44 | 7/21/92 DAPT 26 DAP 61 DAPPI 63 | 8/21/92 DAPT 57 DAP 92 DAPPI 94 |
|---|---|---|---|---|---|---|
| 1 | CHECK | | | 0.0 | 0.0 | 0.0 |
| 2 | Classic + Pinnacle + Fusion | .0039 +.75 +.125 | PE | 66.7 | 75.0 | 100.0 |
| 3 | Blazer + Basagran + Fusion | .375 + .75 + .125 | PE | 100.0 | 100.0 | 98.8 |
| 4 | Pursuit + Fusion | .0625 +.125 | PE | 100.0 | 100.0 | 100.0 |
| 5 | Classic + Pinnacle + Fusion | .0039+ .0039 + .166 | PE | 100.0 | 66.7 | 95.0 |
| 6 | Blazer + Basagran + Fusion | 0.375 +.75 + .166 | PE | 100.0 | 100.0 | 100.0 |
| 7 | Pursuit + Fusion | .0625 +.166 | PE | 100.0 | 100.0 | 99.5 |
| 8 | F 6285 | 0.375 | PPI | 100.0 | 100.0 | 100.0 |
| 9 | F 6285 + Command | .375 + .5 | PPI | 100.0 | 91.7 | 98.8 |
| 10 | F 6285 + Treflan | .375 + .6 | PPI | 66.7 | 83.3 | 99.5 |
| 11 | Trific 60 DF | 1 | PPI | 44.7 | 8.3 | 72.5 |
| 12 | Treflan 4 EC | 1 | PPI | - | - | 55.0 |
| 13 | Trifluralin 4 EC | 1 | PPI | 100.0 | 83.3 | 76.3 |
| 14 | Trific 60 DF + Sencor | 1. + .25 | PPI | 33.3 | 5.0 | 53.8 |
| | LSD = 0.05 | | | nsd | nsd | 31.0 |

DAP= Days after planting
DAPPI= Days after pre plant inc TRT
DAPT= Days after post TRT

**Table 10. Percent visual crop injury in soybeans**

| Trt # | Treatment | Rate lbs ai/a | Application Time | 7/2/92 DAPT 7 DAP 42 DAPPI 44 | 7/21/92 DAPT 26 DAP 61 DAPPI 63 |
|---|---|---|---|---|---|
| 1 | CHECK | | | 0.00 | 0.00 |
| 2 | Classic + Pinnacle + Fusion | .0039 +.75 +.125 | PE | 0.00 | 10.00 |
| 3 | Blazer + Basagran + Fusion | .375 + .75 + .125 | PE | 6.25 | 0.00 |
| 4 | Pursuit + Fusion | .0625 +.125 | PE | 1.25 | 2.50 |
| 5 | Classic + Pinnacle + Fusion | .0039+ .0039 + .166 | PE | 1.25 | 0.00 |
| 6 | Blazer + Basagran + Fusion | 0.375 +.75 + .166 | PE | 6.25 | 1.25 |
| 7 | Pursuit + Fusion | .0625 +.166 | PE | 1.25 | 0.00 |
| 8 | F 6285 | 0.375 | PPI | 13.75 | 2.50 |
| 9 | F 6285 + Command | .375 + .5 | PPI | 8.75 | 2.50 |
| 10 | F 6285 + Treflan | .375 + .6 | PPI | 21.25 | 10.00 |
| 11 | Trific 60 DF | 1 | PPI | 10.00 | 2.50 |
| 12 | Treflan 4 EC | 1 | PPI | 3.75 | 1.25 |
| 13 | Trifluralin 4 EC | 1 | PPI | 13.75 | 7.00 |
| 14 | Trific 60 DF + Sencor | 1. + .25 | PPI | 5.00 | 23.75 |
| | LSD = 0.05 | | | 11.91 | 16.97 |

DAP= Days after planting
DAPPI= Days after pre plant inc TRT
DAPT= Days after post TRT

# TIMING OF POSTEMERGENT APPLICATIONS OF BEACON AND/OR ACCENT FOR JOHNSONGRASS OR GRASSY SANDBUR CONTROL.

*by*
*Randall Currie*

SUMMARY

All treatments provided good control of sandbur at the second rating period. Percent sandbur control correlated well with corn yield. A 10% increase in control increased yield by 4.9 bu. All treatments also provided acceptable control of Johnsongrass. Overall yield of corn was poor, but a 1% reduction in Johnsongrass increased yield by 2.2 bu.

## INTRODUCTION

Early application of postemergence herbicides allows the targeting of smaller weeds but frequently misses later emerging weeds. A later application usually hits several flushes of weeds, but many weeds may be larger and harder to kill or may have already limited yield. Applying a split application of some herbicides early and a little more later entails greater application cost. Therefore, the objective of this study was to compare early post, post, late post, and early + late postemergence application of Beacon and/or Accent for control of Johnsongrass or grassy sandbur in corn.

## PROCEDURES

Two sites were selected, a sandy loam site with a past history of grassy sandbur, and a silt loam site with a heavy infestation of rhizome Johnson grass. Although both sites had modest infestations of other weed species, none except the target species were present at statistically significant levels.

Because the grassy sandbur area was difficult to irrigate and irrigation capacity was limited, no suplemental irrigation was planned. Therefore, the short-season corn variety, Pioneer 3737, was planted at 14,000 seed/a, as described in Table 1. From an excess of plots, only those plots with a final population of 10,000 plants/a were selected. The treatments were applied as described in Tables 2, 3 and 4.

**Table 1. Planting information - sandbur site**

| | |
|---|---|
| Crop: | Corn |
| Variety: | P3737 |
| Planting Date: | 4-14-92 |
| Planting Method: | JD Max Emerge II |
| Rate, Unit: | 14000 seed/a |
| Depth, Unit: | 1 1/2″ |
| Row Spacing, Unit: | 30″ |
| Soil Temperature, Unit | 55° |
| Soil Moisture: | Good |

**Table 2. Early postemergence application information for sandbur contol**

| | |
|---|---|
| Application Date: | 5-21-92 |
| Time of Day | 4:30-4:55 PM |
| Application Method: | Tractor sprayer - shielded |
| Application Timing: | Early post, 4-leaf corn |
| Air Temperature, Unit: | 80° |
| Wind Velocity, Unit: | S - 20 MPH |
| Dew Presence (Y/N): | N |
| Soil Temperature, Unit: | 73° |
| Soil Moisture: | Dry |
| % Cloud Cover: | 30% |
| Pressure, Unit: | 30# PSI |
| Nozzle Type: | XR FF |
| Nozzle Size: | 8004 |
| Nozzle Spacing, Unit: | 20″ |
| Nozzles/Row: | Broadcast |
| Boom Length, Unit: | 10′ |
| Boom Height, Unit: | 19″ |
| Ground Speed, Unit: | 4 MPH |
| Carrier: | $H_20$ |
| Spray Volume, Unit: | 17 GPA |
| Propellant: | $CO_2$ |

**Table 3. Postemergence application information for sandbur control.**

| | |
|---|---|
| Application Date: | 6-2-92 |
| Time of Day | 10:30 - 11:00 AM |
| Application Method: | Backpack sprayer |
| Application Timing: | Post, 6-to 7- leaf corn |
| Air Temperature, Unit: | 59° |
| Wind Velocity, Unit: | N - 10 MPH |
| Dew Presence (Y/N): | Y |
| Soil Temperature, Unit: | 58° |
| Soil Moisture: | Very wet |
| % Cloud Cover: | 100% |
| | |
| Pressure, Unit: | 30# PSI |
| Nozzle Type: | XR FF |
| Nozzle Size: | 8004 |
| Nozzle Spacing, Unit: | 20″ |
| Nozzles/Row: | Broadcast |
| Boom Length, Unit: | 10′ |
| Boom Height, Unit: | 19″ |
| Ground Speed, Unit: | 4 MPH |
| Carrier: | $H_20$ |
| Spray Volume, Unit: | 17 GPA |
| Propellant: | $CO_2$ |

**Table 4. Late postemergence application information for sandbur control**

| | |
|---|---|
| Application Date: | 6-16-92 |
| Time of Day | 10:30 - 10:40 AM |
| Application Method: | Backpack sprayer |
| Application Timing: | Late Post, 8 1/2 - to 9-leaf corn |
| Air Temperature, Unit: | 82° |
| Wind Velocity, Unit: | S - 5 MPH |
| Dew Presence (Y/N): | N |
| Soil Temperature, Unit: | 72° |
| Soil Moisture: | Good, dry surface |
| % Cloud Cover: | 0% |
| | |
| Pressure, Unit: | 30# PSI |
| Nozzle Type: | XR FF |
| Nozzle Size: | 8004 |
| Nozzle Spacing, Unit: | 20″ |
| Nozzles/Row: | Broadcast |
| Boom Length, Unit: | 10′ |
| Boom Height, Unit: | 19″ |
| Ground Speed, Unit: | 4 MPH |
| Carrier: | $H_20$ |
| Spray Volume, Unit: | 17 GPA |
| Propellant: | $CO_2$ |

The threat of impending thunderstorms necessitated the use of a poor, wet, cloddy, seedbed at the Johnsongrass location as described in Table 5. Although the poor seedbed appeared to hamper other weed species, it favored a uniform emergence of 130 to 160 thousand rhizome-derived and approximately 37.5 thousand seedling-derived Johnsongrass plants per acre. Herbicide applications were applied as described in Tables 6,7,and 8.

**Table 5. Planting information - Johnsongrass site**

| | |
|---|---|
| Crop Stage | Corn, 4-leaf |
| Variety: | Pioneer 3162 |
| Panting Date: | 4-16-92 |
| Planting Method: | JD Max Emerge II |
| Rate, Unit: | 28000 seed/a |
| Depth, Unit: | 1 1/2″ |
| Row Spacing, Unit: | 30″ row - 60″ bed |
| Soil Temperature, Unit | 55° |
| Soil Moisture: | Wet |

**Table 6. Application information for early postemergence treatments.**

| | |
|---|---|
| Application Date: | 5-18-92 |
| Time of Day | 2:15 - 2:45 PM |
| Application Method: | Tractor sprayer - shielded |
| Application Timing: | Early Post, 4-leaf corn |
| Air Temperature, Unit: | 81° |
| Wind Velocity, Unit: | S - 15 MPH |
| Dew Presence (Y/N): | N |
| Soil Temperature, Unit: | 70° |
| Soil Moisture: | Dry |
| % Cloud Cover: | 0% |
| | |
| Application Equipment: | Tractor sprayer - shielded |
| Pressure, Unit: | 30# PSI |
| Nozzle Type: | XR FF |
| Nozzle Size: | 8004 |
| Nozzle Spacing, Unit: | 20″ |
| Nozzles/Row: | Broadcast |
| Boom Length, Unit: | 10′ |
| Boom Height, Unit: | 19″ |
| Ground Speed, Unit: | 4 MPH |
| Carrier: | $H_20$ |
| Spray Volume, Unit: | 17 GPA |
| Propellant: | $CO_2$ |

**Table 7. Postemergence Johnsongrass control**

| | | | |
|---|---|---|---|
| Application Date: | 6-1-92 | Application Equipment: | Hand sprayer |
| Time of Day | 1:30 - 1:50 PM | Pressure, Unit: | 30# PSI |
| Application Method: | 10 ft. hand sprayer | Nozzle Type: | XR FF |
| Application Timing: | Post, 6-to 7- leaf corn | Nozzle Size: | 8004 |
| Air Temperature, Unit: | 59˚ | Nozzle Spacing, Unit: | 20″ |
| Wind Velocity, Unit: | 0 | Nozzles/Row: | Broadcast |
| Dew Presence (Y/N): | Y | Boom Length, Unit: | 10′ |
| Soil Temperature, Unit: | 58˚ | Boom Height, Unit: | 19″ |
| Soil Moisture: | Very wet | Ground Speed, Unit: | 4 MPH |
| % Cloud Cover: | 100% | Carrier: | $H_20$ |
| | | Spray Volume, Unit: | 17 GPA |
| | | Propellant: | $CO_2$ |

**Table 8. Application information for late postemergence johnsongrass control**

| | | | |
|---|---|---|---|
| Application Date: | 6-16-92 | Application Equipment: | Hand sprayer |
| Time of Day | 9:00 - 9:10 AM | Pressure, Unit: | 30# PSI |
| Application Method: | Hand sprayer - walking | Nozzle Type: | XR FF |
| | | Nozzle Size: | 8004 |
| Application Timing: | Late Post, 8 1/2 - to 9- leaf corn | Nozzle Spacing, Unit: | 20″ |
| | | Boom Length, Unit: | 10′ |
| Air Temperature, Unit: | 74˚ | Boom Height, Unit: | 19″ |
| Wind Velocity, Unit: | S - 5 MPH | Ground Speed, Unit: | 4 MPH |
| Dew Presence (Y/N): | N | Carrier: | $H_20$ |
| Soil Temperature, Unit: | 65˚ | Spray Volume, Unit: | 17 GPA |
| Soil Moisture: | Dry surface, wet below | Propellant: | $CO_2$ |
| % Cloud Cover: | 0% | | |

Counts of the numbers of the target weed species for a given area were taken throughout the season. These counts were used to calculate the percent reduction in weed numbers as compared to the untreated control.

## RESULTS AND DISCUSSION

Dry conditions during the first 5 weeks after planting produced a spotty light infestation of grassy sandbur which made it difficult to predict differences at the first rating date (Table 9). All treatments provided good control at the second rating period. A subsequent flush appeared to negate the effects of the early application by the time the last applications were made. If greater than 63.3% control was present both on 6/2 and 6/26, consistent yield increases were seen (Table 10). Also, percent sandbur control correlated very well with yield and is described by the equation Yield = 22.5 + .49 (% control) ($R^2$ = .81). In general, every 10 % increase in control increased yield by 4.9 bu.

All treatments appeared to provide an acceptable level of Johnsongrass control on 6/25/92 (Table 11). Although on June 26, 3/4 of the label rate early and 1/4 later of Beacon with 1 gal of 28% UAN (Trt 4) did not appear to provide statistically significant increases in control over a single application of the label rate without 28% UAN, on July 14 both split applications (Trt 4 and Trt 9) did provide a statistically significant although probably not practical increase in control over a single post application. Also the different rates of split application (in Trt 4) did not appear to differ significantly.

Overall yield in the Johnsongrass test was poor. The best plot yielded well below the historical yield potential of this field. In 1991, even the weedy check yielded 130 bu/a, and plots with >90% weed control yielded from 180 - 200 bu/a in this field. The specific reason for this overall poor yield in 1992 is not known. One could speculate that the poor seedbed or moisture or light competition between plots with differing levels of control may have contributed.

All treatments caused a dramatic increase in yield over the untreated control (Table 12). Only early application of Accent or Beacon provided a level of control that was significantly lower than that of the best treatment. Percent control on 7/14/92 correlated very well with yield and is described by the equation Yield = 12.3 + .939 (% control) with a $R^2$ value of .936, which in general would predict a 2.2 bushel yield increase for every 1% reduction in Johnsongrass.

Because of the unusual nature of the 1992 season and the unusual nature of plot sites, the results should be used only as a general guide for management decisions.

**Table 9. Sandbur control with postemergence applications**

| Trt # | Treatment | Rate lbs ai/a | Application Time | 3/22/92 | 6/2/92 | 6/15/92 | 6/26/92 |
|---|---|---|---|---|---|---|---|
| 1 | CK | | | 0 | 0 | 0 | 0 |
| 2 | Beacon + COC | .0357 + 2 pts | Post | 17.8 | 93.1 | 86.8 | 83.4 |
| 3 | Beacon + COC + UAN | .0357 + 2 pts + 1 gal | Post | 0 | 100 | 70.2 | 80.6 |
| 4 | Beacon + COC + UAN | .0267 + 2 pts + 1 gal | Early Post | 53.1 | 99.7 | 30.7 | 69.1 |
| | Beacon + COC + UAN | .0089 + 2 pts + 1 gal | Late Post | - | - | - | - |
| 5 | Beacon + COC + UAN | .0357 + 2 pts + 1 gal | Early Post | 16.6 | 100 | 0 | 34.8 |
| 6 | Accent + COC | .0312 + 2 pts | Post | 26.6 | 99.8 | 48.4 | 63.3 |
| 7 | Beacon + Accent + COC | .0178 + .0161 + 2 pts | Post | 39.1 | 87.5 | 53 | 72.1 |
| 8 | Accent + COC | .0312 + 2 pts | Early Post | 13.7 | 93.8 | 0 | 14.4 |
| 9 | Beacon + COC + UAN | .0241 + 2 pts + 1 gal | Early Post | 69.3 | 100 | 0 | 44.5 |
| | Beacon + COC + UAN | .0116 + 2 pts + 1 gal | Late Post | - | - | - | - |
| | LSD = 0.05 | | | nsd | 24.9 | nsd | 38.1 |

**Table 10 . Impact of grassy sandbur on corn yield**

| Trt # | Treatment lbs ai/a | Rate | Application Time | Test Weight | % Moisture | Bushels/a |
|---|---|---|---|---|---|---|
| 1 | CK | | | 60.43 | 11.58 | 35.16 |
| 2 | Beacon + COC | .0357 + 2 pts | Post | 62.43 | 12.43 | 61.69 |
| 3 | Beacon + COC + UAN | .0357 + 2 pts + 1 gal | Post | 62.23 | 12.25 | 63.39 |
| 4 | Beacon + COC + UAN | .0267 + 2 pts + 1 gal | Early Post | 61.90 | 12.05 | 55.33 |
| 4 | Beacon + COC + UAN | .0089 + 2 pts + 1 gal | Late Post | | | |
| 5 | Beacon + COC + UAN | .0357 + 2 pts + 1 gal | Early Post | 61.95 | 12.20 | 53.61 |
| 6 | Accent + COC | .0312 + 2 pts | Post | 61.95 | 11.98 | 49.15 |
| 7 | Beacon + Accent + COC | .0178 +.0161 + 2 pts | Post | 61.40 | 12.08 | 53.69 |
| 8 | Accent + COC | .0312 + 2 pts | Early Post | 61.80 | 12.78 | 45.90 |
| 9 | Beacon + COC + UAN | .0241 + 2 pts + 1 gal | Early Post | 61.18 | 11.90 | 42.48 |
| 9 | Beacon + COC + UAN | .0116 + 2 pts + 1 gal | Late Post | | | |
| | LSD = 0.05 | | | 1.69 | 0.98 | 14.92 |

**Table 11. Percent Johnsongrass control**

| Trt # | Treatment | Rate lbs ai/a | Application Time | 6/15/92 | 6/26/92 | 7/14/92 |
|---|---|---|---|---|---|---|
| 1 | CK | | | 0.0 | 0.0 | 0.0 |
| 2 | Beacon + COC | .0357 + 2 pts | Post | 64.7 | 85.8 | 62.4 |
| 3 | Beacon + COC + UAN | .0357 + 2 pts + 1 gal | Post | 68.4 | 90.9 | 80.1 |
| 4 | Beacon + COC + UAN | .0267 + 2 pts + 1 gal | Early Post | - | - | - |
| | Beacon + COC + UAN | .0089 + 2 pts + 1 gal | Late Post | 80.5 | 88.8 | 78.7 |
| 5 | Beacon + COC + UAN | .0357 + 2 pts + 1 gal | Early Post | 81.3 | 90.2 | 52.8 |
| 6 | Accent + COC | .0312 + 2 pts | Post | 72.1 | 89.4 | 83.1 |
| 7 | Beacon + Accent + COC | .0178 + 0161 + 2 pts | Post | 71.1 | 88.4 | 83.0 |
| 8 | Accent + COC | .0312 + 2 pts | Early Post | 73.0 | 81.3 | 57.6 |
| 9 | Beacon + COC + UAN | .0241 + 2 pts + 1 gal | Early Post | - | - | - |
| | Beacon + COC + UAN | .0116 + 2 pts + 1 gal | Late Post | 82.6 | 93.3 | 86.4 |
| | LSD = 0.05 | | | 10.8 | 6.0 | 13.1 |

**Table 12. Impact of Johnsongrass control on corn yield**

| Trt # | Treatment | Rate lbs ai/a | Application Time | Test Weight | % Moisture | Bushels/a |
|---|---|---|---|---|---|---|
| 1 | CK | | | 41.6 | 10.1 | 10.6 |
| 2 | Beacon + COC | .0357 + 2 pts | Post | 60.0 | 15.7 | 81.5 |
| 3 | Beacon + COC + UAN | .0357 + 2 pts + 1 gal | Post | 60.0 | 15.8 | 76.6 |
| 4 | Beacon + COC + UAN | .0267 + 2 pts + 1 gal | Early Post | 59.4 | 15.1 | 81.6 |
| 5 | Beacon + COC + UAN | .0357 + 2 pts + 1 gal | Early Post | 60.2 | 15.2 | 69.5 |
| 6 | Accent + COC | .0312 + 2 pts | Post | 61.0 | 17.6 | 81.8 |
| 7 | Beacon + Accent + COC | .0178 + 0161 + 2 pts | Post | 62.2 | 17.0 | 105.7 |
| 8 | Accent + COC | .0312 + 2 pts | Early Post | 59.3 | 15.9 | 56.3 |
| 9 | Beacon + COC + UAN | .0241 + 2 pts + 1 gal | Early Post | 60.8 | 16.4 | 95.3 |
| | LSD = 0.05 | | | 13.5 | 3.7 | 32.8 |

# BENEFITS OF INCLUDING SOYBEANS IN A CONTINUOUS CORN OR GRAIN SORGHUM SYSTEM

*by*
*Kevin Dhuyvetter, Alan Schlegel, and James Schaffer*

## SUMMARY

Rotating corn and grain sorghum with soybeans was evaluated to examine the impact on optimal nitrogen levels and profitability of cropping systems. Continuous corn responds to applied N much better than corn grown in rotation with soybeans. Maximum yield, maximum net revenue, and cost/bushel are all achieved at lower levels of N with corn grown in rotation with soybeans compared to continuous corn. The economics of the corn-soybean rotation compared to continuous corn are highly sensitive to the relative prices of the two crops. Neither continuous sorghum nor sorghum grown in rotation with soybeans has shown much of a response to applied N. Soil nitrate levels in the corn rotations increased as N rates increased. Soil nitrate levels were higher in the corn-soybean rotation compared to the continuous corn. Soil nitrate levels were similar in the sorghum rotations and did not change significantly as N rates increased.

## INTRODUCTION

The most common cropping practices under irrigation in southwest Kansas are continuous corn and grain sorghum. The 1990 Farm Bill has given producers more planting flexibility, allowing them to change their cropping rotation. However, crop rotations will be changed only if there is an economic benefit to do so. Introducing soybeans to continuous corn or grain sorghum offers producers the potential to lower production costs, reduce pest problems, and increase marketing options. However, producers need to know the optimal level of nitrogen to apply so they can maximize returns. Applying excess nitrogen will reduce returns and potentially harm the environment.

## OBJECTIVES

1. Determine the economic feasibility of rotating corn or grain sorghum with soybeans. 2. Examine the effect of soybeans on the optimal economic N rate for corn and grain sorghum. 3. Analyze the effect of soybeans on soil nitrate accumulation.

## PROCEDURES

Four crop systems (soybean/corn, soybean/grain sorghum, continuous corn, and continuous grain sorghum) were established at the SWREC near Garden City in 1990. Nitrogen fertilizer is applied to the corn and grain sorghum at 30, 60, 120, and 240 lb N/acre annually and a no -nitrogen check is included. Measurements include grain yield and soil nitrate content and distribution. Economic analysis is based on estimated yield response curves, average prices, and average productions costs. Government program payments are not included in the economic analysis. Data were collected on the 1991 and 1992 crops.

## RESULTS AND DISCUSSION

The economic advantage of a corn-soybean rotation compared to continuous corn is very sensitive to crop prices (Table 1). At low corn prices ($2.00/bu), a soybean/corn price ratio of approximately 2.4 or greater favors the corn-soybean rotation. However, at higher corn prices ($3.00) the soybean/corn price ratio that favors a corn-soybean rotation increases (2.8 or greater).

Continuous corn responds to applied nitrogen much better than corn in rotation with soybeans (Figure 1). Maximum yield in continuous corn requires 186 lb/acre of N (Figure 2), whereas maximum yield in a corn-soybean rotation is achieved with 154 lb/acre (Figure 3). Based on a corn price of $2.25/bu and a nitrogen price of $0.15/lb, the optimum economic level of N in continuous corn is 173 lb/acre (Figure 2). The optimum level of N in a corn-soybean rotation is 126 lb/acre (Figure 3). With production costs of $250/acre for continuous corn and $250/acre for continuous corn and $225/acre for corn-soybeans, costs/bushel are minimized at N rates of 160 lb/acre and 92 lb/acre, respectively (Figures 2 & 3).

Grain sorghum yields in a soybean rotation have shown no response to applied N. In a continuous sorghum, yields have shown a slight linear response to applied N (figure 4). Because of this low response to N, the economics of nitrogen fertilization and soybean rotation for grain sorghum have not been included. The response to N is expected to change as the study continues and more data are collected.

Accumulation of soil nitrate ($NO_3$-N) in the soil profile (Figure 5) increased as the level of N applied increased in the corn rotations. The soybean-corn rotation had higher soil nitrate levels than the continuous corn. The soil nitrate levels was less in the grain sorghum rotations than in the corn rotations and were similar for the continuous sorghum and the soybean-sorghum rotation (Figure 5).

**Table 1. Economic advantage of corn-soybean rotation vs. continuous corn**

| Price | Price of Soybeans | | | | | | |
|---|---|---|---|---|---|---|---|
| of Corn | $5.00 | $5.50 | $6.00 | $6.50 | $7.00 | $7.50 | $8.00 |
| | - $ - | | | | | | |
| $1.75 | 77.31 | 110.52 | 143.73 | 176.94 | 210.15 | 243.35 | 276.56 |
| $2.00 | 16.19 | 49.40 | 82.61 | 115.81 | 149.02 | 182.23 | 215.44 |
| $2.25 | -44.93 | -11.72 | 21.49 | 54.69 | 87.90 | 121.11 | 154.32 |
| $2.50 | -106.05 | -72.84 | -39.63 | -6.43 | 26.78 | 59.99 | 93.20 |
| $2.75 | -167.17 | -133.96 | -100.75 | -67.54 | -34.33 | -1.13 | 32.08 |
| $3.00 | -228.28 | -195.08 | -161.87 | -128.66 | -95.45 | -62.24 | -29.03 |
| $3.25 | -289.40 | -256.19 | -222.98 | -189.77 | -156.57 | -123.36 | -90.15 |

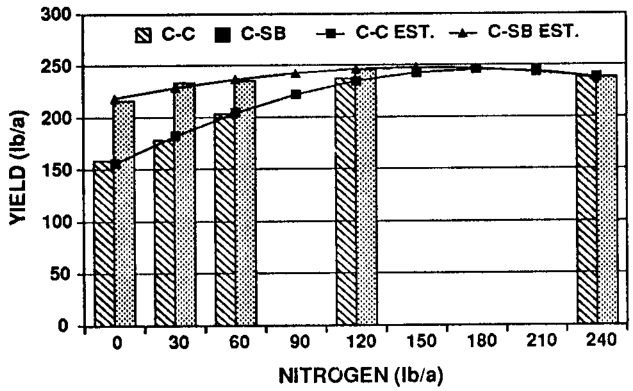
Assumptions:

Corn yield is optimum economic yield based on corn and nitrogen prices.

| | | |
|---|---|---|
| Corn-Corn production costs^ | $250 | ($/ac) |
| Corn-Soybean production costs^ | $225 | ($/ac) |
| Price of nitrogen* | $0.15 | ($/lb) |
| Soybean yield | 66 | (bu/ac) |
| Soybean-Corn production costs | $135 | ($/ac) |

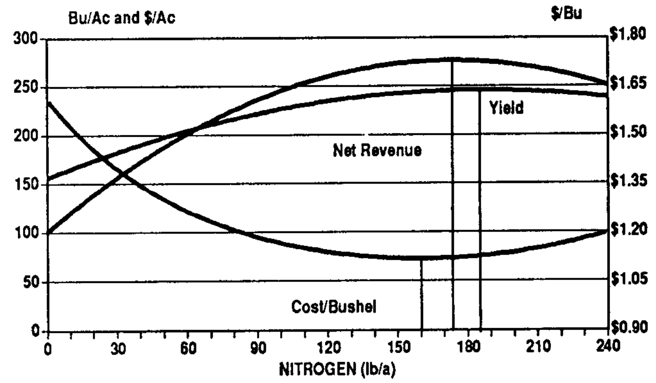
^ Does not include the cost of nitrogen.
* Nitrogen is applied at the optimal economic level.

Figure 1. Corn rotations: actual vs. estimated yields.




C-C = Corn-Corn, C-SB = Corn-Soybean

Figure 2. Continuous corn.




Pc = $2.25/bu, Pn = $0.15/lb, Production costs = $250/ac

Figure 3. Corn - soybean rotations.

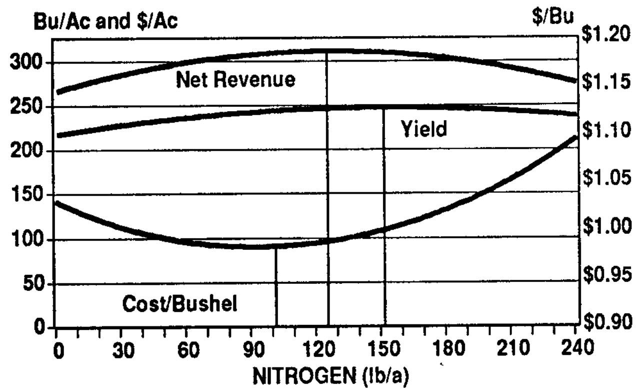
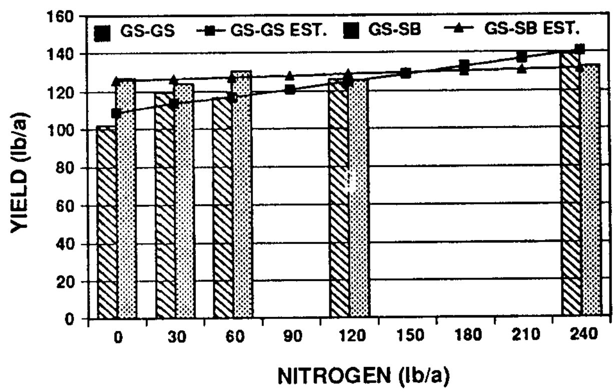
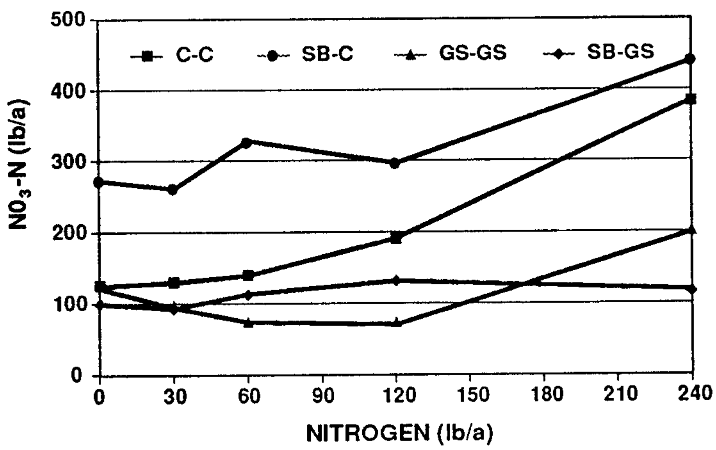



Figure 4. Sorghum rotations: actual vs. estimated yields.




GS-GS = Sorghum-Sorghum, GS-SB = Sorghum-Soybean

Figure 5. Nitrate in the soil profile (0-10 ft), Fall 1991.




C-C = Corn-Corn, SB-C = Soybean-Corn

GS-GS = Sorghum-Sorghum, SB-GS = Soybean-Sorghum

Southwest Research-Extension Center

# LEPA SPRAY MODE / TILLAGE STUDY

*by*

*William Spurgeon and Dennis Tomsicek*

## SUMMARY

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

## INTRODUCTION

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

## PROCEDURES

Corn was planted in a circular pattern. Various tillage treatments and spray modes were used to determine which combination reduced runoff the most. Slopes ranged from 1 to 6 percent and averaged 3 percent. Bubble-mode plots had a higher average slope than the flat-spray plots in 1990 and 1991. The flat-spray plots had a slightly higher average slope in 1992.

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

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

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

The irrigation application amount was kept at or below 1 inch, the current recommendation for flat slopes. Borders were installed across the field to prevent runoff of water from one treatment affecting any treatment further downhill.

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

## RESULTS AND DISCUSSION

Runoff rates were so high in the bubble mode in 1990 and 1991 that corn yields were reduced . Table 1 shows yields for the different tillage treatments and irrigation modes. Ripping and diking both increased yields slightly. Diking with ripping increased yields the most.

Diking with ripping had the greatest effect on yields when the bubble mode was used. This could be because of the increased intake rate with ripping and because this treatment had the best reservoirs.

**Figure 1. Predicted corn yield as a function of ground slope.**

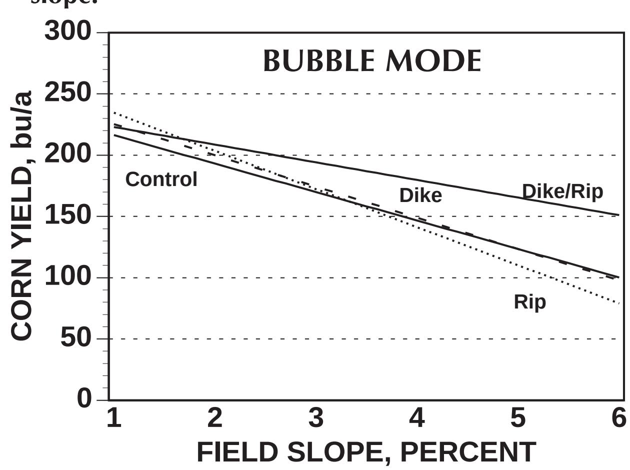
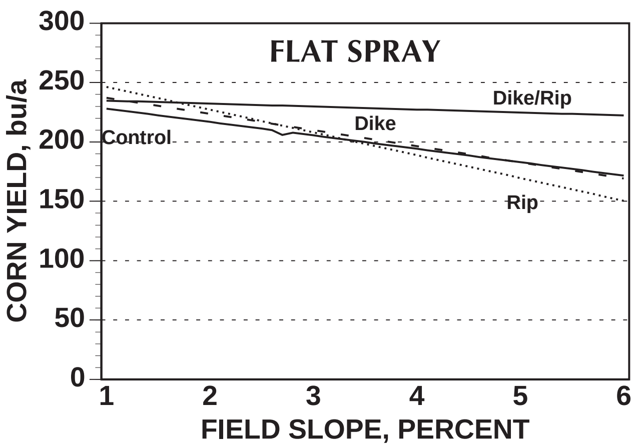


Table 1. Effect of spray mode and tillage treatment on corn yield (bu/a).

| Tillage Treatment | Spray Mode Bubble | Spray Mode Flat Spray | Average |
|---|---|---|---|
| **1990** | | | |
| Control | 168.1 | 210.8 | 189.5 |
| Dike | 174.7 | 214.0 | 194.3 |
| Rip | 176.0 | 224.6 | 200.3 |
| Dike/Rip | 204.4 | 225.9 | 215.1 |
| Average | 180.8 | 218.8 | |
| **1991** | | | |
| Control | 145.9 | 217.1 | 181.5 |
| Dike | 150.8 | 231.8 | 191.3 |
| Rip | 141.5 | 221.8 | 181.7 |
| Dike/Rip | 169.4 | 230.5 | 200.0 |
| Average | 151.6 | 225.3 | |
| **1992** | | | |
| Control | 213.3 | 189.9 | 201.6 |
| Dike | 209.3 | 211.7 | 210.5 |
| Rip | 204.0 | 199.6 | 201.8 |
| Dike/Rip | 209.6 | 181.1 | 195.4 |
| Average | 209.0 | 196.6 | |
| **2-year average (91-92)** | | | |
| Control | 157.0 | 213.9 | 185.5 |
| Dike | 162.9 | 223.0 | 192.9 |
| Rip | 158.5 | 223.0 | 191.0 |
| Dike/Rip | 186.7 | 228.0 | 207.6 |
| Average | 166.8 | 222.0 | |

Figure 2. Predicted corn yield as a function of ground slope.




The flat spray mode showed less sensitivity to tillage treatment because of the larger area wetted as compared to the bubble mode.

A factor that had an important impact on this study was field slope. Figures 1 and 2 show predicted yields for the bubble and spray modes based on field slope and tillage. The slope of the prediction line indirectly indicates the amount of runoff from irrigation and rainfall. The slope of the line predicts the amount of yield loss per percent field slope.

An average yield loss of 24 bu/a per percent field slope occurred when using the bubble mode and

Table 2. Total water applied (soil water extracted + irrigation + rainfall) in inches.

| Tillage Treatment | Spray Mode Bubble | Spray Mode Flat | Avg |
|---|---|---|---|
| **1990** | | | |
| Control | 30.2 | 29.3 | 29.8 |
| Dike | 30.2 | 27.0 | 28.6 |
| Rip | 29.6 | 27.7 | 28.7 |
| Dike/Rip | 28.0 | 27.3 | 27.7 |
| Average | 29.5 | 27.8 | |
| **1991** | | | |
| Control | 26.6 | 27.8 | 27.2 |
| Dike | 26.8 | 27.6 | 27.2 |
| Rip | 26.6 | 28.2 | 27.4 |
| Dike/Rip | 27.2 | 27.5 | 27.4 |
| Average | 26.8 | 27.8 | |
| **1992** | | | |
| Control | 22.9 | 22.9 | 22.9 |
| Dike | 22.8 | 22.7 | 22.7 |
| Rip | 23.1 | 22.7 | 22.9 |
| Dike/Rip | 23.6 | 22.4 | 23.0 |
| Average | 23.1 | 22.6 | |

Table 3. Change in soil water content, in inches, for 5 ft of profile during the growing seasons.

| Tillage Treatment | Spray Mode Bubble | Spray Mode Flat | Avg |
|---|---|---|---|
| **1990** | | | |
| Control | -5.3 | -4.4 | -4.9 |
| Dike | -5.3 | -2.1 | -3.7 |
| Rip | -4.7 | -2.8 | -3.8 |
| Dike/Rip | -3.1 | -2.4 | -2.8 |
| Average | -4.6 | -2.9 | |
| **1991** | | | |
| Control | -1.9 | -3.1 | -2.5 |
| Dike | -2.1 | -2.9 | -2.5 |
| Rip | -1.9 | -3.5 | -2.7 |
| Dike/Rip | -2.5 | -2.8 | -2.7 |
| Average | -2.1 | -3.1 | |
| **1992** | | | |
| Control | -1.2 | -1.1 | -1.1 |
| Dike | -1.1 | -0.9 | -1.0 |
| Rip | -1.3 | -0.9 | -1.1 |
| Dike/Rip | -1.8 | -0.6 | -1.2 |
| Average | -1.3 | -0.9 | |

indicates that runoff was severe. The flatter lines for the spray mode show that less yield was lost to runoff. The average yield loss for the spray mode was 12 bu/a per percent slope.

Total water applied is shown in Table 2. This includes the seasonal soil water change, irrigation, and rainfall amounts. The seasonal soil water change for each of the 3 years is shown in Table 3. Rainfall amounts were 3.8, 8.0, and 13.25 inches for 1990 (June 27 to September 21), 1991 (June 3 to September 19), and 1992 (May 19 to September 30), respectively. Irrigation amounts were 21.1, 16.7, and 8.5 inches for 1990, 1991, and 1992, respectively. Not all of the water applied was available for use by the crop because of runoff from the plot area.

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

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

**Table 4. Irrigation water use efficiency (IWUE) and total water use efficiency (TWUE) in bushels per acre-inch[1].**

| Tillage Treatment | Spray Mode Bubble | Flat | Avg |
|---|---|---|---|
| **1990** | | | |
| Control | 8.0 | 10.0 | 9.0 |
| | (5.6) | (7.2) | (6.4) |
| Dike | 8.3 | 10.1 | 9.2 |
| | (5.8) | (7.9) | (6.9) |
| Rip | 8.3 | 10.6 | 9.5 |
| | (5.9) | (8.1) | (7.0) |
| Dike/Rip | 9.7 | 10.7 | 10.2 |
| | (7.3) | (8.3) | (7.8) |
| Average | 8.6 | 10.4 | |
| | (6.1) | (7.9) | |
| **1991** | | | |
| Control | 8.7 | 13.0 | 10.9 |
| | (5.5) | (7.5) | (6.5) |
| Dike | 9.0 | 13.9 | 11.5 |
| | (5.6) | (8.4) | (7.0) |
| Rip | 8.5 | 13.3 | 10.9 |
| | (5.3) | (7.9) | (6.6) |
| Dike/Rip | 10.1 | 13.8 | 12.0 |
| | (6.2) | (8.4) | (7.3) |
| Average | 9.1 | 13.5 | |
| | (5.7) | (8.1) | |
| **1992** | | | |
| Control | 25.1 | 22.4 | 23.7 |
| | (9.3) | (8.3) | (8.8) |
| Dike | 24.6 | 24.9 | 24.8 |
| | (9.2) | (9.4) | (9.3) |
| Rip | 24.0 | 23.5 | 23.8 |
| | (8.8) | (8.8) | (8.8) |
| Dike/Rip | 24.7 | 21.3 | 23.0 |
| | (8.9) | (8.1) | (8.5) |
| Average | 24.6 | 23.0 | |
| | (9.1) | (8.6) | |
| **2-year average** | | | |
| Control | 8.4 | 11.5 | 9.9 |
| | (5.5) | (7.5) | (6.5) |
| Dike | 8.7 | 12.0 | 10.3 |
| | (5.7) | (8.2) | (6.9) |
| Rip | 8.4 | 12.0 | 10.2 |
| | (5.6) | (8.0) | (6.8) |
| Dike/Rip | 9.9 | 12.3 | 11.1 |
| | (6.8) | (8.3) | (7.5) |
| Average | 8.8 | 11.9 | |
| | (5.9) | (8.0) | |

[1](TWUE in parentheses)

# SPACING FOR IN-CANOPY, LOW PRESSURE, SPRAY NOZZLES

*by*
*William Spurgeon and Dennis Tomsicek*

## SUMMARY

Low pressure spray nozzles were placed 2 ft off the ground on 5, 10, and 15 ft spacings. Plots were on a low sloping (0 to 1 percent), deep, silt loam soil. Little difference occurred in corn yield for any spacing treatment. Yield was slightly higher for samples taken from rows next to the nozzles in the 10 ft spacing treatment as compared to the rows between nozzles in 1991. We expect that the 15 ft spacing will not work in hot dry years. More information is needed to verify that the 10 ft spacing is adequate.

## INTRODUCTION

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

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

The objective of this study was to determine the effect of spacing of in-canopy flat-spray nozzles on corn yield and soil water distribution.

## PROCEDURES

Corn was planted in circular rows in a deep silt loam soil. The nozzles tracked well between corn rows. Soil slope was generally 0 to 1 percent. The field was furrow diked in 1991 to minimize runoff.

Treatments consisted of LEPA nozzles (6 psi) operated in the flat spray mode placed in every other row (5 ft spacing), Low Drift Nozzles (LDN) (15 psi) placed in every 4th row (10 ft spacing), and rotators (20 psi) placed in every 6th row (15 ft spacing). All nozzles were 2 to 3 ft from the ground surface.

Aluminum access tubes were installed to measure soil water with a neutron probe. The tubes were installed in one row next to the nozzle (N) for each of the spacing treatments. Tubes were also installed in the row furthest from the nozzle (O) for the 10 and 15 ft treatments. A tube was also installed in the middle row (M) of the 15 ft treatment. Measurements were taken weekly to calculate soil water changes during the season.

Irrigation depth was generally kept at 0.75 to 1 inch to ensure that no runoff occurred. The treatments were replicated 10 times. Borders were installed between relications.

Forty feet of row were hand harvested from each plot. The samples were taken from rows in each of the relative nozzle positions (N, M, and O), Yields were adjusted to 15.5 percent moisture and are reported in bushels per acre.

## RESULTS AND DISCUSSION

Irrigation for all plots totaled 16.5 and 7.75 inches for 1991 and 1992, respectively. Rainfall amounts for the season were 8.5 and 13.8 inches for 1991 (June 5 to September 19) and 1992 (May 20 to September 25), respectively. Water use from rain and irrigation totaled 25.0 and 21.7 inches for 1991 and 1992, respectively.

Yield from the study by row position relative to the nozzle position is shown in Table 1. Very little yield difference was seen in 1992 because of higher than normal rainfall and low irrigation amounts. Yield was higher in corn rows closest to the nozzles for the drier year. More information is needed in dry years to verify that the 10 ft spacing is performing adequately. No statistics were run on the data because of the small difference in yield

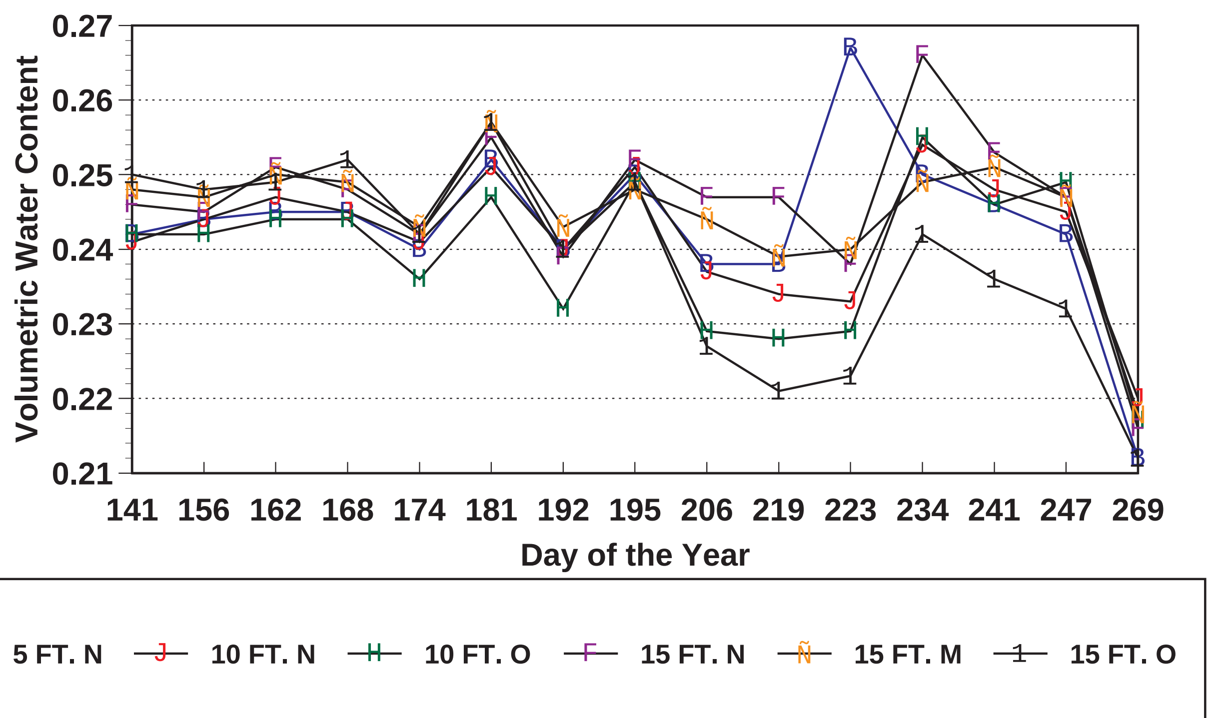
The average volumetric soil water content for the 5 foot profile is shown in Figure 1. Yield was lower for the samples taken furthest from the nozzles for the 10 and 15 ft nozzle spacings. The s soil water content for these treatments was the lowest of the six sample locations. This would tend to imply interception of water by the growing plant.

An important concern is slope greater than 1 percent in fields. Steeper slopes will cause more runoff, especially for the 10 and 15 ft. nozzle spacings, because the spray gets intercepted by the growing crop.

**Table 1. Yields for LEPA In-Canopy Spacing Study**

| Year | Treatements 5N | 10N | 10O | 15N | 15M | 15O |
|---|---|---|---|---|---|---|
| 1991 | 205 | 218 | 205 | — | — | — |
| 1992 | 183 | 196 | 194 | 196 | 197 | 192 |

**Figure 1. Soil water content during the season for spacing treatments.**



# LEPA IRRIGATION MANAGEMENT FOR SOYBEANS

*by*
*William Spurgeon, Alan Schlegel, and Dennis Tomsicek*

## SUMMARY

Soybean yield average for the 2-year period (1991-92) increased with increased water applications. Past research has shown that the water use curve is usually flat and may decrease with overwatering. This did not happen in 1991 and 1992 for the given conditions.

## INTRODUCTION

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

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

## PROCEDURES

Soybeans were planted in a circular pattern. The center pivot was run around the field once to establish tower tracks, which were used as markers for the planter to follow. The soybeans were planted on May 15 and May 8 in 1991 and 1992, respectively. The field was furrow diked to prevent runoff.

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

Treatments of no irrigation, 0.4, 0.7, 1.0, and 1.3 times the base irrigation (BI) were used. Each treatment was replicated five times. One irrigation (0.50 inches) was applied for all treatments early in the season in each year. Base irrigations were generally 1 inch, except for the first irrigation.

Twenty feet of row were harvested from each plot. Yields were adjusted to 13 percent moisture and are reported in bushels per acre.

## RESULTS AND DISCUSSION

Yield and water use data are given in Table 1. Two-year yield averages by treatment are shown in Figure 1. Yields increased with increasing water applied. Past research has shown yield response to water applied for soybeans to be relatively flat. Yield can decrease with overwatering in some years.

The summer of 1992 was unseasonably cool and wet. This resulted in lower and more variable yields, because the water demand was less. The cool weather made it difficult for the soybeans to take full advantage of increased irrigation depths.

Rainfall for the 1991 season (June 5 to September 19) was 8.5 inches. The 1992 season (June 12 to September 16) was wetter with 10.9 inches of rain. Base irrigations were 13.4 and 4.0 inches for 1991 and 1992, respectively.

Although the fully watered plots were not stressed, the yield continued to increase with increasing depths of applied water. Figure 2 shows the average volumetric soil water content for the 5 ft. profile by water treatment throughout the 1992 season. Soil water contents varied for the fractional BI treatments. Soil water content decreased with time for the underwatered treatments.

For the conditions encountered, LEPA in the bubble mode with furrow diking performed well. Yield was excellent for the warmer season of 1991.

**Figure 1. Two-year soybean yield averages for the various LEPA irrigation treatments.**

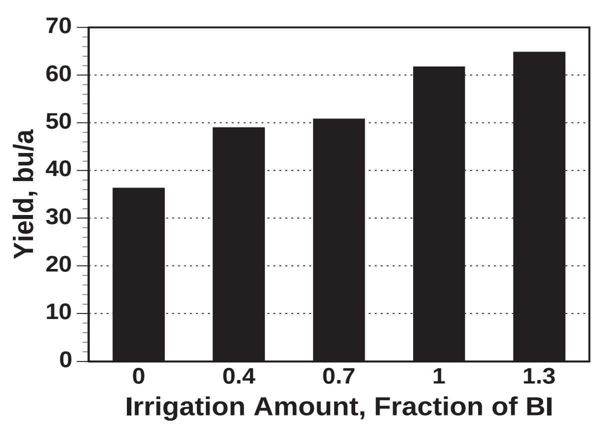
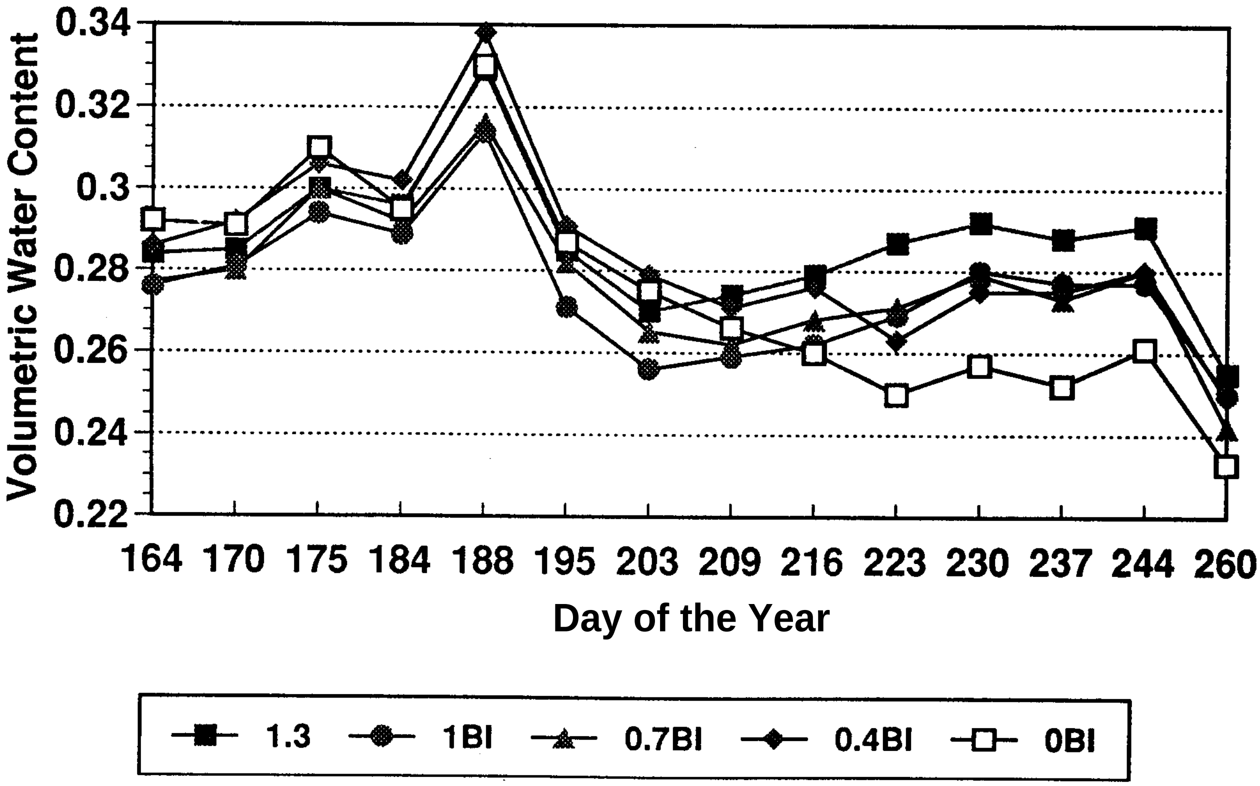


**Table 1. Soybean yield, irrigation, and total water use for LEPA irrigation.**

| Irrigation Treatment | Irrigation inches | Yield bu/a | Change in Soil Water inches | Total Water Use inches | TWUE bu/a-in | IWUE bu/a-in |
|---|---|---|---|---|---|---|
| 1991 | | | | | | |
| 1.3 BI | 17.2 | 78.0 | -1.4 | 27.1 | 2.9 | 4.5 |
| 1.0 BI | 13.4 | 71.6 | -1.6 | 23.5 | 3.0 | 5.3 |
| 0.7 BI | 9.5 | 64.7 | -3.7 | 21.7 | 3.0 | 6.8 |
| 0.4 BI | 5.7 | 60.2 | -3.9 | 18.1 | 3.3 | 10.6 |
| 0.0 BI | 0 | 33.4 | -3.2 | 11.7 | 2.9 | - |
| 1992 | | | | | | |
| 1.3 BI | 5.2 | 51.3 | -1.7 | 17.8 | 2.9 | 9.9 |
| 1.0 BI | 4.0 | 51.5 | -1.6 | 16.5 | 3.1 | 12.9 |
| 0.7 BI | 2.8 | 36.7 | -2.1 | 15.8 | 2.3 | 13.1 |
| 0.4 BI | 1.6 | 37.6 | -2.2 | 14.8 | 2.5 | 23.5 |
| 0.0 BI | 0 | 39.0 | -3.5 | 14.4 | 2.7 | - |
| 2-year average | | | | | | |
| 1.3 BI | 11.2 | 64.7 | -1.6 | 22.5 | 2.9 | 7.2 |
| 1.0 BI | 8.7 | 61.6 | -1.6 | 20.0 | 3.1 | 9.1 |
| 0.7 BI | 6.2 | 50.7 | -2.9 | 18.8 | 2.7 | 10.0 |
| 0.4 BI | 3.7 | 48.9 | -3.1 | 16.5 | 2.9 | 17.0 |
| 0.4 BI | 0.0 | 36.2 | -3.4 | 13.1 | 2.8 | - |

**Figure 2. Average soil water content for the top 5 feet by Irrigation treatment for the 1992 growing season.**



# FUNGICIDES FOR WHEAT LEAF RUST

*by*
*Merle D. Witt and Robert L. Bowden**

Leaf rust is estimated to cause an average of 4% annual yield loss to wheat in Kansas. This is the most persistently damaging of all the wheat diseases in the state. Wheat usually produces smaller kernels because of this disease. Yield reductions from leaf rust additionally result from a smaller plant root system, increased plant water use, and hastened maturity.

Plots were established to evaluate leaf rust disease loss of irrigated TAM 107 wheat and to evaluate the control benefits of commercial fungicides. Results form 1991 and 1992 are given in Table 1. Leaf rust incidence was first detected in late May in 1991 and in early June in 1992. Thus, these late infections did not cause severe grain losses but did account for 21.7 bushel per acre (23%) loss in 1991 and 13.7 bushel per acre (22%) loss in 1992. These losses were estimated by comparing the untreated plot yields with the Folicur disease- controlled treatments.

Severe leaf rust epidemics may not occur consistently enough to justify routine fungicide applications. However, assuming a total expense of $15.00 per acre for fungicide plus application costs and a wheat price of $3.00 per bushel, the Tilt and Bayleton/Dithane treatments both provided nearly a 3X return on the investment in 1991 and about a 2X return on investment in 1992. Because Folicur is not yet commercially available, its return on investment cannot be calculated.

**Table 1. Wheat yield benefits with leaf rust fungicide usage on TAM 107.**

| | Grain Yield | | Test Weight | |
|---|---|---|---|---|
| Fungicide | 1991 | 1992 | 1991 | 1992 |
| | - bu/a - | | | |
| Tilt (at flag leaf stage) | 85.2B* | 55.9B | 59.6B | 53.8A |
| Bayleton/Dithane (at boot stage) | 85.0B | 59.6B | 60.2C | 55.2B |
| Folicur (at flag leaf & boot stages) | 93.1B | 61.2B | 60.5C | 56.5C |
| Unsprayed Check | 71.4A | 47.5A | 58.6A | 53.3A |

* Means followed by the same letter are not significantly different (P=0.05).

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

# PEARL MILLET GRAIN HYBRIDS

*by*
*Merle D. Witt and William D. Stegmeier*

Pearl millet as a short-statured, grain-type, hybrid crop has made a great deal of progress in recent years, with a major plant breeding effort by Mr. William Stegmeier at the Fort Hays Branch Experiment Station of Kansas State University. Experimental hybrids created were evaluated in 1992 at Garden City under dryland field conditions and compared with a grain sorghum hybrid check (DeKalb DK39Y). Resulting data are given in Table 1.

Many of the pearl millet hybrids yielded significantly more grain then did the sorghum hybrid. The test was seeded with three replications on June 16, 1992. The pearl millets averaged 26% greater grain yield than DK39Y sorghum. Additionally, many of the millets had quicker maturity and higher test weights then did the sorghum. This type of pearl millet is becoming a competitive feed grain crop for this region. Additional stalk strength is needed to reduce lodging, but excellent gains have been make in seed size, emergence vigor, and seed set with cool night temperature, along with desired plant and grain yields.

**Table 1. Pearl millet hybrid results in 1992 as compared with sorghum check.**

| Hybrid I.D.# | Height Index | Days to Bloom | % Lodging | Test Wt. | Grain lbs/acre |
|---|---|---|---|---|---|
| 92-105 | 45 | 53 | 50 | 59 | 3332 |
| 92-112 | 43 | 55 | 3 | 60 | 3676 |
| 92-115 | 43 | 55 | 17 | 60 | 3831 |
| 92-125 | 55 | 66 | 17 | 60 | 3896 |
| 92-126 | 56 | 67 | 13 | 60 | 4585 |
| 92-403 | 49 | 54 | 3 | 59 | 3333 |
| 92-412 | 54 | 61 | 82 | 60 | 3280 |
| 92-416 | 57 | 68 | 68 | 59 | 4372 |
| 92-424 | 55 | 63 | 33 | 60 | 4378 |
| 92-437 | 52 | 59 | 32 | 61 | 3985 |
| 92-438 | 47 | 56 | 32 | 59 | 3707 |
| 92-439 | 45 | 61 | 7 | 60 | 3329 |
| 91-3542 | 55 | 59 | 20 | 61 | 3487 |
| 91-3548 | 54 | 57 | 33 | 59 | 3416 |
| 91-3552 | 53 | 58 | 37 | 61 | 3903 |
| 91-3555 | 54 | 58 | 63 | 59 | 3327 |
| 91-3556 | 59 | 58 | 23 | 58 | 3000 |
| 91-3558 | 53 | 58 | 50 | 60 | 3890 |
| 91-3564 | 58 | 60 | 45 | 58 | 3804 |
| 91-3567 | 59 | 63 | 70 | 60 | 4436 |
| 91-3574 | 56 | 54 | 37 | 58 | 3058 |
| 91-3579 | 52 | 57 | 40 | 59 | 3643 |
| 91-3604 | 66 | 70 | 70 | 60 | 3951 |
| 91-3619 | 46 | 56 | 60 | 59 | 4140 |
| 91-3641 | 57 | 66 | 73 | 61 | 4291 |
| 91-3647 | 48 | 55 | 28 | 60 | 3287 |
| 91-3673 | 50 | 57 | 52 | 61 | 3341 |
| 92-0021 | 48 | 56 | 10 | 60 | 2680 |
| 92-0141 | 49 | 57 | 50 | 60 | 3200 |
| DK39Y sorghum (Check) | 45 | 65 | 19 | 56 | 2901 |
| Test Av. | 52 | 59 | 38 | 59 | 3649 |
| L.S.D. (.05) | 4.8 | 2.5 | 36.9 | 2.8 | 621 |

# WHEAT VARIETY PRODUCTION OF STOVER AND GRAIN COMPONENTS

*by*
*Merle D. Witt*

Wheat varieties differ in the amount of straw produced and the amount of grain produced. Thus, the harvest index percentage (ratio of grain weight/ grain + stover weight) also differs among varieties. Residue amounts for ground cover are of increasing interest partly because of implementing compliance plan considerations of the Federal Farm Program. Results on dryland in 1991 showed the tall variety Larned as having higher straw yields with a lower harvest index ratio as compared with semi-dwarf varieties. Resulting values are indicated in Table 1.

**Table 1. Residue Differences of Dryland Wheat Varieties in 1991.**

| Variety | Straw lbs/acre | Grain Bushels/Acre | Grain Lbs/Acre | Harvest* Index% |
|---|---|---|---|---|
| TAM 107 | 2560 | 28.4 | 1704 | 40.0 |
| Rawhide | 2570 | 27.6 | 1656 | 38.5 |
| Newton | 2831 | 28.6 | 1716 | 37.9 |
| Larned | 3211 | 27.5 | 1639 | 33.8 |
| LSD (5%) | 240 | ns | ns | 4.0 |

* Harvest index ratio = grain weight/grain weight + stover weight

# CROP VARIETY TESTS HIGH YIELDERS 1990-1992

*by*
*Merle D. Witt & Alan Schlegel*

Brief lists of "high" yielding varieties at Garden City are presented as quick reference to some top-performing crop choices. More complete information on these and other crops is published in Crop Performance Test Reports available at your county extension office. Results follow for: Alfalfa, Barley - Dryland, Barley - Irrigated, Corn, Oats, Sorghum - Dryland, Sorghum - Irrigated, Soybeans, Sunflowers, Wheat - Dryland, Wheat - Irrigated

## CORN HYBRIDS

### GARDEN CITY

| High 10 (3-yr 1990-1992) | Bu/A | % Lodged |
|---|---|---|
| Pioneer 3162 | 241 | 0 |
| Northrup-King N8318 | 239 | 0 |
| Ohlde 300 | 238 | 0 |
| Crow's 682 | 235 | 0 |
| Deltapine G-4673B | 235 | 1 |
| Hoegemeyer 2715 | 233 | 1 |
| Germain GC96008 | 232 | 1 |
| Jacques 8210 | 230 | 0 |
| Northup-King PX9540 | 230 | 0 |
| Oro 190 | 229 | 0 |

| High 10 (2-yr av 1991-1992) | Bu/A | % Lodged |
|---|---|---|
| Coop 2315WC | 252 | 0 |
| Deltapine 4581 | 252 | T |
| ICI (Garst) 8272 | 249 | 0 |
| ICI (Garst) 8315 | 249 | T |
| Ohlde 300 | 249 | 0 |
| Northrup-King N8318 | 244 | 0 |
| Asgrow RX899 | 240 | 0 |
| Crows 682 | 240 | 1 |
| DeKalb DK715 | 240 | 0 |
| Oro 188 | 239 | 0 |
| Pioneer 3162 | 239 | 0 |

### COLBY
(last year data)

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

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

# CORN HYBRIDS CONTINUED

## TRIBUNE

| High 10 (3-yr av) | Bu/A | % Lodged | High 10 (2-yr av) | Bu/A | % Lodged |
|---|---|---|---|---|---|
| Oro 150 | 226 | 3 | Pioneer 3162 | 238 | 1 |
| Northrup-King N6873 | 223 | 1 | Deltapine G-4513 | 236 | 2 |
| Deltapine G-4513 | 223 | 1 | Oro 150 | 234 | 4 |
| Triumph 1265 | 221 | 1 | Bo-jac 613 | 233 | 1 |
| Pioneer 3162 | 219 | 1 | Northrup-King N6330 | 231 | 1 |
| Hyperformer HS 9773 | 219 | 3 | Cargill 8027 | 230 | 2 |
| Cargill 8027 | 219 | 2 | Triumph 1265 | 227 | 1 |
| Cargill6227 | 218 | 1 | Hyperformer HS 9773 | 226 | 5 |
| Triumph 1595 | 218 | 1 | Deltapine G-4513 | 224 | 2 |
| Golden-Acres T-E 6994 | 214 | 1 | Cargill 6227 | 224 | 2 |

# GRAIN SORGHUM—IRRIGATED

## GARDEN CITY

| High 10 (2 yrs. 1990-1991) | 2-yr av | Days to Bloom |
|---|---|---|
| Casterline SR 324E | 128 | 70 |
| Dekalb DK-56 | 126 | 72 |
| DekalbDK-66 | 124 | 75 |
| Groagri GSC1313 | 123 | 68 |
| Jacques 60E | 123 | 69 |
| Casterline X15343EXP | 121 | 76 |
| Groagri GSC3146 | 121 | 70 |
| Deltapine G-1616 | 120 | 69 |
| Garst 5319 | 119 | 70 |
| Hyperformer HSC Cherokee | 119 | 71 |

| High 5 3-yr av | | Days to Bloom |
|---|---|---|
| Dekalb DK 66 | 127 | 75 |
| Casterline SR324E | 126 | 70 |
| Oro G Extra | 120 | 70 |
| Garst 5319 | 118 | 70 |
| Deltapine G1616 | 117 | 69 |
| Asgrow A504 | 53 | 88 |

## COLBY
(last year data)

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

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

## TRIBUNE

| High 10 | 2-yr av | Days to Bloom |
|---|---|---|
| Cargill 837 | 159 | 86 |
| TX3042 XTX2737 | 140 | 76 |
| Dekalb DK-48 | 137 | 83 |
| Dekalb DK-56 | 133 | 86 |
| Asgrow Osage | 131 | 88 |
| Casterline SR319E | 130 | 89 |
| Garrison SG - 942 | 130 | 93 |
| Oro Amigo | 127 | 91 |
| Pioneer 8379 | 123 | 88 |
| Groagri GSC1313 | 122 | 91 |

| High 5 | 3-yr av | Days to Bloom |
|---|---|---|
| Cargill 837 | 152 | 85 |
| Dekalb DK-48 | 147 | 83 |
| Casterline SR319E | 139 | 87 |
| Dekalb DK-56 | 138 | 86 |
| Asgrow Osage | 134 | 87 |
| Oro Amigo | 134 | 89 |

# GRAIN SORGHUM—DRYLAND

## GARDEN CITY

| High 10 (3 yrs. 1990-1992) | Bu/A | Days to 1/2 Bloom |
|---|---|---|
| Casterline SR-319E | 54 | 90 |
| Groagri GSC1214 | 54 | 79 |
| Northrup-King KS-714Y | 54 | 89 |
| Asgrow Sneca | 52 | 82 |
| DekalbDK-41Y | 52 | 81 |
| ICI (Garst) 5511 | 50 | 89 |
| Cargill 575 | 48 | 90 |
| Cargill 630 | 48 | 79 |
| Northup-King KS 383Y | 48 | 77 |
| Trimph TR 58Y | 48 | 89 |
| TX2752 X TX430 | 48 | 90 |

| High 10 | 2-yr av | Days to 1/2 Bloom |
|---|---|---|
| Groagri GSC 1214E | 47 | 79 |
| Hyperformer 1225DR | 45 | 89 |
| Deltapine 1506 | 44 | 84 |
| TX 3042X TX2737 | 44 | 77 |
| Asgrow A504 | 43 | 90 |
| Northrup-King KS 383Y | 43 | 77 |
| DeKalb DK-41Y | 42 | 81 |
| Casterline SR 319E | 42 | 90 |
| Hyperformer HSC 1289C | 41 | 90 |
| Northrup-King KS5556 | 41 | 80 |
| Oro Ivory | 41 | 80 |
| Pioneer 8699 | 41 | 76 |

## TRIBUNE

| High 10 | 2-yr av | Days to Bloom |
|---|---|---|
| Cargill 607 E | 65 | 70 |
| Golden Acres T-EY-60 | 65 | 71 |
| Groagri GSC 1214 E | 61 | 71 |
| TX2752 * TX 2737 | 58 | 70 |
| Pioneer 8601 | 57 | 69 |
| Cargill 630 | 55 | 71 |
| Pioneer 8699 | 55 | 67 |
| Oro Alpha | 54 | 65 |
| Oro Edge | 54 | 65 |
| Deltapine 1506 | 53 | 78 |
| Triumph TR58Y | 53 | 77 |

| High 5 | 3-yr av | Days to Bloom |
|---|---|---|
| Golden Acres T-EY-60 | 60 | 75 |
| Groagri GSC 1214 E | 60 | 75 |
| Cargill 607 E | 59 | 74 |
| Pioneer 8601 | 57 | 72 |
| Pioneer 8699 | 54 | 70 |

## COLBY

(last year data)

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

| High 10 | 3-yr av | Days to Bloom |
|---|---|---|
| Cargill 630 | 95 | 66 |
| NC + Y363 | 95 | 68 |
| Golden Acres T-FY-60 | 94 | 68 |
| Triumph TR60-G | 93 | 70 |
| Pioneer850 | 92 | 67 |
| Asgrow MADERA | 92 | 62 |

## SOYBEANS - IRRIGATED

**(GARDEN CITY)**

| High 5 (3-yr av 1990-1992) | Bu/A | Maturity Group | High 5 (2-yr av 1991-1992) | Bu/A | Maturity Group |
|---|---|---|---|---|---|
| Pioneer 9341 | 47.2 | III | Hoegemeyer 401 | 56.9 | IV |
| Stine 3790 | 60.2 | III | Diamond SC400 | 55.3 | IV |
| DeKalb CX415 | 59.3 | IV | DeKalb CX 458 | 59.6 | IV |
| DeKalb CX458 | 56.5 | IV | Deltapine DP 3456 | 58.1 | IV |
| Deltapine DP3456 | 58.0 | IV | K1190 | 56.4 | IV |

## ALFALFA

**(GARDEN CITY)**

| High 5 | 2 yr av 1991-1992 Tons/A |
|---|---|
| Drussel Reward | 11.34 |
| W-L Research 86-20 | 11.12 |
| ICI 645 | 10.95 |
| Mike Brayton Seeds MBS4112 | 10.87 |
| Dairyland Magnum III | 10.84 |

## SPRING OAT - IRRIGATED

**(GARDEN CITY)**

| High 5 (3-yr av 1990-1992) | Bu/A | High 5 (2-yr av 1991-1992) | Bu/A |
|---|---|---|---|
| Don | 97 | Don | 101 |
| Bates | 92 | Premier | 98 |
| Premier | 91 | Bates | 97 |
| Horicor | 82 | Dane | 88 |
| Dane | 81 | Hazel | 87 |
| | | Ogle | 87 |

# SUNFLOWERS

## (GARDEN CITY)

| High 5 (3-yr av 1989, 1991-1992) | Lbs/A | % Oil | High 5 (2-yr av 1991-1992) | Lbs/A | % Oil |
|---|---|---|---|---|---|
| Triumph 565 | 2462 | 47.1 | Triumph 565 | 3014 | 18.0 |
| Triumph 560A | 2041 | 47.9 | Kaystar 9101 | 2852 | 38.5 |
| ICI Seeds Hysun 33 | 1730 | 42.7 | Kaystar 8807 | 2761 | 46.0 |
| ICI Seeds Hysun 354 | 1529 | 45.2 | Triumph Seed 560A | 2575 | 49.4 |
| Triumph Seed 548A | 1527 | 46.1 | Interstate IS3311 | 2254 | 46.4 |

# WHEAT-DRYLAND

## GARDEN CITY

| High 5 (3-yr av, 1990-1992) | Bu/A | High 5 (2-yr av, 1991-1992) | Bu/A |
|---|---|---|---|
| Quantum 562 | 46 | Arapahoe | 38 |
| Agseco EX9001 Exp | 45 | Quantum 562 | 38 |
| Agseco 7805 | 43 | Agseco 7805 | 37 |
| Karl | 42 | Agseco EX9001 Exp | 37 |
| TAM 200 | 42 | TAM 200 | 36 |

## COLBY

(last year data)

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

## TRIBUNE

| High 5 (3-yr av) (1993,91,90) | Bu/A | High 5 (2-yr av) (1993 , 91) | Bu/A |
|---|---|---|---|
| AGSECO 7805 | 47 | TAM 200 | 50 |
| TAM 200 | 46 | Quantum 562 | 48 |
| Quantum 562 | 45 | AGSECO 7805 | 48 |
| TAM 107 | 44 | Karl | 48 |
| Karl | 44 | TAM 107 | 47 |
| | | Rawhide | 47 |
| | | Cimarron | 47 |
| | | Agripro Tomahawk | 47 |

# WHEAT - IRRIGATED

## GARDEN CITY

| High 5 (3-yr av) | Bu/A | High 5 (2-yr av) | Bu/A |
|---|---|---|---|
| Agripro Sierra | 57 | Cimarron | 77 |
| Agseco 7853 | 57 | Agripro Sierra | 74 |
| 2172 | 57 | 2163 | 74 |
| Karl | 56 | 2172 | 73 |
| TAM 107 | 55 | Agripro Tomahawk | 71 |

## COLBY

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

## TRIBUNE

| High 5 (3-yr av) | Bu/A | High 5 (2-yr av) | Bu/A |
|---|---|---|---|
| TAM 200 | 89 | Agripro Laredo | 93 |
| Cimarron | 83 | TAM 200 | 92 |
| AgriPro Tomahawk | 81 | Ike | 92 |
| AGSECO 7846 | 79 | Cimarron | 89 |
| 2163 | 79 | AGSECO 1846 | 87 |

# WINTER BARLEY - IRIGATED

## (GARDEN CITY)

| High 3 (3-yr av 1990-1992) | Bu/A | High 3 (2-yr av 1991-1992) | Bu/A |
|---|---|---|---|
| Perkins | 70 | Perkins | 84 |
| Post | 70 | Hitchcock | 82 |
| Hitchcock | 65 | Weskan | 76 |

# WINTER BARLEY - DRYLAND

## (GARDEN CITY)

| High 3 (3-yr av 1990-1992) | Bu/A | High 3 (2-yr av 1991-1992) | Bu/A |
|---|---|---|---|
| Post | 46 | Perkins | 55 |
| Hitchcock | 45 | Post | 52 |
| Kanby | 44 | Kanby | 51 |

# ACKNOWLEDGMENTS

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

**Donations:**
Abbott Laboratories
American Cyanamid
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CIBA-GEIGY
DeKalb-Pfizer Genetics
Delta Pine and Land Co.
Finney County
FMC Corporation
Helena Chemical
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Miles, Inc. (Mobay Chemical Corp.)
Monsanto Agricultural Products Co.
Ohlde Seed Farms
Orthman Manufacturing
Pioneer Hi-Bred Intl.
Pueblo Chemical and Supply Co.
Resource Seeds, Inc.
Rhone Poulenc Ag Co.
Ruffin Micronutrient
Senninger Irrigation Inc.
Spink County Equipment
Taylor-Evans Seed Co.
Uniroyal Chemical Co.
Valent USA Corp.
Wilbur-Ellis

**Grant Support:**
ADM
Agrolinz, Inc.
American Cyanamid
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BASF Corp
Cedar Chemical
CIBA-GEIGY
Dow Elanco
E.I. duPont de Nemours and Co., Inc.
FMC Corp.
ICI Americas Inc.
Kansas Agriculture Experiment Station
Lipha Tech, Inc.
Miles, Inc. (Mobay Chemical Corp.)
Monsanto Agricultural Products Co.
Mycogen Corp.
National Crop Insurance Services
Natural Fibers Corp.
Nutra-Flo Co.
Pioneer Hi-Bred Intl.
Potash and Phosphate Institute
Rhone Poulenc Ag. Co.
Ruffin Micronutrient
Sandoz Crop Protection
**State Board of Agriculture:**
Corn Commission
Sorghum Commission
Soybean Commission
SW KS Groundwater Management Dist. #3
Terra International, Inc.
Uniroyal Chemical Co.
United States Department of Agriculture-Cooperative State Research Service
Valent USA Corp.

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Adams Rib
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Jamie Cheatum
Deines Aero Spray, Inc
Robert Drees
Gary Drussel
Garden City Recreation Commission
Jerry Gigot
Terry Gigot
Sam Hands
Randy Huston
KKG Farms
Steve Lobmeyer
Darrel Mangan
Harold Mai
Dan Miller
Tom Miller & Ingalls Aerial Sprayers
Doug Peterson
David Pigg
Michael and Mark Ramsey
Stacey Steward
Peg Steward

**Performance Tests:**
AgriPro Biosciences, Inc.
AGSECO
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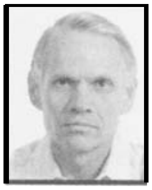

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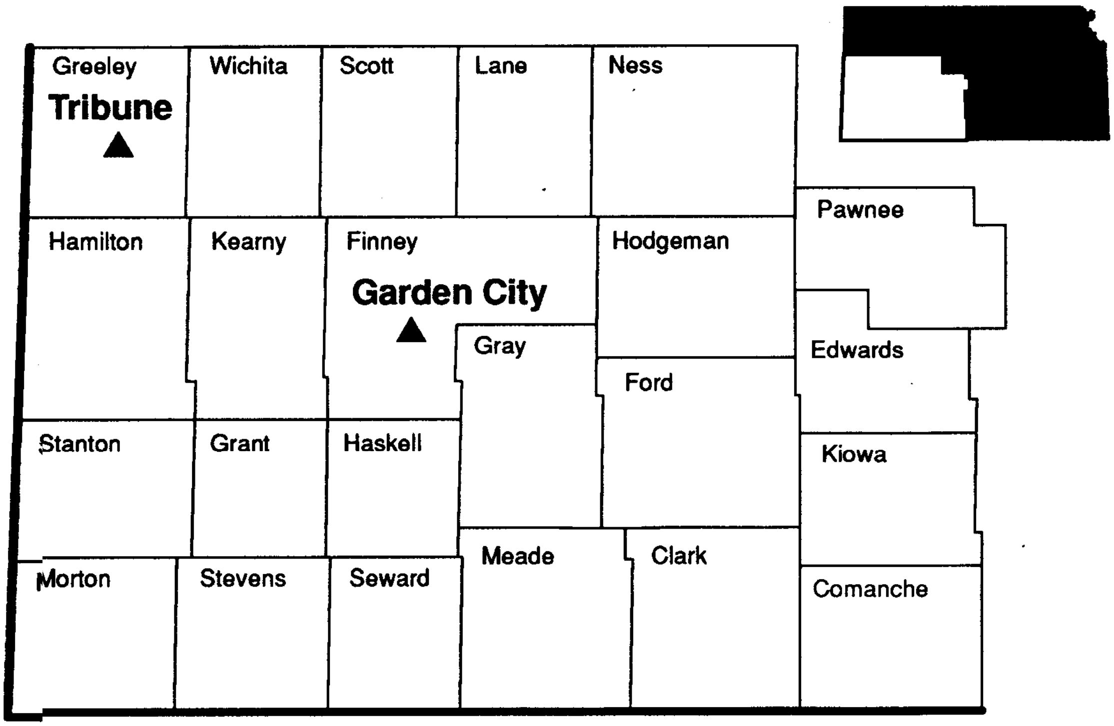


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Report of Progress 689 August 1993

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