# FIELD DAY 2003


Southwest Research–Extension Center

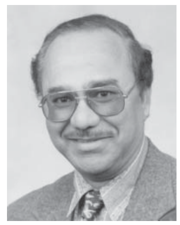
## Report of Progress 910

*Kansas State University*
*Agricultural Experiment Station*
*and Cooperative Extension Service*

**Pat Coyne**—Center Head. B.S. degree, Kansas State University, 1966; Ph.D. degree, Utah State University, 1969. He joined the KSU faculty in 1985 as Head of the Agricultural Research Center—Hays. He was appointed head of the three western Kansas ag research centers at Hays, Garden City, and Colby in 1994. Research interests have focused on plant physiological ecology and plant response to environmental stress.

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

**Conall Addison**—Extension Specialist, 4-H Youth Development. Conall received an accounting degree from Tulsa University in 1966. He followed with a BS in Animal Science in 1970, and an MS in Animal Breeding in 1972, both from Oklahoma State University. Conall started his Extension career as a 4-H agent in Wagoner County Oklahoma. In 1974 he moved to Stafford County Kansas where he served as the County Agriculture Agent. He was appointed in 1995 to his current position in Garden City where he focuses on Youth Development programs for the 24 SW Area Counties.



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

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

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

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

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

# CONTENTS

# 2003 RESEARCH-EXTENSION CENTER STAFF

| | |
|---|---|
| Patrick Coyne | Head |
| Paul Hartman | Area Extension Director |
| Conall Addision | Extension Specialist, 4-H Youth Development |
| Mahbub Ul Alam | Extension Specialist, Irrigation |
| Dewayne Bond | Assistant Scientist |
| Larry Buschman | Corn Entomologist |
| Randall Currie | Weed Scientist |
| Les DePew | Professor Emeritus |
| Troy Dumler | Extension Agricultural Economist |
| Jeff Elliott | Research Farm Manager |
| Andy Erhart | Professor Emeritus |
| Jaycie Fidel | Extension Specialist, Family Nutrition Program |
| Gerald Greene | Professor Emeritus |
| Ron Hale | Extension Specialist, Animal Production |
| George Herron | Professor Emeritus |
| Norman Klocke | Irrigation Engineer |
| Ray Mann | Professor Emeritus |
| Charles Norwood | Professor Emeritus |
| Alan Schlegel | Agronomist-in-Charge, Tribune |
| Phil Sloderbeck | Extension Specialist, Entomology |
| Curtis Thompson | Extension Specialist, Crops and Soils |
| Tom Willson | Environmental Scientist |
| Merle Witt | Agronomist-Crop Production |
| Carol Young | Extension Specialist, Family and Consumer Sciences |

# 2003 SUPPORT PERSONNEL

Jovita Baier, Administrative Specialist
Melanie Brant, Senior Administrative Assistant
Mary Embree, Accountant I
Manuel Garcia, Gen. Maintenance & Repair Tech. II
Dallas Hensley, Agricultural Technician
Roberta Huddleston, Senior Administrative Assistant
William Irsik, Equipment Mechanic Senior
Ruby Long, Plant Science Technician I
Henry Melgosa, Plant Science Technician II
Steve Michel, Agricultural Technician
Gary Miller, Plant Science Technician II
Dale Nolan, Plant Science Technician II - Tribune
Eva Rosas, Administrative Specialist
David Romero, Jr., Equipment Mechanic
Jeff Slattery, Agricultural Technician - Tribune
Ramon Servantez, Plant Science Technician II
Monty Spangler, Agricultural Technician
Dennis Tomsicek, Plant Science Technician II
John Wooden, Plant Science Technician II

Southwest Research-Extension Center
4500 East Mary, Bldg. 947
Garden City, KS 67846
620-276-8286
Fax No. 620-276-6028

Note: Trade names are used to identify products. No endorsement is intended, nor is any criticism implied of similar products not mentioned.

Contribution 03-323-J from the Kansas Agricultural Experiment Station.

# WEATHER INFORMATION FOR GARDEN CITY 2002

*by*
*Jeff Elliott*

Precipitation for 2002 totaled 11.99 inches, which was 6.8 inches below the 30-year average. It was the driest year since 1988, as well as the fourth driest since the 1950's. Only two months in 2002, October and December, had above average precipitation. During the 12-month period ending with July 2002, we recorded 9.18 inches of precipitation. Since we began keeping records in 1908, only 1934-35 was drier for August-July with 8.98 inches. Snowfall measured 16.6 inches, which was 1.1 inches below normal.

Once again, July was the warmest month with a mean temperature of 80.0 °F, which was 2.6 degrees above the 30-year average. As usual, January was the coldest with an average temperature of 32.0 °F compared to 28.4 °F for the mean.

The minimum daily temperature was below zero on two occasions in 2002, with the lowest being a minus 2 °F recorded March 3. Triple digit temperatures were recorded on 18 days, eight of which occurred in July. The highest temperature recorded was 105 °F on June 3 and again on July 26.

One record low temperature was recorded in 2002 on August 13, 54 °F. Record highs were reached on January 9, 77 °F, January 27, 74 °F, and January 28, 72 °F. Other record high temperatures were recorded on April 16, 96 °F, as well as on June 1, 2, and 3, with 102, 102, and 105 °F, respectively. A record 105 °F was tied on July 26, with another record tied at 103 °F on August 19. The all time temperature extremes recorded at the Research Center were minus 22 °F, recorded in January 1984, and 111 °F recorded in July 1913 and July 1934.

The last spring freeze (31 °F) was on April 25, one day earlier that normal. The first freeze in the fall (32 °F) was on October 13, two days later than normal. This resulted in a frost-free period of 170 days, compared to an average of 167 days.

Open pan evaporation for the months of April through October totaled over 78 inches, compared to 70.6 inches in an average year. Mean wind speed was 5.19 mph, which was similar to the long term average.

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

| | Precipitation inches | | Temperature (°F) 2002 Average | | Mean | | 2002 Extreme | | Wind MPH | | Evaporation inches | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | 2002 | Avg. | Max. | Min. | 2002 | Avg. | Max. | Min. | 2002 | Avg. | 2001 | Avg. |
| January | 0.41 | 0.43 | 49.1 | 14.9 | 32.0 | 28.4 | 77 | -1 | 3.79 | 4.68 | | |
| February | 0.48 | 0.48 | 49.5 | 18.9 | 34.2 | 33.7 | 76 | 4 | 5.33 | 5.39 | | |
| March | 0.03 | 1.38 | 56.2 | 20.6 | 38.4 | 42.3 | 80 | -2 | 6.42 | 6.72 | | |
| April | 1.17 | 1.65 | 71.0 | 40.4 | 55.7 | 52.1 | 96 | 22 | 6.85 | 6.73 | 9.82 | 8.35 |
| May | 0.91 | 3.39 | 77.9 | 47.7 | 62.8 | 62.0 | 95 | 34 | 7.19 | 6.04 | 12.20 | 9.93 |
| June | 1.16 | 2.88 | 93.5 | 63.8 | 78.7 | 72.4 | 105 | 51 | 7.16 | 5.59 | 15.61 | 12.32 |
| July | 2.45 | 2.59 | 94.1 | 65.8 | 80.0 | 77.4 | 105 | 55 | 5.03 | 4.85 | 14.90 | 13.41 |
| August | 2.15 | 2.56 | 90.6 | 63.0 | 76.8 | 75.5 | 103 | 50 | 5.38 | 4.17 | 13.10 | 11.19 |
| September | 0.82 | 1.25 | 83.5 | 54.0 | 68.7 | 67.0 | 97 | 38 | 4.83 | 4.63 | 9.80 | 8.88 |
| October | 1.84 | 0.91 | 61.9 | 37.7 | 49.8 | 54.9 | 92 | 25 | 4.39 | 4.84 | 4.64 | 6.52 |
| November | 0.10 | 0.86 | 56.2 | 26.6 | 41.4 | 40.5 | 77 | 10 | 3.30 | 4.86 | | |
| December | 0.47 | 0.41 | 47.9 | 19.5 | 33.7 | 31.3 | 67 | 5 | 2.56 | 4.47 | | |
| **Annual** | **11.99** | **18.79** | **69.3** | **39.4** | **54.4** | **53.1** | **105** | **-2** | **5.19** | **5.25** | **80.07** | **70.60** |

| | | | |
|---|---|---|---|
| Average latest freeze in spring | April 26 | 2002: | April 25 |
| Average earliest freeze in fall | Oct. 11 | 2002: | October 13 |
| Average frost-free period | 167 days | 2002: | 170 days |

All averages are for the period 1971-2000.

K-STATE

Southwest Research-Extension Center

# WEATHER INFORMATION FOR TRIBUNE

*by*

*Dewayne Bond and Dale Nolan*

Precipitation was 7.43 inches below normal for a yearly total of 10.01 inches, with 11 months having below normal precipitation. October was the wettest month with 3.59 inches. The largest single amount of precipitation was 1.21 inches on September 10. March and December were the driest months with 0.07 inches of precipitation. Snowfall for the year totaled 12.1 inches; 6.8 inches in January, 2.0 inches in February, 0.5 inches in March, 1.3 inches in October and 1.5 inches in December for a total of fifteen days snow cover. The longest consecutive period of snow cover, 4 days, occurred from January 31 to February 3.

Record high temperatures were recorded on 8 days: January 9, 75 °F; February 24, 75 °F; April 16, 96 °F; June 1, 2, and 3, 105 °F; July 26, 106 °F; and August 19, 105 °F. August 1 tied a record of 104 °F set in 1980. Record low temperatures were set May 25, 34 °F and August 18, 48 °F. The hottest day of the year was July 26, 106 °F. July was the warmest month with a mean temperature of 78.7 °F and an average high of 95.3 °F. The coldest day of the year was March 3, -4 °F. January was the coldest month of the year with a mean temperature of 31.6 °F and an average low of 15.0 °F.

For 10 months, the air temperature was above normal. June and October had the greatest departures from normal, 6.5 °F above and 4.6 °F below, respectively. There were 23 days of 100 °F or above temperatures, 13 days above normal. There were 77 days of 90 °F or above temperatures, 15 days above normal. The last day of 32 °F or less in the spring, April 28, was 8 days earlier than the normal date, and the first day of 32 °F or less in the fall, October 13, was 10 days later than the normal date. This produced a frost-free period of 168 days, 18 days more than the normal of 150 days.

April through September open pan evaporation totaled 87.56 inches, 16.91 inches above normal. Wind speed for the same period averaged 6.7 mph, 1.2 mph more than normal.

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

| | Precipitation inches | | Temperature (°F) 2002 Average | | Normal | | 2002 Extreme | | Wind MPH | | Evaporation inches | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | 2002 | Normal | Max. | Min. | Max. | Min. | Max. | Min. | 2002 | Avg. | 2002 | Avg. |
| January | 0.39 | 0.45 | 48.2 | 15.0 | 42.2 | 12.8 | 75 | -2 | | | | |
| February | 0.11 | 0.52 | 49.9 | 18.1 | 48.5 | 17.1 | 75 | 0 | | | | |
| March | 0.07 | 1.22 | 54.0 | 19.3 | 56.2 | 24.2 | 78 | -4 | | | | |
| April | 0.38 | 1.29 | 71.1 | 35.6 | 65.7 | 33.0 | 96 | 19 | 6.6 | 6.3 | 10.80 | 8.28 |
| May | 1.19 | 2.76 | 78.1 | 45.7 | 74.5 | 44.1 | 96 | 33 | 6.8 | 5.8 | 14.58 | 10.88 |
| June | 1.04 | 2.62 | 93.1 | 61.2 | 86.4 | 54.9 | 105 | 47 | 7.4 | 5.3 | 18.97 | 13.88 |
| July | 0.33 | 3.10 | 95.3 | 62.2 | 92.1 | 59.8 | 106 | 54 | 6.4 | 5.4 | 17.48 | 15.50 |
| August | 1.43 | 2.09 | 91.6 | 60.7 | 89.9 | 58.4 | 105 | 48 | 6.8 | 5.0 | 15.27 | 12.48 |
| September | 1.30 | 1.31 | 81.5 | 51.3 | 81.9 | 48.4 | 95 | 35 | 6.3 | 5.2 | 10.46 | 9.63 |
| October | 3.59 | 1.08 | 61.2 | 34.8 | 70.0 | 35.1 | 87 | 20 | | | | |
| November | 0.11 | 0.63 | 54.4 | 27.3 | 53.3 | 23.1 | 73 | 8 | | | | |
| December | 0.07 | 0.37 | 50.6 | 20.4 | 44.4 | 15.1 | 69 | 10 | | | | |
| **Annual** | **10.01** | **17.44** | **69.2** | **37.7** | **67.1** | **35.5** | **106** | **-4** | **6.7** | **5.5** | **87.56** | **70.65** |

| | | | |
|---|---|---|---|
| Average latest freeze in spring[1] | May 6 | 2002: | April 28 |
| Average earliest freeze in fall | October 3 | 2002: | October 13 |
| Average frost-free period | 150 days | 2002: | 168 days |

[1]Latest and earliest freezes recorded at 32 °F. Average precipitation and temperature are 30-year averages (1971-2000) calculated from National Weather Service. Average temperature, latest freeze, earliest freeze, wind, and evaporation are for the same period calculated from station data.

K-STATE

Southwest Research-Extension Center

# SOIL PROPERTIES AFTER 40 YEARS OF FERTILIZATION

*by*
*Alan Schlegel*

## SUMMARY

Soil organic matter was increased by N and P fertilization. Soil pH was decreased by increased N rates. Application of 40 lb $P_2O_5$/a was not sufficient to maintain soil test P levels for corn but was sufficient for grain sorghum. Soil test P levels increased when 80 lb $P_2O_5$/a was applied to corn. Soil test K levels were increased by K fertilization of grain sorghum.

## INTRODUCTION

This study was initiated in 1961 to determine responses of continuous corn and grain sorghum grown under flood irrigation to N, P, and K fertilization. This long-term research project has shown that phosphorus (P) and nitrogen (N) fertilizer must be applied to optimize production of irrigated corn and grain sorghum in western Kansas. Soil chemical properties in the surface soil were determined after 40 years of fertilization.

## PROCEDURES

Initial fertilizer treatments in 1961 to corn and grain sorghum in adjacent fields were N rates of 0, 40, 80, 120, 160, and 200 lb N/a without P and K; with 40 lb $P_2O_5$/a and zero K; and with 40 lb $P_2O_5$/a and 40 lb $K_2O$/a. In 1992, the treatments for the corn study were changed with the K variable being replaced by a higher rate of P (80 lb $P_2O_5$/a). All fertilizers were broadcast by hand in the spring and incorporated prior to planting. The soil is a Ulysses silt loam. Both studies were irrigated to minimize water stress. Soil samples (0-6 inches) were taken in both studies after 40 years of annual fertilization.

## RESULTS AND DISCUSSION

Long-term N applications decreased soil pH for both corn and grain sorghum (Tables 1 and 2). Soil pH was 0.5 units less in corn and 0.8 units less in grain sorghum with 200 lb N/a compared with zero N. Phosphorus fertilization had no effect on soil pH. Both N and P fertilization increased soil organic matter content. Nitrogen fertilization of corn increased organic matter content from 2.1% without N to 2.4% with the highest N rate. Similar trends were observed with grain sorghum. In the corn study, soil test P was 8 ppm higher with 40 lb/a $P_2O_5$ than without P (12 vs. 4 ppm Bray 1-P), but still less than at the start of the study (17 ppm Bray 1-P in 1961). Application of 80 lb/a $P_2O_5$ for 9 years to corn increased soil test P to 21 ppm. In the sorghum study, annual applications of 40 lb/a $P_2O_5$ increased soil test P levels to above 20 ppm indicating that this rate was more than adequate for crop growth. Also in the sorghum study, soil test P increased with increasing N rates. Since the N fertilizer supplied no P to the soil, this may be a reflection of the N fertilizer reducing soil pH, which may have affected the Bray 1-P soil test. Averaged across N rates, K fertilization increased soil K levels by 70 ppm.

**Table 1. Soil properties after 40 years of N and P fertilizer applications to irrigated corn, Tribune, KS.**

| Nitrogen | $P_2O_5$ | pH | OM | Bray-1 P |
|---|---|---|---|---|
| - - - - - - - - - -lb/a | - - - - - - - - - - | | % | ppm |
| 0 | 0 | 7.9 | 2.0 | 2 |
| 0 | 40 | 7.9 | 2.1 | 16 |
| 0 | 80 | 7.9 | 2.1 | 25 |
| 40 | 0 | 7.9 | 2.2 | 4 |
| 40 | 40 | 7.9 | 2.2 | 12 |
| 40 | 80 | 7.8 | 2.2 | 22 |
| 80 | 0 | 7.8 | 2.2 | 6 |
| 80 | 40 | 7.7 | 2.3 | 10 |
| 80 | 80 | 7.8 | 2.3 | 23 |
| 120 | 0 | 7.8 | 2.2 | 3 |
| 120 | 40 | 7.8 | 2.2 | 10 |
| 120 | 80 | 7.8 | 2.2 | 17 |
| 160 | 0 | 7.7 | 2.2 | 4 |
| 160 | 40 | 7.6 | 2.4 | 13 |
| 160 | 80 | 7.6 | 2.4 | 17 |
| 200 | 0 | 7.5 | 2.3 | 5 |
| 200 | 40 | 7.5 | 2.4 | 11 |
| 200 | 80 | 7.4 | 2.4 | 26 |
| MEANS | | | | |
| N, lb/a | 0 | 7.9 | 2.1 | 14 |
| | 40 | 7.9 | 2.2 | 13 |
| | 80 | 7.8 | 2.3 | 13 |
| | 120 | 7.8 | 2.2 | 10 |
| | 160 | 7.6 | 2.3 | 11 |
| | 200 | 7.4 | 2.4 | 14 |
| | $LSD_{0.05}$ | 0.1 | 0.1 | 3 |
| $P_2O_5$, lb/a | 0 | 7.7 | 2.2 | 4 |
| | 40 | 7.7 | 2.3 | 12 |
| | 80 | 7.7 | 2.3 | 21 |
| | $LSD_{0.05}$ | 0.1 | 0.1 | 2 |

**Table 2. Soil properties after 40 years of N, P, and K fertilizer applications to irrigated grain sorghum, Tribune, KS.**

| Nitrogen | $P_2O_5$ | $K_20$ | pH | OM | Bray-1 P | K |
|---|---|---|---|---|---|---|
| - - - - - - - lb/a - - - - - | | | | % | - - - - - - - - ppm | - - - - - - - |
| 0 | 0 | 0 | 7.7 | 2.2 | 5 | 636 |
| 0 | 40 | 0 | 7.6 | 2.2 | 23 | 625 |
| 0 | 40 | 40 | 7.6 | 2.2 | 20 | 688 |
| 40 | 0 | 0 | 7.6 | 2.2 | 5 | 640 |
| 40 | 40 | 0 | 7.2 | 2.4 | 17 | 652 |
| 40 | 40 | 40 | 7.4 | 2.2 | 23 | 747 |
| 80 | 0 | 0 | 7.1 | 2.3 | 10 | 653 |
| 80 | 40 | 0 | 7.3 | 2.4 | 26 | 657 |
| 80 | 40 | 40 | 7.3 | 2.4 | 23 | 717 |
| 120 | 0 | 0 | 7.3 | 2.3 | 8 | 652 |
| 120 | 40 | 0 | 7.1 | 2.4 | 27 | 661 |
| 120 | 40 | 40 | 7.1 | 2.5 | 36 | 747 |
| 160 | 0 | 0 | 7.0 | 2.2 | 11 | 622 |
| 160 | 40 | 0 | 6.9 | 2.3 | 34 | 657 |
| 160 | 40 | 40 | 7.0 | 2.4 | 24 | 704 |
| 200 | 0 | 0 | 6.8 | 2.4 | 22 | 657 |
| 200 | 40 | 0 | 6.9 | 2.4 | 28 | 618 |
| 200 | 40 | 40 | 6.8 | 2.5 | 34 | 692 |
| MEANS | | | | | | |
| N, lb/a | | 0 | 7.6 | 2.2 | 16 | 650 |
| | | 40 | 7.4 | 2.3 | 15 | 680 |
| | | 80 | 7.2 | 2.4 | 19 | 675 |
| | | 120 | 7.2 | 2.4 | 23 | 687 |
| | | 160 | 7.0 | 2.3 | 23 | 661 |
| | | 200 | 6.8 | 2.4 | 28 | 656 |
| | | $LSD_{0.05}$ | 0.2 | 0.1 | 7 | 27 |
| $P_2O_5$-$K_20$, lb/a | | 0 | 7.3 | 2.3 | 10 | 643 |
| | | 40-0 | 7.2 | 2.4 | 26 | 645 |
| | | 40-40 | 7.2 | 2.4 | 26 | 716 |
| | | $LSD_{0.05}$ | 0.2 | 0.1 | 5 | 19 |

# SOIL PROPERTIES AFTER APPLICATION OF ANIMAL WASTES[1]

*by*
*Alan Schlegel, Lloyd Stone[2], and H. Dewayne Bond*

## SUMMARY

This study evaluated established best management practices for land application of animal wastes on crop productivity and soil properties. Swine (effluent water from a lagoon) and cattle (solid manure from a beef feedlot) wastes were applied at rates to meet corn P or N requirements along with a rate double the N requirement. Other treatments included rates of N fertilizer (data not shown) and an untreated control. Soil test P was increased by application of both cattle and swine wastes, but particularly so with cattle manure. Application of both animal wastes significantly increased nitrate-N accumulation in the soil profile, with some movement of nitrate-N below the crop root zone. The greatest amounts of residual nitrate-N were observed following over-application of cattle manure (2xN rate) or application of swine effluent based on crop P requirements. Soil organic carbon levels were considerably increased by application of cattle manure, while application of swine effluent had much less effect on soil C. Limiting application rates and monitoring soil test P levels are suggested practices for effective utilization of animal wastes for crop production.

## INTRODUCTION

The potential for animal wastes to recycle nutrients, build soil quality, and increase crop productivity is well established. A concern with land application of animal wastes is that excessive applications may damage the environment though excessive accumulation (and subsequent loss) of nutrients. This study evaluated established best management practices for land application of animal wastes on crop productivity and soil properties.

## PROCEDURES

This study was initiated in 1999. The two most common animal wastes in western Kansas were evaluated; solid cattle manure from a commercial beef feedlot and effluent water from a lagoon on a commercial swine facility. The rate of waste application was based on the amount needed to meet the estimated crop P requirement, crop N requirement, or twice the N requirement with allowances for residual soil nutrients (Table 1) and nutrient content of the wastes (Table 2). Other treatments were rates of N fertilizer (data not shown) along with an untreated control. Soil test P and organic C levels were determined in the surface soil (0-6 in.) and residual nitrate-N in the profile (0-8 ft) in the fall of 2002 after four annual applications of animal wastes.

## RESULTS AND DISCUSSION

Soil test P was increased more from application of cattle manure than swine effluent (Table 3). Soil test P was greatest when cattle manure was applied at the 2xN rate (106 ppm compared with 21 ppm in the control). Soil test P levels were 6 to 25 ppm higher following application of swine effluent than the untreated control. Although these levels of soil test P (even the levels observed when applying cattle manure at the 2xN rate) are not hazardous to plant growth and are below the threshold values established to limit application of swine wastes from larger operations, they do show the need to monitor soil test P levels when applying animal wastes. A positive impact from application of cattle manure was increased soil organic C levels, reflecting the greater amounts of C in solid manure than in lagoon effluent.

[1]The project was partially supported by funds from KDHE and KCARE.
[2]Department of Agronomy, Kansas State University, Manhattan.

Application of both swine effluent and cattle manure greatly increased the amount of residual nitrate-N throughout the profile (Table 4). Although there was considerable accumulation of nitrate-N in the surface 2 ft, this N is readily available for crop use. Crop roots may also utilize nitrate-N in the 2-5 ft depth. However, nitrate-N that has moved below 5 ft probably is not available for crop use as it is beyond the effective rooting depth of corn. As expected, cattle manure applied at the 2xN rate caused the greatest accumulation of residual nitrate-N. However, with swine effluent the P-based application rate resulted in greater accumulation of nitrate-N than the 2xN rate. This corresponds to the greater amount of total effluent applied (Table 1) when application rates for swine effluent are P-based rather than N-based.

**Table 1. Application rates of animal wastes, Tribune, KS, 1999 to 2002.**

| Application basis | Cattle manure | | | | Swine effluent | | | |
|---|---|---|---|---|---|---|---|---|
| | ton/a | | | | 1000 gal/a | | | |
| | 1999 | 2000 | 2001 | 2002 | 1999 | 2000 | 2001 | 2002 |
| P requirement | 15.0 | 4.1 | 6.6 | 5.8 | 28.0 | 75.0 | 62.0 | 63.4 |
| N requirement | 15.0 | 6.6 | 11.3 | 11.4 | 28.0 | 9.4 | 38.0 | 0 |
| 2XN requirement | 30.0 | 13.2 | 22.6 | 22.8 | 56.0 | 18.8 | 76.0 | 0 |

**Table 2. Analysis of animal waste, Tribune, KS, 1999 to 2002.**

| Nutrient content | Cattle manure | | | | Swine effluent | | | |
|---|---|---|---|---|---|---|---|---|
| | lb/ton | | | | lb/1000 gal | | | |
| | 1999 | 2000 | 2001 | 2002 | 1999 | 2000 | 2001 | 2002 |
| Total N | 27.2 | 36.0 | 33.9 | 25.0 | 8.65 | 7.33 | 7.83 | 11.62 |
| Total $P_2O_5$ | 29.9 | 19.6 | 28.6 | 19.9 | 1.55 | 2.09 | 2.51 | 1.60 |

**Table 3. Soil P and organic C levels after four annual applications of animal waste, fall 2002.**

| Nutrient source | Application Basis | Bray 1-P | Organic C |
|---|---|---|---|
| | | ppm | % |
| Cattle | P | 59 | 1.52 |
| Manure | N | 99 | 1.64 |
| | 2 X N | 106 | 1.96 |
| Swine | P | 46 | 1.39 |
| Effluent | N | 27 | 1.26 |
| | 2 X N | 32 | 1.34 |
| Control | 0 | 21 | 1.21 |

**Table 4. Profile nitrate-N content after four annual applications of animal waste, fall 2002.**

| Nutrient source | Application Basis | Nitrate-N | | |
|---|---|---|---|---|
| | | 0-2 ft | 2-5 ft | 5-8 ft |
| | | | lb/acre | |
| Cattle | P | 276 | 56 | 40 |
| Manure | N | 346 | 310 | 107 |
| | 2 X N | 610 | 429 | 77 |
| Swine | P | 801 | 272 | 64 |
| effluent | N | 277 | 141 | 179 |
| | 2 X N | 269 | 215 | 106 |
| Control | 0 | 11 | 4 | 11 |

# SOYBEAN AND GRAIN SORGHUM IRRIGATION—SUMMER 2002

*by*
*Norman Klocke*

## SUMMARY

Irrigation needs to be scheduled during dry years using soil water and crop water use as indicators for irrigation needs. This field study demonstrated that over-irrigation can occur when system capacity can apply irrigation in excess of crop demand. Grain sorghum and soybean crops tended to maximize yields with a total of 15 inches of applied irrigation water. This included 3 inches after planting to encourage early development in dry root zones. The plots receiving no further irrigation utilized significant stored soil water during the growing season but experienced reduced yields. Plots receiving 17 and 21 inches of irrigation tended to produce less grain than the plots receiving 15 inches. These plots were also suspected to have growing season leaching due to the apparent increase in calculated evapotranspiration (ET) with no increase in yield. In addition, off season leaching is dependent on irrigation management and how dry the root zone is at the end of the irrigation season. This requires management of irrigation to match crop water needs. Over-irrigating and leaching during the growing season should be avoided; moreover, leaving room for off-season rain will reduce off-season leaching potential. This study showed that achieving both of these goals and optimizing yields at the same time is challenging for irrigation management.

## INTRODUCTION

The 2002 cropping season was unusually dry and was preceded by an unusually dry winter and spring. Rainfall from planting until harvest totaled 5.9 inches, about half of normal, but planting was delayed until May 29, after a storm totaling 0.67 inch of rainfall. This rain was just enough to allow germination and adequate emergence in dry soil.

The irrigation study was designed to study the relationship of grain yields to the amount of water applied to soybean and grain sorghum. The irrigation management scheme for the study was to schedule irrigations according to crop growth stages and vary application depths according to prescribed allocations. Management is often driven by water allocations, especially in dry years. As water allocations become more restrictive, irrigation management will need to respond with strategies to maximize yields within these constraints. Irrigation scheduling, or the timing of water applications from soil water and crop water use information (ET), will be important. Timing irrigations by the stage of growth will also be important because past research indicates that flowering and seed fill stages are critical for reducing water stress with respect to potential grain yield in annual crops. The objective of this study was to determine the grain yield responses from a range of water allocations with stage of growth irrigation management.

## PROCEDURES

A subsurface drip irrigation (SDI) system was used to deliver the water. The drip tapes were buried 14 inches beneath the surface and spaced 5 feet apart. However, the irrigation system was not the central issue of this research and could just as well have been a center pivot. The SDI system was managed like a center pivot because water was applied in 1 inch increments, which was not to the best advantage of the SDI system. However, this methodology will continue to be used in future irrigation experiments.

The plots were planted on May 29 into the only surface moisture available during the spring. Immediately after planting, all treatments received 3 inches of water to help with the emergence and early growth of the crop since soil conditions were so dry. The application depth was large to encourage capillary rise of water nearer to the surface. This irrigation simulated wetter soil water conditions at the start of the growing season that actually occurred in 2002. Subsequent irrigations were delayed in all treatments as a result of this “pre-wetting” of the root zone.

Water treatments are outlined in Table 1. Target irrigation amounts were set for each stage of growth. These amounts were not necessarily applied if soil water depletions did not warrant irrigating. A depletion of 50% of the available soil water in the active root zone was the threshold for irrigation. This was the case for the 21- and 17-inches application treatment for both grain sorghum and soybean during vegetative and seed fill growth stages.

**Table 1. 2002 Holcomb grain sorghum and soybean irrigation.**

| Irrigation Total * | Irrigation by Growth Stage: Vegetative | Flower | Seed Fill |
|---|---|---|---|
| | Inches | | |
| Sorghum | | | |
| 21 | 4 | 10 | 4 |
| 17 | 4 | 6 | 4 |
| 15 | 4 | 4 | 4 |
| 10 | 3 | 2 | 2 |
| 4 | 1 | 0 | 0 |
| Soybean | | | |
| 21 | 4 | 10 | 4 |
| 17 | 4 | 6 | 4 |
| 15 | 4 | 4 | 4 |
| 10 | 3 | 2 | 2 |
| 3 | 0 | 0 | 0 |

* Included 3-inches blanket irrigation after planting.

## RESULTS AND DISCUSSION

The soybean and grain sorghum treatments, which received 15 inches of irrigation including the post-planting application, tended to have the highest grain yields (Figures 1 and 2). However, variability in yields within irrigation treatments showed that there were no differences among the means for grain yield with irrigations of 10, 15, 17, and 21 inches for grain sorghum or soybean. Only the treatments receiving the 3 inches pretreatment irrigation stood alone statistically. Higher irrigation applications tended to produce slightly lower grain yields than the 15-inches treatment.

Soybean yields also suffered from high pH soil conditions and chlorosis during the growing season. This may have affected the potential yield of the plots as a whole, but the plots were randomized to minimize these effects. The growing season for the soybean and grain sorghum was shortened somewhat due to the late planting date.

Calculations of evapotranspiration (ET) for both grain sorghum and soybean indicated higher apparent values of ET for the 17- and 21-inches treatments than the 15-inches treatment (Figures 3 and 4). These calculations were made on the basis of changes in soil water storage, rainfall received, irrigation applied, and the assumption of no water leaching past the root zone. The ET values for the grain sorghum and soybean 17-inches treatments were 15.9 and 19.4 inches, respectively, which were somewhat lower than expected. However, the growing season was shorter than normal and the SDI system can be efficient in delivering water to the crop and reducing the evaporation component of ET. If the 15-inches application satisfied maximum ET, the 17-inches treatment had 1.5 inches of excess water and the 21-inches treatment had 4.5 inches of excess water. Without instrumentation to confirm this assumption, we suspect leaching in the higher water application treatments and less desirable growing conditions for the plant roots.

Initial and final soil water depletion information for 4 and 8 feet of soil depth are summarized in Table 2. Initial soil water depletion measurements were taken after the initial application of 3 inches of water to all treatments. Significant soil water was mined by the lowest irrigation treatments for both soybean and sorghum. This use of stored soil water contributed to the yields produced by these treatments. The soil water depletion by the 21-, 17-, and 15-inches treatments took place mostly during September after irrigation ceased and the crops matured.

Soil water depletion at the end of the growing season is one of the factors in curtailing leaching and groundwater contamination during the following spring. With normal off season rainfall/snowmelt of 10 inches, the 21-, 17-, and 15-inches irrigation treatments could only store 2-3 inches of additional water in the top 4 feet of soil, where the bulk of next year's roots will draw water. This will leave the possibility for off-season leaching.

Acknowledgements:
This project was made possible by the work of a team of Kansas State research technicians: Dennis Tomsicek, John Wooden, and Dallas Hensley.

**Figure 1. Mean grain yields and 90% confidence intervals for grain sorghum across irrigation treatments.**

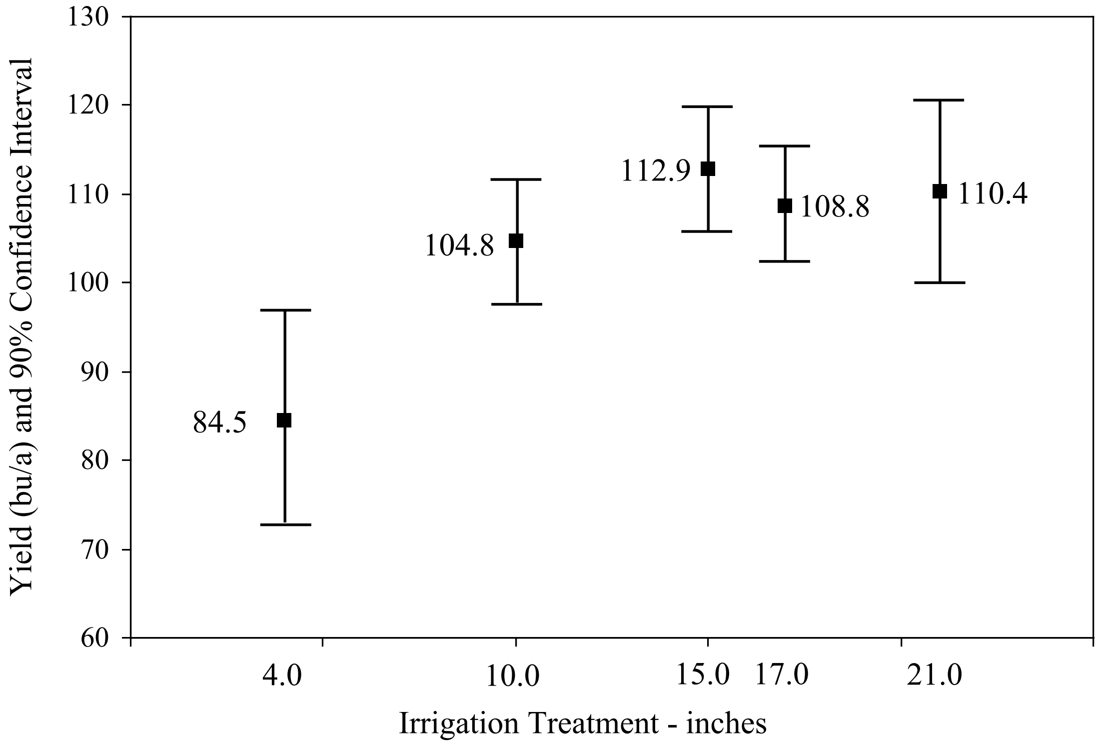



**Figure 2. Mean grain yields and 90% confidence intervals for soybean across irrigation treatments.**

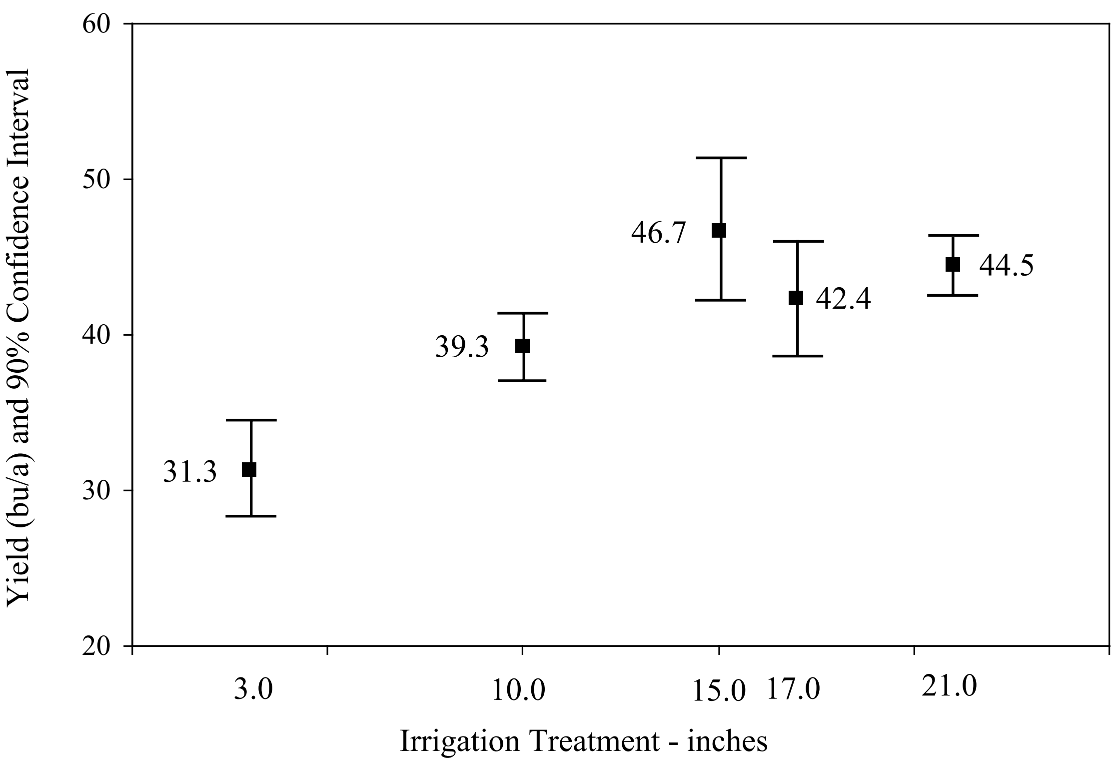
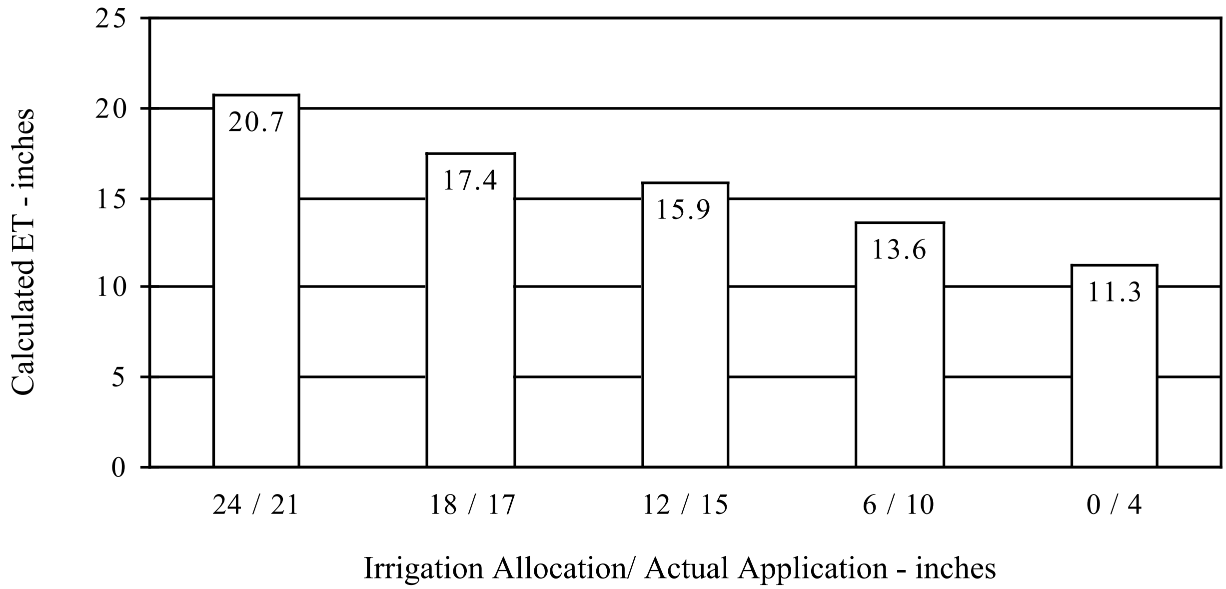


**Figure 3. 2002 SDI grain sorghum calculated ET.**




---

**Figure 4. 2002 SDI soybean calculated ET.**

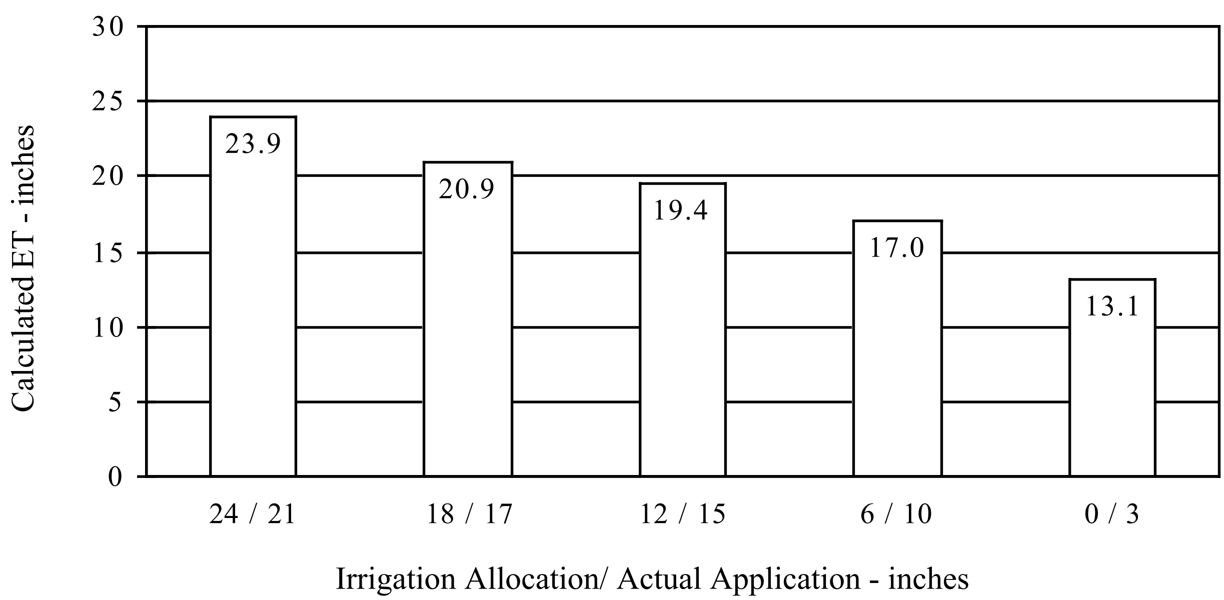


**Table 2. Soil water depletion from field capacity in 4 ft and 8 ft soil profiles and soil water used.**

| Irrigation Treatment | Depletion on 7/18/2002 | | Depletion on 10/7/2002 | | Soil Water Used | |
|---|---|---|---|---|---|---|
| | 4 ft | 8 ft | 4 ft | 8 ft | 4 ft | 8 ft |
| | Inches | | | | | |
| Grain Sorghum | | | | | | |
| 21 | 2.2 | 4.6 | 2.3 | 5.0 | 0.1 | 0.4 |
| 17 | 2.5 | 5.2 | 2.9 | 6.4 | 0.4 | 1.2 |
| 15 | 2.2 | 4.4 | 2.7 | 5.0 | 0.5 | 0.6 |
| 10 | 2.0 | 4.6 | 4.1 | 8.9 | 2.1 | 4.3 |
| 4 | 2.0 | 4.3 | 5.9 | 12.3 | 3.4 | 8.0 |
| Soybean | | | | | | |
| 21 | 2.2 | 4.6 | 3.2 | 6.6 | 1.0 | 2.0 |
| 17 | 2.0 | 4.4 | 3.4 | 7.4 | 1.4 | 3.0 |
| 15 | 2.2 | 5.2 | 3.8 | 8.7 | 1.6 | 3.5 |
| 10 | 2.4 | 5.1 | 5.1 | 11.1 | 2.7 | 6.0 |
| 3 | 2.0 | 4.4 | 6.5 | 13.6 | 4.5 | 9.2 |

# REGISTERED AND EXPERIMENTAL HERBICIDES FOR WEED CONTROL IN GRAIN SORGHUM

*by*
*Curtis Thompson and Alan Schlegel*

## SUMMARY

Marksman, Aim, Ally, or AGH 10018 caused significant sorghum injury; however, these herbicides necessarily did not reduce sorghum yield. Sorghum not treated with preemergence herbicides tended to yield lower because of early weed competition. Using prepack mixes of chloracetamides and atrazine resulted in the best broad-spectrum weed control and best sorghum yields. Kochia, Russian thistle, redroot pigweed, tumble pigweed, large crabgrass, witchgrass, and puncturevine were evaluated in this study.

## INTRODUCTION

Grain sorghum continues to be the most popular summer crop grown on dryland in Southwest Kansas. Grass and broadleaf weed control in grain sorghum continues to be a challenge and represents a major expense for Kansas producers. Grass and broadleaf weeds will reduce sorghum yields significantly if left untreated. This experiment evaluates several soil-applied and postemergence products for grass and broadleaf weed control.

## PROCEDURES

An experiment was established at the SWREC–Tribune to evaluate registered and experimental herbicides for weed control in grain sorghum. Grain sorghum was no-till planted in 30-inch rows into wheat stubble on May 22, 2002. Large crabgrass, Kochia, and redroot pigweed seed were spread to increase weed populations. Roundup RT at 1 quart/acre was applied to all plots the same day as planting and the preemergence (PRE) treatments were applied to the soil surface with a backpack sprayer set at 30 psi to deliver 20 gpa spray solution. Postemergence treatments were delayed because of a severe hail storm on June 12; these were applied on June 26 with the backpack sprayer set at 40 psi to deliver 10 gpa spray solution. Sorghum had approximately 5 collars at the time of application. Weeds were 1 to 8 inches tall and extremely variable from the hail. July 2 and August 2 weed control ratings were made visually on a scale of 0 (no control) to 100 (complete control). An exception was the second evaluation of puncturevine in which numbers represent puncturevine cover from 0 (no puncturevine in the plot) to 5 (plot completely covered with puncturevine). Limited irrigation was applied during the growing season to activate herbicides and allow grain sorghum to produce despite the severe drought. Grain sorghum was harvested on November 20.

## RESULTS AND DISCUSSION

All treatments containing Marksman, Aim, Ally, or AGH 10018 caused significant sorghum injury (Table 1). However, injury did not necessarily result in reduced sorghum yields. Sorghum yields were reduced primarily from weed competition. This was especially true when only postemergence herbicides were applied. Early weed competition tended to reduce sorghum yields. Sorghum treated with Dual II Mag or Outlook applied alone yielded less because of inadequate broadleaf weed control from these chloracetamide herbicides. Sorghum treated with a premix of atrazine and a chloracetamide (Bicep II Mag, Bicep Lite II Mag, Guardsman Max, or Bullet) produced more grain.

Dual II Mag controlled large crabgrass 80% or more (Table 1). Outlook applied alone controlled crabgrass about 60%. The addition of atrazine tended to increase crabgrass control. All treatments containing Dual II Mag, Bicep II Mag, Bicep Lite II Mag, Guardsman Max, Guardsman Max Lite, or Bullet controlled witchgrass.

Kochia and Russian thistle were controlled with the premixes of chloracetamides and atrazine (Table 2). The postemergence products gave 75 to 89% control indicating they were not as effective as many of the preemergence products. Kochia and Russian thistle were too large to be controlled completely with the POST treatments.

Redroot and tumble pigweed were controlled with premixes of chloracetamides and atrazine (Table 2). Dual II Mag and Outlook controlled pigweeds 75% or more at the early evaluation time but unacceptable control was observed at the August evaluation.

Puncturevine control was quite variable. Treatments containing Peak or Ally gave the best control of puncturevine, with 87% or better control (Table 2). An exception was Ally tank-mixed with Aim and 2,4-D in which puncturevine was controlled 77%. Aim appeared to reduce puncturevine control when applied with Ally and 2,4-D.

**Table 1. Sorghum and grassy weed response to preemergence and postemergence herbicides. Tribune, 2002.**

| | Treatment | Rate | Application timing | Sorghum grain Yield | Sorghum grain Moisture | Sorghum grain Test weight | Sorghum injury | Large crab-grass | Witch-grass |
|---|---|---|---|---|---|---|---|---|---|
| | | (product/a) | | (bu/A) | (%) | (lb/bu) | (%) | - (% control ) - | |
| 1 | Untreated | | | 13 | 12.5 | 59.2 | - | - | - |
| 2 | Dual II Mag | 1.34 pt | PRE | 11 | 12.4 | 59.3 | 0 | 86 | 92 |
| 3 | Outlook | 15 oz. | PRE | 8 | 12.5 | 59.0 | 0 | 59 | 60 |
| 4 | Bicep II Mag | 4.2 pt | PRE | 58 | 12.8 | 59.2 | 0 | 88 | 93 |
| 5 | Bicep Lite II Mag | 3.0 pt | PRE | 61 | 13.0 | 59.3 | 0 | 88 | 93 |
| 6 | Guardsman Max | 3.5 pt | PRE | 66 | 12.9 | 59.0 | 0 | 78 | 83 |
| 7 | Guardsman Lite | 2.7 pt | PRE | 63 | 12.7 | 59.5 | 1 | 82 | 91 |
| 8 | Guardsman Lite + Paramount | 2.7 pt + 5.3 oz | PRE + PRE | 57 | 12.8 | 58.9 | 1 | 77 | 94 |
| 9 | Bullet | 3.5 qt | PRE | 66 | 12.9 | 58.9 | 0 | 80 | 92 |
| 10 | Paramount + Marksman | 5.3 oz + 2.0 pt | POST + POST | 48 | 12.8 | 59.0 | 15 | 41 | 50 |
| 11 | Paramount + Atrazine + COC | 5.3 oz + 1.5 pt + 2.0 pt | POST + POST + POST | 32 | 12.5 | 59.1 | 3 | 56 | 63 |
| 12 | Marksman | 2.0 pt | POST | 51 | 12.5 | 59.4 | 14 | 48 | 48 |
| 13 | Moxy & Atrazine | 2.0 pt | POST | 34 | 12.5 | 59.3 | 1 | 52 | 59 |
| 14 | Dual II Mag + Peak + Atrazine + COC | 1.34 pt + 0.5 oz + 1.5 pt + 2.0 pt | PRE + POST + POST + POST | 42 | 12.6 | 58.8 | 4 | 76 | 83 |
| 15 | Dual II Mag + Peak + Banvel + NIS | 1.34 pt + 0.5 oz + 0.25 pt + 0.25 % v/v | PRE + POST + POST + POST | 48 | 12.5 | 59.2 | 9 | 83 | 95 |
| 16 | Dual II Mag + Atrazine + Aim + NIS | 1.34 pt + 1.5 pt + 0.33 oz + 0.25 % v/v | PRE + POST+ POST + POST | 42 | 12.8 | 59.2 | 25 | 88 | 90 |
| 17 | Dual II Mag + Ally + 2, 4-D amine + NIS | 1.34 pt + 0.05 oz + 0.5 pt + 0.25 % v/v | PRE + POST+ POST + POST | 53 | 12.9 | 58.9 | 21 | 87 | 95 |
| 18 | Paramount + Atrazine + COC | 5.3 oz + 1.5 pt + 2.0 pt | POST + POST + POST | 67 | 12.8 | 59.4 | 1 | 62 | 59 |
| 19 | Outlook + Aim + Atrazine + NIS | 15 oz + 0.33 oz + 1.5 pt+ 0.25 % v/v | PRE + POST+ POST + POST | 42 | 12.6 | 59.2 | 20 | 72 | 90 |
| 20 | AGH 01018 + Preference | 0.5 oz + 0.25% v/v | POST + POST | 16 | 12.7 | 59.1 | 45 | 35 | 39 |
| 21 | AGH 01018 + 2, 4-D ester + Preference | 0.5 oz + 0.5 pt + 0.25% v/v | POST + POST + POST | 31 | 12.7 | 59.0 | 48 | 40 | 31 |
| 22 | AGH 01018 + 2, 4-D amine + Preference | 0.5 oz + 0.5 pt + 0.25% v/v | POST + POST + POST | 28 | 12.6 | 58.8 | 33 | 43 | 54 |
| 23 | Ally + Aim + 2, 4-D amine + Preference | 0.05 oz + 0.25 oz + 0.5 pt + 0.25% v/v | POST + POST + POST + POST | 20 | 12.6 | 59.2 | 10 | 58 | 63 |
| 24 | Untreated | | | 4 | 12.4 | 59.2 | — | — | — |
| | LSD (0.05) | | | 21 | 0.5 | 0.5 | | 25 | 28 |

**Table 2. Broadleaf weed response to preemergence and postemergence herbicides. Tribune, 2002.**

| | Treatment | Rate | Application timing | Tumble pigweed July 2 | Tumble pigweed Aug 2 | Redroot pigweed July 2 | Redroot pigweed Aug 2 | Kochia July 2 | Kochia Aug 2 | Russian thistle July 2 | Russian thistle Aug 2 | Puncture-vine July 2 | Puncture-vine Aug 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (product/a) | | - - - - - - - - | - - - - - - | % | Control | - - - - | - - - - | - - - - | - - - - | | (0–5) * |
| 1 | Untreated | | | — | — | — | — | — | — | — | — | — | — |
| 2 | Dual II Mag | 1.34 pt | PRE | 80 | 68 | 83 | 68 | 38 | 13 | 38 | 13 | 24 | 2.0 |
| 3 | Outlook | 15 oz. | PRE | 76 | 19 | 73 | 20 | 46 | 9 | 40 | 10 | 13 | 3.3 |
| 4 | Bicep II Mag | 4.2 pt | PRE | 100 | 98 | 100 | 98 | 100 | 100 | 100 | 98 | 72 | 2.6 |
| 5 | Bicep Lite II Mag | 3.0 pt | PRE | 100 | 98 | 100 | 98 | 100 | 100 | 100 | 93 | 55 | 3.0 |
| 6 | Guardsman Max | 3.5 pt | PRE | 100 | 96 | 100 | 99 | 100 | 100 | 100 | 98 | 74 | 2.5 |
| 7 | Guardsman Lite | 2.7 pt | PRE | 100 | 94 | 100 | 96 | 99 | 97 | 100 | 96 | 89 | 2.8 |
| 8 | Guardsman Lite + Paramount | 2.7 pt + 5.3 oz | PRE + PRE | 100 | 96 | 100 | 94 | 99 | 98 | 100 | 100 | 87 | 2.7 |
| 9 | Bullet | 3.5 qt | PRE | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 99 | 67 | 2.5 |
| 10 | Paramount + Marksman | 5.3 oz + 2.0 pt | POST + POST | 59 | 91 | 60 | 95 | 35 | 85 | 45 | 90 | 35 | 1.8 |
| 11 | Paramount + Atrazine + COC | 5.3 oz + 1.5 pt + 2.0 pt | POST + POST + POST | 75 | 93 | 74 | 93 | 60 | 84 | 76 | 80 | 40 | 2.0 |
| 12 | Marksman | 2.0 pt | POST | 63 | 96 | 66 | 97 | 40 | 77 | 45 | 81 | 45 | 2.3 |
| 13 | Moxy & Atrazine | 2.0 pt | POST | 80 | 88 | 84 | 93 | 81 | 88 | 91 | 97 | 62 | 0 |
| 14 | Dual II Mag + Peak + Atrazine + COC | 1.34 pt + 0.5 oz + 1.5 pt + 2.0 pt | PRE + POST+ POST + POST | 99 | 100 | 98 | 100 | 89 | 92 | 90 | 94 | 87 | 0.5 |
| 15 | Dual II Mag + Peak + Banvel + NIS | 1.34 pt + 0.5 oz + 0.25 pt + 0.25 % v/v | PRE + POST+ POST + POST | 97 | 96 | 98 | 100 | 82 | 89 | 88 | 99 | 90 | 0.5 |
| 16 | Dual II Mag + Atrazine + Aim + NIS | 1.34 pt + 1.5 pt + 0.33 oz + 0.25 % v/v | PRE + POST+ POST + POST | 99 | 96 | 99 | 97 | 81 | 80 | 82 | 66 | 45 | 2.4 |
| 17 | Dual II Mag + Ally + 2, 4-D amine + NIS | 1.34 pt + 0.05 oz + 0.5 pt + 0.25 % v/v | PRE + POST+ POST + POST | 97 | 99 | 97 | 99 | 81 | 85 | 93 | 98 | 95 | 0.0 |
| 18 | Paramount + Atrazine + COC | 5.3 oz + 1.5 pt + 2.0 pt | POST + POST + POST | 85 | 91 | 85 | 88 | 70 | 88 | 71 | 87 | 67 | 1.3 |
| 19 | Outlook + Aim + Atrazine + NIS | 15 oz + 0.33 oz + 1.5 pt + 0.25 % v/v | PRE + POST+ 95 POST + POST | 96 | 97 | 96 | 79 | 90 | 78 | 78 | | 33 | 2.8 |
| 20 | AGH 01018 + Preference | 0.5 oz + 0.25% v/v | POST + POST | 94 | 93 | 93 | 91 | 76 | 28 | 90 | 83 | 82 | 0.8 |

continued

**Table 2. Broadleaf weed response to preemergence and postemergence herbicides. Tribune, 2002, continued.**

| | Treatment | Rate | Application timing | Tumble pigweed July 2 | Tumble pigweed Aug 2 | Redroot pigweed July 2 | Redroot pigweed Aug 2 | Kochia July 2 | Kochia Aug 2 | Russian thistle July 2 | Russian thistle Aug 2 | Puncture-vine July 2 | Puncture-vine Aug 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (product/a) | | - - - - - - - - - - | - - | (% Control) | - - | - - | - - | - - | - - - - - - - - - - - | (0 – 5)* | |
| 21 | AGH 01018 + 2, 4-D ester + Preference | 0.5 oz + 0.5 pt + 0.25% v/v | POST + POST + POST | 93 | 96 | 95 | 96 | 82 | 84 | 93 | 94 | 88 | 0.0 |
| 22 | AGH 01018 + 2, 4-D amine + Preference | 0.5 oz + 0.5 pt + 0.25% v/v | POST + POST + POST | 88 | 95 | 89 | 93 | 78 | 66 | 90 | 89 | 85 | 0.5 |
| 23 | Ally + Aim + 2, 4-D amine + Preference | 0.05 oz + 0.25 oz + 0.5 pt + 0.25% v/v | POST + POST + POST + POST | 88 | 96 | 88 | 95 | 66 | 74 | 88 | 90 | 77 | 0.8 |
| 24 | Untreated | | | — | — | — | — | — | — | — | — | — | — |
| | LSD (0.05) | | | 7 | 9 | 9 | 9 | 12 | 12 | 9 | 8 | 32 | 1.6 |

* Scale of (0-5) where 0 = no puncturevine and 5 = plot completely covered with puncturevine (density was variable).

# HERBICIDES FOR WEED CONTROL IN SUNFLOWER

*by*
*Curtis Thompson and Alan Schlegel*

## SUMMARY

Spartan alone applied as a preemergence burndown herbicide provided good broadleaf weed control. Spartan tank-mixed with Prowl gave excellent broadleaf and crabgrass weed control. Prowl controlled crabgrass effectively, however it did not give adequate broadleaf weed control unless it was tank-mixed with Spartan. Express provided adequate control of Russian thistle, tumble and redroot pigweeds but did not adequately control kochia (likely due to ALS resistance). The grass herbicides, Select and Assure II, did not provide season long crabgrass control.

## INTRODUCTION

There are few herbicides registered for weed control in sunflower. This needs to be addressed since broadleaf weed control remains a serious problem in sunflower. Several herbicides used in sunflower provide some broadleaf weed control but seldom provide complete control. This experiment evaluates preplant, preemergence, and postemergence herbicides for broadleaf and grass weed control in sunflower.

## PROCEDURES

An experiment was established at SWREC–Tribune to evaluate registered and experimental herbicides for weed control in sunflower. Herbicide treatments were applied 30 days prior to planting (30EPP) on May 2, 2002, 7 days prior to planting (7EPP) on May 22, immediately after planting (PRE) on May 29, and to 8-lf sunflower (POST) on June 25. Pioneer '63M91 Nusun" sunflower was no-till planted at 14,000 seed/a in 30-in. rows into wheat stubble on May 29, 2003. An experimental SU-tolerant sunflower was planted in the plots that received Express as a post-emergence treatment. Large crabgrass, kochia, and redroot pigweed seed were spread to increase weed populations. All preplant and preemergence treatments were applied to the soil surface with a backpack sprayer set at 30 psi to deliver 20 gpa spray solution. Postemergence treatments were delayed because of severe hail on June 12 and were applied on June 25 with the backpack sprayer set at 40 psi to deliver 10 gpa spray solution. Weeds were 1 to 8 inches tall and extremely variable from the hail. July 4 and August 21 weed control ratings were made visually on a scale of 0 (no control) to 100 (complete control). Limited irrigation was applied during the growing season to activate herbicides and allow sunflower to produce despite the severe drought. Sunflower was harvested on October 1.

## RESULTS AND DISCUSSION

Due to hail, sunflower stands and yields were quite variable. As a result, the sunflower yields were not always highest in plots with good weed control or lowest in plots with poor weed control (Table 1). Sunflower test weight and grain moisture were not affected by herbicide treatment. No herbicide injury was observed with any of the herbicide treatments.

Kochia was controlled 90% or more with V-10080 30EPP, Prowl + Roundup, Prowl + Outlook + Roundup, applied 7EPP or all treatments which contained Spartan (Table 2). Spartan applied alone as a burndown at the PRE application controlled kochia 94%. The addition of Roundup to the Spartan increased the control to 97%. This is an indication that Spartan can work quite effectively as a burndown herbicide for some broadleaf weeds. Express applied POST controlled kochia 50 to 70%. Large kochia plants and ALS resistant kochia likely made it more difficult for Express to give adequate control.

Russian thistle was controlled effectively with those treatments that gave good kochia control with the exception of the Prowl + Roundup treatments and the Prowl + Outlook + Roundup treatments applied 7EPP, which provided 64 to 80% control (Table 2). The treatments containing Express controlled Russian thistle 90 to 99% despite the large Russian thistle. Apparently no ALS resistant Russian thistle was present in this study. Spartan applied as a burndown herbicide without Roundup also controlled Russian thistle.

Tumble and redroot pigweeds were controlled with all treatments containing Spartan regardless of the timing of application (Table 2). When Spartan was used as the burndown herbicide, 91 to 100% of the pigweeds were controlled. Treatments with Prowl + Roundup or Prowl + Outlook + Roundup controlled redroot pigweed more effectively and they controlled tumble pigweed. Express gave excellent control of both Tumble and redroot pigweed.

Large crabgrass was controlled best with treatments containing Prowl. Assure and Select provided good control of crabgrass at the July evaluation but control tended to fall off by the August 21 evaluation (Table 1). Spartan did not provide adequate control of large crabgrass.

Several treatments applied in this study are not currently registered for use in sunflower. It is therefore important to be sure an herbicide is labeled for use on sunflower before using. Express was applied to SU-tolerant sunflower and not the Pioneer hybrid planted on the remainder of the experiment. Clearfield sunflower recently received a full federal registration (March 2003). Do not use Express or any other SU-herbicide for weed control in Clearfield sunflower. Beyond is the only herbicide currently registered for use in Clearfield sunflower.

**Table 1. Sunflower and grassy weed response to preplant, preemergence, and postemergence herbicides, Tribune, 2002.**

| | Treatment* | Rate | Application timing | Yield | Sunflower seed moisture | Test weight | Large crabgrass July 4 | Large crabgrass Aug. 21 |
|---|---|---|---|---|---|---|---|---|
| | | (product/a) | | (lb/a) | (%) | (lb/bu) | -(%control)- | |
| 1 | Untreated | | | 587 | 8.6 | 29.2 | - | - |
| 2 | Roundup Ultra Max + Select + COC + AMS | 1.6 pt + 6 oz + 2 pt + 2.5 lb | 30 EPP + POST + POST + POST | 379 | 9.9 | 29.8 | 92 | 93 |
| 3 | Valor + Roundup Ultra Max + Select + COC + AMS | 2 oz + 1.6 pt + 6 oz + 2 pt + 2.5 lb | 30 EPP + 30 EPP + POST + POST + POST | 561 | 8.3 | 29.3 | 89 | 90 |
| 4 | V-10080 + COC + AMS + Select + COC + AMS | 2 pt + 2 pt + 2.5 lb + 6 oz + 2 pt + 2.5 lb | 30 EPP + 30 EPP + 30 EPP + POST + POST + POST | 701 | 6.0 | 29.2 | 98 | 88 |
| 5 | Roundup Ultra Max + Select + COC + AMS | 1.6 pt + 6 oz + 2 pt + 2.5 lb | 7 EPP + POST + POST + POST | 638 | 9.0 | 29.3 | 91 | 70 |
| 6 | Roundup Ultra Max + Select + Express + COC + AMS | 1.6 pt + 6 oz + 0.33 oz + 2 pt + 2.5 lb | 7 EPP + POST + POST + POST + POST | 636 | 6.9 | 28.9 | 93 | 88 |
| 7 | Roundup Ultra Max + Assure II + Express + COC + AMS | 1.6 pt + 7 oz + 0.33 oz + 2 pt + 2.5 lb | 7 EPP + POST + POST + POST + POST | 694 | 8.4 | 28.2 | 84 | 88 |
| 8 | Roundup Ultra Max + Spartan + Mustang + Select + COC + AMS | 1.6 pt + 3 oz + 4.3 oz + 6 oz + 2 pt + 2.5 lb | 7 EPP + 7 EPP + POST + POST + POST + POST | 483 | 5.2 | 29.5 | 98 | 90 |
| 9 | Prowl + Spartan + Roundup Ultra Max | 3.6 pt + 2 oz. + 1.6 pt | 7 EPP + 7 EPP + 7 EPP | 603 | 5.6 | 29.2 | 98 | 98 |
| 10 | Prowl + Roundup Ultra Max | 3.6 pt + 1.6 pt | 7 EPP + 7 EPP | 639 | 7.6 | 29.0 | 93 | 93 |
| 11 | Prowl $H_20$ + Roundup Ultra Max | 3.1 pt + 1.6 pt | 7 EPP + 7 EPP | 708 | 6.7 | 28.8 | 98 | 99 |
| 12 | Prowl $H_20$ + Spartan + Roundup Ultra Max | 3.1 pt + 2 oz + 1.6 pt | 7 EPP + 7 EPP + 7 EPP | 627 | 6.3 | 28.7 | 100 | 99 |
| 13 | Prowl + Outlook + Roundup Ultra Max | 3 pt + 1 pt + 1.6 pt | 7 EPP + 7 EPP + 7 EPP | 518 | 9.9 | 29.4 | 99 | 100 |
| 14 | Prowl $H_20$ + Outlook + Roundup Ultra Max | 2.6 pt + 1 pt + 1.6 pt | 7 EPP + 7 EPP + 7 EPP | 675 | 6.9 | 29.5 | 100 | 100 |
| 15 | Spartan | 2 oz | PRE | 375 | 6.1 | 29.4 | 30 | 69 |
| 16 | Spartan + Roundup Ultra Max | 2 oz + 1.6 pt | PRE + PRE | 698 | 7.8 | 29.5 | 26 | 53 |

Continued

**Table 1. Sunflower and grassy weed response to preplant, preemergence, and postemergence herbicides, Tribune, 2002, continued.**

| Treatment* | Rate | Application timing | Yield | Sunflower seed moisture | Test weight | Large crabgrass July 4 | Large crabgrass Aug. 21 |
|---|---|---|---|---|---|---|---|
| | (product/a) | | (lb/a | (%) | (lb/bu) | -(%control)- | |
| 17 Prowl + Roundup Ultra Max | 3.6 pt + 1.6 pt | PRE + PRE | 660 | 7.5 | 29.1 | 92 | 97 |
| 18 Prowl $H_2$0 + Roundup Ultra Max | 3.1 pt + 1.6 pt | PRE + PRE | 642 | 7.0 | 29.0 | 95 | 100 |
| 19 Prowl + Roundup Ultra Max | 3 pt + 1.6 pt | PRE + PRE | 814 | 8.8 | 28.3 | 91 | 90 |
| 20 Prowl $H_2$0 + Roundup Ultra Max | 2.6 pt + 1.6 pt | PRE + PRE | 671 | 7.0 | 29.1 | 96 | 96 |
| 21 Dual II Mag + Spartan + Roundup Ultra Max | 1.3 pt + 2 oz + 1.6 pt | PRE + PRE + PRE | 599 | 6.7 | 29.3 | 86 | 89 |
| 22 Roundup Ultra Max + Assure II + COC | 1.6 pt + 10 oz + 2 pt | PRE + POST + POST | 642 | 8.0 | 29.1 | 94 | 85 |
| 23 Roundup Ultra Max + Assure II + COC | 1.6 pt + 20 oz + 2 pt | PRE + POST + POST | 740 | 7.9 | 29.4 | 97 | 86 |
| 24 Roundup Ultra Max + Assure II + COC | 1.6 pt + 40 oz + 2 pt | PRE + POST + POST | 691 | 7.6 | 30.5 | 98 | 91 |
| 25 LSD (0.05) | | | 362 | 2.3 | 1.5 | 7 | 16 |

*Prowl $H_2$0 - experimental water soluble formulation of Prowl.

**Table 2. Broadleaf weed response to preplant, preemergence, and postemergence sunflower herbicides, Tribune, 2002.**

| | Treatment* | Rate (product/a) | Application timing | Tumble pigweed 7-4 | Tumble pigweed 8-21 | Redroot pigweed 7-4 | Redroot pigweed 8-21 | Kochia 7-4 | Kochia 8-21 | Russian thistle 7-4 | Russian thistle 8-21 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (% Control) | | | | | | | |
| 1 | Untreated | | | — | — | — | — | — | — | — | — |
| 2 | Roundup Ultra Max + Select + COC + AMS | 1.6 pt + 6 oz + 2 pt + 2.5 lb | 30 EPP + POST + POST + POST | 23 | 0 | 25 | 0 | 23 | 5 | 23 | 15 |
| 3 | Valor + Roundup Ultra Max + Select + COC + AMS | 2 oz + 1.6 pt + 6 oz + 2 pt + 2.5 lb | 30 EPP + 30 EPP + POST + POST + POST | 96 | 87 | 100 | 93 | 80 | 75 | 95 | 83 |
| 4 | V-10080 + COC + AMS + Select + COC + AMS | 2 pt + 2 pt + 2.5 lb + 6 oz + 2 pt + 2.5 lb | 30 EPP + 30 EPP + 30 EPP POST + POST + POST | 93 | 89 | 99 | 91 | 96 | 93 | 91 | 83 |
| 5 | Roundup Ultra Max + Select + COC + AMS | 1.6 pt + 6 oz + 2 pt + 2.5 lb | 7 EPP + POST + POST + POST | 18 | 25 | 18 | 25 | 15 | 13 | 17 | 30 |
| 6 | Roundup Ultra Max + Select + Express + COC + AMS | 1.6 pt + 6 oz + 0.33 oz + 2 pt + 2.5 lb | 7 EPP + POST + POST + POST + POST | 97 | 90 | 98 | 94 | 70 | 70 | 90 | 95 |
| 7 | Roundup Ultra Max + Assure II + Express + COC + AMS | 1.6 pt + 7 oz + 0.33 oz + 2 pt + 2.5 lb | 7 EPP + POST + POST + POST + POST | 95 | 90 | 99 | 99 | 60 | 59 | 94 | 99 |
| 8 | Roundup Ultra Max + Spartan + Mustang + Select + COC + AMS | 1.6 pt + 3 oz + 4.3 oz + 6 oz + 2 pt + 2.5 lb | 7 EPP + 7 EPP + POST + POST + POST + POST | 100 | 96 | 100 | 100 | 99 | 100 | 100 | 100 |
| 9 | Prowl + Spartan + Roundup Ultra Max | 3.6 pt + 2 oz. + 1.6 pt | 7 EPP + 7 EPP + 7 EPP | 95 | 96 | 100 | 100 | 100 | 100 | 100 | 98 |
| 10 | Prowl + Roundup Ultra Max | 3.6 pt + 1.6 pt | 7 EPP + 7 EPP | 87 | 86 | 99 | 97 | 94 | 97 | 73 | 64 |
| 11 | Prowl $H_2$0 + Roundup Ultra Max | 3.1 pt + 1.6 pt | 7 EPP + 7 EPP | 92 | 86 | 98 | 96 | 90 | 87 | 75 | 80 |
| 12 | Prowl $H_2$0 + Spartan + Roundup Ultra Max | 3.1 pt + 2 oz + 1.6 pt | 7 EPP + 7 EPP + 7 EPP | 98 | 100 | 100 | 100 | 98 | 100 | 100 | 97 |
| 13 | Prowl + Outlook + Roundup Ultra Max | 3 pt + 1 pt + 1.6 pt | 7 EPP + 7 EPP + 7 EPP | 98 | 90 | 98 | 90 | 94 | 87 | 86 | 73 |
| 14 | Prowl $H_2$0 + Outlook + Roundup Ultra Max | 2.6 pt + 1 pt + 1.6 pt | 7 EPP + 7 EPP + 7 EPP | 96 | 96 | 98 | 98 | 93 | 90 | 77 | 69 |
| 15 | Spartan | 2 oz | PRE | 96 | 91 | 100 | 98 | 94 | 94 | 95 | 94 |
| 16 | Spartan + Roundup Ultra Max | 2 oz + 1.6 pt | PRE + PRE | 98 | 95 | 100 | 100 | 98 | 97 | 98 | 99 |
| 17 | Prowl + Roundup Ultra Max | 3.6 pt + 1.6 pt | PRE + PRE | 85 | 85 | 96 | 95 | 78 | 87 | 69 | 78 |
| 18 | Prowl $H_2$0 + Roundup Ultra Max | 3.1 pt + 1.6 pt | PRE + PRE | 88 | 87 | 96 | 95 | 73 | 79 | 70 | 55 |
| 19 | Prowl + Roundup Ultra Max | 3 pt + 1.6 pt | PRE + PRE | 83 | 71 | 90 | 81 | 85 | 73 | 69 | 61 |
| 20 | Prowl $H_2$0 + Roundup Ultra Max | 2.6 pt + 1.6 pt | PRE + PRE | 84 | 84 | 91 | 93 | 62 | 66 | 59 | 61 |
| 21 | Dual II Mag + Spartan + Roundup Ultra Max | 1.3 pt + 2 oz + 1.6 pt | PRE + PRE + PRE | 100 | 94 | 100 | 100 | 99 | 98 | 100 | 100 |
| 22 | Roundup Ultra Max + Assure II + COC | 1.6 pt + 10 oz + 2 pt | PRE + POST + POST | 24 | 31 | 27 | 33 | 46 | 23 | 55 | 52 |
| 23 | Roundup Ultra Max + Assure II + COC | 1.6 pt + 20 oz + 2 pt | PRE + POST + POST | 15 | 25 | 15 | 28 | 36 | 28 | 31 | 30 |
| 24 | Roundup Ultra Max + Assure II + COC | 1.6 pt + 40 oz + 2 pt | PRE + POST + POST | 20 | 30 | 30 | 33 | 48 | 43 | 65 | 50 |
| 25 | LSD (0.05) | | | 8 | 9 | 10 | 10 | 15 | 14 | 16 | 18 |

* Prowl $H_2$0 - experimental water soluble formulation of Prowl.

# USE OF A WHEAT COVER CROP TO REDUCE ATRAZINE RATES IN IRRIGATED CORN

*by*
***Randall Currie***

## SUMMARY

The presence of the wheat cover crop alone resulted in a 3 fold reduction in weed biomass. However, this reduction was not sufficient to produce an economically acceptable level of control. Economical control was only achieved with atrazine treatments. Even the lowest rate of atrazine completely masked the effect of the cover crop, producing very similar levels of control regardless of presence of cover. The presence of a cover crop elevated corn yield in 8 of 9 location-year combinations; in one instance the presence of a cover crop depressed yield.

## INTRODUCTION

It has long been known that winter wheat or rye killed at boot stage improves weed control in vegetable production. It would logically follow that a cover crop would improve weed control provided by a herbicide, perhaps even allowing reduced herbicide use. The objective of this experiment was to measure the effect of full and reduced rates of atrazine for weed control in irrigated corn, with and without a wheat cover crop.

## PROCEDURES

The study was established in a 2 by 3 factorial arrangement of cover crop (with and without) and atrazine rate (0, 0.75 and 1.5 lb/a). Plots with a cover crop were planted to winter wheat in October. Wheat was allowed to grow until May 1, when it was killed by an application of 1 qt/a glyphosate. The corn hybrid DK592SR was then planted no-till in all plots, followed immediately by application of atrazine treatments. Palmer amaranth was the only weed consistently present in all replications. The experiment was repeated at three separate locations, and it was further replicated by re-imposing the treatments on the same plots in three successive years, providing a total of nine location-year combinations (Table 1).

**Table 1. Descriptions of location by year of repeated treatments combinations.**

| Season | Location | Times System Was Imposed | Location by Year Index |
|---|---|---|---|
| 97-98 | 1 | 1 | 11 |
| 98-99 | 1 | 2 | 12 |
| 99-00 | 1 | 3 | 13 |
| 98-99 | 2 | 1 | 21 |
| 99-00 | 2 | 2 | 22 |
| 00-01 | 2 | 3 | 23 |
| 99-00 | 3 | 1 | 31 |
| 00-01 | 3 | 2 | 32 |
| 01-02 | 3 | 3 | 33 |

## RESULTS AND DISCUSSION

Palmer amaranth height multiplied by number proved to be a very reproducible index of weed biomass (Table 2), and produced no location by year interaction. The presence of cover alone resulted in a 3 fold reduction in weed biomass. However this level of reduction was not sufficient for an economically acceptable level of control. Further, even the lowest rate of atrazine completely masked this effect, producing very similar levels of control regardless of presence or absence of the wheat cover crop. Variation in control was reduced by increasing the levels of atrazine from 0.75 lb/a to1.5 lb/a (data not shown). However, improvement in weed control was not statistically significant. It is of note that in 2 of 9 location-years 100% control was achieved with the highest rate of atrazine with the cover crop (data not shown).

Palmer amaranth biomass at the end of the season was much more variable across locations and years, producing a significant interaction. In only the first year (location 11) was there a significant herbicide by cover interaction. This location had a very similar pattern of response to that seen using the height by number index of biomass.

**Table 2. Pigweed biomass as indexed by weed height times weed number/sq ft.**

| Atrazine Rate lb/a | Height X Number* Cover: Cover | No Cover | Avg** |
|---|---|---|---|
| 0 | 114.3 | 354.4 | 234.4 |
| 0.75 | 16.0 | 18.5 | 17.3 |
| 1.5 | 7.6 | 8.1 | 7.9 |
| Avg.*** | 45.9 | 127.0 | |

*LSD for Cover X atrazine @ 5% = 140; 10% = 117
**LSD for 5% = 33.9; 10% = 28.4
***LSD for 5% = 26.7; 10% = 23.2

The 0.75 lb/a atrazine treatment reduced Palmer amaranth biomass at seasons end in only 4 of 9 location-year combinations (Table 3). In contrast, the 1.5 lb/a atrazine treatments reduced end-of-season palmer pigweed biomass in 5 of 9 location-year combinations and 6 of 9 at the P=0.10 significance level.

The response of cover to final Palmer amaranth biomass was much more variable (Table 4). Although biomass was reduced by cover in 6 of 9 location-year combinations, it was only statistically significant in 2 of 9. It is possible that a more favorable climate for growth of both Palmer amaranth and corn was produced by this cover which, allowed it to compensate for early season stunting resulting from presence of the wheat cover.

The presence of a cover crop elevated corn yield by 18 to 28 bu in 5 out of 9 location-year combinations (Table 5). However, if the significance level is relaxed to P=0.10, a similar level of yield elevation was seen in 8 of 9 location-year combinations. In only one location-year did the presence of a cover crop depress yield. This location had extremely low weed pressure, which suggest that the advantage of having a cover crop may be based on a complex relationship of improved water use and weed control.

Cover crop alone elevated yield in the absence of atrazine in 2 location-years (Table 6). In the absence of cover, 0.75 lb/a atrazine elevated yield over the control in 2 of 9 location-years. In contrast, 0.75 lb/a atrazine plus a cover crop increased yield over the control in 5 of 9 location-years. In the absence of cover, 1.5 lb/a atrazine elevated yield over the control in 4 of 9 location-years; when the cover was included, yield increased in 6 of 9 location-years.

**Table 3. Pigweed biomass averaged over cover at each location.**

| Atrazine History lb/a | 11 | 12 | 13 | 21 | 22 | 23 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|
| | (Tons of dry matter/a) | | | | | | | | |
| 0 | 4.12 | 1.82 | 1.06 | 1.30 | 0.89 | 2.63 | 0.14 | 3.93 | 2.63 |
| 0.75 | 0.39 | 1.0 | 0.90 | 0.90 | 0.62 | 2.62 | 0.31 | 3.16 | 3.00 |
| 1.5 | 0.24 | 0.67 | 0.68 | 0.66 | 0.29 | 2.36 | 0.10 | 2.76 | 3.04 |
| LSD @ 5% = | 0.69 | 0.69 | 0.27 | 0.64 | ns | ns | ns | 0.87 | ns |

**Table 4. Pigweed biomass averaged over atrazine rates at each location.**

| | 11 | 12 | 13 | 21 | 22 | 23 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|
| | Bu/a | | | | | | | | |
| Cover | 1.69 | 0.87 | 0.84 | 0.92 | 0.64 | 0.25 | 0.26 | 2.69 | 2.69 |
| No Cover | 1.47 | 1.46 | 0.92 | 1.29 | 0.67 | 2.64 | 0.11 | 3.87 | 3.08 |
| LSD @ 5% = | ns | 0.56 | ns | ns | 0.24 | ns | ns | 0.71 | ns |

**Table 5. Corn yield averaged over herbicide at each location.**

| | Locations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 11 | 12 | 13 | 21 | 22 | 23 | 31 | 32 | 33 |
| | Bu/a | | | | | | | | |
| Cover | 114.5 | 92.1 | 68.4* | 100.0 | 56.4** | 48.4 | 106.3 | 64.3 | 10.3 |
| No Cover | 96.5 | 120.1 | 59.8* | 79.5 | 45.3** | 26.3 | 155.7 | 141.29 | 5.6 |
| LSD @ 5% = | 9.9 | 12.36 | ns | 14.6 | ns | 13.9 | 11.1 | 16.6 | ns |

* Statistically significant at P = 0.12.
** Statistically significant at P = 0.10.

**Table 6. Corn yield.**

| Atrazine Rate lb/a | 11 -cover | 11 +cover | 12 -cover | 12 +cover | 13 -cover | 13 +cover |
|---|---|---|---|---|---|---|
| | (Bu/a) | | | | | |
| 0 | 45.7 | 84.8 | 74.8 | 112.9 | 46.0 | 57.9 |
| 0.75 | 112.9 | 129.7 | 95.3 | 117.3 | 68.5 | 71.6 |
| 1.5 | 130.2 | 129.2 | 106.1 | 130.3 | 65.1 | 75.9 |
| LSD = | 17.2 | | 21.4 | | 20.0 | |

| Atrazine Rate lb/a | 21 -cover | 21 +cover | 22 -cover | 22 +cover | 23 -cover | 23 +cover |
|---|---|---|---|---|---|---|
| | (Bu/a) | | | | | |
| 0 | 75.7 | 91.4 | 45.5 | 48.0 | 24.0 | 44.8 |
| 0.75 | 84.9 | 100.0 | 44.4 | 60.2 | 26.4 | 46.6 |
| 1.5 | 77.8 | 109.0 | 46.2 | 61.1 | 28.7 | 54.0 |
| LSD = | 25.3 | | 22.5 | | 24.0 | |

| Atrazine Rate lb/a | 31 -cover | 31 +cover | 32 -cover | 32 +cover | 33 -cover | 33 +cover |
|---|---|---|---|---|---|---|
| | (Bu/a) | | | | | |
| 0 | 96.7 | 86.9 | 25.9 | 46.2 | 5.9 | 6.2 |
| 0.75 | 95.7 | 94.2 | 38.8 | 74.4 | 3.8 | 10.9 |
| 1.5 | 96.3 | 99.8 | 59.0 | 72.3 | 6.8 | 13.5 |
| LSD = | 16.6 | | 28.9 | | 12.04 | |

# WHEAT FORAGE AS A DOUBLE CROP IN CONTINUOUSLY IRRIGATED CORN

*by*
*Randall Currie*

## SUMMARY

Atrazine use history at no time reduced wheat forage yield. Further, it appeared to elevate yield with a prior history of 0.75 lbs/a. No explanation of this effect is offered here. However, results of this study clearly show that yield was not depressed. Severe injury has been observed in wheat planted into sandy soils and the results reported here only apply to a silt loam soil under the conditions described herein. It is a violation of federal law to double crop wheat in silt loam soils with greater than 1% organic matter into corn and sorghum stubble that has been treated with atrazine at 1 lb/a. The work presented here is in no way intended to encourage this practice. The reader is advised that, unless an exemption is obtained, federal and state laws require pesticide usage to be in accordance with the label. This includes any pre-harvest and/or post-harvest intervals that are contained on the label.

## INTRODUCTION

Southwestern Kansas has a long growing season that will allow significant growth of winter annual plants after corn harvest. Winter annual grasses such as wheat and rye have long been used in vegetable production as a cover crop to improve weed control. An ongoing study in Garden City has shown that wheat planted after corn harvest and killed in early boot stage as a cover crop improves corn yields. It has been argued that this cover crop may be more useful as forage than left as mulch for weed control. Therefore, as an adjunct to these studies, wheat forage yields were measured to determine the value of this alternative use.

## PROCEDURES

The study was established in a 2 by 3 factorial arrangement of cover crop (with and without) and atrazine rate (0, 0.75 and 1.5 lb/a). A wheat forage crop was inserted between corn crops by planting wheat after corn harvest in October. A 1-inch irrigation was applied, to ensure uniform emergence if sufficient rain was not received. This was done as an adjunct to a study measuring the impact of wheat as a killed cover crop on soil water use and weed control, discussed at length in the previous article in this publication (See pages 26-28).

Wheat was allowed to grow until the late boot stage, at which point all aboveground wheat biomass was harvested from 1 foot of row. Corn was planted as described in the previous paper (See pages 26-28). The experiment was repeated at three separate locations from 1999 and 2003, and it was further replicated by re-imposing the treatments on the same plots in three successive years. There were a total of nine location-year combinations, which are described in Table 1.

**Table 1. Descriptions of location by year of repeated treatments combinations.**

| Season | Location | Times System Was Imposed | Location by Year Index |
|---|---|---|---|
| 97-98 | 1 | 1 | 11 |
| 98-99 | 1 | 2 | 12 |
| 99-00 | 1 | 3 | 13 |
| 98-99 | 2 | 1 | 21 |
| 99-00 | 2 | 2 | 22 |
| 00-01 | 2 | 3 | 23 |
| 99-00 | 3 | 1 | 31 |
| 00-01 | 3 | 2 | 32 |
| 01-02 | 3 | 3 | 33 |

Locations 11, 12, and 13 were fallowed one year prior to commission of the study. At that point in the study, no atrazine had been applied so data were averaged over all 15 plots. There were 3 plots/replicate and 5 replicates. In locations 12, 22, and 32, a full season of corn at the various levels of atrazine had been grown and data are presented by atrazine history. Therefore, plots represent 1 plot/replicate for a total of 5 replications. In locations 13, 23, and 33, two full seasons of corn had been grown and 5 samples per treatment were likewise measured.

## RESULTS AND DISCUSSION

The fallow period prior to the first wheat planting in locations 11, 12, and 13 consistently produced higher forage yields (Table 2). Planting wheat back into a single season of corn stubble reduced forage yield 2 out of 3 times. There was no statistically significant impact of prior atrazine treatment on wheat forage yield. Planting wheat into corn stubble from two seasons also reduced yield compared to fallow history in all cases. Reductions in location 33 likely resulted from a historically significant drought discussed at length in the previous article in this publication. It is of note that at no time was a reduction in forage yield associated with any prior atrazine use history. Furthermore, previous use of the 0.75 lb/a atrazine rate may have elevated yield, although no explanation of this effect is offered here. Nonetheless, the results clearly showed that yield was not depressed by prior atrazine use history. The author has observed severe injury from residual atrazine to wheat planted into sandy soils; therefore, the results of this study apply only to silt loam soils under conditions described for this study. It should also be noted that it is a violation of federal law to double crop wheat in silt loam soils into corn and sorghum stubble that have been treated with 1 lb/a of atrazine. The work presented here is for the sole purpose of documenting crop response. It is not intended as an endorsement of cropping practices that ignore label restriction. The reader is advised that, unless an exemption is obtained, federal and state laws require pesticide usage to be in accordance with the label. This includes any pre-harvest and/or post-harvest intervals that are contained on the label.

**Table 2. Wheat forage yields.**

| Atrazine History lbs/a | Locations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 11 | 12 | 13 | 21 | 22 | 23 | 31 | 32 | 33 |
| | (Tons of dry matter/a) | | | | | | | | |
| 0 | 4.0 | 4.1 | 1.6 | 3.6 | 1.8 | 1.2 | 3.1 | 2.2 | 0.4 |
| 0.75 | — | 4.8 | 2.2 | — | 2.1 | 2.4 | — | 1.9 | 0.8* |
| 1.5 | — | 4.5 | 2.4 | — | 1.7 | 1.8 | — | 2.2 | 0.6 |
| LSD 0.10= | | 0.8 | 0.9 | | 0.9 | 0.5 | | 0.8 | 0.3 |

K-STATE
Southwest Research-Extension Center

# WATER USE EFFICIENCY OF CORN COMPETING FOR LIGHT WITH PALMER PIGWEED

*by*

***Randall Currie and Rafael Massinga[1]***

## SUMMARY

A study was undertaken under fully-irrigated conditions to determine the effect of full season Palmer amaranth infestation on corn water use efficiency (WUE). Palmer amaranth was planted approximately 0, 5, 10, 20, 40, and 80 inches apart concurrently with corn in 1996, 1997 and at two locations in 1998. WUE was well defined by the equation Bu/in = 0.56 + (0.052 x inches between pigweed), with a $R^2$ value of 0.98.

## PROCEDURES

Field experiments were conducted at the Southwest Research-Extension Center in Garden City, Kansas in 1996, 1997 and 1998. Plots were established East of the station in 1996 (E96) and at West in 1997 (W97). In 1998 two sites were established; one East (E98) and the other West of station (W98).

Fields were disked, bedded and fertilized with 175 lbs/a anhydrous ammonia (82%N), in the fall prior to planting. In mid-spring, 1 qt/a of glyphosate was applied as necessary to assure a weed-free bed for planting. The corn hybrid DK592SR was planted at density of 36,000 plants/a.

The experiment was established as a randomized complete block design in a factorial arrangement with six weed densities with four replications. Palmer amaranth was hand planted at same date as corn in a 10 inch band over the corn rows at densities of 5, 10, 20, 40, and 80 inches apart. Plots were furrow irrigated immediately after planting to assure uniform germination.

At 2- to 4-leaf stage, Palmer amaranth seedlings were thinned to single plant/clump. Plots were maintained free of all other weeds throughout the growing season by hand hoeing. Final harvests of both corn and Palmer amaranth were conducted at corn maturity.

### WATER MEASUREMENT

Approximately two weeks after emergence a single access tube was placed at center of each plot between two consecutive Palmer amaranth plants. Soil water content in the top 8 ft of the soil profile at 12 in increments was determined with a neutron attenuation moisture meter. Measurements were made approximately every 10 days from mid-late June to corn physiological maturity. Readings were converted to volumetric soil water content. Water use was calculated by subtracting the water content at last measurement date from that of the initial water content and adding the precipitation and amount of irrigation. Irrigation was applied when a neutron probe reading indicated that water deficit reached 1.5 in, and immediately after a reading date to minimize its influence on the following moisture monitoring.

Because we wanted to evaluate the effect of Palmer amaranth on the efficiency of corn water use to produce marketable yield we compared corn water use efficiency (WUE) based on grain yield. Therefore, corn WUE was calculated by dividing the corn grain yield by the total amount of water use and expressed as grain yield per inch of water.

## RESULTS AND DISCUSSION

Total seasonal water use and water use efficiency. WUE decreased with increase in Palmer amaranth density. This decrease is well defined by the equation Bu/in = 0.56 + (0.052 x inches between pigweed). Corn WUE indicated that the effect of Palmer amaranth density in reducing corn grain yield supplanted the increase in water use associated with the weed interference. The trend on the rate of water use (between years and locations) was a similar, with rate of water use reaching a peak after a pronounced increase. The periods of pronounced increase on rate of WU were associated the stage extending from corn tasseling to pollination which is the period of maximum water requirement by the crop.

[1]Department of Agronomy, Kansas State University, Manhattan.

VOLUMETRIC SOIL WATER CONTENT BY DEPTH

Overall, soil water content decreased with time and increased with depth. However, due to recharge of the soil profile by rain and irrigation some fluctuations were observed. The lowest water content in the top soil profile indicates that water extraction was greatest at that portion of the soil profile.

The soil water content profiles between the weed free corn and the corn in mixture with the various densities of Palmer amaranth was similar indicating that under the conditions of this study competition for water was minimal and that the demands of both crop and weed were satisfied while maintaining water extraction on the top soil profile. The conditions to minimize water competition were provided by irrigation that helped to maintain the soil water content on the study area between 80 and 90 % of field capacity. Further studies of corn and Palmer amaranth competition under different levels of soil water availability might give another perspective of competition between these two species.

# EFFICACY OF INSECTICIDES FOR THE CONTROL OF SOUTHWESTERN CORN BORER, 2002

*by*

***Larry Buschman and Phil Sloderbeck***

## SUMMARY

This trial evaluated the efficacy of insecticides for controlling southwestern corn borer (SWCB), *Diatraea grandiosella* Dyar. The second generation SWCB infestation was moderate but not very uniform in distribution. All the insecticide treatments significantly reduced SWCB larvae per plant, amount of stalk and total tunneling, and percent girdled plants.

## PROCEDURES

The plots were machine-planted to DK589RR seed at the Southwest Research-Extension Center near Garden City, KS. The plots were 4 rows wide (10 ft), 50 ft long and separated by 4 border rows of corn and 10-ft wide alleys. The plot design was a randomized block design with 4 replicates. Treatments were applied on August 7 and 9 with a high clearance sprayer using a 10-ft boom with 3 nozzles directed at each row (one on each side of the row on 16-inch drop hoses directed at the ear zone and a third nozzle directed at the top of the plant). The sprayer was calibrated to deliver 20 gal/a at 2 mph and 40 psi. The second generation SWCB infestation resulted from free flying feral moths. Ten plants from the second and third rows were dissected in late September to record observations on second generation corn borers. One of the four Tracer plots was heavily infested and resembled an untreated control plot. This plot was excluded in the results reported. It is possible there was an unseen application problem in this plot, resulting in the heavy infestation.

## RESULTS AND DISCUSSION

The second generation SWCB infestation was moderate and not very uniform. It averaged 0.6 larvae per plant in the untreated check. All the insecticide treatments significantly reduced SWCB larvae per plant, amount of stalk and total tunneling, and percent girdled plants (Table 1). The standard treatment, Warrior, reduced SWCB larvae per plant 95-100%. The Intrepid treatments reduced SWCB per plant by 70-92%, while Tracer reduced them by 77%. The efficacy of Tracer was numerically lower than that of Warrior, but was not significantly different.

**Table 1. Corn borer observations taken September 26-30, 2002 on the efficacy of corn borer insecticides on second generation southwestern corn borer (SWCB). SWREC Garden City, Finney Co., Kansas. Treatments applied August 2, 2002.**

| Treat. No. | Treatment | Rate: Product Per acre | 2nd Gen. SWCB / Plant ( % Control) | 2nd Gen. Tunnels / Plant | 2nd Gen. Stalk Tunneling Cm / Plant (% Control) | 2nd Gen. Shank Tunneling cm / Plant | 2nd Gen. Total Tunneling cm / Plant (% Control) | % Infested Plants | % Girdled Plants (%Control) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Check | | 6.0 a | 0.6 | 6.4 a | 0.3 | 6.7 a | 40 | 47 a |
| 2 | Intrepid 2F ** | 2 oz | 1.8 b | 0.4 | 2.0 b | 0.2 | 2.1 b | 26 | 10 b |
| | Latron CS-7 | 0.25% | (70%) | | (69%) | | (69%) | | (79%) |
| 3 | Intrepid 2F ** | 4 oz | 0.5 b | 0.3 | 0.9 b | 0.3 | 1.1 b | 24 | 5 b |
| | Latron CS-7 | 0.25% | (92%) | | (86%) | | (84%) | | (89%) |
| 4 | Intrepid 2F ** | 8 oz | 0.8 b | 1.1 | 0.7 b | 0.1 | 0.8 b | 14 | 5 b |
| | Latron SC-7 | 0.25% | (87%) | | (89%) | | (88%) | | (89%) |
| 5 | Tracer | 3 oz | 1.4 b | 0.4 | 1.7 b | 0.2 | 1.9 b | 18 | 13 b |
| | Latron SC-7 | 0.25% | (77%) | | (73%) | | (72%) | | (72%) |
| 6 | XDE-225 .497CS ** | 3 oz | 1.0 b | 0.1 | 0.6 b | 0.1 | 0.7 b | 18 | 5 b |
| | Latron SC-7 | 0.25% | (83%) | | (91%) | | (90%) | | (89%) |
| 7 | Warrior T | 3.2 oz | 0.0 b | 0.1 | 0.1 b | 0.1 | 0.1 b | 8 | 0 b |
| | Latron SC-7 | 0.25% | (100%) | | (98%) | | (99%) | | (100%) |
| 8 | Warrior T | 3.84 oz | 0.3 b | 0.3 | 1.0 b | 0.2 | 1.2 b | 20 | 3 b |
| | Latron SC-7 | 0.25% | (95%) | | (84%) | | (82%) | | (94%) |
| | P-value | | 0.003 | 0.5919 | 0.0008 | 0.4646 | 0.0007 | 0.1205 | 0.0509 |
| | LSD | | 2.623 | 1.081 | 2.418 | 0.281 | 2.491 | 20.623 | 2.854 |

Means in the same column followed by the same letter do not differ significantly (LSD P=0.05)
**These products are not currently registered for use on corn.

# EFFECT OF A SIMULATED HAILSTORM ON WHEAT[1]

*by*
*Merle Witt*

## SUMMARY

The recently added U.S. wheat market class designated as "Hard White Winter Wheat" (HWWW) is of interest because of its potential to be planted over several million acres in Kansas. This research evaluated seeded HWWW as compared to traditional Hard Red Winter Wheat (HRWW) for response to simulated hail defoliation.

## PROCEDURES

The HWWW variety 'Trego' and HRWW variety 'Tam 107' were established by fall seeding in alternating drilled strips on October 5, 2001. Plots were seeded at 42 lb/a in 6-row plots with 10-in. row spacing and a row length of 20 ft. Plots were replicated four times. The plot area had been fallowed the previous year.

Defoliation of plots was accomplished on April 22, 2002 using a gas-powered string trimmer to simulate hailstorm levels of 100%, 66%, 33%, or 0% (check) at the early boot stage of growth. Plant foliage was eliminated above 5 in., 7.5 in., and 10 in., respectively, when the canopy was initially 13 in. tall. Plots were then allowed to mature and individual 90 $ft^2$ plots were combine harvested June 17, 2002.

## RESULTS AND DISCUSSION

Defoliation treatments caused similar and equal grain yield losses to both white and red winter wheats. Compared to the check plots, the 100% defoliation treatment level at boot stage reduced grain production approximately 45%; the 66% defoliation treatment level reduced grain production about 21%; and the 33% defoliation treatment level reduced grain production about 5% (Table 1).

Increased defoliation severity caused increasing reduction in final plant height and delay of maturity. This also related to reduced grain test weight and reduced seed size. The year 2002 provided an extremely harsh, drought-shortened grain filling period with small head size. The HWWW responded in a similar fashion as did the HRWW.

[1] Funding provided by National Crop Insurance Services.

**Table 1. Effect of boot stage simulated hail defoliation on white versus red seeded wheat, 2002.**

| Defoliation Level (%) | May Heading Date | Heads/ 10-ft row | Mature Height Inches | Grain bu/a (% loss) | Grain Test Wt | Grain g/100 seeds | % $H_2O$ |
|---|---|---|---|---|---|---|---|
| HWWW | | | | | | | |
| 100% | 10 | 418 | 19 | 23.3 (43) | 54.5 | 2.5 | 19.7 |
| 66% | 9 | 423 | 20 | 32.4 (20) | 58.5 | 2.6 | 16.6 |
| 33% | 8 | 416 | 22 | 38.2 (6) | 59.2 | 2.8 | 15.6 |
| 0 | 7 | 362 | 23 | 40.6 | 59.4 | 2.8 | 14.8 |
| HRWW | | | | | | | |
| 100% | 9 | 389 | 18 | 22.0 (46) | 53.5 | 2.5 | 18.9 |
| 66% | 8 | 391 | 20 | 31.6 (22) | 56.8 | 2.6 | 15.1 |
| 33% | 7 | 352 | 23 | 39.7 (3) | 58.1 | 2.7 | 14.0 |
| 0 | 6 | 322 | 24 | 40.7 | 58.4 | 2.9 | 13.8 |
| L.S.D. at 5% level | | | | | | | |
| Defoliation | 0.6 | 54 | 2 | 7.4 | 1.3 | 0.2 | 2.0 |
| Seed Color | 0.1 | 24 | n.s. | n.s. | 0.4 | n.s. | 0.4 |
| Defol X Color | 0.3 | 48 | n.s. | n.s. | 0.8 | n.s. | 0.8 |
| C.V.% | 2.1 | 8.1 | 3.5 | 4.4 | 1.0 | 3.9 | 3.2 |

# SIMULATED WINTERKILLING OF TWO TYPES OF WHEAT[1]

*by*
***Merle Witt***

## SUMMARY

Hard White Winter Wheat (HWWW) is of interest because it has the potential to be planted across several million acres in Kansas  This research evaluated seeded HWWW as compared to traditional seeded Hard Red Winter Wheat (HRWW) for responses to "winter-kill" under dryland conditions in southwest Kansas.

## PROCEDURES

HWWW variety 'Trego' and HRWW variety 'Tam 107' were established by fall seeding alternating drill strips on October 5, 2001.  Plots were seeded at 50 lb/a using 6-row plots with 10-in. row spacing and 20 ft row length. Plots were replicated four times. This dryland plot area had been fallowed in 2001, following canola in 2000.

To mimic winter kill, stand losses were achieved by replacing 0%, 25%, 50%, or 75% of the planted white or red winter wheat with seed of a spring wheat variety 'Barrie'.  The spring wheat emerged in selected blended percentages along with the winter wheat seed so that uniform fall stands were established in all plots.  Then, as expected, Barrie succumbed to freezing winter temperatures such that remaining winter wheat stands were 25%, 50%, 75%, or 100% (check). Complete winter killing of the spring wheat was eventually confirmed with no beardless spring wheat heads appearing among the bearded winter wheat heads.  Combine harvesting of individual plots was done June 21, 2002.

## RESULTS AND DISCUSSION

Wheat stand loss treatments in the winter caused similar and equal grain yield losses to both white and red winter wheats.  The 75% stand loss treatment reduced grain production approximately 59% whereas the 50% stand loss treatment reduced grain production approximately 29%.  The 25% stand loss treatment lowered grain production by nearly 15% as compared to the grain yield of the check plots (Table 1).

Stand loss treatments caused a slight delay in maturity as well as lower seed weight and higher seed moisture at harvest.  The HWWW responded in similar fashion to the HRWW variety.

[1]Funding provided by National Crop Insurance Services.

**Table 1. Effect of winter stand loss on white seeded versus red seeded wheat, 2002.**

| Winter Stand Loss | May Heading Date | Heads/ 10' row | Mature Height Inches | Grain bu/a (% loss) | Grain Test Wt | Grain g/100 seeds | Grain % $H_2O$ |
|---|---|---|---|---|---|---|---|
| HWWW | | | | | | | |
| 75% | 9 | 166 | 21 | 19(58) | 54.2 | 3.0 | 19.7 |
| 50% | 8 | 308 | 22 | 32(29) | 56.7 | 3.0 | 18.1 |
| 25% | 8 | 330 | 24 | 40(12) | 57.5 | 3.1 | 17.5 |
| 0 | 8 | 372 | 24 | 45 | 58.1 | 3.2 | 16.9 |
| HRWW | | | | | | | |
| 75% | 8 | 150 | 20 | 18(60) | 55.2 | 2.9 | 17.9 |
| 50% | 8 | 219 | 22 | 33(30) | 56.8 | 2.9 | 16.7 |
| 25% | 8 | 284 | 23 | 38(19) | 58.0 | 3.0 | 15.9 |
| 0 | 7 | 374 | 23 | 47 | 58.4 | 3.0 | 15.6 |
| L.S.D. at 5% level of significance | | | | | | | |
| Stand Loss | — | 38 | 1.7 | 4.3 | 0.5 | n.s. | 0.6 |
| Seed Color | — | n.s. | n.s. | n.s | 0.4 | 0.1 | 1.0 |
| SL X Color | — | 97 | n.s. | n.s. | n.s. | n.s. | n.s. |
| C.V.% | — | 22.9 | 4.2 | 3.1 | 0.8 | 3.6 | 8.4 |

# DRYLAND SOYBEAN PRODUCTION[1]

*by*
***Merle Witt***

## SUMMARY

Soybean production on dryland is becoming increasingly important in Kansas. Total acreage in the state approached 3 million in 2002 and has nearly doubled over the last 20 years. With much of the acreage increase on dryland, identifying appropriate production practices is of great interest. During the past 3 years, we have studied three Maturity Groups at four planting dates.

## PROCEDURES

Maturity Groups II, III, and IV soybeans were planted approximately April 15, May 1, May 15, and June 1 during the years 2000-2002. Plots were 50 feet long with 30-inch row spacing, and all plots included borders. Plots were replicated four times on a dryland production system. Seeding rate was 100,000 seeds per acre (approx. 45 pounds per acre). Pursuit Plus herbicide was used for weed control. Plots were grown on land that had been fallowed the previous year in each year of the study.

## RESULTS AND DISCUSSION

Results for 2002 are show in Table 1. Yields were highest with the longest maturity (MG IV) and favored by the May 15 (26.0 bu/a) and June 1 (25.3 bu/a) planting dates.

Results from the 3 year period 2000 – 2002 were averaged and are shown in Table 2. Availability of moisture during the critical pod-filling period was the single most important factor affecting yield. Maturity group played a key role each year with the longest season (Maturity group IV) soybeans having the most flexibility to utilize unpredictable precipitation over a longer period as well as to utilize soil moisture to a greater depth.

Later planting dates reduce vegetative growth and water requirements prior to flowering, which minimizes the effect of maturity groups, but can be more risky in having seedbed moisture available for emergence. The best planting date varied with year and was dependent upon rainfall timing, but planting a longer season MG IV soybean enhanced yield in every year.

[1]These studies were funded with Soybean Checkoff money.

**Table 1. Dryland soybeans – planting date by maturity group, 2002.**

| MG II (Turner) | | | | Grain | | |
|---|---|---|---|---|---|---|
| Date | Days to Emerge | Days to Bloom | Height (inches) | Test Wt | g/100 Seeds | bu/a |
| April 15 | 17 | 59 | 14 | 55.5 | 13.3 | 9.8 |
| May 1 | 13 | 49 | 16 | 55.4 | 13.6 | 11.7 |
| May 15 | 11 | 36 | 18 | 56.3 | 13.4 | 17.1 |
| June 1 | 5 | 22 | 17 | 55.4 | 13.9 | 17.1 |
| **MG III (Macon)** | | | | Grain | | |
| Date | Days to Emerge | Days to Bloom | Height (inches) | Test Wt | g/100 Seeds | bu/a |
| April 15 | 17 | 64 | 16 | 55.3 | 13.5 | 12.1 |
| May 1 | 13 | 49 | 18 | 55.6 | 13.2 | 17.4 |
| May 15 | 11 | 37 | 18 | 55.8 | 13.8 | 21.3 |
| June 1 | 5 | 22 | 17 | 54.8 | 13.9 | 20.3 |
| **MG IV (KS4694)** | | | | Grain | | |
| Date | Days to Emerge | Days to Bloom | Height (inches) | Test Wt | g/100 Seeds | bu/a |
| April 15 | 17 | 63 | 19 | 56.0 | 14.0 | 21.0 |
| May 1 | 13 | 49 | 20 | 56.4 | 13.8 | 23.2 |
| May 15 | 11 | 37 | 20 | 56.1 | 14.0 | 26.0 |
| June 1 | 5 | 22 | 20 | 56.4 | 13.9 | 25.3 |
| L.S.D. (5%) Dates | | 0.9 | 1.2 | n.s. | n.s. | 3.3 |
| L.S.D. (5%) MG | | 0.0 | 1.2 | 0.6 | n.s. | 3.3 |
| L.S.D. (5%) Dates X MG | | 1.8 | n.s. | n.s. | n.s. | 6.6 |

**Table 2. Dryland soybean – planting date by maturity group, 2000 – 2002.**

MG II (Turner)

| Date | Days to Emerge | Days to Bloom | Height (inches) | Grain Test Wt | Grain g/100 Seeds | Grain bu/a |
|---|---|---|---|---|---|---|
| April 15 | 21 | 67 | 16 | 56.6 | 13.0 | 13.5 |
| May 1 | 13 | 54 | 18 | 56.9 | 12.5 | 15.9 |
| May 15 | 10 | 48 | 19 | 57.3 | 12.5 | 19.6 |
| June 1 | 7 | 37 | 20 | 57.2 | 12.7 | 21.1 |
| Average | 13 | 51 | 18 | 57.0 | 12.7 | 17.5 |

MG III (Macon)

| Date | Days to Emerge | Days to Bloom | Height (inches) | Grain Test Wt | Grain g/100 Seeds | Grain bu/a |
|---|---|---|---|---|---|---|
| April 15 | 21 | 69 | 19 | 56.6 | 11.6 | 16.5 |
| May 1 | 13 | 56 | 21 | 56.7 | 11.6 | 21.0 |
| May 15 | 10 | 51 | 21 | 56.8 | 11.7 | 21.7 |
| June 1 | 7 | 38 | 21 | 56.7 | 11.7 | 23.1 |
| Average | 13 | 53 | 20 | 56.7 | 11.6 | 20.6 |

MG IV (KS4694)

| Date | Days to Emerge | Days to Bloom | Height (inches) | Grain Test Wt | Grain g/100 Seeds | Grain bu/a |
|---|---|---|---|---|---|---|
| April 15 | 21 | 71 | 21 | 57.6 | 11.4 | 22.5 |
| May 1 | 13 | 58 | 24 | 57.7 | 11.5 | 24.3 |
| May 15 | 10 | 52 | 24 | 57.7 | 11.4 | 24.2 |
| June 1 | 7 | 40 | 25 | 56.6 | 12.2 | 23.6 |
| Average | 13 | 55 | 24 | 57.4 | 11.7 | 23.7 |

# ACKNOWLEDGMENTS

The staff of the Southwest 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:**
BASF Corp.
Bayer Chemical
Cropland Coop, Inc.
DeKalb Genetics Corp.
Garst Seed Co.
Monsanto Co.
Northrup King
Pioneer Hi-Bred Intl.
Pueblo Chemical
Syngenta
Teeter Irrigation
Triumph Seed

**Grant Support:**
Aventis CropScience
BASF Corp.
Bayer Chemical
DowAgro Sciences
DuPont
FMC Corp.
Gowan
Kansas Dept. of Agriculture
Kansas Dept. of Health & Environment
Kansas Dept. of Wildlife & Parks
KCARE
Monsanto Co.
Morehouse Agronomy Research Fund
National Crop Insurance Services
National Sunflower Association
Syngenta
Potash & Phosphate Institute
Kansas Corn Commission
Kansas Fertilizer Research Fund
Kansas Grain Sorghum Commission
Kansas Soybean Commission
Kansas Water Resources Institute
USDA/ARS

**Cooperators:**
Bartos Agricultural Consulting, Inc.
Cropland Coop, Inc.
Garden City Company
Teeter Irrigaiton

**Performance Tests:**
ABI Garst/Agripro
Agripro/Garst
AgriPro Seeds, Inc.
AGSECO Inc.
American White Wheat Producers Assn.
Asgrow Seed Co.
Cal/West
Croplan Genetics
Crosbyton
Dairyland Seeds
DeKalb
Drussel Seed & Supply
Dyna-Gro
Ehmke Seed
Fontanelle
Forage Genetics
Frontier
Garst Seed Co.
General Mills
Goertzen Seed Research
Golden Harvest
Golden World
Great Plains Research Co.
Helena
Hytest
J.C. Robinson Seed Co.
Kaystar Seed
Midland Seeds
Midwest Seed Genetics, Inc.
MMR Genetics
Monsanto Global Seed Group
Mycogen Seeds
NC+ Hybrids
Northrup King
PGI
Pioneer Hi-Bred Intl.
ROTH
Seed Resource
Sharp Bros. Seed Company
Simplot
Sorghum Partners
Star Seed
Stine Seed Farms
Syngenta Seeds, Inc.
Trical
Triumph Seed Co., Inc.
U.S. Seeds
Warner
W-L Research

**Jaycie Fidel**—Extension Specialist, Family Nutrition Program. Jaycie received her B.S. and M.S. in nutritional science from Brigham Young University. Her extension program involves development of culturally-appropriate nutrition education programs and materials geared toward Spanish-speaking families.

**Ron Hale**—Extension Animal Scientist. Ron received his M.S. from Brigham Young University and his Ph.D. from Texas A&M. He joined the staff in 2001. His extension responsibilities include all aspects of animal production.

**Norman Klocke—**Water resources engineer. Norm received B.S. from the University of Illinois, his M.S. from the University of Kansas, and his Ph.D. from Colorado State University. He joined the staff in 2001. His research emphasis includes limited irrigation, water conservation, and leaching.

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

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

**Curtis Thompson—**Extension Agronomist. Curtis received his M.S. from North Dakota State University and his Ph.D. from the University of Idaho. He joined the staff in 1993. His extension responsibilities include all aspects of soils and field crop production.

**Carol Young**—Extension Home Economist and Program Specialist. Carol received her M.Ed. from Wichita State University in educational administration. She joined the staff in 1982 with Extension agent experience in Edwards, Sumner, and Osage counties. Carol promotes programs that benefit families and communities and teaches planning, leadership, and citizen involvement skills.

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

**Tom Willson**—Environmental Scientist. Tom received a B.A. in Biology and Environmental Studies from the University of California, Santa Cruz and studied Soil Science at Colorado State University before receiving his PhD in Soil Ecology and Sustainable Agriculture from Michigan State University. Tom's current research activities include integrating manure and irrigation water management in grain and forage production, water quality projects, and resource conserving/odor reducing technologies. He joined the staff in October 2000.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service, Manhattan 66506

SRP 910 June 2003