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Southwest Research–Extension Center

Report of Progress
895

Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service

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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.

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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.

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WEATHER INFORMATION FOR GARDEN CITY

by
Jeff Elliott

Precipitation for 2001 totaled 20.73 inches. This is almost two inches above the 30-year average, and was the result of good rains in May, June, and July. May was extremely wet, totaling 7.82 inches compared to 3.39 inches in an average year. This was the wettest May on record and also the third wettest month ever recorded at Garden City. The month with the most precipitation ever recorded was July of 1950 with 8.27 inches. On the other extreme, precipitation for the months of October through December totaled only 0.15 inches. This tied 1910 for the year with the driest last three months.

Snowfall measured 26.2 inches, of which 26.0 inches fell in the first three months of 2001. This is 8.5 inches more than average.

As usual, July was the warmest month in 2001 with a mean temperature of 82.7 F. Only one July since 1950 had a higher average temperature. November 2001 was also the second warmest since 1950. The last nine months of 2001 had mean temperatures that were each above the 30-year average. February was the coldest month with a mean temperature of 29.7 F.

No daily minimum temperatures below zero were recorded in 2001, although 0 F was reached on January 20 and February 10. Temperatures of 100 F or higher were recorded on 28 days in 2001. Nine consecutive days over 100 degrees were recorded starting July 30. Record high temperatures were set on July 8, 105 F, and on November 1, 85 F. Record lows were recorded on May 25, 38 F, and on September 9, 39 F.

The last spring freeze (31 F) occurred on April 23, three days earlier than average. The first fall freeze (31 F) fell on October 6, 5 days earlier than average. The resulting frost-free period was 165 days, compared to an average of 167 days.

Open pan evaporation from April 1 through October 31 totaled 75.17 inches compared to 70.6 inches average. Mean wind speed was 4.81 mph was slightly less than the long-term average of 5.25 mph.

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

	Precipitation inches		Temperature (°F) 2001 Average		Mean		2001 Extreme		Wind MPH		Evaporation inches	
Month	2001	Avg.	Max.	Min.	2001	Avg.	Max.	Min.	2001	Avg.	2001	Avg.
January	1.23	0.43	43.9	17.8	30.9	28.4	65	0	4.5	4.7		
February	0.71	0.48	39.5	19.9	29.7	33.7	64	0	5.5	5.4		
March	1.16	1.38	52.4	29.2	40.8	42.3	77	16	5.2	6.7		
April	1.49	1.65	71.6	40.6	56.1	52.1	92	26	6.3	6.7	8.68	8.35
May	7.82	3.39	77.5	50.2	63.9	62.0	96	38	4.5	6.0	9.77	9.93
June	3.02	2.88	86.6	59.1	72.9	72.4	100	49	5.0	5.6	11.92	12.32
July	2.73	2.59	97.9	67.5	82.7	77.4	105	63	4.4	4.9	14.53	13.41
August	1.31	2.56	94.3	62.7	78.5	75.5	104	57	4.0	4.2	12.56	11.19
September	1.11	1.25	85.0	53.2	69.1	67.0	97	38	4.7	4.6	9.71	8.88
October	0.00	0.91	72.7	37.5	55.1	54.9	88	28	5.4	4.8	8.0	6.52
November	0.07	0.86	62.6	32.5	47.5	40.5	85	5	4.7	4.9		
December	0.08	0.41	52.5	18.6	35.5	31.3	72	5	3.5	4.5		
Annual	**20.73**	**18.79**	**69.7**	**40.7**	**55.2**	**53.1**	**105**	**0**	**4.8**	**5.3**	**75.17**	**70.60**

Average latest freeze in spring	April 26	2001:	April 23
Average earliest freeze in fall	Oct. 11	2001:	October 6
Average frost-free period	167 days	2001:	165 days

All averages are for the period 1971-2000.

WEATHER INFORMATION FOR TRIBUNE

by

Dewayne Bond and Dale Nolan

Precipitation was 3.70 inches below normal with only 3 months recording above normal precipitation for a yearly total of 13.74 inches. May was the wettest month. The largest single amount of precipitation was 0.93 inches on August 17. December and October were the driest months with 0.11 and 0.12 inches of precipitation, respectively. Snowfall for the year totaled 22.3 inches — 13.7 inches in January, 4.1 inches in February, 4.0 inches in March, and 0.5 inches in December — for a total of 32 days of snow cover. The longest consecutive period of snow cover, 19 days, occurred from January 16 to February 3.

Record high temperatures were set November 1 and December 5, 86 F and 72 F, respectively. Record low temperatures were set May 25 and October 6, 35 F and 24 F, respectively. The hottest day of the year, which tied a record set in 1978, was July 8 at 105 F. July was the warmest month with a mean temperature of 80.6 F and an average high of 96.1 F.

The coldest day of the year was January 20, -2 F. January was also the coldest month of the year with a mean temperature of 29.4 F and an average low of 15.9 F. For 10 months, the air temperature was above normal. November, 6.8 F above normal and February, 2.6 F below normal, had the greatest departures. There were 14 days of 100 F or above temperatures, four days more than normal. There were 74 days of 90 F or above temperatures, 12 days more than normal. The last day of 32 F or less in the spring was on April 24, which was 12 days earlier than the normal date. The first day of 32 F or less in the fall came on October 6 and was 3 days later than the normal date. This produced a frost-free period of 165 days, which was 15 days more than the normal of 150 days.

April through September open pan evaporation totaled 71.58 inches, 0.93 inches above normal. Wind speed for the same period averaged 5.1 mph, 0.4 mph less than normal.

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

	Precipitation inches		Temperature (°F) 2001 Average		Normal		2001 Extreme		Wind MPH		Evaporation inches	
Month	2001	Normal	Max.	Min.	Max.	Min.	Max.	Min.	2001	Avg.	2001	Avg.
January	1.52	0.45	42.8	15.9	42.2	12.8	69	-2				
February	0.37	0.52	40.6	19.8	48.5	17.1	66	0				
March	0.53	1.22	51.3	27.3	56.2	24.2	74	15				
April	0.34	1.29	69.9	36.9	65.7	33.0	88	22	5.6	6.3	8.91	8.28
May	3.63	2.76	74.9	46.3	74.5	44.1	93	35	5.0	5.8	9.36	10.88
June	1.22	2.62	86.7	55.6	86.4	54.9	101	42	5.7	5.3	14.90	13.88
July	3.43	3.10	96.1	65.2	92.1	59.8	105	60	4.9	5.4	15.89	15.50
August	1.76	2.09	91.9	59.1	89.9	58.4	102	52	4.7	5.0	13.37	12.48
September	0.42	1.31	83.4	48.6	81.9	48.4	97	33	4.4	5.2	9.15	9.63
October	0.12	1.08	71.3	34.3	70.0	35.1	90	21				
November	0.29	0.63	61.2	28.7	53.3	23.1	86	3				
December	0.11	0.37	51.1	17.8	44.4	15.1	72	1				
Annual	**13.74**	**17.44**	**68.4**	**38.0**	**67.1**	**35.5**	**105**	**-2**	**5.5**	**5.5**	**71.58**	**70.65**

Average latest freeze in spring[1]	May 6	2001:	April 24
Average earliest freeze in fall	October 3	2001:	October 6
Average frost-free period	150 days	2001:	165 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. Wind and evaporation readings, 4.6 and 7.00, respectively, were taken in October, but have not been taken regularly in the past.

NITRATE LEACHING FOLLOWING ANIMAL WASTE AND NITROGEN FERTILIZER APPLICATIONS TO IRRIGATED CORN

by
Alan Schlegel, Loyd Stone[1]*, and Dewayne Bond*

SUMMARY

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. This study evaluates 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 were N fertilizer (60, 120, and 180 lb N/a) and an untreated control. Corn yields were increased by application of animal wastes and N fertilizer. The drainage rate (at the 5-ft depth) was much greater early in the season and decreased rapidly with crop growth. Application of animal wastes had no effect on drainage rate. Soil NO_3-N concentration generally did not decrease across the sampling periods. Nitrate loss was similar for swine effluent and cattle manure when applied based on N requirements. Limiting animal waste application to recommended levels and managing irrigation to minimize drainage early in the growing season may effectively limit NO_3 leaching.

PROCEDURES

This study was initiated in 1999 to determine the effect of land application of animal wastes on crop production and soil properties. 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. Other nutrient treatments were three rates of N fertilizer (60, 120, and 180 lb N/a) along with an untreated control.

To determine the amount of nitrate-N movement in the soil profile, suction-cup lysimeters were used to collect soil water samples at 5 ft depths periodically during June and July. To determine drainage rate at the 5-ft soil depth, water content and matric potential were measured approximately twice a week from June through August by using tensiometers and neutron attenuation. The 5-ft depth was selected to represent the maximum effective rooting depth of corn, so any nutrient movement past this depth is assumed non-recoverable by the corn plant. The rate of NO_3 movement was calculated by multiplying the daily drainage rate by daily NO_3-N concentration. Total NO_3 movement is the sum of the daily NO_3-N movement from the first to the last soil water collection.

RESULTS AND DISCUSSION

Grain yields were increased by application of animal wastes and commercial fertilizer compared to the untreated control (Figure 1). Corn yields were greater following application of cattle manure than swine effluent or N fertilizer. Within animal waste sources, yields were similar for all rates of application.

Estimated total drainage from June through August 2001 was 3.40 inches (Figure 2). Drainage during the soil water collection period (June 4 to July 10, 2001) was 2.91 inches. Soil solution NO_3 concentrations remained relatively constant throughout the sampling period (data not shown). Following application of cattle manure, estimated amount of NO_3 movement was about twice as great with the 2XN compared to the 1XN application rate (Figure 3). Estimated NO_3 movement following application of swine effluent was similar to that of cattle manure.

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

Total NO_3 movement was greatest when the animal wastes were over-applied (2XN rate). Nitrate loss was much less from N fertilizer than animal wastes. In the control treatment, NO_3–N loss was negligible (less than 3 lb/a).

Fig. 1. Grain yield in 2001 following application of animal wastes and N fertilizer.

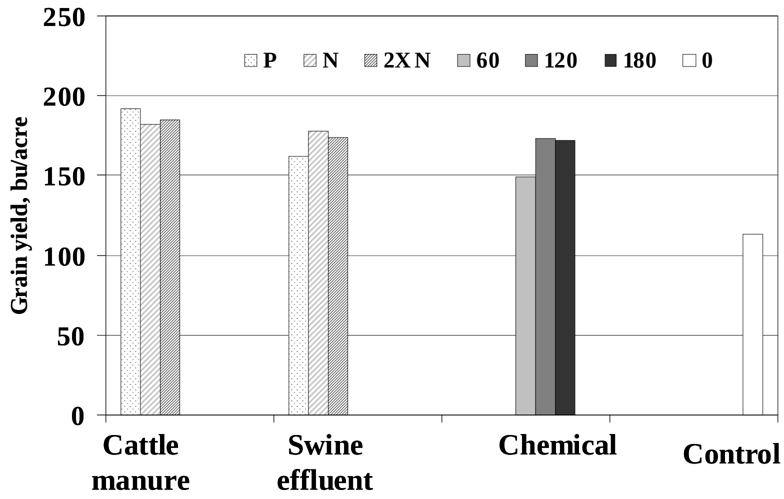


Fig. 2. Estimated daily drainage rate during 2001.

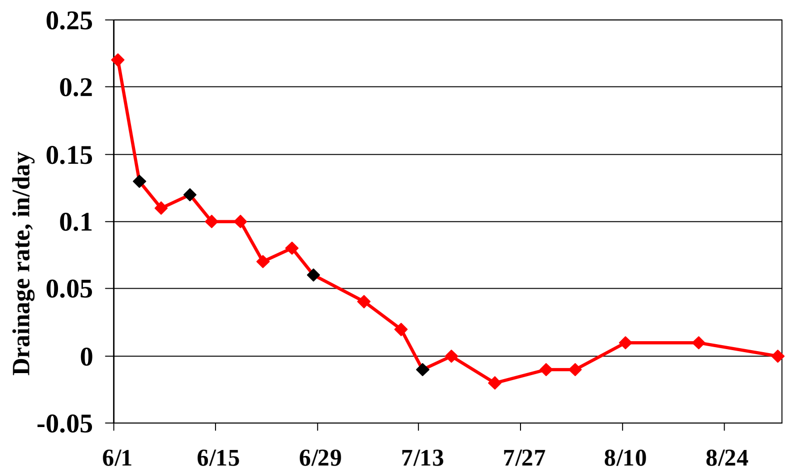
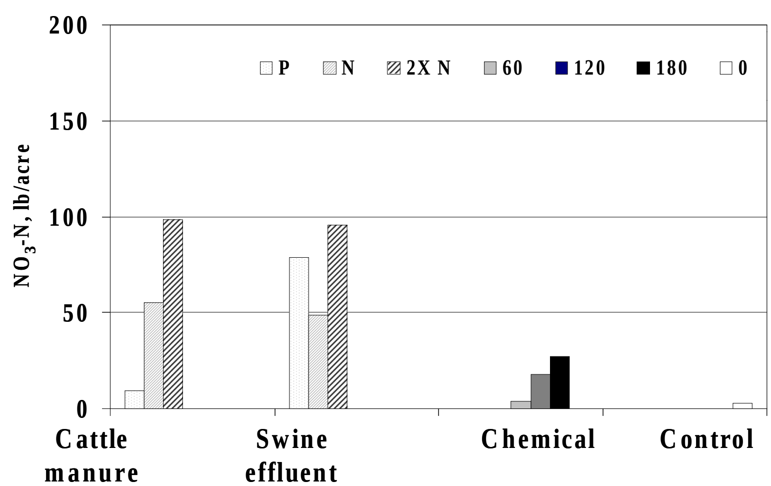


Fig. 3. Estimated NO3-N movement past the 5-ft depth in 2001.



POST-HARVEST WEED CONTROL IN A WHEAT-FALLOW ROTATION

by
Alan Schlegel and Troy Dumler

SUMMARY

A study was initiated in 1994 to evaluate the impact of post-harvest weed control on grain yield and stored soil water in a wheat-fallow (WF) rotation. Averaged across a 6-yr period, grain yields were 47% greater with no-till (NT) than with conventional tillage (CT). Allowing weed growth after harvest did not reduce yields compared to tillage, in fact, a delayed minimum tillage (DMT) system (allowing weed growth post-harvest and controlling weeds with chemicals and tillage the following year prior to wheat planting) yielded 8 bu/a more than CT. The water used by weed growth post-harvest was offset by increased storage of water during the remainder of the fallow year because of increased residue on the soil surface (wheat stubble and dead weed growth). An economic analysis showed that production costs were greatest with NT and least with DMT. Although yields were greater with NT, net returns were greater with DMT and least with CT.

PROCEDURES

This study was established in 1994 after wheat harvest to evaluate the impact of post-harvest weed control on grain yield and soil water. The study was completed in 2002 after 6 wheat crops. The control of broadleaf plants in wheat stubble post-harvest has been linked with declines in brood habitat for pheasants. However, there has been limited information available on the impact of weed growth on soil water and subsequent grain yield. The treatments were conventional tillage (CT), no-till (NT), and a delayed minimum tillage (DMT) system. The CT system was tilled with a sweep plow twice post-harvest and as needed during the following fallow year (usually about five times). The NT treatment was sprayed with Landmaster BW (twice) and atrazine post-harvest and then sprayed as needed in the fallow year prior to wheat (about three times). The DMT system was left untouched from wheat harvest through the winter. Then, the first weed control operation in the spring was spraying with Landmaster BW, followed by tillage with a sweep plow the remainder of the fallow year (about three times). The wheat variety was TAM 107 prior to 1999 and TAM 110 in 1999 to 2001. Wheat was planted in September at 50 lb/a. All treatments received starter fertilizer (80 lb/a of 11-52-0) at planting and topdress N (70 lb N/a) in the spring. All plots were machine harvested. Soil water was measured to a depth of 6 ft after wheat harvest, fall after harvest, spring of fallow year, and at wheat planting for each crop.

An economic analysis compared the relative costs and returns for each system. Costs for tillage, herbicide applications, planting, and harvesting were based on custom rates for western Kansas. Seed and herbicide costs were based on local prices. Grain prices used in the budget were the average prices at harvest from 1996 to 2001 in western Kansas. Gross income was calculated each year by multiplying crop yield by harvest grain prices. Net returns were calculated as gross income minus production costs and reflect returns to land and management.

RESULTS AND DISCUSSION

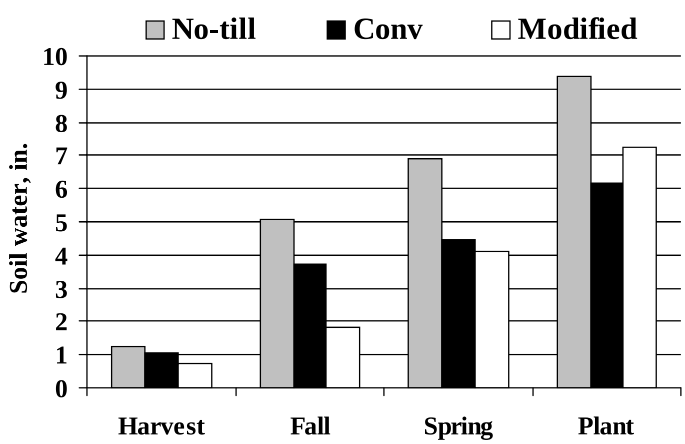
The NT system produced the highest yields and CT the lowest yields (Table 1). Averaged across the 6-yr period, NT yielded 47% more than CT. Allowing weed growth after harvest did not reduce yields compared to using tillage for weed control. In fact, yields were 8 bu/a greater with the DMT system compared to CT. One purpose for controlling weed growth is to save soil water. Allowing weed growth after harvest resulted in less soil water in the fall (post-harvest) than controlling weeds with chemicals or tillage (Fig. 1). However, by spring soil water was equal in the DMT and CT systems. The weeds in the DMT system captured more snow over-winter than the tilled treatment. By wheat planting, there was more soil water in the DMT treatment than CT because of increased surface cover. As expected, the NT system was the most effective for capturing and storing soil water.

An economic analysis compared the costs and net returns from the three systems. Average production costs were greatest with NT ($123/acre), less with CT ($101/a) and least with DMT ($92/a). Net returns (6-yr average) were greater with DMT ($39/a) than NT ($30/a) and much less with CT ($3/a). In individual years, DMT was the most profitable in 3 of 6 years and least profitable in 1year. No-till was the most profitable in 2 of 6 years, and DMT and NT were equally profitable 1 year. The CT system was the least profitable in 5 of the 6 years.

Table 1. Wheat response to post-harvest weed control in a wheat-fallow rotation, Tribune, KS 1996-2001.

Treatment	1996	1997	1998	1999	2000	2001	Mean
	- - - - - -	- - - - - -	- - - - bu/acre	- - - -	- - - - - -	- - - - - -	
No-till	36	46	72	72	41	52	53
Conventional tillage	21	30	56	48	27	37	36
No weed control (postharvest)	42	36	57	65	32	30	44
LSD $_{0.05}$	9	4	7	6	11	6	3

Fig. 1. Impact of post-harvest weed control on profile available soil water in a wheat-fallow rotation, Tribune, KS 1996-2001.



CORN, GRAIN SORGHUM, SOYBEAN, AND SUNFLOWER RESPONSE TO LIMITED IRRIGATION[1]

by
Alan Schlegel

SUMMARY

Research was initiated in spring 2001 under sprinkler irrigation to evaluate limited irrigation in a no-till crop rotation. Corn and soybean yields were increased about 47% when irrigation was increased from 5 to 15 inches, while sorghum yields increased 39%. Sunflower was the least responsive to irrigation. Corn and grain sorghum yields were the same with 5 inches of irrigation. The most profitable crop was grain sorghum with 5 inches of irrigation and corn at the higher irrigation amounts.

PROCEDURES

A study was initiated under sprinkler irrigation at the Tribune Unit, Southwest Research-Extension Center in the spring of 2001. The objective was to determine the impact of limited irrigation on crop yield, water use, and profitability. Crops were corn, grain sorghum, sunflower, and soybean. All crops were grown no-till while other cultural practices (hybrid selection, fertility practices, weed control, etc.) were selected to optimize production. Irrigations were scheduled to supply water at the most critical stress periods for the specific crops and limited to 1.5 inches/week. Seasonal irrigation amounts were about 5, 10, and 15 inches. Soil water was measured at planting and at harvest in 1-ft increments to a depth of 8 ft. Grain yields were determined by machine harvest. Crop water use was calculated as soil water depletion (profile soil water at planting minus profile soil water at harvest) plus in-season rainfall + in-season irrigation. Crop water use efficiency was determined by the amount of grain produced divided by crop water use.

RESULTS AND DISCUSSION

Grain yield of corn and sorghum were equal when receiving 5 inches of irrigation (Table 1). While at greater amounts of irrigation, corn yields were greater than sorghum yields. Soybean responded better to irrigation than did sunflower. Sunflower yields were reduced by stem borer infestation.

Table 1. Impact of irrigation amounts on grain yields, Tribune, KS 2001.

Irrigation amount inches	Corn	Sorghum	Soybean	Sunflower
	- - - - - - - - -bu/a		- - - - - - -	lb/a
5	124	124	34	1725
10	169	149	41	1978
15	184	172	47	1759

Another component of this research is determining water use characteristics of the four crops at varying irrigation amounts. Profile available soil water at harvest was less with sorghum (average of 4.7 inches in the soil profile at harvest) compared to the other crops (average of 5.7 to 6.4 inches in the profile). As expected, the soil was driest with the lowest amount of irrigation (about 4 inches in the profile averaged across all crops), but similar for the higher irrigation amounts (about 6.4 to 6.9 inches). This indicates that as irrigation amounts increase and the crop has less reliance on stored soil moisture, a greater amount of water remains in the profile at harvest. Since a dryer soil is more effective than a wetter soil in capturing precipitation, the amount of over-winter precipitation storage may decrease with the higher irrigation amounts. Water use efficiency (WUE) was greater for the feed grain crops (corn and grain sorghum) than for the oilseed crops (Table 2). For corn and sorghum, WUE tended to be greater with the intermediate amount of irrigation. While for the soybean and sunflower, WUE tended to decrease as irrigation increased.

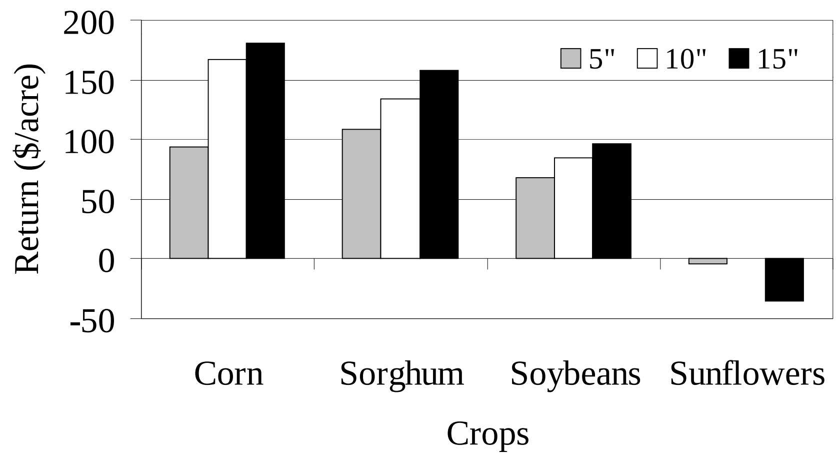
[1]The Kansas Corn Commission and Kansas Grain Sorghum Commission funded this research.

Table 2. Water use efficiency for corn, sorghum, soybean, and sunflower as affected by irrigation amounts, Tribune, KS 2001.

Irrigation amount inches	Corn	Sorghum	Soybean	Sunflower
	- - lb of grain/inch of crop water use - -			
5	472	396	133	161
10	493	408	129	126
15	434	391	128	80

An economic analysis using current prices and costs showed that corn was the most profitable (return to land, irrigation equipment, and management) crop with 10 or 15 inches of irrigation (Figure 1). Sorghum was the most profitable crop with 5 inches of irrigation. For all crops except sunflower, profitability increased with increased irrigation amounts.

Figure 1. Effect of irrigation amounts on profitability of various crops, Tribune, KS 2001.



SOURCES OF FECAL COLIFORM CONTAMINATION IN THE UPPER ARKANSAS RIVER

by
Tom Willson

SUMMARY

A study was initiated to investigate the relative contribution of urban and rural sources of fecal contamination in the Arkansas River between Deerfield and Ford, Kansas. A total of 21 sample locations were established to differentiate types of upstream land use. These were sampled every 2 months and immediately following runoff events to identify drainage areas that contributed most to fecal coliform contamination. Additional samples were taken at 24-h intervals after runoff to document the survival and transport of the bacteria in the river. Samples taken between runoff events, and early spring runoff samples with limited precipitation, generally did not exceed the primary recreation standard of 900 colony forming units (cfu) per 100 ml. These samples also showed a relatively greater contribution from urban rather than rural sources. By contrast, samples taken during a period of high rainfall in May and June, 2001 had higher counts overall, and higher counts from rural than from urban areas. Additional testing will be performed over the next 2 years to determine the causes of fecal contamination at each location, and bacterial source tracing methods will be used to differentiate between human and non-human sources.

INTRODUCTION

The 1972 Federal Clean Water Act set in motion a number of initiatives designed to achieve "swimable, fishable waters" in lakes and streams throughout the United States. While the enforcement of this act has dramatically improved the quality of waters in Kansas and elsewhere, most of the improvement has been due to the reduction of point-source pollution though the National Pollution Discharge Elimination System (NPDES) and other measures. By contrast very little progress had been made in implementing the key non-point source pollution provision of the act, the establishment of Total Maximum Daily Load (TMDL) standards for various contaminants in surface waters.

Simply stated, a TMDL limits the total amount of a given contaminant that can enter a lake or stream segment over time so that that water body is able to comply with the minimum quality standards for its intended use. In the mid 1990s the US Environmental Protection Agency (EPA) was sued by several environmental groups for failing to enforce the TMDL provisions of the Clean Water Act. The State of Kansas joined EPA in an out-of court settlement that requires the State to establish TMDLs in all Kansas watersheds by 2006. The State has accelerated this timetable so that under the current plan all TMDLs will be established by 2003. For each new TMDL established, the State has projected a 5-year window during which all measures designed to reduce non-point source pollution to achieve the TMDL will be voluntary and incentive-based. After that window, more direct regulatory action will be considered if the goal is not being met.

Most Kansas TMDLs have been assigned based on data from an extensive network of water quality monitoring sites operated by the Kansas Department of Health and Environment (KDHE) and the Kansas Biological Survey. Each permanent sampling station in the KDHE Stream Chemistry Monitoring Network is designed to be representative of water quality 20 miles upstream and 10 miles downstream of that location. Sample locations on the Upper Arkansas River in SW Kansas include Deerfield (14 miles upstream of Garden City) Pierceville (9 miles downstream of Garden City) and Ford (15 miles downstream of Dodge City). The Arkansas River between Garden City and Dodge City is considered one of Kansas' most impaired stream segments for fecal coliform bacteria, because of measurements taken at the Pierceville and Ford sites. The standard for secondary contact recreation (boating and wading) of 2000 colony forming units per 100 ml was exceeded about 44% of the time at Pierceville and 20% of the time at Ford in bimonthly samples over a 10-year period. The standard for primary contact recreation (swimming and fishing) of 900 cfu/100 ml for April through October is violated even more frequently. By contrast, the secondary contact standard was violated only four times and the primary contact standard only twice during the last 10 years at Deerfield.

The purpose of this project is to identify sources of fecal coliform bacteria in the Upper Arkansas River and to test the assumption made by KDHE in its TMDL assessment that the majority of the contamination comes from small, confined feeding operations. This report presents the results of the first year of that study.

PROCEDURES

Eighteen sample locations were established along the Arkansas River between Deerfield and Ford, KS (Table 1). These provide convenient access to the river and differentiate drainage areas with contrasting land uses. Three additional locations were added to differentiate contributions along the main Garden City storm drain, and to include Mulberry Creek, the only significant tributary of the river within this 90 mile segment.

We attempted to sample all of these locations within 24 hours after each rain or snowmelt event great enough to produce runoff from Garden City storm drains. Additional samples were obtained at 24 hour intervals to measure the transport and survival of bacteria in the river system. Baseline samples were taken every two months to coincide with the dates used by the KDHE stream chemistry monitoring network.

Samples were obtained by hand from the part of the channel with the greatest flow, and analyzed at Servi-Tech Laboratory in Dodge City within 24 hours. Due to the long incubation time required for this analysis, samples could only be processed 3.5 days per week. This and other logistical concerns reduced the total number of samples obtained to those shown in Tables 2-4.

RESULTS AND DISCUSSION

In the samples taken between runoff events (Table 2) there is an obvious effect of the Garden City wastewater treatment plant, which discharges effluent into the stream just upstream of the G3 sample location. As a point source with relatively constant discharge, the effect of the treatment plant is greatest when the flow in the river is the lowest. Indeed, wastewater effluent accounted for all of the flow in the river at G3 in the October 8, 2001 sample. The treatment plant has been upgraded to include a final disinfection step as of February 2002. The future impact of the plant on fecal coliform in the river should be negligible, as can be seen in the March 2002 sample. In that case, the fecal coliform count actually declined at G3 as flow in the river was diluted with apparently cleaner wastewater effluent.

Early spring runoff samples (Table 3) tended to occur under conditions with relatively dry soils and modest, isolated precipitation events. In general they show a similar pattern to the baseline samples in that contamination seems to be more severe at G3 and at other locations where urban sources of runoff enter the river. The Garden City wastewater treatment plant empties into the city's main storm drain, which also collects runoff from a wide area of residential and light industrial development. The greatest concentration of on-site wastewater systems (e.g. septic systems) also occurs in this area just east of the city. It is likely that much of the fecal contamination detected downstream of G3 on April 11, 2001 came from these sources, and from some of the agricultural sources along the river, including small animal feeding operations, manure handling, and grazing. Evidence for agricultural inputs is greater in the Ford, KS location (F2) on the April 11 sample date. The area upstream of this sample point is sparsely populated, but it features a number of small beef feeding operations. Most of these operations are located well away from the river, but may also incorporate pastures or grazed cropland near the river. Some also have enhanced drainage to the river because of flood control projects along US 400.

Early April would have been a logical time to apply manure or lagoon effluent prior to planting summer crops, but it is unclear whether a 0.95-inch rain on relatively dry soils would have produced significant runoff from the agricultural fields. Temporary manure stockpiles are another potential source of contamination if they are located too close to the river or if they can drain directly into ditches or stream channels.

The role of land application of animal wastes in producing fecal coliform contamination in SW Kansas remains controversial. In other regions, land application is rarely considered a significant source of bacteria because manure tends either to be incorporated or desiccated soon after application. In SW Kansas animal waste is applied somewhere along the river corridor during most of the year, and it is probably left on the surface as frequently as it is incorporated. While desiccation would be the norm

Table 1. Sample locations characterized by upstream land use.*

Site (Code)	Distance from Previous (Miles Downriver)	Distance	Location from Deerfield (City)	(Landmark)	(Type)	Upstream Land Use (Runoff Sources Within 10 Miles)	Long-Term KDHE Coliform Fecal Data** (cfu / 100ml)
D1	**0**	**0**	**Deerfield**	**Bridge**	**Rural**	**Crops, City of Lakin, Rural Homes**	**266**
H1	8	8	Holcomb	Bridge	Rural	Crops, CAFOs and AFOs, City of Deerfield, some IBP Waste	
G1	6	14	Garden City	Sagebrush Estates	Rural	Crops, City of Holcomb, AFOs, some Wildlife	
G2	3	17	Garden City	US 83 Bypass Bridge	Urban	Southern Garden City, Holcomb, AFOs, Stables	
S1***			GC (Storm Drain)	Campus Dr.	Urban	Northern Garden City (residences and light industry) industry)	
S2***			GC (Storm Drain)	Mansfield Dr	Urban	North and East Garden City, Septic Systems	
G3	1	18	Garden City	Brookover Ranch	Urban	Garden City, Septic Systems, AFOs, Stables	
G4	2	20	Garden City	Brookover Ranch	Urban	All of the above, plus Con Agra Beef ****	
G5	3	23	Garden City	Dewey Ranch	Rural	All of the above	
P	**5**	**28**	**Pierceville**	**Bridge**	**Rural**	**All of the above**	**2923**
C1	5.5	33.5	Charleston	Bridge	Rural	Crops, Grazing	
I	8	41.5	Ingalls	Bridge	Rural	CAFO, Grazing, Crops	
C2	6.5	48	Cimarron	Park	Rural	CAFO, Grazing, Crops, City of Ingalls	
H2	9.5	57.5	Howell	Bridge	Rural	CAFO, AFO, Grazing, Crops, City of Cimarron	
D2	9.5	67	Dodge City	14th St Bridge	Rural	AFO, Grazing, Crops	
D3	1	68	Dodge City	Pump Station #1	Urban	Dodge City, AFOs, Crops	
D4	1.5	69.5	Dodge City	404 Road	Urban	Dodge City, AFOs, National Beef	
D5	1	70.5	Dodge City	Truck Wash	Urban	Dodge City Wastewater, Pets	
F1	4.5	75	Ft. Dodge	117 Road	Rural/Urban	Dodge City, Septic Systems, Excel	
F2	**11**	**86**	**Ford**	**US 400 Bridge**	**Rural**	**AFO, CAFO, Grazing Crops**	**1463**
F3* **			**Ford (Mulberry Cr.)**	**RR Bridge**	**Rural**	**AFO, CAFO, Grazing Crops**	**108**

*The KDHE Stream Chemistry Monitoring Network sites are shown in bold.
**These data are averages for bimonthly samples prior to September 2000. (Two years for Mulberry Creek, > 10 years for Deerfield and Pierceville.)
***Sites S1, S2, and F3 are on tributaries to the Arkansas River. They are located 1.5, 0.2, and 0.8 miles from the river, respectively.
****The Con Agra plant closed December 2000 and was undergoing cleanup opperations Spring 2001. All discharges and land application subject to permit.

Table 2. Fecal coliform counts in the Arkansas River between runoff events.*

				Date:	4/9/2001	10/8/2001	12/17/2001	1/14/2002	3/11/2002
				Weather Conditions:	65F, Sunny	65F, Sunny	45F, Sunny	55 F, Suny	55 F, P.C.
				Relative Flow in River:	med-high	very low	low	low	low
				Days since runoff event:	NA	NA	NA	NA	NA
				Type of runoff event:	NA	NA	NA	NA	NA
Site	Distance from Previous	Distance from Deerfield	Location		Fecal Coliform Count**				
(code)	(Miles Downriver)		(City)	(Landmark)	(CFU's / 100 ml)				
D1	**0**	**0**	**Deerfield**	**Bridge**	**1**	**50**	**80**	**6**	**20**
H1	8	8	Holcomb	Bridge	27	dry	10	1	30
G1	6	14	Garden City	Sagebrush Estates	5	30	10	0	50
G2	3	17	Garden City	US 83 Bypass Bridge	7	dry	10	0	150
S1			GC (Storm Drain)	Campus Dr.		dry	dry	dry	dry
S2			GC (Storm Drain)	Mansfield Dr		“	“	“	“
G3	1	18	Garden City	Brookover Ranch	171	19200	500	2300	70
G4	2	20	Garden City	Brookover Ranch	119	dry	900	180	100
G5	3	23	Garden City	Dewey Ranch	66	“	300	9	130
P	**5**	**28**	**Pierceville**	**Bridge**	**34**	**“**	**dry**	**dry**	**30**
C1	5.5	33.5	Charleston	Bridge	6	“	“	“	90
I	8	41.5	Ingalls	Bridge	2	“	“	“	dry
C2	6.5	48	Cimarron	Park		“	“	“	“
H2	9.5	57.5	Howell	Bridge		“	“	“	“
D2	9.5	67	Dodge City	14th St Bridge		“	“	“	“
D3	1	68	Dodge City	Pump Station #1		“	“	“	“
D4	1.5	69.5	Dodge City	404 Road		“	“	“	“
D5	1	70.5	Dodge City	Truck Wash		“	“	“	“
F1	4.5	75	Ft. Dodge	117 Road		“	“	“	“
F2	**11**	**86**	**Ford**	**US 400 Bridge**		**<10**	**10**	**0**	**<10**
F3			**Ford (Mulberry Cr.)**	**RR Bridge**		**<10**	**10**	**2**	**<10**

*The KDHE Stream Chemistry Monitoring Network sites are shown in bold.
** Blank spaces indicate samples that were skipped because of time constraints.

Table 3. Fecal coliform counts in the Arkansas River after early spring runoff events. *

Date:	2/26/2001	2/27/2001	4/11/2001	4/12/2001	
Weather Conditions:	45F, P.C.	20F, Windy	45F, V. Windy	55F, Sunny	
Relative Flow in River:	med	med-low	high	high	Long-Term
Days since runoff event:	2	3	1	2	Average for
Type of runoff event:	Snow Melt	Snow Melt	.95"	.95"	February-April

Site (Code)	Distance from Previous (Miles downriver)	Distance from Deerfield (City)	Location (Landmark)		Fecal Coliform Count** (CFU's / 100 ml) 2/26/2001	2/27/2001	4/11/2001	4/12/2001	Long-Term Average for February-April
D1	**0**	**0**	**Deerfield**	**Bridge**	**9**		**50**		**108**
H1	8	8	Holcomb	Bridge	7		460		
G1	6	14	Garden City	Sagebrush Estates	1		820		
G2	3	17	Garden City	US 83 Bypass Bridge	1		810		
S1			GC (Storm Drain)	Campus Dr.					
S2			GC (Storm Drain)	Mansfield Dr					
G3	1	18	Garden City	Brookover Ranch			>2000***		
G4	2	20	Garden City	Brookover Ranch			>2000***		
G5	3	23	Garden City	Dewey Ranch			1520		
P	**5**	**28**	**Pierceville**	**Bridge**	**420**		**1290**		**3310**
C1	5.5	33.5	Charleston	Bridge	440		1650	>2000***	
I	8	41.5	Ingalls	Bridge	50		1590		
C2	6.5	48	Cimarron	Park	9		30	740	
H2	9.5	57.5	Howell	Bridge	0	90	12		
D2	9.5	67	Dodge City	14th St Bridge	1	15	10		
D3	1	68	Dodge City	Pump Station #1		6			
D4	1.5	69.5	Dodge City	404 Road	1	5	70		
D5	1	70.5	Dodge City	Truck Wash		6	110		
F1	4.5	75	Ft. Dodge	117 Road		43	80		
F2	**11**	**86**	**Ford**	**US 400 Bridge**		**20**	**1420**		**1880**
F3			**Ford (Mulberry Cr.)**	**RR Bridge**		**3**	**170**		**129**

*The KDHE Stream Chemistry Monitoring Network sites are shown in bold.
** Blank spaces indicate samples that were not taken because of time constraints.
*** Insufficient dilution - too many colonies for accurate reading.

Table 4. Fecal coliform counts in the Arkansas River after late spring runoff events. *

				Date:	5/21/2001	6/11/2001	
				Weather Conditions:	60F, Windy	95F Sunny	
				Relitive Flow in River:	V. High	V.High	Long-Term
				Days since runoff event:	1, 2 ,4	3,4	KDHE Average for
				Type of runoff event:	>2.5" week	2" week	May.& June
Site	Distance from Previous	Distance from Deerfield	Location		Fecal Coliform Count **		
(Code)	(Miles downriver)		(City)	(Landmark)	(CFU's / 100 ml)		
D1	**0**	**0**	**Deerfield**	Bridge	**2400**	**800**	**345**
H1	8	8	Holcomb	Bridge	6600	1100	
G1	6	14	Garden City	Sagebrush Estates	11300	1500	
G2	3	17	Garden City	US 83 Bypass Bridge	1800	2500	
S1			GC (Storm Drain)	Campus Dr.	600		
S2			GC (Storm Drain)	Mansfield Dr	300		
G3	1	18	Garden City	Brookover Ranch	2000	2400	
G4	2	20	Garden City	Brookover Ranch	3100	2800	
G5	3	23	Garden City	Dewey Ranch	2100	3200	
P	**5**	**28**	**Pierceville**	Bridge	**600**	**4400**	**2078**
C1	5.5	33.5	Charleston	Bridge		3400	
I	8	41.5	Ingalls	Bridge		2500	
C2	6.5	48	Cimarron	Park		3200	
H2	9.5	57.5	Howell	Bridge		2200	
D2	9.5	67	Dodge City	14th St Bridge		2300	
D3	1	68	Dodge City	Pump Station #1			
D4	1.5	69.5	Dodge City	404 Road		600	
D5	1	70.5	Dodge City	Truck Wash		700	
F1	4.5	75	Ft. Dodge	117 Road	1100	1500	
F2	11	86	**Ford**	US 400 Bridge	**90**	**1600**	**2978**
F3			**Ford (Mulberry Cr.)**	RR Bridge	**130**	**230**	**143**

*The KDHE Stream Chemistry Monitoring Network sites are shown in bold.
** Blank spaces indicate samples that were not taken because of time constraints.

in dryland crops, virtually all of the cropland along the river is irrigated. Surface applied feedlot manure would therefore stay moist throughout the growing season under flood or sprinkler irrigation systems.

Time constraints prevented us from obtaining complete sample runs on February 27 and April 12, 2001, but the samples that were obtained indicate that it is possible to track individual “outbreaks” of fecal coliform as they travel downstream. The front of bacteria detected at Ingalls on February 26 seems to have moved downstream to Howell on the 27^{th}. Similarly, the two samples taken on April 12 show a downstream movement of the broad peak observed from Garden City to Ingalls on the 11^{th}.

Only under conditions of near record precipitation in late May and early June (Table 4) do we see greater fecal coliform counts associated with rural runoff than with urban runoff. It is likely that the high moisture contents of soils during this period dramatically enhanced runoff from agricultural fields. The same conditions may have caused normally effective waste containment strategies to fail in small animal feeding operations, truck washes, and other potential sources of bacteria along the river. High water tables may also have interfered with the effectiveness of septic systems in the flood plain, or even encouraged accidental leakage from waste containment lagoons. While further study may be able to differentiate between these potential sources, it is important to note that at this point, none of them can be excluded. We will have to face the possibility that current regulations concerning storage, handling, and land-application of animal waste within the river corridor may be insufficient to preserve water quality during sustained periods of high rainfall. At the same time, it is important that we recognize that urban runoff may be the most important source of bacterial contamination during smaller, more isolated runoff events.

FUTURE PLANS

This study will continue in 2002 and 2003. The consistency of sampling will increase, and all samples will be processed at a new laboratory facility at SWREC in Garden City. Routine sampling for fecal coliform bacteria will be augmented with counts of fecal streptococcus bacteria. Isolates of fecal streptococcus can be characterized for substrate utilization and antibiotic resistance patterns, and these patterns can be used to determine the probable source of the fecal contamination, whether human beings, domestic livestock, domestic pets, or wildlife. The goal of this project is to pinpoint those practices most responsible for contamination in the river, so that conservation agencies can make the best possible use of limited funding available for education and remediation programs.

The techniques developed in this watershed can be used in any watershed in which the sources of fecal bacteria in surface waters are as yet unknown. That scenario is valid for the majority of unconfined watersheds in Kansas.

THE IMPACT ON STORED SOIL MOISTURE OF GLYPHOSATE RATE AND TIMING OF APPLICATION FOR CONTROL OF VOLUNTEER WHEAT

by
Randall Currie and Curtis Thompson

SUMMARY

Glyphosate rate was less important very early or late in season, but was much more important in the March and April applications. At these application times, the most soil water was saved. The residue grown from October to March may conserve more water than the wheat plant consumes.

INTRODUCTION

Wheat is a major weed in wheat-fallow-wheat rotations in Kansas. Although the approximate rates and timings to kill wheat with glyphosate are known, the effects of these treatments on soil water storage during the fallow period is poorly understood. This is especially important since water storage is the main objective of a fallow period.

PROCEDURES

Five glyphosate rates, 0 (untreated control), 0.19, 0.38, 0.56, and 0.75 lbs ai/a were applied on uniform wheat stands during November, March, April, or May to produce 20 rate-timing combinations. A bare-ground control was also included by applying glyphosate as needed. Soil moisture was measured monthly for a year with measurements taken at 1 foot increments to a depth of 8 feet. After wheat senescence, the entire study area was maintained weed free with 1 lb ai/a glyphosate as necessary.

RESULTS AND DISCUSSION

Overall, effects on soil water from rate and timing of glyphosate were similar in the August, September, and October readings. Glyphosate applied in March and April elevated soil water above the untreated control in the top 2 feet of soil in October (Fig. 1). When applied in April, 0.75 lb/a glyphosate elevated soil moisture in the top 2 feet relative to the bare-ground control. Total soil moisture in the top 5 feet of soil was highest with March and April applications compared to the untreated control (Fig. 2). As with surface moisture, more total soil water was in the top 5 feet in plots receiving the 0.75 lb/a March application compared to the bare ground control. These results show that residue grown from October to March conserves more water than the wheat plant consumes.

Fig. 1. Additional water savings at planting at 0-2 feet.

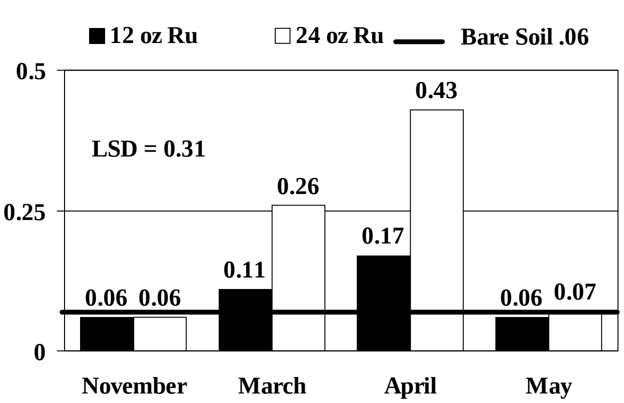
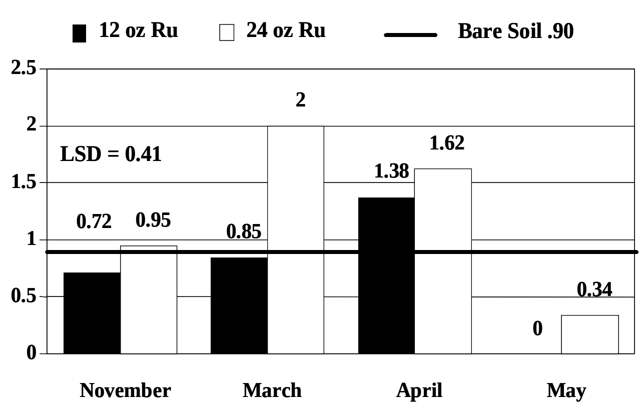


Fig. 2. Additional water savings at planting at 0-5 feet.



THE IMPACT OF A SINGLE RESIDUE INCORPORATION ON THE SEED SOIL BANK OF *PALMER AMARANTH* UNDER SIX CROP MANAGEMENT HISTORIES

by
Randall Currie

SUMMARY

A history of atrazine use reduced *Palmer amaranth* seedling emergence early in the season. However, only timing of *Palmer amaranth* emergence was affected. Total seasonal depletion of its seed soil bank remained unchanged.

INTRODUCTION

Most weed control studies do not account for the long-term effect of weed seeds when studying a particular management system. The objective of this study was to assess the effects of past weed management history.

PROCEDURES

This study was established following completion of a 3-year study of three levels of atrazine (0, 0.75 and 1.5 lbs/a) with and without a cover crop for production of irrigated corn. In this second study, which was initiated in October 2000, half of each of these six systems was tilled with two passes of a double gang disk and half were left untilled. Thus, for each of the three levels of atrazine, there is a tilled plot with and without a cover crop; and an untilled plot with and without a cover crop for a total of 12 study plots. These 12 treatments were repeated five more times. This experimental design allowed measurement of the impact of tillage on the seed soil bank created by these cropping systems. In the spring of 2001 the fallow phase of a corn-fallow-corn rotation was commenced, with bi-weekly weed counts followed by a 1 lb/a application of glyphosate.

RESULTS AND DISCUSSION

A history of atrazine use reduced *Palmer amaranth* seedling emergence by 2 to 33 fold early in the season across all management systems (Fig. 1). Due to a high degree of variability, however, these differences were not always statistically significant. Tilled plots with a previous history of atrazine use showed a dramatic reduction in *Palmer amaranth* seedling emergence compared to untilled plots without previous atrazine use.

The effect of previous cropping system had diminished by June 6 (Fig. 2). At that point, all systems were similar, with the exception of the cover crop with no fall tillage system. With a previous history of atrazine use, this management system produced 77.6 fewer seedlings per m^2. By June 11 all systems produced similar numbers of emerged seedlings (Fig. 3). *Palmer amaranth* seedling emergence declined dramatically and variability increased from June 27 to July 30 (Fig. 4). Cumulative germination for these rating dates was 3 to 4 fold less than any previous single rating date. Cumulative emergence for the season across all levels of management did not differ and ranged from 232 to 327 *Palmer amaranth* seedlings per m^2 (Fig. 5). Although previous management history affected the timing of *Palmer amaranth* emergence, total seasonal depletion of its seed soil bank was not affected.

Fig. 1. Palmer amaranth seedling emergence per M^2 on May 11, 2001 with and without previous atrazine use or wheat cover crop.

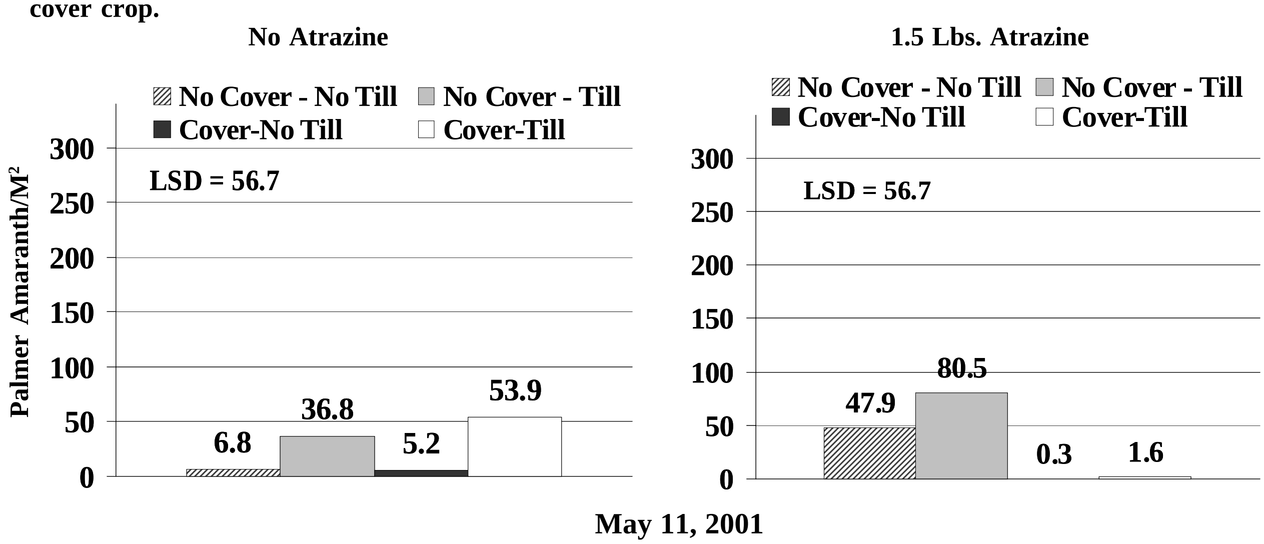


Fig. 2. Palmer amaranth seedling emergence per M^2 on June 6, 2001 with and without previous atrazine use or wheat cover crop.

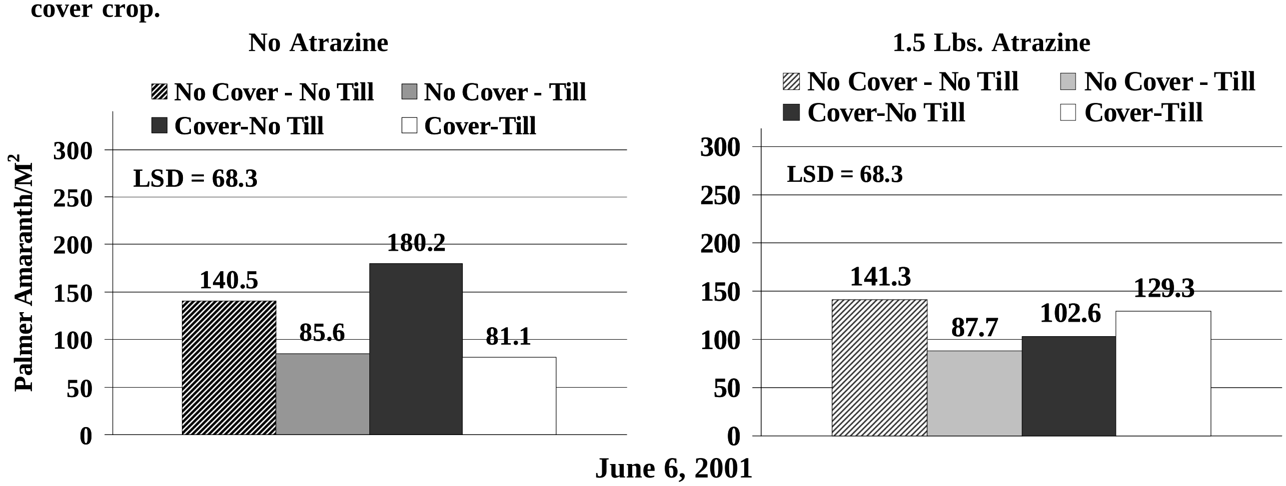


Fig. 3. Palmer amaranth seedling emergence per M^2 on June 11, 2001 with and without previous atrazine use or wheat cover crop.

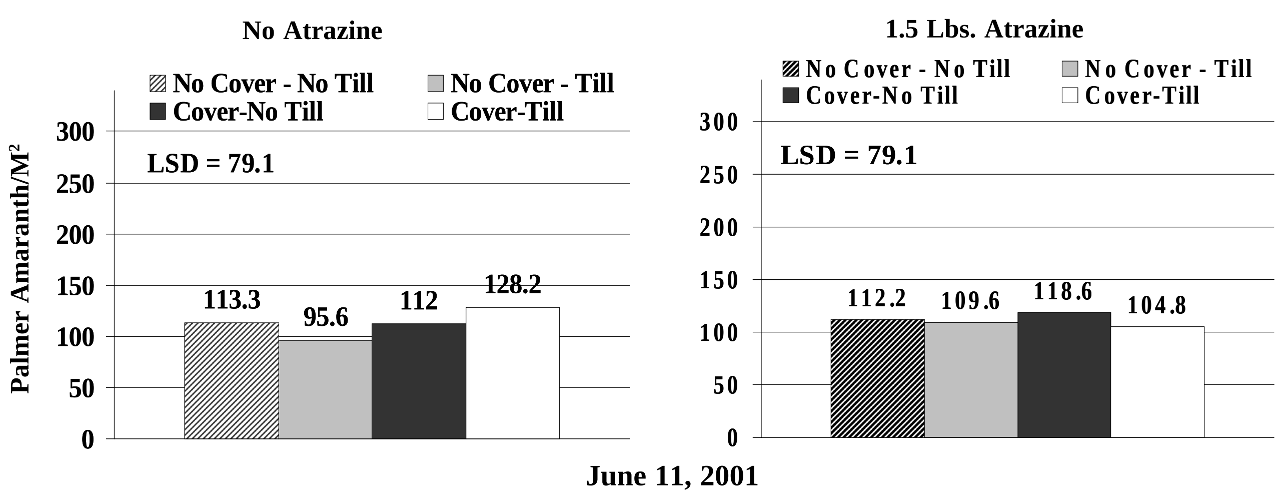


Fig. 4. Palmer amaranth seedling emergence per M^2 from June 27, - July 30, 2001 with and without previous atrazine use or wheat cover crop.

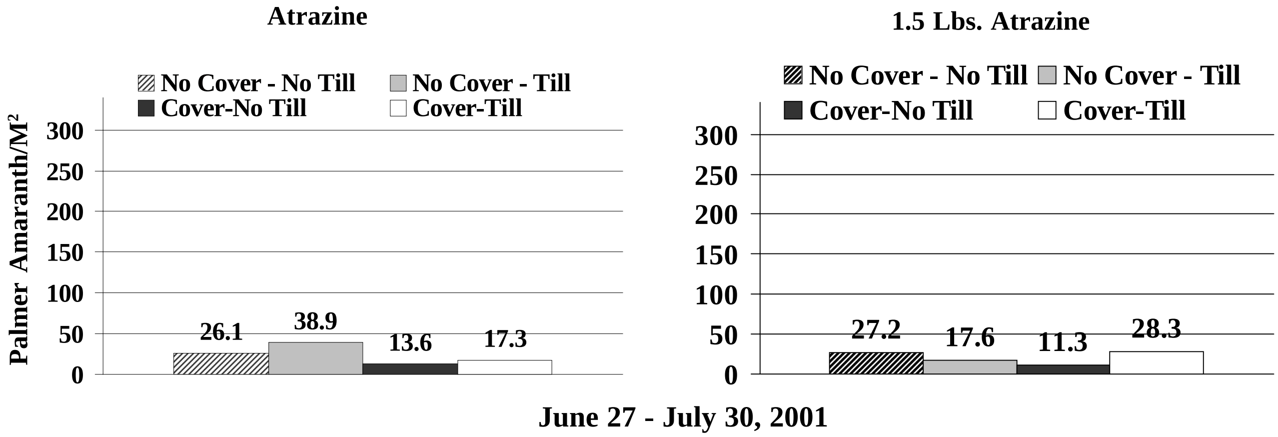
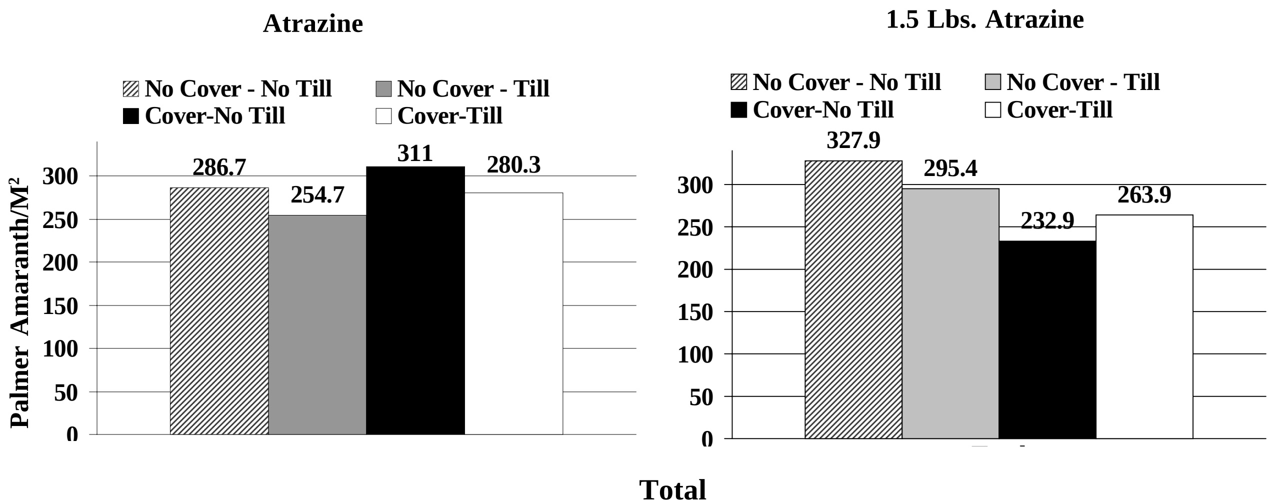


Fig. 5. Total season-long palmer amaranth seedling emergence per M^2 on June 6, 2001 with and without previous atrazine use or wheat cover crop.



CORN RESPONSE TO SIMULATED DRIFT OF IMAZETHAPYR, GLYPHOSATE, GLUFOSINATE, AND SETHOXYDIM

by

Randall Currie, Kassim Al-Khatib[1], Troy Price[2] and Curtis Thompson

SUMMARY

At rates lower than 10% of use rate, consistent injury was not seen. Injury seen at 4 weeks after treatment often recovered by 8 weeks after treatment. Injury produced by 10% of use rate poorly predicted yield loss. Only glyphosate produced severe yield loss at all locations at 33% of use rate. Sethoxydim produced severe injury at 2 of 3 locations. Glufosinate and imazethapyr produced severe yield loss at 1 of 3 locations and modest injury at 1 of 3 locations. Injury is complex and strongly influenced by environment.

INTRODUCTION

Imazethapyr and sethoxydim are widely used to control broadleaf and grass weeds in soybean fields in Kansas. Drift of these herbicides into corn may occur because of the proximity of corn and soybean fields. Since soybean may be planted in late April and early May, application of these herbicides frequently corresponds to early growth stages of corn, when plants are most vigorous and most susceptible to off-target herbicides. Glyphosate and glufosinate drift also may occur to corn fields in Kansas since glyphosate- and glufosinate-resistant corn and glyphosate-resistant soybean may be planted adjacent to susceptible corn. Therefore, glyphosate applied on Roundup Ready® soybean or corn and glufosinate applied to glufosinate-resistant corn may move off-target injuring susceptible corn. The objectives of this study were to determine injury and yield reduction of corn caused by imazethapyr, sethoxydim, glyphosate, and glufosinate applied at simulated drift rates; and second, determine if early symptoms of herbicide drift injury are predictive of corn yield reduction.

PROCEDURES

Drift was simulated with applications of 1, 3, 10, or 33% of the use rate. Use rate for imazethapyr, sethoxydim, glufosinate, and glyphosate was .06, .15, .36, and 1 lb ai/a, respectively.

RESULTS AND DISCUSSION

Only glyphosate at 33% of use rate injured corn at all three locations enough to produce yield loss (Fig. 1). At two of the three locations, 10% of the use rate of glyphosate reduced yield to 37% and 96 % of that of the untreated control. Greater than 36% injury was needed 4 WAT (weeks after treatment) to consistently reduce yield at all locations (Fig. 2 and 3). At only one location did glufosinate produce yield loss (Fig. 4). Greater than 10% injury was needed to produce yield loss. At 4 WAT 87% injury was observed at this location; however, by 8 WAT only 2% injury was measured (Figs. 5 and 6). This level of injury reduced yield to 60% of the untreated control. Imazethapyr at 33% of the use rate reduced corn yield at only one location where 78% injury produced a yield that was 30% of the untreated control (Figs. 7, 8, and 9). Sethoxydim at 33% of the use rate reduced corn yield at only one location, where 23% injury produced a yield that was 81% of the untreated control (Figs. 10, 11 and 12).

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Fig. 1. Yield loss from glyphosate injury.

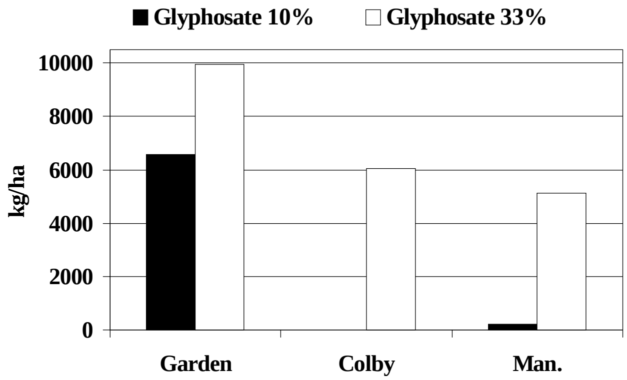


Fig. 4. Yield loss from glufosinate injury.

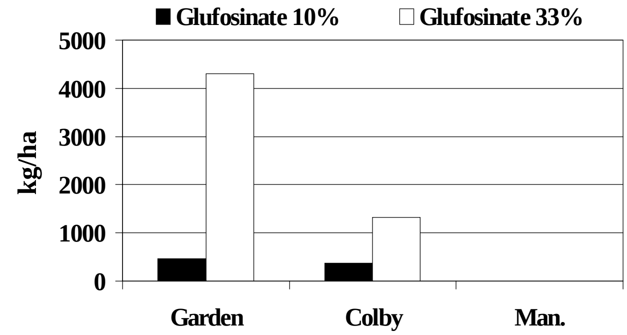


Fig. 2 Glyphosate injury 4 weeks after treatment.

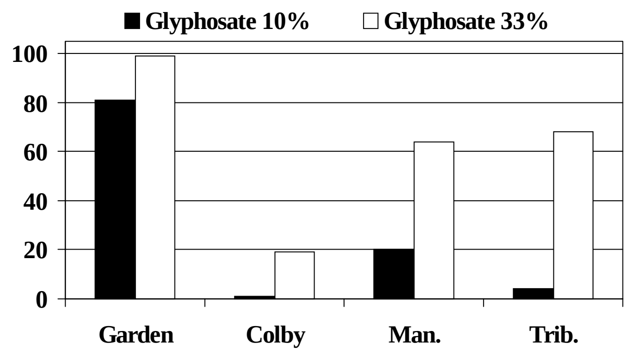


Fig. 5. Glufosinate injury 4 weeks after treatment.

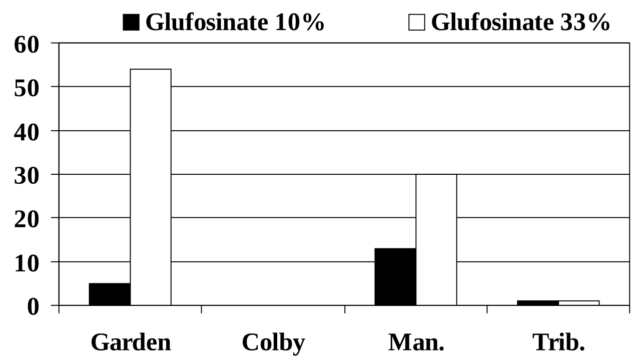


Fig. 3 Glyphosate injury 8 weeks after treatment.

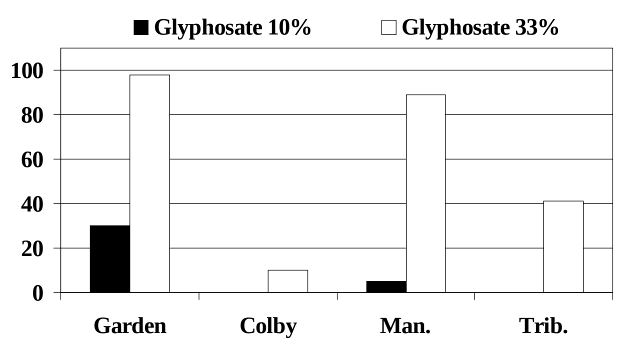


Fig. 6. Glufosinate injury 8 weeks after treatment.

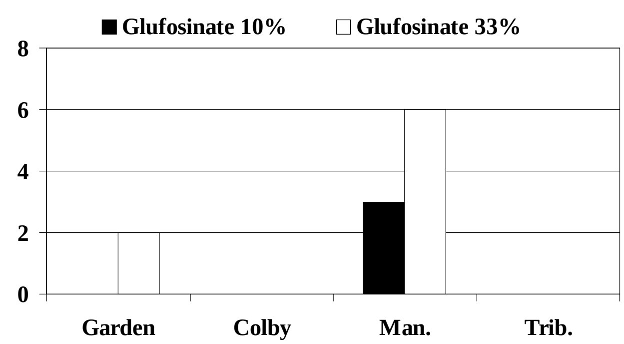


Fig. 7. Yield loss from imazethapyr injury.

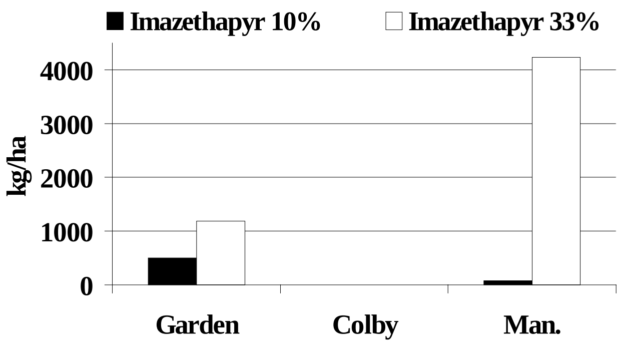


Fig. 10. Yield loss from sethoxydim injury.

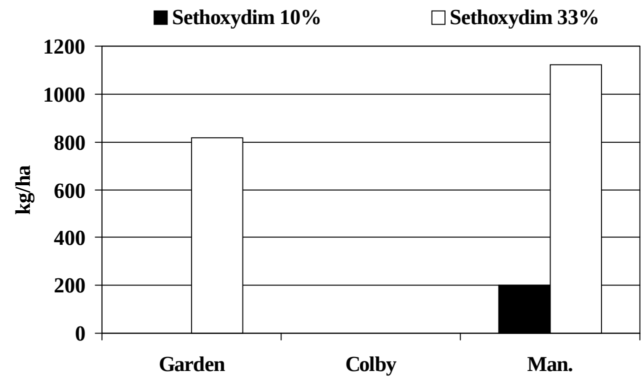


Fig. 8. Imazethapyr injury 4 weeks after treatment.

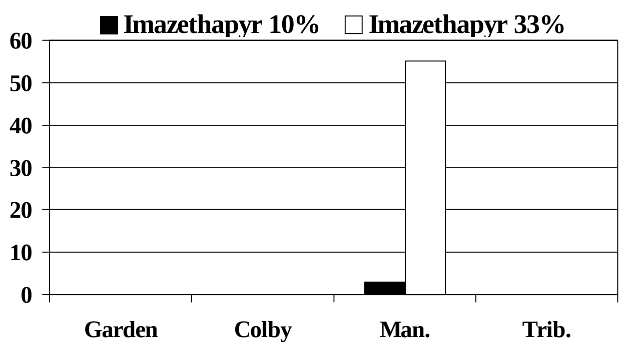


Fig. 11. Sethoxydim injury 4 weeks after treatment.

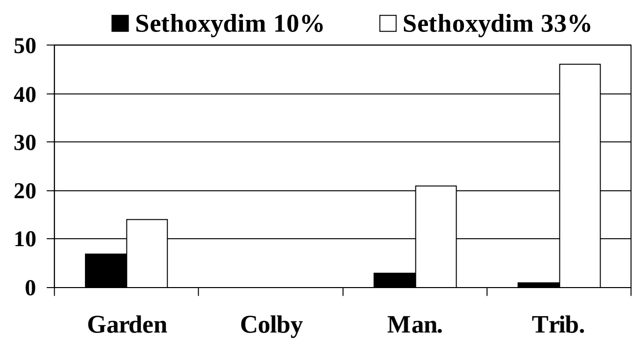


Fig. 9. Imazethapyr injury 8 weeks after treatment.

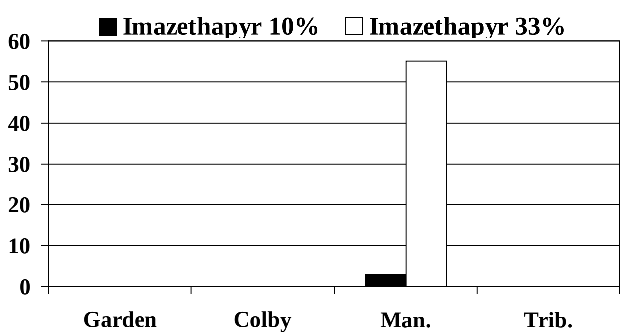
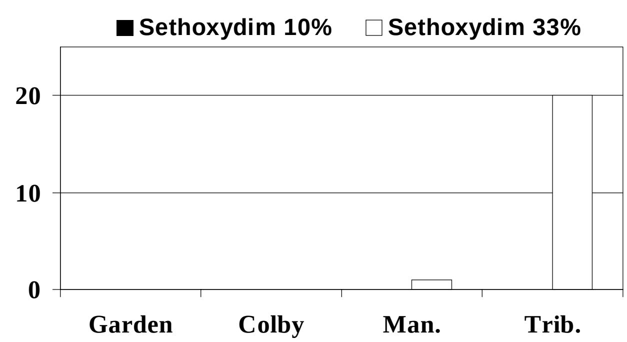


Fig. 12. Sethoxydim injury 8 weeks after treatment.



EFFECT OF TILLAGE ON ARTHROPOD POPULATIONS IN A CORN-FALLOW-CORN SYSTEM THAT HAD VARIOUS LEVELS OF PREVIOUS ATRAZINE USE WITH AND WITHOUT A COVER CROP

by
Randall Currie and Larry Buschman

INTRODUCTION

Although it is a widely held belief that substitution of any weed control method that reduces reliance on herbicides is better for the environment, this supposition is seldom if ever tested. The objective of this study was to measure the effect of a single tillage event on insect populations.

PROCEDURES

After completion of a 3-year study of 3 levels of atrazine (0, 0.75 and 1.5 kg/ha) with and without a cover crop for production of irrigated corn, a second study was begun by tilling half of each plot with two passes of a double gang disk in October 2000. Pit fall traps were constructed out of PVC tubing. Holes to place the top of each tube at the soil surface were dug with a soil probe deployed with a hydraulic ram to preserve the micro landscape around each trap to as great an extent as possible. A 2:1 vol/vol solution of ethylene glycol and water was used as the killing and preserving solution in the bottom of each fall trap. Insects were collected at 2-week intervals from October 2000 to June 2001 during all periods that temperatures were high enough to collect meaningful numbers of insects. The plot area was sprayed bi-weekly with a 1 lb ai/a application of glyphosate as necessary to simulate a perfect no-till fallow system.

RESULTS AND DISCUSSION

These methods produced a rich array of arthropods from 14 collection dates. At no time did any arthropod respond positively to tillage (Table 1). Statistically significant effects were attributed to previous crop history on 1 to 3 collection dates for the orders *Homoptera*, *Lepidoptera*, and *Coleoptera*. Tillage and tillage by previous cropping history effects were significant in one or more collection dates across all these orders. The most striking effect was found in *Lycosid* #1, (resembling *Lycosa carolinensis*), where all main effects were significant at 1 or more collection dates, with tillage being a significant effect in 12 out of 14 sample dates. The *Carabid* #1 (resembling *Abacidus permundus*) showed tillage effects on 8 of 14 collection dates. A broad array of other carabids showed the effect of previous cropping history on 5 collection dates and tillage effects on 7 collection dates. *Gryllus* spp, *Lycosid* #1 and *Carabid* #1 never showed a response to previous atrazine use, but their numbers increased 156, 220, and 497%, respectively, in response to no-tillage.

Table 1. Impact of tillage system on field cricket, common carabids, other carabids, and wolf spiders.

	Field Cricket			Common Carabids		
	Cover			Cover		
	+	-	Average	+	-	Average
No-Till	10.6	7.7	9.2a[1]	19.6	10.1	14.9a
Till	6.3	5.4	5.9b	3.3	2.7	3.0b
Average	8.4A[2]	6.6B		11.5A	6.4B	

	Other Carabids			Wolf Spiders		
	Cover			Cover		
	+	-	Average	+	-	Average
No-Till	147.0	133.7	140.3a	44.9	32.0	38.5a
Till	112.3	99.9	106.1b	18.9	16.1	17.5b
Average	129.6	116.8		31.9A	24.1B	

[1] Within an insect type, means with different letters (a,b) are significantly different (P<.05).
[2] Within an insect type, means with different letters (A,B) are significantly different (P<.05).

COMPARISON OF 44 HERBICIDE TANK MIXES FOR WEED CONTROL IN ROUND-UP READY CORN

by
Randall Currie

SUMMARY

Of the top yielding treatments, 75% were a preemergence treatment followed by a postemergence treatment, although there were some successful total preemergence or total postemergence programs. Four treatments produced greater than 95% control on four of the five weed species tested and had yields that were not statistically different from the top yielding treatment. All of these treatments had a chloroacetamide-like preemergence grass herbicide plus atrazine included in the tank mix.

INTRODUCTION

Roundup became a major weed control component in the majority of soybeans planted within 2 years of the introduction of Roundup-resistant soybean. In contrast, Roundup resistant corn has had less impact on corn weed control programs. Therefore, it was the objective of this study to compare an array of Roundup and non-Roundup weed control systems in irrigated corn.

PROCEDURES

Weeds were seeded as described in Table 1. Corn was planted as described in Table 2. Treatments were applied as described in Table 3. Corn was combine harvested and yields were adjusted to 15.5%. Weed and crop stages at given dates are described in Table 4.

RESULTS AND DISCUSSION

For all weed species tested, treatments followed by the letter T produced top yields and were not statistically different than one another. The top 75% of these treatments were a preemergence treatment followed by a postemergence treatment (Table 5).

Table 1. Weed seeding information corn herbicide study, Garden City, KS, 2001.

Variety:	Palmer amaranth, yellow foxtail, crabgrass, sunflower, barnyard grass, and shattercane
Planting date:	4-24-01
Planting method:	14 ft. Great Plains Drill
Carrier:	Cracked corn at 40 lbs/a (used with a mixture of the above weeds, except shattercane)
Rate, unit:	Palmer amaranth at 276 grams/a = approx. 700,000 seeds/a Yellow foxtail at 1032 grams/a = approx. 344,124 seeds/a Crabgrass at 5557 grams/a = approx. 9.8 million seeds/a Sunflower at 1814 grams/a = approx. 40,000 seeds/a Barnyard grass at 817 grams/a = approx. 817,000 seeds/a Shattercane at 5 lbs/a = approx. 119,400 seeds/a
Depth, unit:	Shattercane was drilled at 0, 1, and 2 inch depths. In a separate operation, the cracked corn mixture was surface applied by removing delivery tubes from the drill.
Row spacing, unit:	10 inches
Soil temperature, unit:	70 F
Soil moisture:	Dry top 0.75 inch, moist below

Table 2. Production information for corn herbicide study, Garden City, KS, 2001.

Variety:	Dekalb DK607RR
Planting date:	4-25-01
Planting method:	John Deere Max Emerge II, 6-row planter
Rate, unit:	40,000 seeds/a
Depth, unit:	1.5 inches
Row spacing, unit:	30 inches
Soil temperature, unit:	70 F
Soil moisture:	Dry top 1 inch, moist below
Emergence date:	5-1-01

Table 3. Application information for Roundup-Ready corn test, Garden City, KS, 2001.

Application date:	4-25-01	6-5-00	6-14-01	6-19-01
Time of day:	2:00-6:45 p.m.	1:15 p.m.	8:45 a.m.-12:00 p.m.	10:45 a.m.
Application method:	Broadcast	Broadcast	Broadcast	Broadcast
Application timing:	PRE	Epost, 2-4 in. weeds	Post, 4-6 in. weeds	Lpost
Air temperature, unit:	81 F	64 F	73 F	63 F
Wind welocity, unit:	0-5 mph SSE	0-2 mph N	5-12 mph N	6-15 mph N
Dew presence:	None	None	None	None
Soil temperature, unit:	70 F	64 F	73 F	74 F
Soil moisture:	Dry top 1 in., moist below	Very good moist below	Good	Dry top 0.5 in.
% Relative humidity:	23%	76%	26%	56%
% Cloud cover:	0%	100%	30%	100%
Chemical applied:	Pre treatments from protocols	Epost treatments from protocols	Post treatmetns from protocols	Lpost from protocols
Application equipment:	Windshield sprayer	Windshield sprayer	Windshield sprayer	Windshield sprayer
Nozzle type/brand:	Teejet XR	Teejet XR	Teejet XR	Teejet XR
Nozzle size:	8004 VS	8004 VS	8004 VS	8004 VS
Nozzle spacing, unit:	20 in.	20 in.	20 in.	20 in.
Boom length, unit:	10 ft	10 ft	10 ft	10 ft
Boom height, unit:	18 in.	18 in.	20 in.	22 in.
Pressure, unit:	38 psi	38 psi	38 psi	38 psi
Ground speed:	3.3 mph	3.3 mph	3.3 mph	3.3 mph
Application rate:	20 gpa	20 gpa	20 gpa	20 gpa
Incorporation equipment:	None	None	None	None
Time to incorporate, unit:	N/A	N/A	N/A	N/A
Incorporation depth, unit:	N/A	N/A	N/A	N/A
Spray volume, unit:	3 Liter	3 Liter	3 Liter	3 Liter
Carrier:	H_2O	H_2O	H_2O	H_2O
Propellant:	CO_2	CO_2	CO_2	CO_2

Note: Hail damage to corn on 5-29-01, 70-80% defoliation, corn stage of growth was at 3 collar.

Four treatments — 4, 9, 11, and 32 — produced greater than 95% control on four of the five weed species tested and had yields that were not statistically different from the top yielding treatment. All of these treatments had a chloroacetamide-like preemergence grass herbicide plus atrazine.

Sunflower control was not statistically different from the best treatment at two or more rating dates in 64% of the treatments (Table 6). Only treatments containing atrazine provided 100% control at two

Table 4. Corn and weed stages of growth.

Date	Corn	Weeds (inches tall)
6/4/01	2-3 collar, approximately 10 in. tall	
6/13/01	3-5 collar, approximately 28 in. tall	Sunflower = 10; Pigweed = 15; Shattercane = 13; Crabgrass = 7; Yellow Foxtail = 11; Barnyard Grass = 5; Velvet Leaf = 3
7/3/01	7-9 collar	
7/16/01	10-12 collar, beginning tassel	Sunflower = 56; Pigweed = 65; Shattercane = 60; Crabgrass = 30; Yellow Foxtail = 30; Barnyard Grass = 40; Velvet Leaf = 12
8/2/01	Tassel	Sunflower = 55; Pigweed = 72; Shattercane = 70; Crabgrass = 36; Yellow Foxtail = 40; Barnyard Grass = 49; Velvet Leaf = 36
8/21/01	Tassel, half starch layer,	Sunflower = 50; Pigweed = 78; Shattercane = 68; Crabgrass = 36;

rating dates. For Shattercane, 54% of the treatments did not differ from the top treatment on two or more rating dates (Table 7). Two treatments provided greater than 99% control at both rating dates. Both of these treatments contained the herbicides Balance and atrazine. Palmer amaranth control was not statistically different from the best treatment on two or more rating dates for 34% of the treatments (Table 8). Only two treatments provided 100% control at both rating dates and both of these treatments contained an atrazine application followed by a later application of glyphosate. Crabgrass control did not statistically differ from the best treatment for 36% of the treatments on two or more rating dates (Table 9). Only treatment 44 provided 100% control at both rating dates. Fifty two percent of the treatments for yellow foxtail did not statistically differ from the best treatment on two or more rating dates (Table 10). Foxtail stands were weak so this data is best used to find products with poor control.

Table 5. Harvest data in bushels/acre.

Treatment	Rate (lbs ai/a)	Appl. Stage	Yield* bu/a
1. Roundup Ultramax	0.75	2-4 in. weeds**	152.4
2. Roundup Ultramax / Roundup Ultramax	0.75 / 0.56	2-4 in. w. / 2-4 in. w.	145.2
3. Degree / Roundup Ultramax	0.89 / 0.75	Pre/ 4-6 in. w.	173.5T
4. Harness Xtra / Roundup Ultramax	1.67 / 0.75	Pre/ 4-6 in. w.	167.0T
5. Degree + Roundup Ultramax	0.89, 0.75	2-4 in. w.	166.6T
6. Harness Xtra + Roundup Ultramax	1.67, 0.75	2-4 in. w.	154.9
7. Readymaster ATZ	2.0	2-4 in. w.	162.5T
8. Dual II Magnum / Marksman	1.27 / 1.4	Pre/ 2-4 in. w.	151.7
9. Bicep II Magnum	2.89	Pre	166.3T
10. Bicep II Magnum / Spirit + NIS + 28%UAN	2.89 / 0.035, 0.25%, 2.5%	Pre/ 4-6 in. w.	149.6
11. Bicep II Magnum / Touchdown IQ	1.45 / 0.75	Pre/ 2-4 in. w.	170.4T
12. Bicep II Magnum / Glyphomax Plus	1.45 / 0.75	Pre/ 2-4 in. w.	179.5T
13. Celebrity Plus + NIS + 28%UAN	0.2, 0.25%, 5.0%	2-4 in. w.	141.1
14. Balance Pro	0.03	Pre	103.7
15. Balance Pro + Atrazine	0.03, 1.0	Pre	153.5
16. Balance Pro / AEF130360-01 + MSO + 28%UAN	0.03 / 0.03, 0.9%, 2.5%	Pre/Post	155.1
17. Balance Pro + Atrazine / AEF130360-01 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	158.0
18. Balance Pro + Atrazine / AEF130360-01 + Liquid 10 + 28%UAN	0.03, 1.0 / 0.03, 1.25%, 2.5%	Pre/Post	148.6
19. Balance Pro + Atrazine / AEF130360-02 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	165.0T
20. BAYFOE 5043 / AEF130360-01 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	142.9
21. BAYFOE 5043 / AEF130360-02 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	126.0
22. Leadoff / Basis Gold + COC + 28%UAN	0.94 / 0.78, 1.25%, 2.5%	Pre/Post	161.3T
23. Dual II Magnum / Callisto + Atrazine + COC + 28%UAN	1.27 / 0.09, 0.5, 1.25%, 2.5%	Pre/Post	157.0T
24. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.31	Pre/Epost	157.9T
25. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.63	Pre/Epost	166.2T
26. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.94	Pre/Epost	180.2T
27. Axiom + Atrazine	0.6, 1.5	Pre	131.2
28. EPIC + Atrazine	0.29, 1.0	Pre	135.1
29. USA 2001 + Atrazine	0.45, 1.0	Pre	158.6T
30. USA 2001 / Basis Gold + Banvel + COC	0.22 / 0.79, 0.125, 1.25%	Pre/Post	159.2T
31. USA 2001 / Roundup Ultramax	0.29 / 0.75	Pre/Post	163.8T
32. Define + Atrazine	0.53, 1.5	Pre	161.8T
33. Define + Atrazine + COC	0.53, 1.5, 1.25%	Epost	144.5
34. EPIC + Define + Atrazine	0.22, 0.23, 1.0	Pre	143.8

continued

Table 5. Harvest data in bushels/acre, continued.

Treatment	Rate (lbs ai/a)	Appl. Stage	Yield* bu/a
35. Define / Buctril	0.3 / 0.375	Pre/Epost	91.7
36. Dual II Magnum / Buctril	0.68 / 0.375	Pre/Epost	132.5
37. Define / Buctril	0.375 / 0.375	Pre/Epost	113.1
38. Dual II Magnum / Buctril	0.86 / 0.375	Pre/Epost	150.9
39. Define / Buctril	0.45 / 0.375	Pre/Epost	139.8
40. Dual II Magnum / Buctril	1.05 / 0.375	Pre/Epost	121.8
41. Touchdown + MSO	0.75, 1.0%	Post	159.1T
42. Touchdown + MSO + 28%UAN / Touchdown + MSO + 28%UAN	0.75, 1.0%, 2.5% / 0.56, 1.0%, 2.5%	Epost/Post	162.4T
43. Bicep II Magnum + Touchdown + MSO + 28%UAN	2.9, 0.75, 1.0%, 2.5%	Post	163.3T
44. Bicep II Magnum / Touchdown + MSO + 28%UAN	2.9 / 0.75, 1.0%, 2.5%	Pre/Post	153.8
Check	———	———	60
LSD (0.05) =			24.3

* Percent moisture was adjusted to 15.5% to find bushels per acre.
** in. w. = inch weeds.

Table 6. Sunflower heights (in.) multiplied by the number of sunflowers and its percent reduction.

Treatment	Rate(lbs. ai/a)	App. Stage	6/4/01	7/3/01
1. Roundup Ultramax	0.75	2-4 in. w*	77.8T	100.0T
2. Roundup Ultramax / Roundup Ultramax	0.75 / 0.56	2-4 in. w / 2-4 in. w	34.1	96.3T
3. Degree / Roundup Ultramax	0.89 / 0.75	Pre/ 4-6 in. w	66.7	100.0T
4. Harness Xtra / Roundup Ultramax	1.67 / 0.75	Pre/ 4-6 in. w	98.5T	100.0T
5. Degree + Roundup Ultramax	0.89, 0.75	2-4 in. w	49.9	100.0T
6. Harness Xtra + Roundup Ultramax	1.67, 0.75	2-4 in. w	80.4T	100.0T
7. Readymaster ATZ	2.0	2-4 in. w	48.3	100.0T
8. Dual II Magnum / Marksman	1.27 / 1.4	Pre/ 2-4 in. w	69.5T	98.3T
9. Bicep II Magnum	2.89	Pre	100.0T	100.0T
10. Bicep II Magnum / Spirit + NIS + 28%UAN	2.89 / 0.035, 0.25%, 2.5%	Pre/ 4-6 in. w	98.6T	100.0T
11. Bicep II Magnum / Touchdown IQ	1.45 / 0.75	Pre/ 2-4 in. w	100.0T	100.0T
12. Bicep II Magnum / Glyphomax Plus	1.45 / 0.75	Pre/ 2-4 in. w	89.1T	100.0T
13. Celebrity Plus + NIS + 28%UAN	0.2, 0.25%, 5.0%	2-4 in. w	64.3	100.0T
14. Balance Pro	0.03	Pre	72.8T	49.8
15. Balance Pro + Atrazine	0.03, 1.0	Pre	100.0T	100.0T
16. Balance Pro / AEF130360-01 + MSO + 28%UAN	0.03 / 0.03, 0.9%, 2.5%	Pre/Post	91.8T	88.5T
17. Balance Pro + Atrazine / AEF130360-01 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	100.0T	100.0T
18. Balance Pro + Atrazine / AEF130360-01 + Liquid 10 + 28%UAN	0.03, 1.0 / 0.03, 1.25%, 2.5%	Pre/Post	100.0T	99.6T
19. Balance Pro + Atrazine / AEF130360-02 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	98.0T	99.5T

continued

Table 6. Sunflower heights (in.) multiplied by the number of sunflowers and its percent reduction, continued.

Treatment	Rate(lbs. ai/a)	App. Stage	6/4/01	7/3/01
20. BAYFOE 5043 / AEF130360-01 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	80.0T	84.2T
21. BAYFOE 5043 / AEF130360-02 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	62.8	92.4T
22. Leadoff / Basis Gold + COC + 28%UAN	0.94 / 0.78, 1.25%, 2.5%	Pre/Post	94.9T	95.3T
23. Dual II Magnum / Callisto + Atrazine + COC + 28%UAN	1.27 / 0.09, 0.5, 1.25%, 2.5%	Pre/Post	94.0T	97.3T
24. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.31	Pre/Epost	33.8	88.6T
25. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.63	Pre/Epost	75.1T	94.9T
26. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.94	Pre/Epost	80.2 T	97.8T
27. Axiom + Atrazine	0.6, 1.5	Pre	100.0T	100.0T
28. EPIC + Atrazine	0.29, 1.0	Pre	98.4T	100.0T
29. USA 2001 + Atrazine	0.45, 1.0	Pre	96.2T	91.8T
30. USA 2001 / Basis Gold + Banvel + COC	0.22 / 0.79, 0.125, 1.25%	Pre/Post	81.3T	83.4T
31. USA 2001 / Roundup Ultramax	0.29 / 0.75	Pre/Post	84.2T	100.0T
32. Define + Atrazine	0.53, 1.5	Pre	100.0T	100.0T
33. Define + Atrazine + COC	0.53, 1.5, 1.25%	Epost	77.2T	100.0T
34. EPIC + Define + Atrazine	0.22, 0.23, 1.0	Pre	98.8T	100.0T
35. Define / Buctril	0.3 / 0.375	Pre/Epost	78.4T	70.0
36. Dual II Magnum / Buctril	0.68 / 0.375	Pre/Epost	66.6	69.8
37. Define / Buctril	0.375 / 0.375	Pre/Epost	47.6	66.4
38. Dual II Magnum / Buctril	0.86 / 0.375	Pre/Epost	80.8T	71.3
39. Define / Buctril	0.45 / 0.375	Pre/Epost	65.2	73.0
40. Dual II Magnum / Buctril	1.05 / 0.375	Pre/Epost	72.4T	70.0
41. Touchdown + MSO	0.75, 1.0%	Post	60.4	99.4T
42. Touchdown + MSO + 28%UAN / Touchdown + MSO + 28%UAN	0.75, 1.0%, 2.5% / 0.56, 1.0%, 2.5%	Epost/Post	93.9T	100.0T
43. Bicep II Magnum + Touchdown + MSO + 28%UAN	2.9, 0.75, 1.0%, 2.5%	Post	67.8	88.1T
44. Bicep II Magnum / Touchdown + MSO + 28%UAN	2.9 / 0.75, 1.0%, 2.5%	Pre/Post	100.0T	100.0T
45. Check	—	—	0	0
LSD (0.05) =			30.8	17.7

*inch weeds = in.w

Table 7. Shattercane heights (in.) multiplied by the number of shattercane and its percent reduction, 2001.

Treatment	Rate(lbs. ai/a)	App.Stage	6/4/01	7/3/01
1. Roundup Ultramax	0.75	2-4 in. weeds*	22.9	99.5T
2. Roundup Ultramax / Roundup Ultramax	0.75 / 0.56	2-4 in. w / 2-4 in. w	21.1	99.8T
3. Degree / Roundup Ultramax	0.89 / 0.75	Pre/ 4-6 in. w	79.5T	100.0T
4. Harness Xtra / Roundup Ultramax	1.67 / 0.75	Pre/ 4-6 in. w	88.3T	100.0T
5. Degree + Roundup Ultramax	0.89, 0.75	2-4 in. w	50.0	99.8T
6. Harness Xtra + Roundup Ultramax	1.67, 0.75	2-4 in. w	49.1	100.0T
7. Readymaster ATZ	2.0	2-4 in. w	48.6	100.0T
8. Dual II Magnum / Marksman	1.27 / 1.4	Pre/ 2-4 in. w	70.3T	76.7T
9. Bicep II Magnum	2.89	Pre	82.2T	85.5T
10. Bicep II Magnum / Spirit + NIS + 28%UAN	2.89 / 0.035, 0.25%, 2.5%	Pre/ 4-6 in. w	89.2T	99.4T
11. Bicep II Magnum / Touchdown IQ	1.45 / 0.75	Pre/ 2-4 in. w	72.5T	99.6T
12. Bicep II Magnum / Glyphomax Plus	1.45 / 0.75	Pre/ 2-4 in. w	93.2T	100.0T
13. Celebrity Plus + NIS + 28%UAN	0.2, 0.25%, 5.0%	2-4 in. w	43.4	100.0T
14. Balance Pro	0.03	Pre	74.7T	75.6
15. Balance Pro + Atrazine	0.03, 1.0	Pre	99.6T	96.6T
16. Balance Pro / AEF130360-01 + MSO + 28%UAN	0.03 / 0.03, 0.9%, 2.5%	Pre/Post	93.5T	99.8T
17. Balance Pro + Atrazine / AEF130360-01 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	99.6T	100.0T
18. Balance Pro + Atrazine / AEF130360-01 + Liquid 10 + 28%UAN	0.03, 1.0 / 0.03, 1.25%, 2.5%	Pre/Post	99.4T	99.6T
19. Balance Pro + Atrazine / AEF130360-02 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	91.2T	99.0T
20. BAYFOE 5043 / AEF130360-01 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	81.5T	97.3T
21. BAYFOE 5043 / AEF130360-02 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	62.0	93.8T
22. Leadoff / Basis Gold + COC + 28%UAN	0.94 / 0.78, 1.25%, 2.5%	Pre/Post	65.7	98.3T
23. Dual II Magnum / Callisto + Atrazine + COC + 28%UAN	1.27 / 0.09, 0.5, 1.25%, 2.5%	Pre/Post	77.2T	68.3
24. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.31	Pre/Epost	58.8	60.5
25. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.63	Pre/Epost	92.9T	97.5T
26. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.94	Pre/Epost	83.2T	98.3T
27. Axiom + Atrazine	0.6, 1.5	Pre	96.4T	97.6T
28. EPIC + Atrazine	0.29, 1.0	Pre	99.3T	98.2T
29. USA 2001 + Atrazine	0.45, 1.0	Pre	91.5T	93.1T
30. USA 2001 / Basis Gold + Banvel + COC	0.22 / 0.79, 0.125, 1.25%	Pre/Post	89.2T	99.0T
31. USA 2001 / Roundup Ultramax	0.29 / 0.75	Pre/Post	93.4T	99.9T
32. Define + Atrazine	0.53, 1.5	Pre	95.6T	96.4T
33. Define + Atrazine + COC	0.53, 1.5, 1.25%	Epost	51.1	39.1
34. EPIC + Define + Atrazine	0.22, 0.23, 1.0	Pre	98.4T	97.6T

continued

Table 7. Shattercane heights (in.) multiplied by the number of shattercane and its percent reduction, 2001, continued.

Treatment	Rate (lbs ai/a)	Appl. Stage	6/4/01	7/3/01
35. Define / Buctril	0.3 / 0.375	Pre/Epost	69.5	55.3
36. Dual II Magnum / Buctril	0.68 / 0.375	Pre/Epost	58.9	47.9
37. Define / Buctril	0.375 / 0.375	Pre/Epost	74.1T	42.2
38. Dual II Magnum / Buctril	0.86 / 0.375	Pre/Epost	76.3T	31.1
39. Define / Buctril	0.45 / 0.375	Pre/Epost	95.4T	90.2T
40. Dual II Magnum / Buctril	1.05 / 0.375	Pre/Epost	56.4	76.9T
41. Touchdown + MSO	0.75, 1.0%	Post	34.3	100.0T
42. Touchdown + MSO + 28%UAN / Touchdown + MSO + 28%UAN	0.75, 1.0%, 2.5% / 0.56, 1.0%, 2.5%	Epost/Post	41.7	100.0T
43. Bicep II Magnum + Touchdown + MSO + 28%UAN	2.9, 0.75, 1.0%, 2.5%	Post	45.4	100.0T
44. Bicep II Magnum / Touchdown + MSO + 28%UAN	2.9 / 0.75, 1.0%, 2.5%	Pre/Post	92.0T	100.0T
45. Check	—	—	0	0
LSD (0.05) =			29.9	23.7

*inch weeds = in.w

Table 8. Palmer amaranth heights (in.) multiplied by the number of Palmer amaranth and its percent reduction.

Treatment	Rate (lbs. ai/a)	App. Stage	6/4/01	7/3/01
1. Roundup Ultramax	0.75	2-4 in. weeds*	73.3	97.7T
2. Roundup Ultramax / Roundup Ultramax	0.75 / 0.56	2-4 in. w / 2-4 in. w	65.3	97.9T
3. Degree / Roundup Ultramax	0.89 / 0.75	Pre/ 4-6 in. w	99.8T	100.0T
4. Harness Xtra / Roundup Ultramax	1.67 / 0.75	Pre/ 4-6 in. w	99.9T	99.9T
5. Degree + Roundup Ultramax	0.89, 0.75	2-4 in. w	87.2T	99.9T
6. Harness Xtra + Roundup Ultramax	1.67, 0.75	2-4 in. w	79.8	100.0T
7. Readymaster ATZ	2.0	2-4 in. w	51.4	99.9T
8. Dual II Magnum / Marksman	1.27 / 1.4	Pre/ 2-4 in. w	99.8T	99.9T
9. Bicep II Magnum	2.89	Pre	100.0T	99.6T
10. Bicep II Magnum / Spirit + NIS + 28%UAN	2.89 / 0.035, 0.25%, 2.5%	Pre/ 4-6 in. w	99.9T	99.8T
11. Bicep II Magnum / Touchdown IQ	1.45 / 0.75	Pre/ 2-4 in. w	99.9T	99.7T
12. Bicep II Magnum / Glyphomax Plus	1.45 / 0.75	Pre/ 2-4 in. w	100.0T	99.7T
13. Celebrity Plus + NIS + 28%UAN	0.2, 0.25%, 5.0%	2-4 in. w	66.3	100.0T
14. Balance Pro	0.03	Pre	94.2T	58.9
15. Balance Pro + Atrazine	0.03, 1.0	Pre	100.0T	98.8T
16. Balance Pro / AEF130360-01 + MSO + 28%UAN	0.03 / 0.03, 0.9%, 2.5%	Pre/Post	99.8T	96.2T
17. Balance Pro + Atrazine / AEF130360-01 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	100.0T	98.8T
18. Balance Pro + Atrazine / AEF130360-01 + Liquid 10 + 28%UAN	0.03, 1.0 / 0.03, 1.25%, 2.5%	Pre/Post	99.2T	98.2T
19. Balance Pro + Atrazine / AEF130360-02 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	99.8T	99.7T
20. BAYFOE 5043 / AEF130360-01 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	97.9T	93.1T
21. BAYFOE 5043 / AEF130360-02 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	97.5T	89.9
22. Leadoff / Basis Gold + COC + 28%UAN	0.94 / 0.78, 1.25%, 2.5%	Pre/Post	99.7T	99.8T
23. Dual II Magnum / Callisto + Atrazine + COC + 28%UAN	1.27 / 0.09, 0.5, 1.25%, 2.5%	Pre/Post	99.6T	99.7T
24. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.31	Pre/Epost	98.9T	100.0T
25. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.63	Pre/Epost	99.8T	100.0T
26. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.94	Pre/Epost	100.0T	100.0T
27. Axiom + Atrazine	0.6, 1.5	Pre	100.0T	98.1T
28. EPIC + Atrazine	0.29, 1.0	Pre	100.0T	97.3T
29. USA 2001 + Atrazine	0.45, 1.0	Pre	99.9T	96.6T
30. USA 2001 / Basis Gold + Banvel + COC	0.22 / 0.79, 0.125, 1.25%	Pre/Post	96.9T	99.2T
31. USA 2001 / Roundup Ultramax	0.29 / 0.75	Pre/Post	99.6T	100.0T
32. Define + Atrazine	0.53, 1.5	Pre	100.0T	99.0T
33. Define + Atrazine + COC	0.53, 1.5, 1.25%	Epost	71.7	100.0T

continued

Table 8. Palmer amaranth heights (in.) multiplied by the number of Palmer amaranth and its percent reduction, continued.

Treatment	Rate (lbs. ai/a)	App. Stage	6/4/01	7/3/01
34. EPIC + Define + Atrazine	0.22, 0.23, 1.0	Pre	100.0T	99.4T
35. Define / Buctril	0.3 / 0.375	Pre/Epost	92.5T	80.5
36. Dual II Magnum / Buctril	0.68 / 0.375	Pre/Epost	99.4T	96.1T
37. Define / Buctril	0.375 / 0.375	Pre/Epost	95.8T	92.3T
38. Dual II Magnum / Buctril	0.86 / 0.375	Pre/Epost	99.9T	94.8T
39. Define / Buctril	0.45 / 0.375	Pre/Epost	98.8T	92.6T
40. Dual II Magnum / Buctril	1.05 / 0.375	Pre/Epost	98.8T	92.3T
41. Touchdown + MSO	0.75, 1.0%	Post	50.5	99.9T
42. Touchdown + MSO + 28%UAN / Touchdown + MSO + 28%UAN	0.75, 1.0%, 2.5% / 0.56, 1.0%, 2.5%	Epost/Post	82.8T	99.9T
43. Bicep II Magnum + Touchdown + MSO + 28%UAN	2.9, 0.75, 1.0%, 2.5%	Post	62.4	98.6T
44. Bicep II Magnum / Touchdown + MSO + 28%UAN	2.9 / 0.75, 1.0%, 2.5%	Pre/Post	100.0T	100.0T
45. Check	—	—	0	0
LSD (0.05) =			17.8	8.8

*inch weeds = in.w

Table 9. Crabgrass heights (in.) multiplied by the number of crabgrass and its percent reduction.

Treatment	Rate (lbs. ai/a)	App. Stage	6/4/01	7/3/01
1. Roundup Ultramax	0.75	2-4 in. weeds*	72.5	98.2T
2. Roundup Ultramax / Roundup Ultramax	0.75 / 0.56	2-4 in. w / 2-4 in. w	55.5	96.2T
3. Degree / Roundup Ultramax	0.89 / 0.75	Pre/ 4-6 in. w	99.8T	99.3T
4. Harness Xtra / Roundup Ultramax	1.67 / 0.75	Pre/ 4-6 in. w	99.9T	99.8T
5. Degree + Roundup Ultramax	0.89, 0.75	2-4 in. w	81.1T	99.8T
6. Harness Xtra + Roundup Ultramax	1.67, 0.75	2-4 in. w	73.5	99.8T
7. Readymaster ATZ	2.0	2-4 in. w	35.9	99.4T
8. Dual II Magnum / Marksman	1.27 / 1.4	Pre/ 2-4 in. w	99.4T	99.1T
9. Bicep II Magnum	2.89	Pre	99.9T	99.7T
10. Bicep II Magnum / Spirit + NIS + 28%UAN	2.89 / 0.035, 0.25%, 2.5%	Pre/ 4-6 in. w	100.0T	99.8T
11. Bicep II Magnum / Touchdown IQ	1.45 / 0.75	Pre/ 2-4 in. w	99.8T	99.8T
12. Bicep II Magnum / Glyphomax Plus	1.45 / 0.75	Pre/ 2-4 in. w	100.0T	99.9T
13. Celebrity Plus + NIS + 28%UAN	0.2, 0.25%, 5.0%	2-4 in. w	75.3	87.0
14. Balance Pro	0.03	Pre	86.6T	64.9
15. Balance Pro + Atrazine	0.03, 1.0	Pre	98.5T	88.1
16. Balance Pro / AEF130360-01 + MSO + 28%UAN	0.03 / 0.03, 0.9%, 2.5%	Pre/Post	89.0T	78.7
17. Balance Pro + Atrazine / AEF130360-01 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	98.3T	97.1T
18. Balance Pro + Atrazine / AEF130360-01 + Liquid 10 + 28%UAN	0.03, 1.0 / 0.03, 1.25%, 2.5%	Pre/Post	99.2T	90.7T
19. Balance Pro + Atrazine / AEF130360-02 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	93.6T	94.2T
20. BAYFOE 5043 / AEF130360-01 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	99.1T	64.6
21. BAYFOE 5043 / AEF130360-02 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	98.7T	63.2
22. Leadoff / Basis Gold + COC + 28%UAN	0.94 / 0.78, 1.25%, 2.5%	Pre/Post	97.0T	94.0T
23. Dual II Magnum / Callisto + Atrazine + COC + 28%UAN	1.27 / 0.09, 0.5, 1.25%, 2.5%	Pre/Post	99.9T	99.4T
24. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.31	Pre/Epost	99.2T	93.1T
25. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.63	Pre/Epost	99.9T	99.8T
26. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.94	Pre/Epost	99.9T	99.9T
27. Axiom + Atrazine	0.6, 1.5	Pre	100.0T	99.9T
28. EPIC + Atrazine	0.29, 1.0	Pre	100.0T	99.8T
29. USA 2001 + Atrazine	0.45, 1.0	Pre	99.8T	96.8T
30. USA 2001 / Basis Gold + Banvel + COC	0.22 / 0.79, 0.125, 1.25%	Pre/Post	99.0T	92.1T
31. USA 2001 / Roundup Ultramax	0.29 / 0.75	Pre/Post	99.9T	99.8T
32. Define + Atrazine	0.53, 1.5	Pre	99.9T	99.7T
33. Define + Atrazine + COC	0.53, 1.5, 1.25%	Epost	60.1	68.2

continued

Table 9. Crabgrass heights (in.) multiplied by the number of crabgrass and its percent reduction, continued.

Treatment	Rate (lbs. ai/a)	App. Stage	6/4/01	7/3/01
34. EPIC + Define + Atrazine	0.22, 0.23, 1.0	Pre	99.9T	99.8T
35. Define / Buctril	0.3 / 0.375	Pre/Epost	97.3T	77.4
36. Dual II Magnum / Buctril	0.68 / 0.375	Pre/Epost	99.3T	96.1T
37. Define / Buctril	0.375 / 0.375	Pre/Epost	99.4T	94.3T
38. Dual II Magnum / Buctril	0.86 / 0.375	Pre/Epost	99.9T	98.8T
39. Define / Buctril	0.45 / 0.375	Pre/Epost	99.8T	97.8T
40. Dual II Magnum / Buctril	1.05 / 0.375	Pre/Epost	99.4T	91.2T
41. Touchdown + MSO	0.75, 1.0%	Post	54.3	90.6T
42. Touchdown + MSO + 28%UAN / Touchdown + MSO + 28%UAN	0.75, 1.0%, 2.5% / 0.56, 1.0%, 2.5%	Epost/Post	94.4T	97.0T
43. Bicep II Magnum + Touchdown + MSO + 28%UAN	2.9, 0.75, 1.0%, 2.5%	Post	77.4	97.3T
44. Bicep II Magnum / Touchdown + MSO + 28%UAN	2.9 / 0.75, 1.0%, 2.5%	Pre/Post	100.0T	100.0T
45. Check	—	—	0	0
LSD (0.05) =			21.1	10.3

*inch weeds = in.w

Table 10. Yellow foxtail heights (in.) multiplied by the number and its percent reduction.

Treatment	Rate (lbs. ai/a)	App. Stage	6/4/01	7/3/01
1. Roundup Ultramax	0.75	2-4 in. weeds*	95.5T	100.0T
2. Roundup Ultramax / Roundup Ultramax	0.75 / 0.56	2-4 in. w / 2-4 in. w	99.2T	100.0T
3. Degree / Roundup Ultramax	0.89 / 0.75	Pre/ 4-6 in. w	100.0T	100.0T
4. Harness Xtra / Roundup Ultramax	1.67 / 0.75	Pre/ 4-6 in. w	100.0T	100.0T
5. Degree + Roundup Ultramax	0.89, 0.75	2-4 in. w	100.0T	100.0T
6. Harness Xtra + Roundup Ultramax	1.67, 0.75	2-4 in. w	100.0T	100.0T
7. Readymaster ATZ	2.0	2-4 in. w	100.0T	100.0T
8. Dual II Magnum / Marksman	1.27 / 1.4	Pre/ 2-4 in. w	99.7T	93.4T
9. Bicep II Magnum	2.89	Pre	100.0T	100.0T
10. Bicep II Magnum / Spirit + NIS + 28%UAN	2.89 / 0.035, 0.25%, 2.5%	Pre/ 4-6 in. w	100.0T	100.0T
11. Bicep II Magnum / Touchdown IQ	1.45 / 0.75	Pre/ 2-4 in. w	100.0T	100.0T
12. Bicep II Magnum / Glyphomax Plus	1.45 / 0.75	Pre/ 2-4 in. w	100.0T	100.0T
13. Celebrity Plus + NIS + 28%UAN	0.2, 0.25%, 5.0%	2-4 in. w	75.0	99.4T
14. Balance Pro	0.03	Pre	100.0T	94.6T
15. Balance Pro + Atrazine	0.03, 1.0	Pre	91.7T	95.1T
16. Balance Pro / AEF130360-01 + MSO + 28%UAN	0.03 / 0.03, 0.9%, 2.5%	Pre/Post	100.0T	98.1T
17. Balance Pro + Atrazine / AEF130360-01 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	100.0T	100.0T
18. Balance Pro + Atrazine / AEF130360-01 + Liquid 10 + 28%UAN	0.03, 1.0 / 0.03, 1.25%, 2.5%	Pre/Post	100.0T	94.5T
19. Balance Pro + Atrazine / AEF130360-02 + MSO + 28%UAN	0.03, 1.0 / 0.03, 0.9%, 2.5%	Pre/Post	100.0T	100.0T

continued

Table 10. Yellow foxtail heights (in.) multiplied by the number and its percent reduction, continued.

Treatment	Rate (lbs. ai/a)	App. Stage	6/4/01	7/3/01
20. BAYFOE 5043 / AEF130360-01 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	100.0T	100.0T
21. BAYFOE 5043 / AEF130360-02 + MSO + 28%UAN	0.3 / 0.03, 0.9%, 2.5%	Pre/Post	75.0	98.1T
22. Leadoff / Basis Gold + COC + 28%UAN	0.94 / 0.78, 1.25%, 2.5%	Pre/Post	100.0T	100.0T
23. Dual II Magnum / Callisto + Atrazine + COC + 28%UAN	1.27 / 0.09, 0.5, 1.25%, 2.5%	Pre/Post	100.0T	100.0T
24. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.31	Pre/Epost	99.8T	75.4
25. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.63	Pre/Epost	100.0T	100.0T
26. Dual II Magnum / Banvel + Atrazine / Roundup Ultramax	1.27 / 0.063, 1.0 / 0.94	Pre/Epost	99.7T	100.0T
27. Axiom + Atrazine	0.6, 1.5	Pre	100.0T	100.0T
28. EPIC + Atrazine	0.29, 1.0	Pre	100.0T	100.0T
29. USA 2001 + Atrazine	0.45, 1.0	Pre	100.0T	99.2T
30. USA 2001 / Basis Gold + Banvel + COC	0.22 / 0.79, 0.125, 1.25%	Pre/Post	100.0T	95.3T
31. USA 2001 / Roundup Ultramax	0.29 / 0.75	Pre/Post	100.0T	100.0T
32. Define + Atrazine	0.53, 1.5	Pre	100.0T	100.0T
33. Define + Atrazine + COC	0.53, 1.5, 1.25%	Epost	100.0T	100.0T
34. EPIC + Define + Atrazine	0.22, 0.23, 1.0	Pre	100.0T	100.0T
35. Define / Buctril	0.3 / 0.375	Pre/Epost	100.0T	100.0T
36. Dual II Magnum / Buctril	0.68 / 0.375	Pre/Epost	75.0	100.0T
37. Define / Buctril	0.375 / 0.375	Pre/Epost	100.0T	75.0
38. Dual II Magnum / Buctril	0.86 / 0.375	Pre/Epost	100.0T	73.6
39. Define / Buctril	0.45 / 0.375	Pre/Epost	99.9T	93.0T
40. Dual II Magnum / Buctril	1.05 / 0.375	Pre/Epost	100.0T	83.6T
41. Touchdown + MSO	0.75, 1.0%	Post	100.0T	96.4T
42. Touchdown + MSO + 28%UAN / Touchdown + MSO + 28%UAN	0.75, 1.0%, 2.5% / 0.56, 1.0%, 2.5%	Epost/Post	69.5	99.0T
43. Bicep II Magnum + Touchdown + MSO + 28%UAN	2.9, 0.75, 1.0%, 2.5%	Post	100.0T	99.7T
44. Bicep II Magnum / Touchdown + MSO + 28%UAN	2.9 / 0.75, 1.0%, 2.5%	Pre/Post	100.0T	100.0T
45. Check	—	—	0	0
LSD (0.05) =			19.5	18.2

*inch weeds = in.w

EVALUATION OF BT AND NON-BT CORN HYBRIDS FOR CORN BORER RESISTANCE AND EFFICACY OF INSECTICIDE TREATMENTS

by
Larry Buschman, Phil Sloderbeck, and Merle Witt

SUMMARY

Two pairs of Bt and non-Bt corn hybrids from Golden Harvest and Garst were evaluated for corn borer resistance and grain yield performance at the Southwest Research and Extension Center in Garden City, Kansas. First generation corn borer pressure in manually infested non-Bt corn averaged 1.6 southwestern corn borers and 14.8 cm (5.8 in.) of tunneling per plant. Second generation corn borer pressure from feral moths averaged 0.5 southwestern corn borer larvae and 10.9 cm (4.3 in.) of tunneling per plant in the non-Bt corn hybrids. Hybrids containing Bt events MON810 and CBH351 had only trace amounts of corn borer and tunneling for first and second generations. The yield loss from corn borer lodging averaged 36.3 bu/a for the non-Bt hybrids, but less than 5 bu/a for the Bt hybrids. Total corn yields averaged 139.2 bu/a for the 2 non-Bt hybrids, and 154.8 bu/a for the 2 Bt hybrids.

PROCEDURES

Corn plots were machine-planted on 28 April 2000 at 36,000 seeds/a at the Southwest Research-Extension Center near Garden City, KS. The two Garst hybrids were 8366 and 8366Bt (Bt event CBH351). The two Golden Harvest hybrids were 2547 and 8366Bt (Bt event CBH351) and Golden Harvest 9230Bt (Bt event MON810). The plots were 6 rows wide and 50 ft long with 10-ft alleyways at the end of each plot to reduce larval migration between plots. Pairs of Bt and non-Bt plots were planted in strips across a 15-acre field. The strips were separated by 24 rows (60 ft) of Bt corn to allow the plots to be sprayed aerially (65 ft swath). A total of 4 insecticide/ miticide treatments were planned, but since spider mite populations did not develop, only a single treatment was applied for corn borers. One set of strips was treated 29 July with Capture at 5.12 oz/a. The experimental design included three factors: 1) insecticide treatment (check and treated), 2) corn borer resistance (standard susceptible and Bt-corn), and 3) seed company (with different Bt events). The plots were arranged as a split/split plot design with 4 replications.

Atrazine was applied before planting on 7 April at 1.5 lb/a. The following herbicides were applied after planting on 28 April: Roundup at 1.7 pt/a, TopNotch at 2.5 qt/a, Balance at 0.7 oz/a, atrazine at 0.5 qt/a, and 2,4-D at 1 qt/a. The field was irrigated 4.5 inches on 28 June, 3.5 inches on 11 June, 5.2 inches on 5 August and 3.6 inches on 17 August.

Spider mite numbers were estimated by collecting half the leaves from 10 plants in each plot. These leaves were placed in large Berlese funnels to extract spider mites and predators in alcohol. A pretreatment sample was taken on 27 June. Spider mite populations did not develop and additional spider mite samples were not taken.

First generation corn borer infestations were light so 10 plants in each plot were manually infested with 15 SWCB neonates per plant on 30 June (2 reps). To collect data on first generation corn borer infestations, five infested plants in each plot were dissected on 1 Aug. Second generation corn borer infestations resulted from feral moth flights. To collect data for second-generation corn borer infestations, 10 plants were dissected from one of the center rows in each plot on 16 Sept. Kernel damage (mostly due to corn earworms) was also recorded for these plants as the number of kernels damaged per ear.

The two middle rows of each plot were harvested in late October to determine grain yield and the row length was adjusted for plants removed for dissections. The ears from corn borer lodged corn were hand harvested and shelled. The ears from standing corn were machine harvested. Grain yield was calculated separately for standing and fallen corn and corrected to 15.5% moisture. Data were analyzed by 3-factor analysis of variance with a split/split plot design. Interaction means are presented graphically.

RESULTS AND DISCUSSION

In the pretreatment sample, spider mite and predator mite numbers averaged 3.0 to 8.5 spider mites and 0.0 to 0.13 predator mites per 10 half plants.

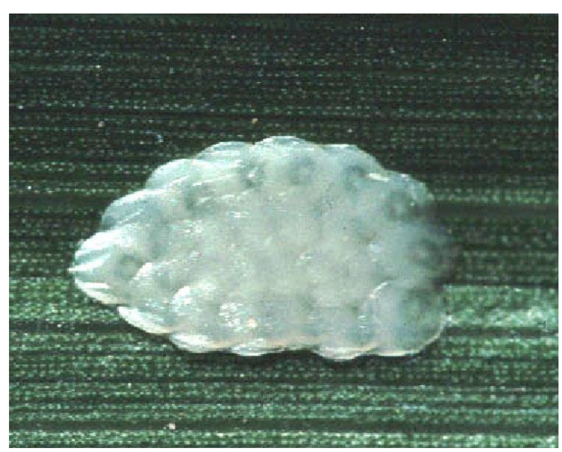
First generation corn borer pressure on the infested non-Bt plants averaged 1.6 southwestern corn borer larvae and 14.8 cm (8.3 in.) tunneling per plant (Table 1). The Bt plants were completely protected from the SWCB. The insecticide treatment had not yet been applied so the effects of insecticide were not significant and the interactions were not significant.

Second generation corn borer pressure averaged 0.5 SWCB larvae per plant and tunneling averaged 10.9 cm (4.3 in.) per plant in the non-Bt corn hybrids (Table 2). There were significant reductions in corn borers of 83% for insecticide treatment, 96% for Bt resistance and a difference of 34% for seed company. There were also significant reductions (or differences) in corn borer tunneling of 86% for insecticide treatment, 96% for Bt resistance and 31% for seed company. The significant interaction between insecticide treatment and corn borer resistance was due to the low corn borer pressure in the Bt corn treatment that did not allow for as much response to insecticide as was observed in the non-Bt treatments (Fig. 1). The significant interaction between corn borer resistance and seed company was due to the difference in the susceptibility of the two non-Bt hybrids (Fig. 2). Tunneling was reduced to trace levels in hybrids containing either MON810 or CBH351 events (Table 1 and Figs. 2 and 3). Data on European corn borer is not presented since only four second generation ECB larvae were found in 320 dissected plants.

Corn earworm damage to kernels averaged 53.0 and 39.5 kernels per ear in the non-Bt and Bt hybrids, respectively (Table 3). There were significant reductions (or differences) in corn earworm damage associated with each factor in the experiment: insecticide, resistance and company. The significant two-way interaction between insecticide treatment and corn borer resistance was due to higher damage in unsprayed non-Bt hybrid (Fig. 3). The significant two-way interaction between seed company and corn borer resistance was due to lower damage in GH non-Bt hybrid (Fig. 3). It is interesting that the insecticide treatment did not reduce kernel damage for the Bt treatments. This suggests much of the kernel damage in Bt treatments may have occurred after the insecticide residue had declined (by dusky sap beetles).

Grain yield lost to corn borer lodging was reduced 85 and 75 % by the insecticide treatment and 94 and 96 % by corn borer resistance for Garst and Golden Harvest hybrids, respectively. The significant interactions were due to higher damage recorded in the non-Bt hybrids that were reduced more by the insecticide treatment (Fig. 4a). The insecticide treatments caused greater reductions in lost yield in the Garst hybrids than in the Golden Harvest hybrids (Fig. 4b). Total grain yields (sum of standing plus fallen) were highest for insecticide treated Bt corn treatments, but the differences were not statistically significant (Table 2). The three-way interactions were due to the low yield of the GH non-Bt hybrid relative to the Bt hybrid, particularly in the sprayed treatment (Fig. 5). The GH Bt hybrid responded more to the Capture treatment than did the Garst Bt hybrid.

SWCB egg mass.



ECB egg mass.

Table 1. F-test probability values for the ANOVA tests and main effect means for 1st generation and 2nd generation SWCB observations.

	First Generation SWCB			Second Generation SWCB			
	SWCB Larvae	Tunnel Number	Tunneling—cm	SWCB Larvae	Stalk Tunnel Number	Shank Tunnel Number	Total Tunneling--cm
Treatment Means							
A. Insecticide							
1. Check	0.9	1.4	7.8	**0.44 a**	**0.69 a**	0.11	**9.9 a**
2. Capture	0.7	1.3	7.1	**0.08 b**	**0.11 b**	0.04	**1.4 b**
B. CB Resistance							
1. Non-Bt	**1.6 a**	**2.7 a**	**14.8 a**	**0.50 a**	**0.76 a**	**0.13 a**	**10.9 a**
2. Bt	**0.0 b**	**0.0 b**	**0.0 b**	**0.02 b**	**0.04 b**	**0.03 b**	**0.4 b**
C. Seed Co.							
1. Garst	1.0	1.5	8.4	**0.31 a**	**0.46 a**	0.11	**6.7 a**
2. G H	0.6	1.2	6.5	**0.21 b**	**0.34 b**	0.05	**4.6 b**
ANOVA F-test Probability							
A. Insecticide	NS	NS	NS	**0.0179**	**0.0249**	NS	**0.0350**
B. CB Resistance	**0.0217**	**0.0130**	**0.02515**	**0.0016**	**0.0058**	**0.0400**	**0.0046**
C. Seed Co.	NS	NS	NS	**0.0193**	**0.0044**	NS	**0.0022**
A x B. Interaction	NS	NS	NS	**0.0094**	**0.026**	NS	**0.0183**
A x C. Interaction	NS	NS	NS	NS	NS	NS	NS
B x C. Interaction	NS	NS	NS	**0.0107**	**0.0084**	NS	**0.0022**
A x B x C Interaction	NS	NS	NS	NS	NS	NS	NS

Table 2. F-test probability values for the ANOVA tests and main effect means for late season observations on CEW and yield.

	CEW Kernals damaged	Standing Yield Bu / Acre	Fallen Yield Bu / Acre	Total Yield Bu / Acre
Treatment Means				
A. Insecticide				
1. Check	**49.4 a**	106.5	**32.2 a**	138.8
2. Capture	**43.1 b**	146.4	**8.9 b**	155.2
B. CB Resistance				
1. Non-Bt	**53.0 a**	**102.9 b**	**36.3 a**	139.2
2. Bt	**39.5 b**	**150.0 a**	**4.9 b**	154.8
C. Seed Co.				
1. Garst	**57.4 a**	123.5	21.5	145.0
2. G H	**35.1 b**	129.4	19.6	149.0
ANOVA F-test Probability				
A. Insecticide	**0.0460**	NS	**0.0124**	NS
B. CB Resistance	**0.0067**	**0.0012**	**0.0002**	0.0836
C. Seed Co.	**0.0001**	NS	NS	NS
A x B. Interaction	**0.0501**	0.0563	**0.0005**	NS
A x C. Interaction	NS	NS	**0.0142**	NS
B x C. Interaction	**>0.0001**	**0.0002**	0.0748	**0.0001**
A x B x C Interaction	NS	**0.0005**	NS	**0.0022**

Fig. 1. Two-way interactions between insecticide treatment and corn borer resistance on 2nd generation SWCB.

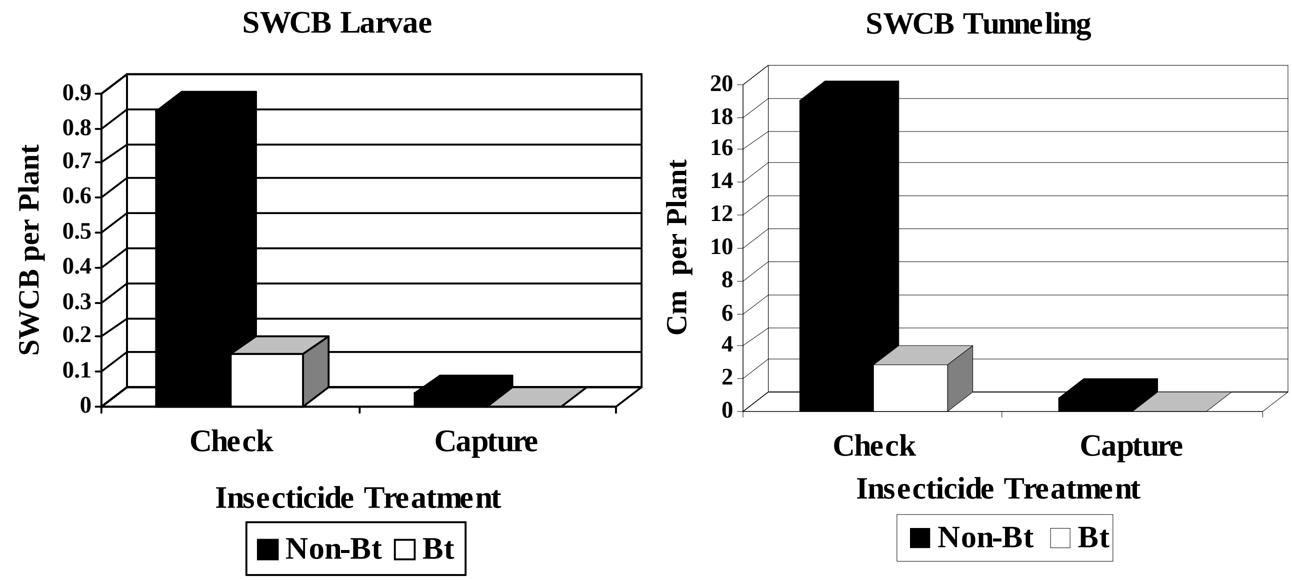


Fig. 2. Two-way interactions between seed company and corn borer resistance on 2nd generation SWCB.

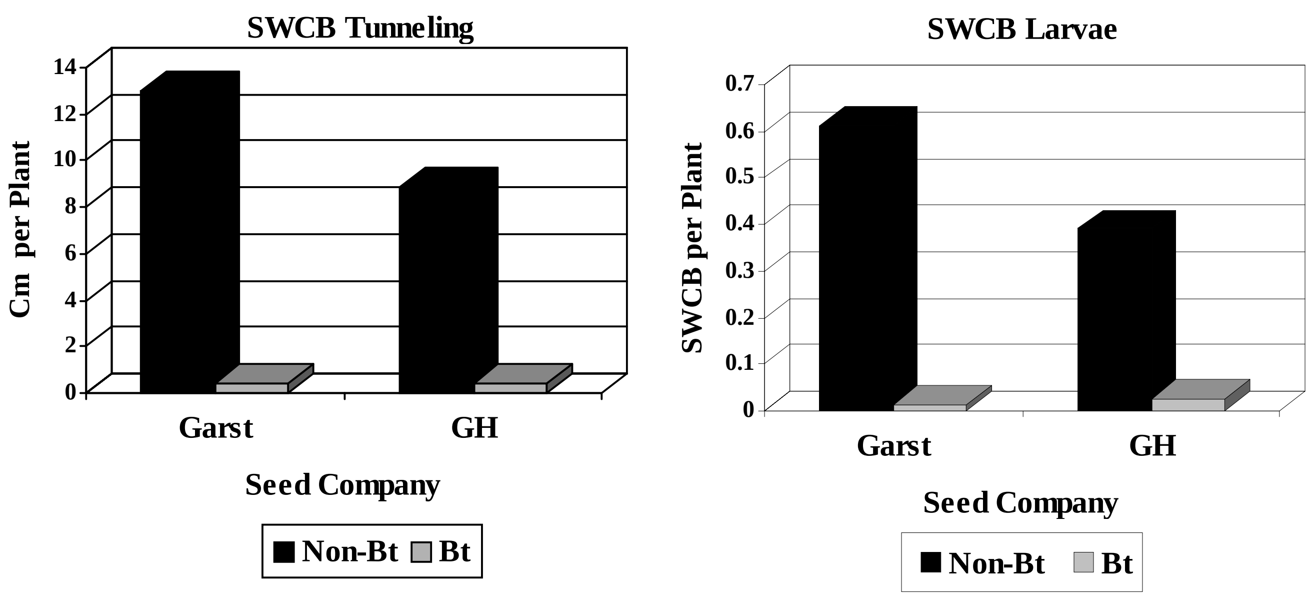


Fig. 3. Two-way Interactions between insecticide treatment and corn borer resistance or seed company and corn borer resistance on CEW kernel damage.

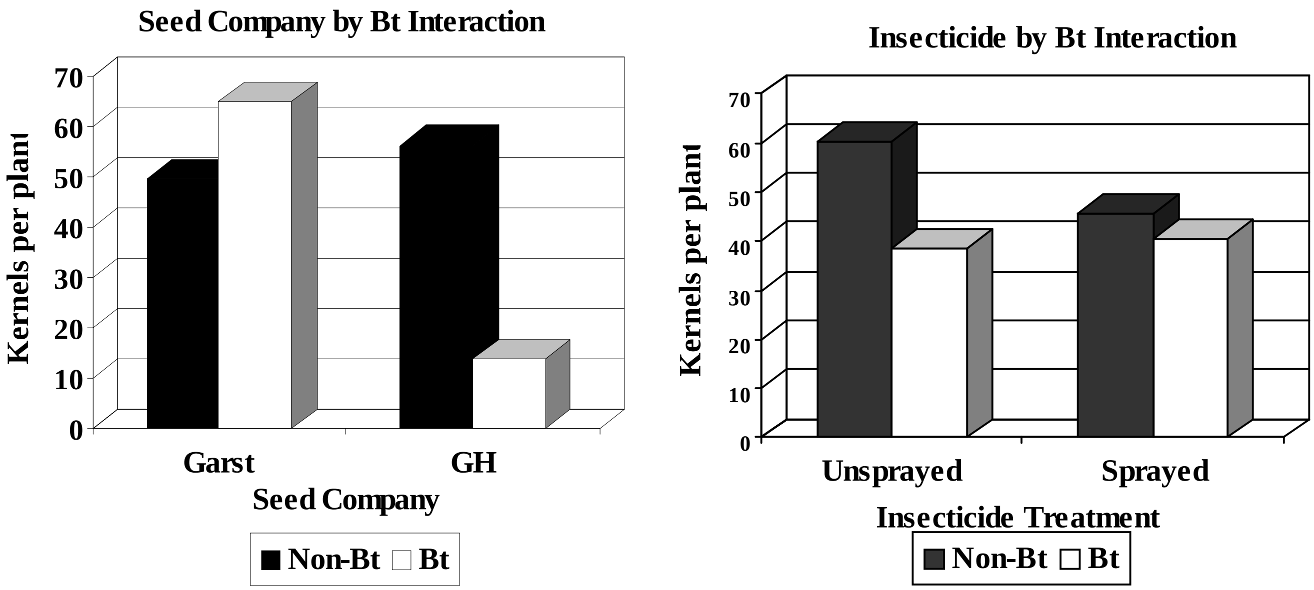


Fig. 4. Two two-way interactions between insecticide treatment and corn borer resistance or insecticide treatment and seed company on fallen grain yield.

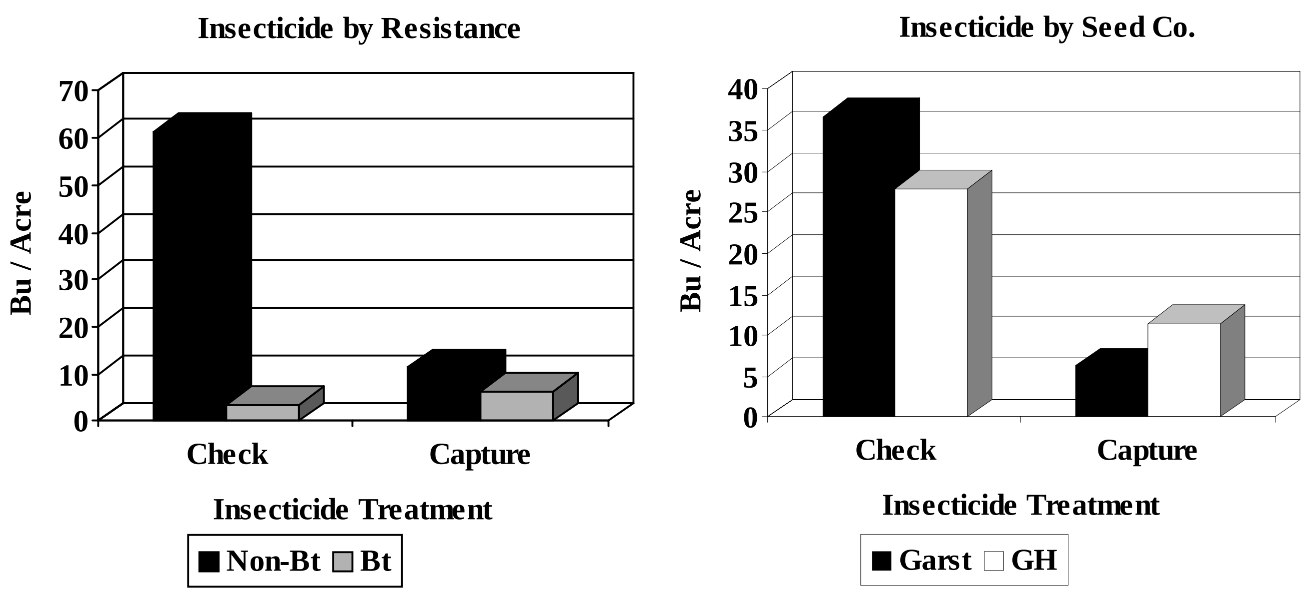
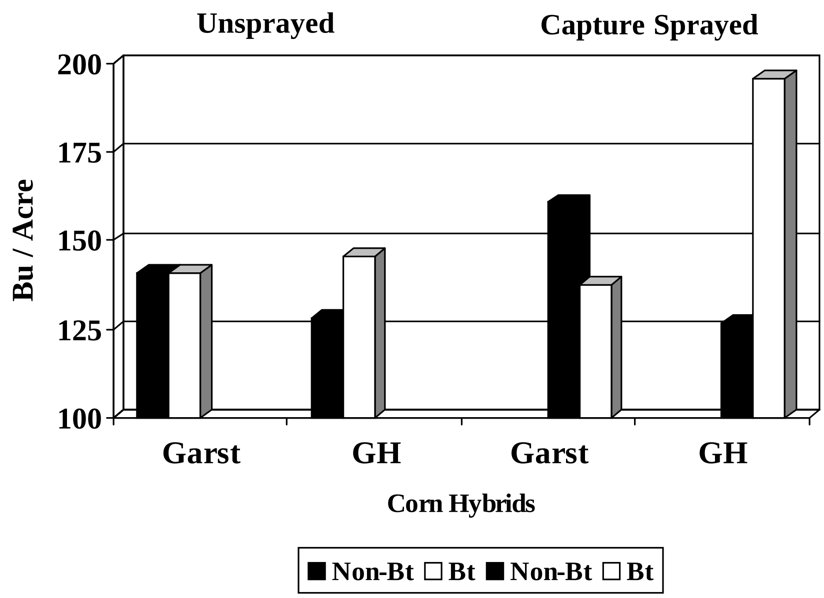


Fig. 5. Three-way interactions between insecticide treatment, corn borer resistance, and seed company on total grain yield.



Machine harvesting corn plots.

SWCB lodged corn.

DISPERSAL OF DYE-MARKED EUROPEAN AND SOUTHWESTERN CORN BORER MOTHS IN AND AROUND AN IRRIGATED CORNFIELD IN SW KANSAS

by

Larry Buschman, Jawwad Qureshi[1], Jose Guzman[1], Phil Sloderbeck, Sonny Ramaswamy[1] and Randy Higgins[1]

SUMMARY

This study evaluated dispersal of European corn borer (ECB), *Ostrinia nubilalis* (Hübner), and the southwestern corn borer (SWCB), *Diatraea grandiosella* Dyar. In the year 2001, dye-marked ECB and SWCB pupae were placed near the center of a center-pivot-irrigated cornfield. The moths were allowed to disperse as they emerged and then recaptured with black light and pheromone traps. There were 21 black light traps and 39 pairs of ECB and SWCB pheromone traps installed in transects around the release point across the cornfield. Feral moths of both species were readily captured throughout the Bt cornfield and the 1st flight was much lower than the 2nd flight for both species. The 1st flight peaked at 0.5 male and 0.38 female SWCB per trap and 8.6 male and 13.2 female ECB per trap. The 2nd flight peaked at 78.3 male and 60.1 female SWCB per trap and 183.3 male and 348.0 female ECB per trap. A total of 2337 dye-marked SWCB moths dispersed from the release point. An average of 18% males and 4.3% females were recaptured beyond the release point. SWCB males and females were recaptured all the way out to the traps located 1200 ft from the release point and one male was recaptured outside the release field over the native grasses. A total of 4933, 5258, and 3751 male and 3312, 3962 and 2703 female dye-marked ECB moths dispersed from the release point in June, July and August releases, respectively. An average of 3.6, 2.7 and 10.1 % of the males and 0.3, 0.6 and 4.4 % of the females were recaptured beyond the release point in the three releases. ECB males and females were recaptured all the way out to the 1200 ft traps. Four ECB males were recaptured outside the release field in the neighboring cornfield. No dye-marked ECB moths were recaptured over the native grasses.

INTRODUCTION

The European corn borer (ECB), *Ostrinia nubilalis* (Hübner), and the southwestern corn borer (SWCB), *Diatraea grandiosella* Dyar, are the two important corn borer pests of corn in North America. The ECB occurs throughout the Corn Belt while the SWCB occurs in the southern corn growing regions. Both corn borers cause damage by feeding on leaf and stem tissue of the developing plant causing physiological yield losses and also by causing harvest losses by causing ears or plants to break or drop. Harvest losses can be much more severe for the SWCB than for the ECB because SWCB larvae actually girdle the corn plants at the end of the season, causing most infested plants to fall to the ground. Harvest losses can exceed 70 bu/a for the SWCB.

Bt-corn will help control damage from these pests, but there is concern that the corn borers may develop resistance to Bt-corn. The success of Bt-corn will be short lived if corn borers develop resistance (or virulence) to Bt-corn. The Environmental Protection Agency (EPA) has made implementation of resistance management a condition for registration for Bt-corn. They have mandated the use of the High Dose/Structured Refuge strategy as a prophylactic Insect Resistance Management (IRM) plan. This plan depends on dispersal of corn borer moths from non-Bt-corn refuge plantings into Bt-cornfields to mate with potential survivors. Insects from the susceptible refuge must be able to disperse into the Bt-corn fields to mate with survivors for the strategy to work (resulting in random mating). It is therefore important to determine how far these insects disperse so that we can determine appropriate refuge planting arrangements.

This study was designed to evaluate dispersal of European and southwestern corn borers by releasing

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marked moths and then trapping for recapture at various distances from the release point.

PROCEDURES

This study was undertaken in a 120-acre center-pivot-irrigated cornfield located 18 miles southwest of Garden City, Kansas (N37, E101). It was located in the "sand hills" south of town, where the corners beyond the reach of the center pivot sprinklers remained in native grass. The surrounding fields were wheat, potato, alfalfa, corn and native grass pasture. The study field had been in winter wheat that had been grazed out in spring and it was replanted to a YieldGard™ Bt-corn hybrid on 25 April 2001. The Bt-cornfield was chosen as the study field to reduce the number of corn borers coming to the traps and to insure that corn borers that were captured had to come from neighboring fields. The study field was not sprayed for corn borers or any other insect.

Southwestern corn borers were reared in the laboratory on SWCB diet containing Sudan Red 7B to dye the insects. Pupae were placed in the field starting the 4th week of May and releases continued until the 4th week of August. Dye-marked ECB were reared in Ames, Iowa and shipped to Garden City. There were three shipments in 2001, 17 June, 11 July and 5 August. Dye-marked ECB and SWCB pupae were taken to the release point near the center of the study field and placed in 19-liter plastic buckets. A wet sponge was added to each bucket to maintain humidity. Each bucket was covered with a sheet of corrugated steel to protect pupae from rain and irrigation. The corrugated lid allowed moths to disperse as they eclosed.

There were 21 black light traps (15 W) used to trap ECB and SWCB males and females. There were 21 to 39 Hartstack wire cone traps with ECB pheromone lures used to trap ECB males. There were 21 to 39 SWCB plastic bucket traps with pheromone lures in used to trap SWCB males. The black light traps were installed in east-west and the north-south transects across the field (Fig. 1). The pheromone traps were installed in proximity to each light trap and along two diagonal transects in the corn (Fig. 1). A light trap and a set of pheromone traps for each corn borer species were installed at the release point. Six pairs of pheromone traps were installed outside the center pivot, four in the native grass corners of the field and two in the nearest irrigated cornfield located southeast of the release field. The traps were monitored daily from the 4th week of May through the 4th week of August. Captured moths were counted, examined for presence of dye, and placed in plastic bags to be taken to the laboratory where they were refrigerated. Females were examined for the presence of a spermatophore to determine if they were mated.

RESULTS AND DISCUSSION

Feral moths of both species were readily captured throughout the Bt cornfield. As usual, the 1st SWCB flight was much lower than the 2nd flight (Fig. 2). The 1st flight peaked the 2nd and 3rd weeks of June at 0.5 males and 0.38 females per trap. The 2nd flight peaked the 2nd week of August at 78.3 males and 60.1 females per trap. The 1st ECB flight was also much lower than the 2nd flight (Fig. 3). The 1st flight peaked the 2nd week of June at 8.6 males and 13.2 females per trap. The 2nd flight peaked the 4th week of July at 183.3 males and 348.0 females per trap.

A total of 2337 dye-marked SWCB moths dispersed from the release point, 1292 male and 1045 female. Most of the SWCB moths were released in late July and August when the corn was in the reproductive stage (Fig. 4). Twenty seven percent of the males and 8.6% of the females were recaptured at the release point. Excluding those captured at the release point, 18% of the males and 4.3% of the females were recaptured beyond the release point. The recapture rate for SWCB males was similar for July and August releases, but the recapture rate for females appeared to be lower in the August releases (Fig. 5). Unfortunately, only a small number of moths were released or recaptured during the pre-reproductive stage.

There were a total of 4933, 5258, and 3751 male and 3312, 3962 and 2703 female dye-marked ECB moths dispersed from the release point in the June, July and August releases, respectively. At the release point, 2.7, 0.9, and 5.9% of the males and 0.5, 0.6, and 6.1% of the females were recaptured in the June, July, and August releases, respectively. Excluding moths captured at the release point, 3.6, 2.7, and 10.1% of the males and 0.3, 0.6, and 4.4% of the females were recaptured beyond the release point. The recapture rate for ECB males and females appeared to be higher in the August release than in earlier releases (Fig. 5). Male and female ECB recaptures at the release point peaked 5 and 7 days after the August release. The number of male and female ECB recaptured away from the release point peaked 3 days after the peak at the release point. Male recapture at the 350 and 1200 ft traps peaked 4 days after the peak at the release point. Female recapture at 350 and 1200 ft was not high enough to give a clear pattern.

Fig. 1. Trap layout in a center pivot circle of corn to study corn borer dispersal, 2001.

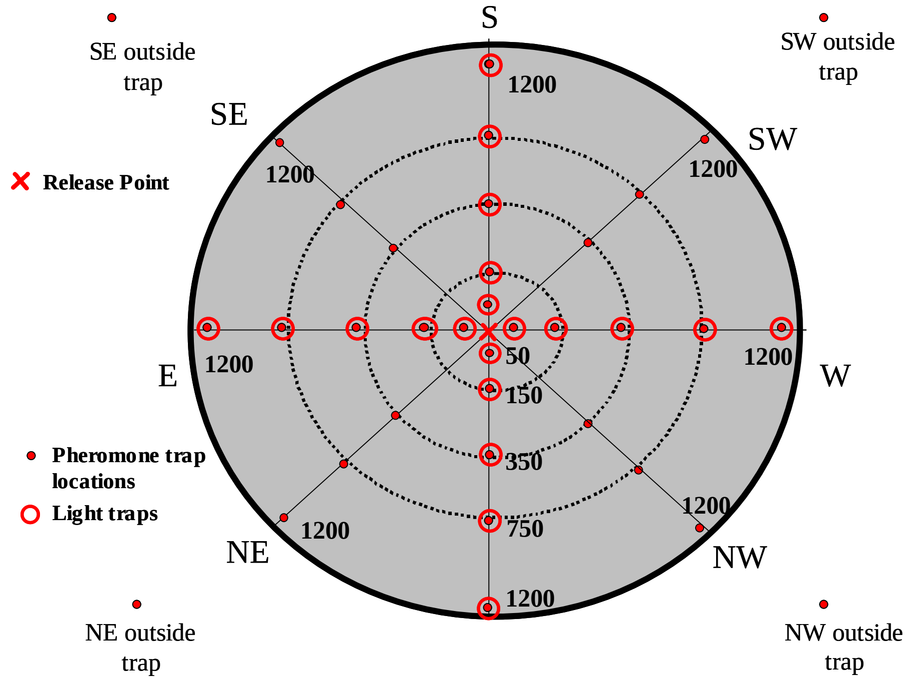
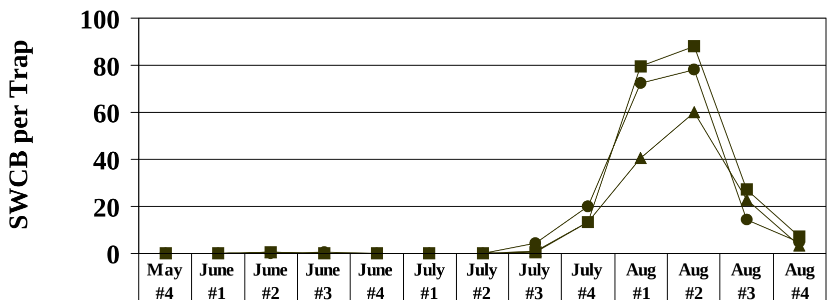


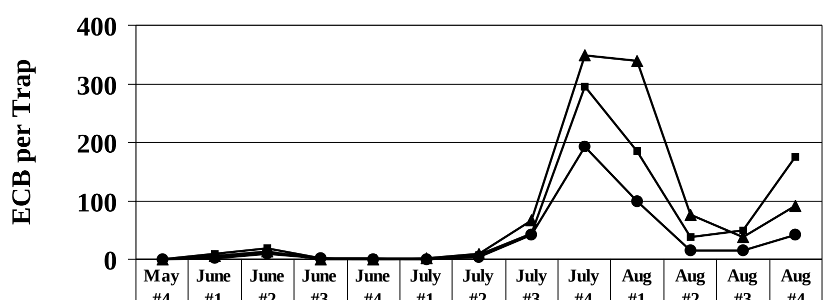
Fig. 2. Feral SWCB moths that flew into the Bt corn field from surrounding fields.



	May #4	June #1	June #2	June #3	June #4	July #1	July #2	July #3	July #4	Aug #1	Aug #2	Aug #3	Aug #4
Males-Ph	0	0	0.05	0.57	0	0	0.03	4.24	20.03	72.3	78.3	14.09	4.61
Males-BL	0	0	0.27	0.09	0	0	0.05	0.57	13.48	79.43	87.9	27.14	6.95
Females-BL	0	0	0.38	0.18	0	0	0.05	0.78	13.1	40.67	60.05	22.76	3.33

Weeks of Growing Season

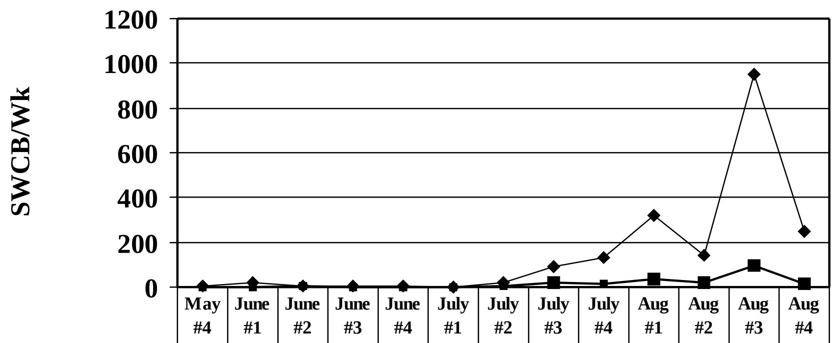
Fig. 3. Feral ECB moths that flew into the Bt corn field from surrounding fields.



	May #4	June #1	June #2	June #3	June #4	July #1	July #2	July #3	July #4	Aug #1	Aug #2	Aug #3	Aug #4
Males-Ph	0	1.58	8.58	2.79	0.42	0.82	4.73	42.21	193.3	99.09	15.06	14.7	42.39
Males-BL	0.52	10.43	18.43	2.29	1.29	0.81	7.48	43.29	296.1	184.8	38.62	48.86	174.5
Females-BL	0	5.33	13.19	0.62	0.43	1.81	8.62	66.71	348	339.9	76.76	37.62	90.95

Weeks of Growing Season

Fig. 4. Dispersal and recapture of SWCB moths at the release point.

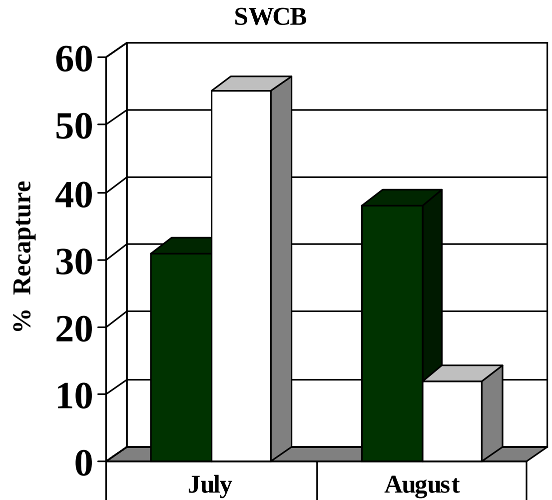


	May #4	June #1	June #2	June #3	June #4	July #1	July #2	July #3	July #4	Aug #1	Aug #2	Aug #3	Aug #4
Moths Released	3	18	5	6	5	0	20	90	133	319	143	953	247
Moths Recaptured	0	0	5	2	0	0	4	18	14	38	19	96	15

Weeks of Growing Season

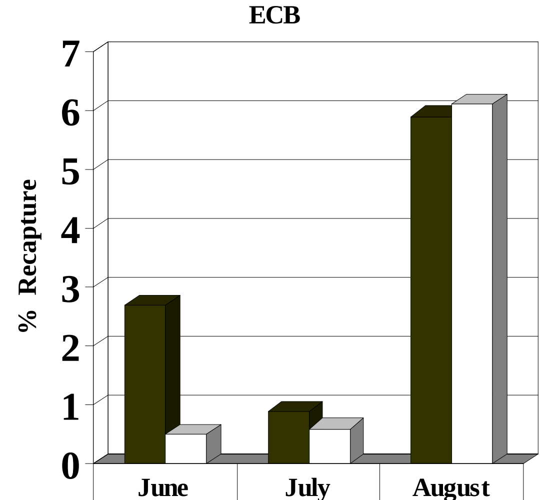
Fig. 5. Corn borer recapture relative to stage of corn development.

SWCB



	July	August
Males	31	38.1
Females	55	12

ECB



	June	July	August
Males	2.7	0.9	5.9
Females	0.5	0.6	6.1

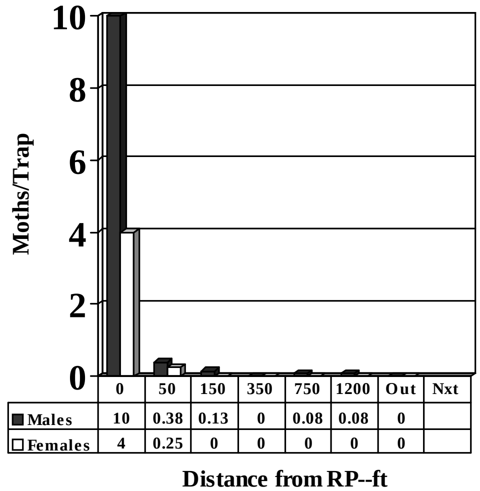
SWCB males were recaptured all the way out to the 1200 ft traps in pre-reproductive corn, but only a few females were released during this period so no conclusions can be made on females (Fig. 6). In post-reproductive corn, SWCB males and females were recaptured all the way out to the 1200 ft traps, and one male was recaptured outside the field. No dye-marked SWCB moths were recaptured in the next cornfield. In post-reproductive corn, the traps to the west and south of the release point appeared to recapture a few more moths than the other traps, but the trend was not very pronounced. There appeared to be a trend that more moths were captured in the pheromone traps that were near light traps than in traps that were separate from the light traps.

ECB males and females were recaptured all the way out to the 1200 ft traps in all three releases (Fig. 7-8). In post-reproductive corn, four ECB males were recaptured in the next field. No dye-marked ECB moths were recaptured over the native grasses. There were no clear trends in the recaptures of male or female ECB in the different directions from the release point.

The black light traps captured more ECB and SWCB males than the pheromone traps (Fig. 9). This was surprising because the SWCB pheromone lure is very effective and it usually captures more males than the black light trap.

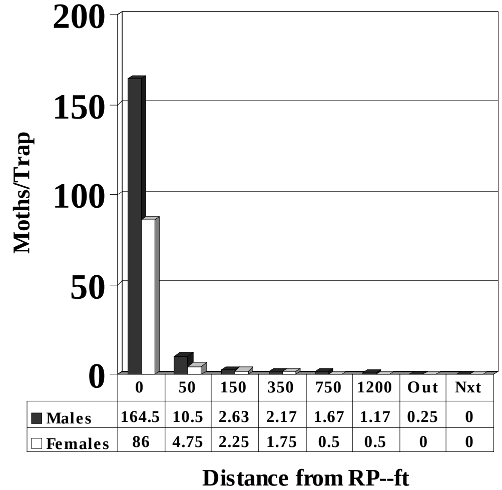
Fig. 6. Recapture of SWCB at different distances away from the release point.

Pre-Reproductive Corn



	0	50	150	350	750	1200	Out	Nxt
Males	10	0.38	0.13	0	0.08	0.08	0	
Females	4	0.25	0	0	0	0	0	

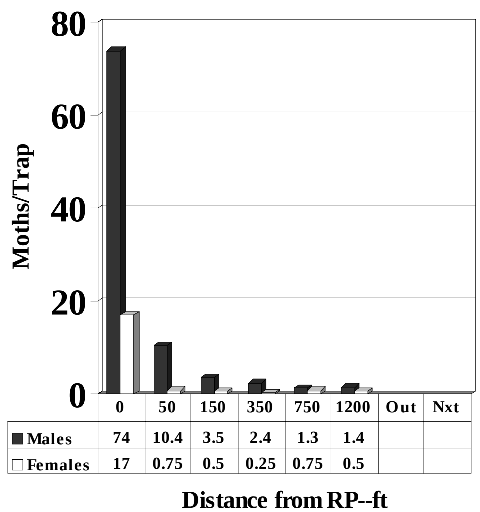
Reproductive Corn



	0	50	150	350	750	1200	Out	Nxt
Males	164.5	10.5	2.63	2.17	1.67	1.17	0.25	0
Females	86	4.75	2.25	1.75	0.5	0.5	0	0

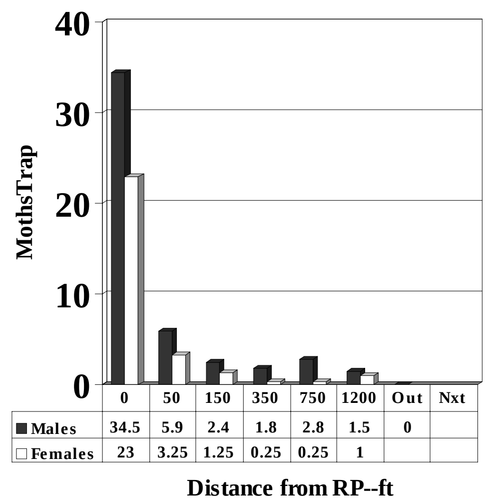
Fig. 7. Recapture of ECB at different distances away from the release point.

Pre-Reproductive - June



	0	50	150	350	750	1200	Out	Nxt
Males	74	10.4	3.5	2.4	1.3	1.4		
Females	17	0.75	0.5	0.25	0.75	0.5		

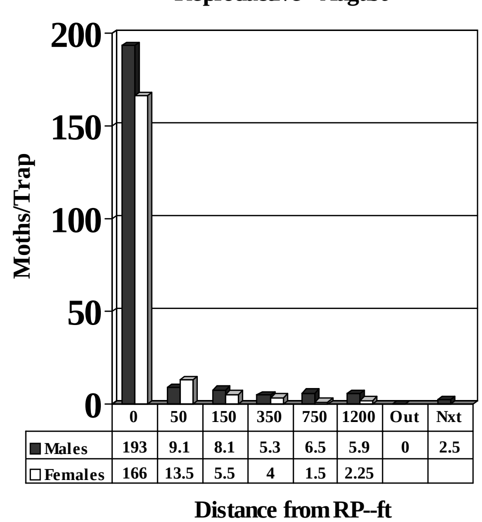
Reproductive - July



	0	50	150	350	750	1200	Out	Nxt
Males	34.5	5.9	2.4	1.8	2.8	1.5	0	
Females	23	3.25	1.25	0.25	0.25	1		

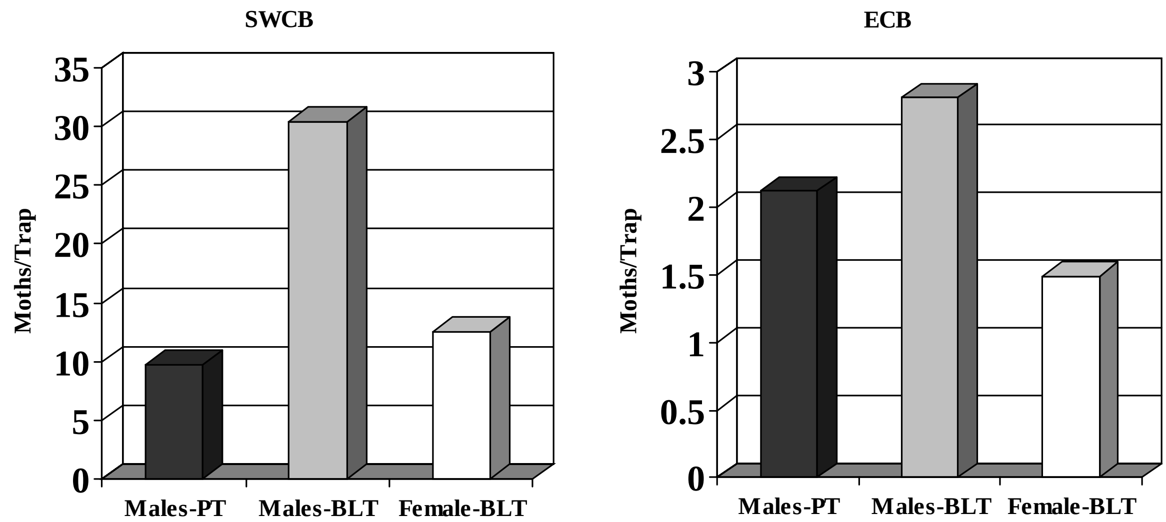
Fig. 8. Recapture of ECB at different distances away from the release point.

Reproductive - August



	0	50	150	350	750	1200	Out	Nxt
Males	193	9.1	8.1	5.3	6.5	5.9	0	2.5
Females	166	13.5	5.5	4	1.5	2.25		

Fig. 9. Relative corn borer recapture at pheromone and black light traps.



Hartstack wire trap (left) used to capture ECB using ECB pheromone lure. Plastic bucket trap (right) used to capture SWCB using SWCB pheromone lure.

EFFICACY OF MITICIDES AND INSECTICIDES AGAINST SPIDER MITES AND CORN BORERS IN CORN

by
Larry Buschman and Phil Sloderbeck

SUMMARY

In the spider mite efficacy trial, spider mite populations reached pretreatment counts of 635 to 1006 mites per plant. The Capture treatments gave up to 67% control that lasted for the 21 days. Capture combined with other miticides did not seem to improve efficacy. In the corn borer/spider mite efficacy trial, corn borer populations were very low and averaged only 1.5 SWCB per 10 plants in the untreated plots. SWCB larvae and percent plants infested were significantly reduced by all treatments. Spider mite populations reached pretreatment counts of 537 to 742 mites per plant. The Capture treatments significantly reduced spider mite numbers up to 21 days. Predator mite populations were not significantly affected by miticide treatments in either trial.

PROCEDURES

Field corn, 'Pioneer 3162IR', was planted 9 May with a John Deer MaxEmerge 6 row planter at a rate of 32,000 seeds/a in a furrow-irrigated field (Finnup #7) at the Southwest Research-Extension Center, Finney County, KS. Two tests, a spider mite test and a corn borer/spider mite test, were established. In each test treatments were arranged in a randomized complete block design with four replications. Plots were four rows (total of 10 ft) wide and 50 ft long with a 4-row (10 ft) border of untreated corn on each side and a 10-ft alley at each end. Treatments were applied on 7 and 9 August with a high clearance sprayer using a 10-ft boom with three nozzles directed at each row (one on each side of the row on 16-in. 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.

SPIDER MITE EFFICACY TRIAL

In an effort to produce a more uniform spider mite infestation across the trial, spider mite infested corn leaves from another infested cornfield were added to 10 plants in the two center rows of each plot in the trial. Spider mite samples were made by collecting half the leaves from 4 plants from the two center rows in each plot. The leaves were placed in large plastic bags for transportation to the laboratory, where they were placed in large 76-liter Berlese funnels. A light bulb was used to dry the vegetation and drive arthropod specimens down into the collecting jar containing methanol. Spider mites and predator mites were counted on black filter paper using a binocular microscope. Sample specimens were mounted on microscope slides to determine species of spider mites. Spider mite samples were collected 7 August for pretreatment and again 5-, 13- and 21-days later for post-treatment samples. Spider mite counts were transformed with Taylor's power transformation for statistical analysis and converted to mites per plant for presentation. Grain yield was not taken because plant stands were not uniform.

CORN BORER EFFICACY TRIAL

Second generation SWCB infestations resulted from free flying feral moths and moths emerging from the manually infested plants in a nearby experiment. Second generation corn borer infestations were evaluated by dissecting 10 plants per plot on 18 September to record larvae and tunneling observations. Corn borer data was transformed with the square root mean + 1 before analysis. Also in this study, spider mites samples were collected 9 Aug. for pretreatment and again 6-, 12-, and 21 days later for post-treatment samples. Spider mite counts were transformed with Taylor's power transformation for statistical analysis and converted to mites per plant for presentation. Grain yield was not taken because plant stands were not uniform.

RESULTS AND DISCUSSION

SPIDER MITE EFFICACY TRIAL

Spider mite populations were slow developing in 2001, but then exploded just before the plots were treated reaching pretreatment counts of 635 to 1006 mites per plant (Table 1). Capture treatments gave up to 67% control, which lasted for the 21 days post treatment. Capture in combination did not seem to improve efficacy. At pretreatment, the mites were 1.6% TSM. At 5-, 12- and 21-days post-treatment, the mites were 7.1, 29.4 and 46.6 % TSM, respectively. The percent TSM differed significantly among treatments. and presence of the TSM explains why the percent control did not exceed 67%, since TSM are not very susceptible to Capture. Predator mite populations were not significantly affected by the miticide treatments (Table 2).

CORN BORER EFFICACY TRIAL

Corn borer populations were very low and averaged only 1.5 SWCB in 10 plants. SWCB and percent plants infested were significantly reduced by all treatments (Table 3). Spider mite populations were slightly lower in the corn borer trial than in the spider mite trial, reaching pretreatment counts of 537 to 742 mites per plant (Table 4). Capture treatments gave up to 89% control at 12 days post treatment, and control was still up to 78% at 21 days. At pretreatment, the mites were 11.4% TSM. At 6-, 12-, and 21-days post-treatment, the mites were 18.9, 29.2, and 42.7 % TSM, respectively. The percent TSM did differ significantly among treatments. Predator mite populations were not significantly affected by the miticide treatments (Table 2).

Splitting corn stalks to measure corn borer tunneling and to find corn borer larvae.

Corn borer cannibalism.

Table 1. Efficacy of insecticide and miticide treatments made 7 August on spider mite, SWREC Garden City, KS.

Treatment	Rate fl.oz/a (lb ai/a)	Spider Mites/plant Pre-treat.	Spider Mites /plant 5 days Post-treat. (% Control)	Spider Mites /plant 13 days Post-treat. (% Control)	Spider Mites /plant 21 days Post-treat. % Control)
Check Untreated	—	1006	403 ab	296	345
Capture 2EC	5.1 (0.08)	897	337 ab (6%)	88 (67%)	102 (67%)
Capture 2EC	6.4 (0.1)	635	162 ab (36%)	123 (34%)	187 (14%)
Capture 2EC & Dimethoate 2EC	5.1 (0.08) 32 (0.5)	617	206 ab (17%)	114 (37%)	135 (36%)
Capture 2EC & Dimethoate 2EC	6.4 (0.1) 32 (0.5)	936	163 ab (57%)	145 (47%)	191 (40%)
Capture 2EC & Furadan 4F	6.4 (0.1) 32 (1.0)	795	130 b (59%)	134 (43%)	187 (53%)
F-test P		0.4386	0.1547	0.3911	0.3024
CV		14.0%	18.0%	14.1%	13.8%

Means followed by the same letter are not significantly different (P < 0.05, LSD)
[a] Percent Control calculated using the method of Henderson (1955).

Table 2. Efficacy of insecticide and miticide treatments made 7 August on predator mites, SWREC Garden City, KS.

Treatment	Rate fl.oz/a (lb ai/a)	Predator Mites /plant Pre-treat.	Predator Mites /plant 5 days Post-treat.	Predator Mites /plant 13 days Post-treat.	Predator Mites /plant 21 days Post-treat.
Check Untreated	—	1.2	0.4	0.9	3.5
Capture 2EC	5.1 (0.08)	0.8	2.8	2.5	3.0
Capture 2EC	6.4 (0.1)	1.4	0.1	0.8	4.4
Capture 2EC & Dimethoate 2EC	5.1 (0.08) 32 (0.5)	0.4	0.1	0.5	2.3
Capture 2EC & Dimethoate 2EC	6.4 (0.1) 32 (0.5)	0.3	0.5	1.1	3.0
Capture 2EC & Furadan 4F	6.4 (0.1) 32 (1.0)	0.8	0.3	1.1	3.3
F-test P		0.717	0.505	0.226	0.238
CV		143%	284%	119%	86%

Means followed by the same letter are not significantly different (P < 0.05, LSD)

Table 3. Efficacy of insecticide and miticide treatments made 9 August on corn borers and spider mites, SWREC Garden City, KS.

Treatment	Rate fl.oz/a (lb ai/a)	SWCB Per 10 plts (% Control)	Tunnels Per 10 plts (% Control)	Tunneling Cm Per 10 plts (% Control)	% Infested Plants
Check Untreated	—	1.5 a	2.8	26.3	25.0 a
Tracer 4SC	1 (0.031)	0.8 ab (50%)	1.3 (54%)	8.0 (70%)	12.5 ab
Tracer 4SC	2 (0.067)	0.8 ab (50%)	1.0 (64)	4.8 (83%)	10.0 ab
Tracer 4SC	3 (0.094)	0.3 ab (83%)	0.8 (71%)	10.0 (62%)	7.5 b
Warrior 1EC	3.8 (0.02)	0.0 b (100%)	0.0 (100%)	0.0 (100%)	0.0 b
Capture 2EC	6.4 (0.1)	0.3 b (83%)	1.3 (54%)	6.0 (77%)	10.0 ab
Capture 2EC & Avid 1.15 EC	6.4 (0.1) 16 (0.019)	0.0 b (100%)	0.8 (71%)	3.5 (87%)	2.5 b
Capture 2EC & Kelthane MF 4EC	6.4 (0.1) 48 (1.5)	0.3b (83%)	0.5 (82%)	3.3 (87%)	2.5 b
F-test P		0.0467	0.2844	0.0934	0.0342
CV		20.5	31.3	65.5	58.8

Means followed by the same letter are not significantly different (P<0.05, LSD)
[a] Percent Control calculated as reduction from the check.

Table 4. Efficacy of insecticide and miticide treatments made 9 August on corn borers and spider mites, SWREC Garden City, KS.

Treatment	Rate fl.oz/a (lb ai/a)	Spider Mites/ plant Pre-treat.	Spider Mites/ plant 6 days Post-treat. (% Control)[a]	Spider Mites/ plant 12 days Post-treat. (% Control)[a]	Spider Mites / plant 21 days Post-treat. (% Control)[a]
Check Untreated	—	646	389 a	362 a	530 a
Tracer 4SC	1 (0.031)	742	554 a (-24%)	234 ab (44%)	505 ab (17%)
Tracer 4SC	2 (0.067)	642	254 ab (34%)	248 ab (31%)	350 ab (34%)
Tracer 4SC	3 (0.094)	565	314 a (8%)	205 abc (35%)	248 b (46%)
Warrior 1EC	3.8 (0.02)	760	241 ab (47%)	135 bc (68%)	340 ab (45%)
Capture 2EC	6.4 (0.1)	676	53 b (87%)	79 cd (79%)	229 bc (59%)
Capture 2EC & Avid 1.15 EC	6.4 (0.1) 16 (0.019)	669	61 b (85%)	42 d (89%)	121 cd (78%)
Capture 2EC & Kelthane MF 4EC	6.4 (0.1) 48 (1.5)	537	48 b (85%)	35 d (88%)	127 d (71%)
F-test P		0.9191	0.0094	>0.0001	0.0012
CV		13.4%	22.2%	14.2%	11.1%

Means followed by the same letter are not significantly different (P<0.05, LSD)
[a]Percent control calculated using the method of Henderson (1955).

Table 5. Efficacy of insecticide and miticide treatments made 9 August on corn borers and predator mites, SWREC Garden City, KS.

Treatment	Rate fl.oz/a (lb ai/a)	Predator Mites /plant Post-treat.	Predator Mites /plant 6 days Pre-treat.	Predator Mites /plant 12 days Post-treat.	Predator Mites /plant 21 days Post-treat.
Check Untreated	—	1.1	0.1	1.4	3.0
Tracer 4SC	1 (0.031)	0.1	1.0	5.4	12.1
Tracer 4SC	2 (0.067)	0.0	0.4	1.6	4.1
Tracer 4SC	3 (0.094)	0.0	0.6	1.9	4.6
Warrior 1EC	3.8 (0.02)	0.1	0.3	1.0	4.0
Capture 2EC	6.4 (0.1)	0.1	0.4	0.0	3.6
Capture 2EC & Avid 1.15 EC	6.4 (0.1) 16 (0.019)	0.1	0.8	0.4	4.8
Capture 2EC & Kalthane MF 4EC	6.4 (0.1) 48 (1.5)	0.4	0.4	1.8	4.8
F-test P		0.320	0.416	0.824	0.315
CV		182%	86%	41%	24%

Means followed by the same letter are not significantly different (P < 0.05, LSD).

SWCB girdled corn plant.

EFFICACY OF REGENT AND COUNTER FOR CORN ROOTWORM AND SOUTHWESTERN CORN BORER SUPPRESSION

by
Larry Buschman, Phil Sloderbeck, and John Wooden

SUMMARY

This trial was conducted to evaluate planting time applications of Regent 4SC and Counter 20CR against corn rootworm and southwestern corn borer larvae. Both insecticides provided protection against corn rootworm injury. The Regent plots also had lower southwestern corn borer infestations, but most of the differences were not statistically significant. This suggests that the Regent treatment reduced corn rootworm damage significantly and provided some first- and second-generation southwestern corn borer suppression.

PROCEDURES

In 2001 two trials were installed in two different fields at the Southwest Research-Extension Center near Garden City, KS. At the Finnup, field 'Pioneer 3162IR' was planted 9 May with a John Deer MaxEmerge 6 row planter, with plots 6 rows wide (total of 15 ft) and 50 ft long with 10-ft alleys. The plot design was a randomized block design with 4 replicates. Counter 20G was applied with planter mounted granular applicator boxes at 6 oz per 1000 ft. A 7-inch bander was mounted before the press-wheel to apply the insecticide in a "T-Band". Regent 4SC was mixed with water and applied at 3 gal of solution per acre at 14 psi through a micotube directed into the seed furrow. Corn rootworm damage was evaluated on 12 July by digging four corn plants from each plot and rating them using the new Iowa State 0 to 3 linear root damage scale. These ratings were then converted to the older Iowa 1 to 6 scale for comparison with data from previous evaluations.

At the Holcomb field Pioneer '31A12' was planted 12 May with a Kinze Model 3100 4-row planter. The plots were 8 rows wide (total of 20 ft) and 138 ft long with 20-ft alleys. However, only the two center rows of each 4-row pass were left untreated in the check plots. The plot design was a randomized block design with 4 replicates. Counter 20G was applied with planter mounted granular applicator boxes at 6 oz per 1000 ft. A 7-inch bander was mounted before the press-wheel to apply the insecticide in a "T-Band". Regent 80WG was mixed with water and applied at 3.3 gal of solution per acre at 14 psi through a micotube directed into the seed furrow. Up to July 11, these plots were irrigated by sub-surface drip on 20, 22, and 27 June and 2 July (0.4, 0.31, 0.12 and 1.00 inches per acre)

Corn rootworm damage was evaluated by digging four corn plants from each plot on 11 July (Holcomb) and 12 July (Finnup) and rated using the Iowa State 0 to 3 linear root damage scale. These ratings were also converted to the older Iowa 1 to 6 scale so the data can be compared with previous data.

At the Finnup trial, 10 plants in each plot were manually infested with an average of 10 SWCB neonate larvae per plant on 27 June. First generation infestation was evaluated using a modified Guthrie rating (0-9 scale) for 10 infested plants per plot on 17 July. Five infested plants per plot were then dissected on 1 August to record the 1st generation corn borer observations. Second generation SWCB infestation resulted from free flying feral moths and moths emerging from the manually infested first generation. On 18 September we dissected 10 plants per plot (not infested with 1st generation neonates) to make observations on 2nd generation corn borers. Grain yield was not determined because the plant stand was variable and the insect pressure was too light to affect yields.

RESULTS AND DISCUSSION

Corn rootworm pressure in the untreated check averaged 0.30 and 0.25 on the Iowa State 0 – 3 scale and 3.1 and 2.7 on the Iowa 1 to 6 root damage scale for the Holcomb and Finnup locations, respectively (Table 1). Both Regent and Counter treatments had lower corn rootworm injury than the untreated check, but when the data from the two sites were analyzed separately the difference was significant only for the Iowa 1 to 6 ratings at Holcomb (Table 1). When the two trials were combined the root ratings for the Regent and Counter treatments were significantly lower than those for the untreated check for both rating systems (Table 1).

The artificial infestation of first generation SWCB resulted in modified Guthrie ratings that averaged 6.9 on the 0 to 9 scale on infested plants in the untreated check (Table 2). There were 1.6 larvae per plant and 12.1 cm (4.8 in.) of tunneling per plant. However, there were no significant differences in 1st generation observations among the treatments. Second generation SWCB resulted in 0.23 larvae per plant and 26.0 cm (10.2 in.) of tunneling per plant in the untreated plots. Regent-treated plots had significantly lower southwestern corn borer tunneling relative to the untreated check and Counter-treated plots (Table 2).

Table 1. Efficacy of Regent and Counter for reducing western corn rootworm damage on corn in SW Kansas, Garden City, KS, 2000.

		Holcomb		Finnup		Combined	
Treatment	Rate	Root Rating 0-3 scale	Root Rating 1-6 scale	Root Rating 0-3 scale	Root Rating 1-6 scale	Root Rating 0-3 scale	Root Rating 1-6 scale
Untreated	—	0.304	3.1 a	0.245	2.7	0.275 a	2.9 a
Counter 20CR	1.3 lb ai/a	0.094	2.2 b	0.146	2.3	0.120 b	2.2 b
Regent 4SC	0.13 lb ai/a	0.105	2.5 b	0.083	2.2	0.094 b	2.4 b
F-Test Prob.		0.1875	0.0364	0.2039	0.2334	0.0456	0.0095
LSD value at p=0.05		—	0.628	—	—	0.1502	0.4041

Means within a column followed by the same letter do not differ significantly (LSD, P=0.05)

Table 2. Efficacy of Regent and Counter for controlling southwestern corn borer larvae, Garden City, KS, 2000.

		First Generation SWCB				Second Generation		
Treatment	Rate	Modified Guthrie Rating 0-9	SWCB Per plant	SWCB Tunnels Per plant	SWCB Tunneling Cm/plant Per plant	SWCB Per plant	SWCB Tunnels plant	SWCB Tunneling Cm/plant
Untreated	—	6.9	1.6	2.0	12.1	0.23	0.40	26.0 ab
Counter 20CR	1.3 lb ai/a	6.2	1.2	1.6	9.5	0.15	0.40	32.3 a
Regent 4SC	0.13 lb ai/a	5.8	0.9	1.5	8.6	0.00	0.15	4.5 b
F-Test Prob.		0.4228	0.1995	0.4168	0.4461	0.2007	0.1914	0.0535
LSD value at p=0.05		—	—	—	—	—	—	22.613

Means within a column followed by the same letter do not differ significantly (LSD, P=0.05).

TIMING THE LAST IRRIGATION FOR OPTIMAL CORN PRODUCTION AND WATER CONSERVATION[1]

by
Mahbub Alam, Troy Dumler, and Gary Gold[2]

SUMMARY

Results of a two-year field study indicate that corn producers in Western Kansas may benefit from making a judicious decision on timing of the last corn crop irrigation. The first closing on August 10-15, corresponding to denting and starch layer formation that has proceeded ¼ to ½ towards the germ layer, resulted in an average yield that was 7 bu/a less than the second closing on August 21-22, which corresponded to starch layer at ½ to ¾ towards the germ layer. However, continuing irrigation until September 1, corresponding to the start of formation of black layer, improved yield by only 2 bu/a. Across both years, the first closing date was statistically different from the last closing date, but the second closing date was not different from either the first or last closing dates. Economic sensitivity tests show that irrigating until the formation of starch layer at ½ to ¾ towards germ layer is feasible with a corn price of $2 per bushel and $6 per inch pumping costs. However, irrigating past this stage of grain development was not feasible even for $2.75 corn and pumping costs as low as $2 per inch. The results indicate that it may be unnecessary to continue irrigating until the end of August when the black layer is visible. Thus, it may be possible to shut off irrigation earlier than currently practiced, thereby conserving water and reducing pumping costs.

INTRODUCTION

Crop production in western Kansas is dependent on irrigation. The irrigation water source for the area is groundwater from the Ogallala aquifer. The water level of the Ogallala aquifer is declining, causing the depth of pumping to increase. The additional fuel consumption required for greater pumping depths and higher energy costs have resulted in higher pumping costs in recent years. Because of declining water levels and higher pumping costs, it is necessary to conserve water by adopting efficient water management practices. Irrigation scheduling is an important management tool. Farmers are interested in information on optimum timing for closing the irrigation season. There are some misconceptions regarding the optimum irrigation closing dates. Some farmers believe that the corn crop must have water to avoid eardrop. Over-application at the end of season based on this misconception results in wasted water, increases cost of production, and may even cause degradation of grain quality due to high humidity or disease. Most of all, excess use of water may reduce the useful life of the Ogallala aquifer, which is a confined aquifer with little or no recharge. Depletion of the Ogallala aquifer will impact irrigated agriculture and the present economy of the area. The objectives of the study were to determine the effects of irrigation closing date on corn yield and assess economic returns from different closing dates.

PROCEDURES

A producer's sprinkler-irrigated field was selected for the study. The soil at the test site belongs to Ulysses silt loam series. It is relatively dark with a deep profile and good water holding capacity. The soil surface, however, develops cracks when dry. Two sets of six nozzles were shut progressively after the formation of the starch layer in corn grains. The first closure was done when the starch layer was ¼ to ½ to the germ, which corresponded to August 10 in 2001 and August 15 in 2000, depending on growing degree units. The second closure was done when the starch layer was ½ to ¾ to the corn germ (August 21 and 22 in 2001 and 2000 respectively). The third

[1]The field demonstration and trial was funded by Kansas Corn Commission check-off fund for the project titled "Irrigation Scheduling Demonstration of Efficient Water Use by Corn in Western Kansas."
[2]Stevens County Extension Agricultural Agent, Kansas State University, Hugoton.

closure occurred when the producer closed the whole system, which happened on September 1 in both years.

Four random plots (30 by 30 ft) were identified within the circle over which the selected nozzles would pass during an irrigation event. Ridges were built around the plots to prevent entry of water from adjacent areas. Gypsum block soil water sensors were buried in the plots at three different depths (1, 2, and 3 ft below the soil surface). Graphs showing soil water status during the growing season are not presented in this paper. The reader may contact authors for details, if desired.

Corn ears were hand harvested. Four contiguous rows measuring 10 ft each were harvested at the middle of each plot to remove any border effect. Grain yields were adjusted to 15.5% moisture content.

RESULTS AND DISCUSSION

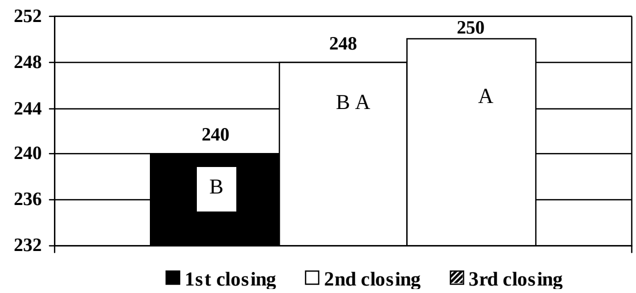
Yield, irrigation applied, and irrigation closing dates in relation to growth stage are presented in Table 1 for 2000 and 2001. Continuation of irrigation from the first closing on August 15 to the second closing on August 22, 2000, increased yield an average of 7 bu/a. The additional irrigation application amounted to 2.1 inches for the 6-day period. The yield difference from the August 22 to the September 1, 2000 closure was 5 bu/a. The additional irrigation for the period was 3 inches.

In 2001, the yield difference between the first and second closing date was 7 bushels per acre. However, there was a loss of one bushel per acre from the second to the third closing date.

A statistical analysis was completed to determine if the results were consistent from year to year and if there was interaction between the years. The analysis indicated that the results were consistent and there was no significant interaction between years. Figure 1 shows the results of the statistical analysis combining both years of data.

Data shown in Figure 1 indicate that the yield difference between the first and the last closing dates is significant; however, the yield difference is not significant between the first and second closing dates. The average yield difference of 8 bushels per acre between the first and second closing dates is approximately equal to the LSD value.

Figure 1. Corn grain yield as affected by irrigation closing dates.



Since the yield data were close among closing times, we did an economic analysis to determine the optimum closing date with different corn prices and pumping costs. The results of this analysis are shown in Figures 2 and 3.

The tool used to determine the optimum closing date was the marginal value vs. marginal cost analysis. In this analysis corn price ranged from \$2.00 to \$2.75 per bushel, while pumping cost ranged from \$2.00 to \$7.00 per inch. Positive returns indicate that the marginal benefit of continuing irrigation was greater than the cost of applying water.

Figure 2 shows that under nearly all scenarios, irrigation remains profitable until the second closing date. The one exception is when the price of corn is \$2.00 per bushel and pumping costs are \$7.00 per inch. However, irrigation past this growth stage may not be profitable (Figure 3).

Table 1: Yield of corn grain as affected by irrigation closing date at different growth stage, Stevens County, Kansas, 2000 -2001.

Year	Irrigation Closing Date	Corn Growth Stage	Additional Irrigation, Inches	Yield, bu/a
2000	August 15	Dented, starch layer ¼ to ½ way to germ	0	238
	August 22	Starch layer ½ to ¾ way to germ layer	2.1	245
	September 1	Starch layer at germ, black layer visible	3.0	250
2001	August 10	Dented, starch layer ¼ to ½ way to germ	0	243
	August 21	Starch layer ½ to ¾ way to germ layer	2.6	250
	September 1	Starch layer at germ, black layer visible	3.0	249

*Note: Additional irrigation compared to the first closing date.

Figure 2. Returns at different levels of input cost and price of corn for difference between 1st and 2nd closing dates.

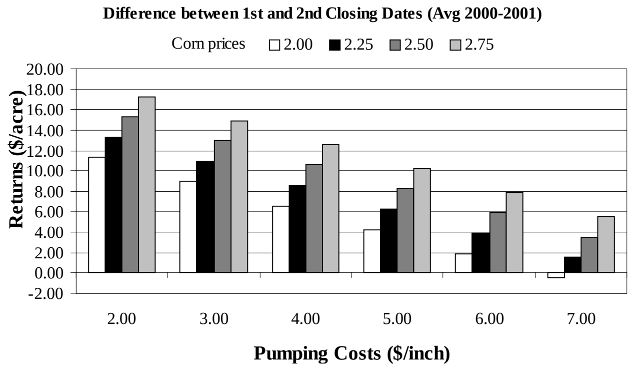
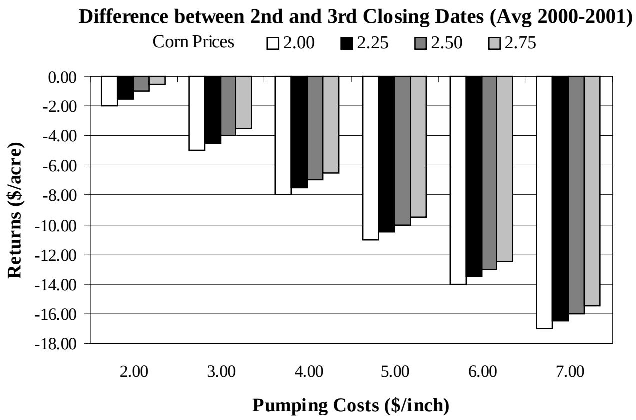


Figure 3. Returns at different levels of input cost and price of corn for difference between 2nd and 3rd closing dates.



Kansas State University water management bulletin No. MF-2174 presents a table showing normal water requirements for corn between stages of growth and maturity. Corn grain, at full dent, will use 2.5 inches of water for the remaining 13 days before reaching physiological maturity. The available water holding capacity of the soil in the study field is estimated to be six inches or more per 3 ft of root zone. It is expected that at 50% management allowable depletion level this soil will provide about 3 inches of water. This may be the reason that there was no appreciable benefit from continuing irrigation past August 21 or after the starch layer has moved past ½ to ¾ towards germ layer. The soil water sensors did indicate that the soil water was sufficient to carry the crop to full maturity.

It is worthwhile to mention that there was no appreciable eardrop observed in the field within the circular area that experienced earlier irrigation closing dates, although the plants were dryer compared to the rest of the field at the time of harvest.

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INSECTICIDE SEED TREATMENTS ON GRAIN SORGHUM

by
Merle Witt

SUMMARY

Seed applied insecticides have the potential to prevent insect plant feeding and plant damage. Early season infestations of greenbugs and other aphids can be restricted using this control method. However, systemic activity tapers off later in the season. This study evaluated the use of seed applied insecticide in the years 2000 and 2001.

PROCEDURES

Sorghum plots were planted each year using untreated seed and seed treated with recommended rates of Gaucho, Adage, or Cruiser insecticides. Two grain sorghum hybrids were used (NC+271 and NK5604) in 30-inch row plots with 8 replications.

RESULTS AND DISCUSSION

Greenbug numbers were low each year in the early season when the insecticides could have prevented damage, but populations were notable after the sorghum had headed. Greenbugs were not controlled late in the season by the planting time insecticide treatments such that resulting grain yields were not significantly improved with seed insecticide treatments (Table 1).

Table 1. Grain yields (bushels/acre) of grain sorghum using insecticide-treated seed.

	Year	
Treatment	2000	2001
Check	82	113
Gaucho	85	112
Adage	88	—
Cruiser	—	114
Average	85	113
L.S.D.	NS	NS

SIMULATED HAIL DAMAGE TO WHITE SEEDED VS. RED SEEDED WHEAT

by
Merle Witt

SUMMARY

This research, sponsored by the national Crop Insurance Services, evaluated a white-seeded wheat and a red-seeded wheat for their responses to simulated hail defoliation under dryland conditions in southwest Kansas.

PROCEDURES

A white-seeded variety, Trego and a red-seeded variety, Tam 107, were established by planting drilled strips on October 5, 2000. Plots were seeded at 50 lb/a in three replicates. Plots were six rows, each 20 ft in length, with 10-in. row spacing.

Defoliation of plots was accomplished on April 24, 2001 using a gas-powered “Weed Eater” to simulate hailstorm levels of 100%, 66%, 33%, or 0% (check) at the early boot stage of growth. Plant foliage was eliminated above 2 in., 4 in., and 6 in., respectively, when the canopy was initially 10 in. tall. Plots were then allowed to mature and individual 90-ft^2 plots were combine harvested July 3, 2001.

RESULTS AND DISCUSSION

Wheat defoliation treatments caused similar grain yield losses to both white-seeded and red-seeded winter wheats. The 100% defoliation treatment at boot stage reduced grain production 48%; the 66% defoliation treatment reduced grain production 36%; and the 33% defoliation treatment reduced grain production 19% (Table 1).

The more severe defoliation levels caused a slight reduction in final plant height and delay of maturity. This also related to reduced grain test weight and reduced seed size. The white variety, Trego, responded in similar fashion to the red variety, TAM 107.

Table 1. Effects of boot stage simulated hail defoliation on white- and red-seeded wheat, Garden City, KS, 2001.

Defoliation Level	May Heading Date	Mature Height Inches	Grain Bu/a (% loss)	Grain Test Wt.	Grain g/1000 seeds
White Wheat - Trego					
100%	25	24	33.9 (47.1)	57.1	28.4
66%	20	25	41.9 (36.0)	57.8	29.5
33%	18	25	52.2 (17.8)	58.2	30.3
0	17	26	63.5	58.2	30.8
Red Wheat – TAM 107					
100%	23	25	32.6 (49.3)	55.8	29.5
66%	19	26	41.1 (36.1)	55.8	29.6
33%	16	26	50.9 (20.8)	57.6	30.2
0	15	27	64.3 —	57.7	30.8
L.S.D. 5%			7.7		
C.V. %			9.8		

WINTERKILLING STUDIES WITH WHITE- AND RED-SEEDED WHEAT

by
Merle Witt

SUMMARY

This research, sponsored by the National Crop Insurance Service, compared responses to winter stand decline for a white-seeded and a traditional red-seeded wheat to simulate winter stand losses under dryland conditions of southwest Kansas.

PROCEDURES

The white-seeded variety, Trego, and red-seeded variety, Tam 107, were established by fall seeding on October 5, 2000. Plots were seeded at 50 lb/a, and plots were replicated three times. Plots were 20 ft. in length, with 6 rows per plot and a 10-in. row spacing.

Stand reduction was accomplished in February 2001 using a hoe to manually eliminate portions of the stand such that remaining levels were 100%, 75%, 50%, and 25%. Plots (90 ft^2) were allowed to mature and were combine harvested July 3, 2001.

RESULTS AND DISCUSSION

Wheat stand loss treatments in the winter caused similar grain yield losses to both white- and red-seeded winter wheats. Relative to full stand check plots, the 75% stand reduction treatment reduced grain production 21%; the 50% stand reduction treatment reduced grain production 14%; and the 25% stand reduction treatment lowered grain production by nearly 7% (Table 1).

The most severe stand loss treatment caused a slight delay in maturity, which related to slightly lower seed weight and seed density. The white-seeded variety, Trego, responded in similar fashion as the red-seeded variety, TAM 107.

Table 1. Effects of winter stand removal on white- versus red-seeded wheat, Garden City, KS in 2001.

Winter Stand Loss	May Heading Date	Mature Height Inches	Grain		
			Bu/a (% loss)	Test Wt.	g/1000 seeds
White Wheat - Trego					
75%	19	27	46.8 (21.2)	59.2	29.9
50%	18	27	51.1 (14.0)	59.6	30.2
25%	18	29	55.4 (6.7)	59.2	30.5
0	18	30	59.4	60.3	31.1
Red Wheat – TAM 107					
75%	17	27	46.8 (20.5)	57.1	29.7
50%	16	27	50.3 (14.6)	57.5	30.9
25%	16	29	55.2 (6.3)	57.0	30.4
0	16	30	58.9	58.2	30.9
L.S.D. 5%			1.2		
C.V.%			1.3		

SOYBEAN PLANTING DATES AND MATURITY GROUPS ON DRYLAND

by
Merle Witt

SUMMARY

Kansas accounts for about 4% of the total U.S. soybean production, but the crop is becoming increasingly important to the state. Kansas soybean acreage has nearly doubled in the last 20 years and approached 3 million acres in 2000. Kansas now ranks 10th in production among states, with much of the acreage increase on dryland. Thus, dryland production practices are of increasing interest. This research assessed planting dates and maturity groups.[1]

PROCEDURES

Soybean of Maturity Groups II, III, and IV were planted on April 15, May 1, May 15, and June 1 during the years 2000 and 2001. Bordered, 50-ft long plots with 30-in. row spacing were replicated four times on a dryland production system.

RESULTS AND DISCUSSION

Best grain yields were produced with the longest Maturity Group of soybeans (MGIV). The highest yielding planting date was the earliest date (April15) in 2000, whereas in 2001, the highest yielding planting date was June 1.

The longer season length MG has consistently outperformed the shorter MG (II) in this and previous studies. It produced a taller canopy, which was more convenient to harvest. Yields from years 2000 and 2001 are shown in the following tables.

[1] This research was sponsored by the Kansas Soybean Commission

Table 1. Dryland soybeans – planting date by maturity group, 2000.

Date	# Days To Emerge	# Days To Bloom	Height (In.)	Grain Test Wt	Grain Bu/a	Grain g/1000 seeds
MGII (Turner)						
April 15	21	77	13	56.5	14.2	14.7
May 1	10	65	15	56.6	15.7	14.2
May 15	5	56	16	57.4	18.9	13.3
June 1	5	46	17	57.4	20.9	12.8
MG III (Macon)						
April 15	21	83	18	55.7	18.6	11.4
May 1	10	71	20	55.9	19.0	11.1
May 15	5	63	21	56.2	20.1	10.6
June 1	5	51	22	57.0	20.7	9.8
MG IV (KS4694)						
April 15	21	87	20	57.7	25.4	9.7
May 1	10	79	25	58.6	22.7	9.5
May 15	5	69	26	57.8	20.7	9.1
June 1	5	55	26	56.8	17.3	9.5
L.S.D. (5%) Dates		2.7	1.2	1.1	1.9	0.72
L.S.D. (5%) MG		2.7	1.2	1.1	1.9	0.72
L.S.D. (5%) Dates X MG		5.4	2.4	2.1	3.9	1.43

Table 2. Dryland soybeans – planting date by maturity group, 2001.

MGII (Turner)				Grain		
Date	# Days To Emerge	# Days To Bloom	Height (In.)	Test Wt	Bu/a	g/1000 seeds
April 15	22	55	19	57.8	16.4	10.9
May 1	14	45	22	58.8	20.2	9.8
May 15	5	45	23	58.5	22.8	10.8
June 1	5	35	25	58.9	25.4	11.3
MG III (Macon)				Grain		
Date	# Days To Emerge	# Days To Bloom	Height (In.)	Test Wt	Bu/a	g/1000 seeds
April 15	22	58	21	58.6	18.9	9.8
May 1	14	47	23	58.5	26.5	10.4
May 15	5	49	24	58.3	23.7	10.7
June 1	5	38	24	58.2	28.3	11.4
MG IV (KS4694)				Grain		
Date	# Days To Emerge	# Days To Bloom	Height (In.)	Test Wt	Bu/a	g/1000 seeds
April 15	22	61	24	59.0	21.1	10.6
May 1	14	50	27	58.2	27.3	11.3
May 15	5	52	27	59.1	25.2	11.2
June 1	5	41	28	56.6	27.0	13.3
L.S.D. (5%) Dates			2.2	0.6	4.1	0.9
L.S.D. (5%) MG			2.5	0.7	4.7	1.1
L.S.D. (5%) Dates X MG			4.4	1.3	8.2	1.8

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