This forty-third annual report of the research program at the Southeast South Dakota Research Farm has special significance for those engaged in agriculture and the agriculturally related businesses in the ten county area of Southeast South Dakota. The results shown are not necessarily complete or conclusive. Interpretations given are tentative because additional data resulting from continuation of these experiments may result in conclusions different from those based on any one year.

Trade names are used in this publication merely to provide specific information. A trade name quoted here does not constitute a guarantee or warranty and does not signify that the product is approved to the exclusion of other comparable products. Some herbicide treatments may be experimental and not labeled. Read and follow the entire label before using.

South Dakota Agricultural Experiment Station
Brookings, SD 57007

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**SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM**
**43rd ANNUAL PROGRESS REPORT**

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**INTRODUCTION ------------------------------------------------------------------------------ Robert K. Berg**

Welcome to our 43rd Annual Progress Report! This document highlights 27 crop and livestock research and demonstration reports from projects conducted at Southeast Research Farm in 2003. It is published by the South Dakota Agricultural Experiment Station and Cooperative Extension Service at South Dakota State University in cooperation with the Southeast South Dakota Experiment Farm Corporation.

Three of our staff received special recognition this year. Bruce Jurgensen, our Maintenance Mechanic, received his 25-year Career Service Award this spring and Bradley Rops and I both received our 10-year Service Awards. Larry Tidemann, Associate Dean and Director of our Cooperative Extension Service retired this fall. I would like to wish him the best and express appreciation for his many years of excellent service to our district and the entire state during his career at SDSU.

## Research Highlights

This year's swine research shows how to use a biofilter to dramatically reduce odors emitted from confinement barns and evaluates ways to use distillers grains in feeder pig rations. Our crop reports show results of the many weed control projects that were conducted here as well as variety trial results for alfalfa, oat, corn, and soybean (including Roundup Ready row crops). Several soil fertility research projects focused on strip/zone till, amending soils with gypsum, nutrient management associated with livestock manure, and other topics. Insects, soybean cyst nematodes, and other pests continue to challenge crop production in our region and work in several of these areas is presented.

Our tillage and crop rotation project continued and its indigenous soil nematode populations were characterized again this year. Several new cropping systems experiments were established to begin testing alternative crop rotation strategies and systematically evaluate Aerway® conservation tillage. Deep tillage trials were also started to see if crop production benefits when nutrients are placed within the soil profile along with deep tillage and to monitor the effects of adding organic residues to increase the storage of carbon in the soil profile. A wide range of row spacings for soybean was also tested.

## Weather and Climate Summary

Our climate for 2003 is summarized in tables and graphs beginning on page iv. Both annual and growing season precipitations were above normal this year. We received 27 inches of annual precipitation, which is 2 inches above our long-term average (108%). Our growing season precipitation measured from April through September was 23.4 inches (125% of normal, + 4.7 inches). Precipitation was normal or well above every month during the growing season (96 to 232%), except August (48%). Every dormant season month received below-normal precipitation (32 to 75%). Our annual snowfall was 38 inches and 60% of it arrived during the first half of the year.

The growing season was a little cooler than normal. We accumulated approximately 95% of our normal growing degree units this year. There was a 123-degree temperature range between our coldest and hottest air temperatures (-23 to +100ºF). The coldest low temperature of the year was -23°F on January 27 and lowest high was 4ºF on January 23. The warmest low temperature was 72°F on July 26 and the hottest high temperature recorded was 100°F on August 25. Average maximum monthly air temperatures were from

5°F below to 4°F above normal. The average minimum monthly air temperatures were 8°F below to 8°F above normal. Our frost-free season was 162 and 174 days on a 32°F and 28°F-basis, respectively. The average annual high temperature was 58°F (1°F below normal) and our average annual low temperature was 36°F (1°F above normal).

The year began cold and relatively dry with sporadic snow cover. Several storms left a lot of snow, but moisture content was low and with our mild temperatures they usually didn't last long. Soil profile moisture was a little low in some fields to start with, but precipitation the previous fall provided crops with adequate moisture for germination and early spring growth. Fieldwork began in early to mid April when small grains and early corn were planted. Conditions continued favorable for planting row crops and forages. Plentiful rainfall in June, July, and September resulted in average or better yields for some small grain and a lot of the corn in our area. Severe weather – including tornados, hail, and flooding - combined with heavy pressure from soybean aphid and other pests caused great damage and dramatically reduced yield of soybean and other crops in some areas. Fall weather was mild which allowed plenty of time to harvest row crops and finish fieldwork before winter. September was the wettest month of the year that helped recharge soil moisture levels for next year. We lost 6 to 8 inches of water as open pan evaporation during the growing season. Evaporation exceeded rainfall received by 3 or 4 inches per month from May through July and by 7 inches in August, but almost matched our rainfall in September.

Crop production ranged from well below average to excellent this season. Most corn yields averaged between 140 to 180 bu/ac. Oat yields of 60 to 100 bu/ac were observed. Spring wheat and soybean yields averaged 20 to 45 bu/ac. Established alfalfa produced 5 to 8 ton/ac of forage on a dry matter basis. Grasshopper, bean leaf beetle, first-generation corn borer, soybean cyst nematode, and bean pod mottle virus pressures were relatively light to moderate. Second-generation corn borer and western bean cutworm activity was commonly seen. Stem canker and charcoal rot were also identified on some of our soybean in addition to phytophthora and other diseases. Soybean aphids were first detected in a few of our fields in 2002. This year they were very widespread, often at extremely high populations – forcing many fields to be treated. Some crop and livestock markets recovered to relatively high prices, especially toward the end of the year.

A wealth of information can be readily accessed from South Dakota State University through the Internet (***http://www.abs.sdstate.edu***). Crop performance and variety trials, daily corn borer populations throughout the season, weather information for many of our research stations, marketing information, several years of our annual research progress reports, and much more are readily available (http://plantsci.sdstate.edu/southeastfarm/).

Please feel free to stop by and visit whenever you can. Let us know if you need additional copies of our report or if we can be of further assistance in any way. We can be reached by electronic mail, regular mail, or telephone at:

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**2003 LAND USE MAP**

**SOUTHEAST RESEARCH FARM**

**BERESFORD, SOUTH DAKOTA**

# 2003 CLIMATE SUMMARY
# SOUTHEAST RESEARCH FARM

| | | |
|---|---|---|
| Annual Precipitation (inch) | 26.95 | 108%* |
| Growing Season Precip (inch) | 23.45 | 125% |
| Jan-Mar | 1.91 | 69% |
| Apr-Jun | 11.12 | 112% |
| Jul-Sep | 12.33 | 141% |
| Oct-Dec | 1.60 | 45% |
| Snow (inch) | 38.7 | 22.7 / 12.0 |
| | | |
| Growing Degree Units (GDU) | 3,044 | 95% |
| Minimum / Maximum Temp | -23º F, Jan 27 | 100º F, Aug 25 |
| Last Spring Frost | 24º F, Apr 10 | 24º F, Apr 10 |
| First Fall Frost | 32º F, Sep 19 | 27º F, Oct 1 |
| Frost Free Period (days); 32º / 28º basis | 162 | 174 |
| Average Annual High & Low | 58 & 36º F | -1 & +1º F |

*% of normal

**Table 1.** Temperatures[a] at the Southeast Research Farm - 2003

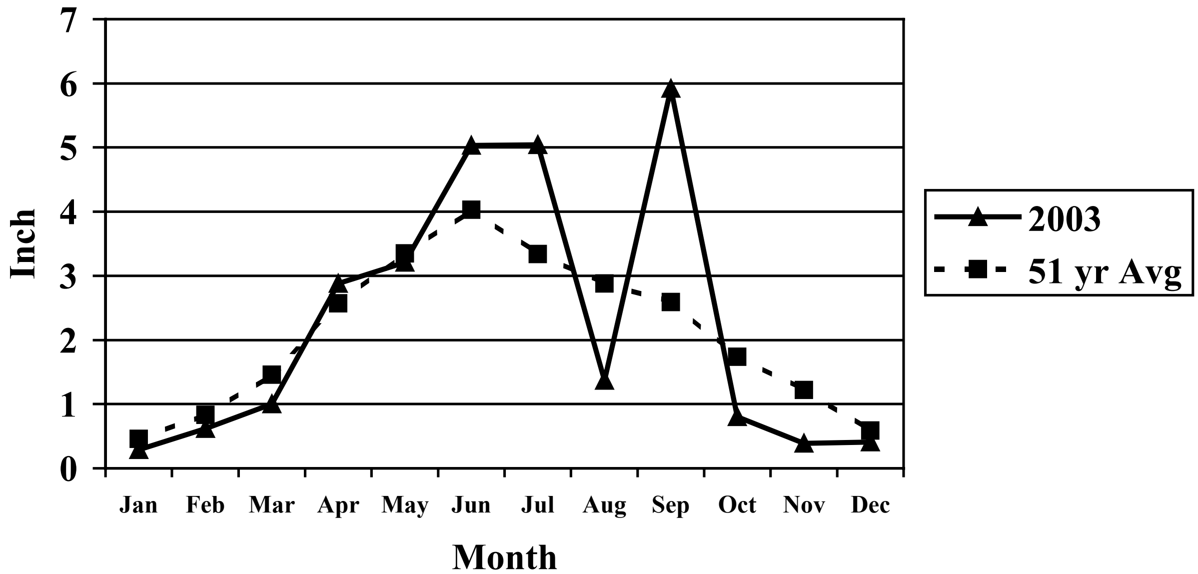
| | 2003 Average Air Temps. (°F) | | 51-year Average Air Temps. (°F) | | Departure from 51-year Average | |
|---|---|---|---|---|---|---|
| | Maximum | Minimum | Maximum | Minimum | Maximum | Minimum |
| January | 28.7 | 6.2 | 26.4 | 5.2 | +2.3 | +1.0 |
| February | 31.5 | 3.3 | 32.6 | 11.3 | -1.1 | -8.0 |
| March | 45.4 | 20.0 | 43.6 | 22.4 | +1.8 | -2.4 |
| April | 61.1 | 37.7 | 60.2 | 35.0 | +0.9 | +2.7 |
| May | 67.6 | 45.6 | 72.3 | 47.3 | -4.7 | -1.7 |
| June | 77.9 | 56.4 | 81.7 | 57.5 | -3.8 | -1.1 |
| July | 84.0 | 61.7 | 86.2 | 62.0 | -2.2 | -0.3 |
| August | 85.8 | 61.1 | 84.6 | 59.4 | +1.2 | +1.7 |
| September | 71.2 | 46.4 | 75.5 | 48.7 | -4.3 | -2.3 |
| October | 66.3 | 37.3 | 63.9 | 37.6 | +2.4 | -0.3 |
| November | 42.0 | 21.0 | 44.8 | 23.6 | -2.8 | -2.6 |
| December | 35.0 | 18.9 | 30.9 | 11.4 | +4.1 | +7.5 |

[a]Computed from daily observations

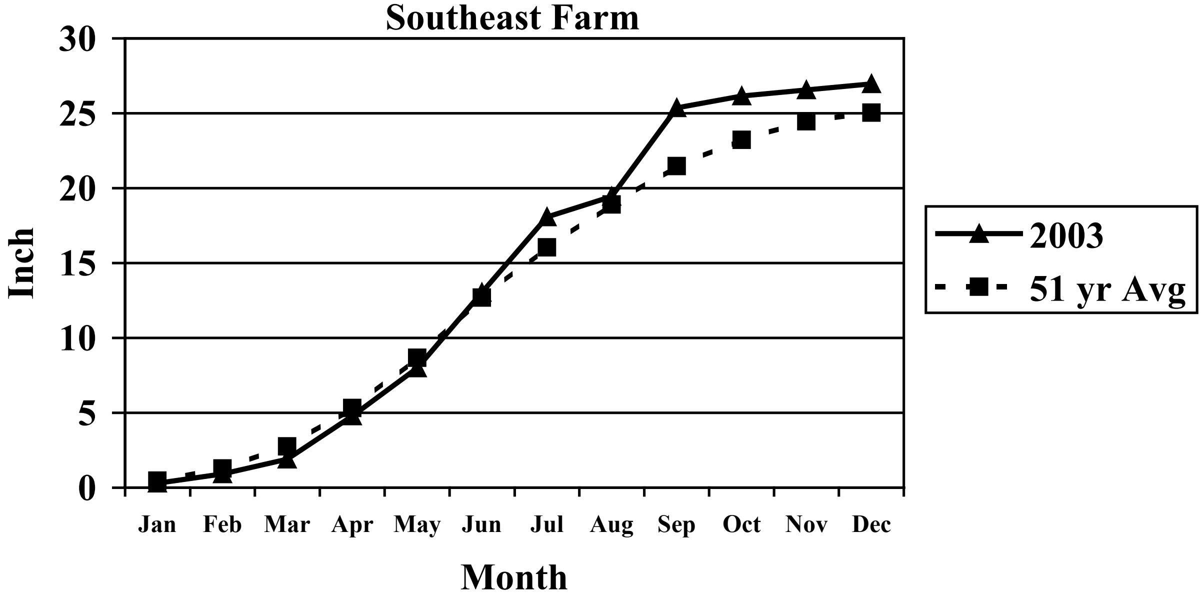
**Table 2.** Precipitation at the Southeast Research Farm - 2003

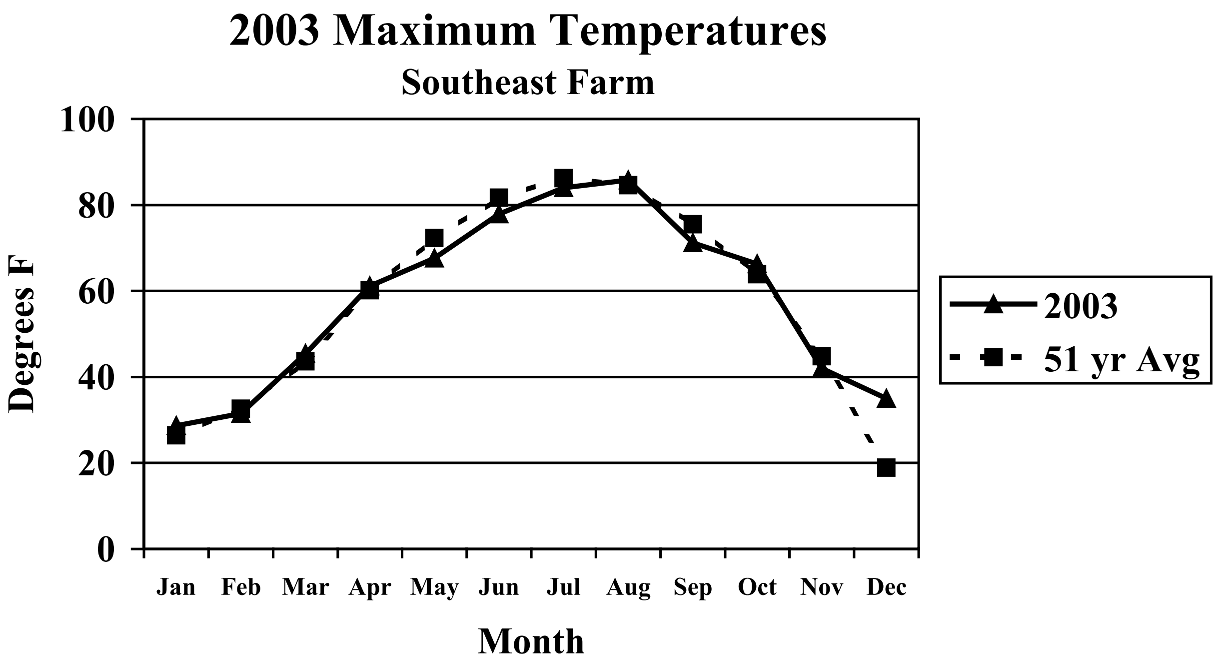
| Month | Precipitation 2003 (inches) | 51-year Average (inches) | Departure from Avg. (inches) |
|---|---|---|---|
| January | 0.29 | 0.46 | -0.17 |
| February | 0.62 | 0.83 | -0.21 |
| March | 1.00 | 1.46 | -0.46 |
| April | 2.88 | 2.57 | +0.31 |
| May | 3.21 | 3.35 | -0.14 |
| June | 5.03 | 4.03 | +1.00 |
| July | 5.04 | 3.34 | +1.70 |
| August | 1.37 | 2.88 | -1.51 |
| September | 5.92 | 2.55 | +3.37 |
| October | 0.80 | 1.76 | -0.96 |
| November | 0.39 | 1.23 | -0.84 |
| December | 0.41 | 0.59 | -0.18 |
| Totals | 26.96 | 25.05 | +1.91 |

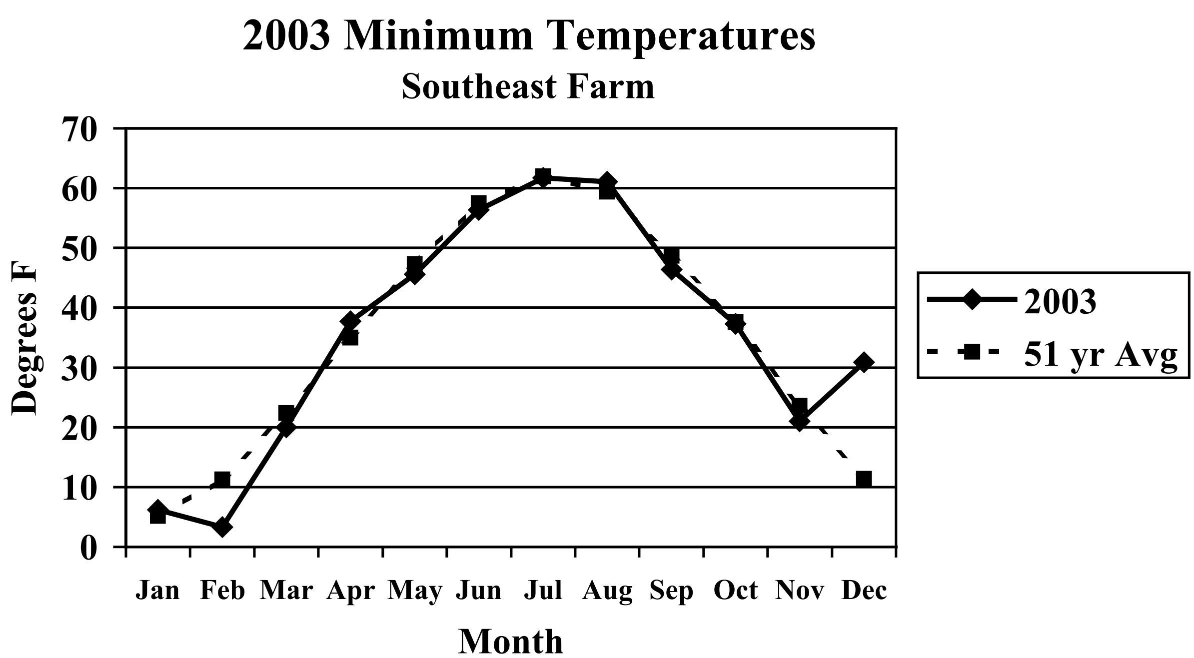
## 2003 Precipitation
### Southeast Farm

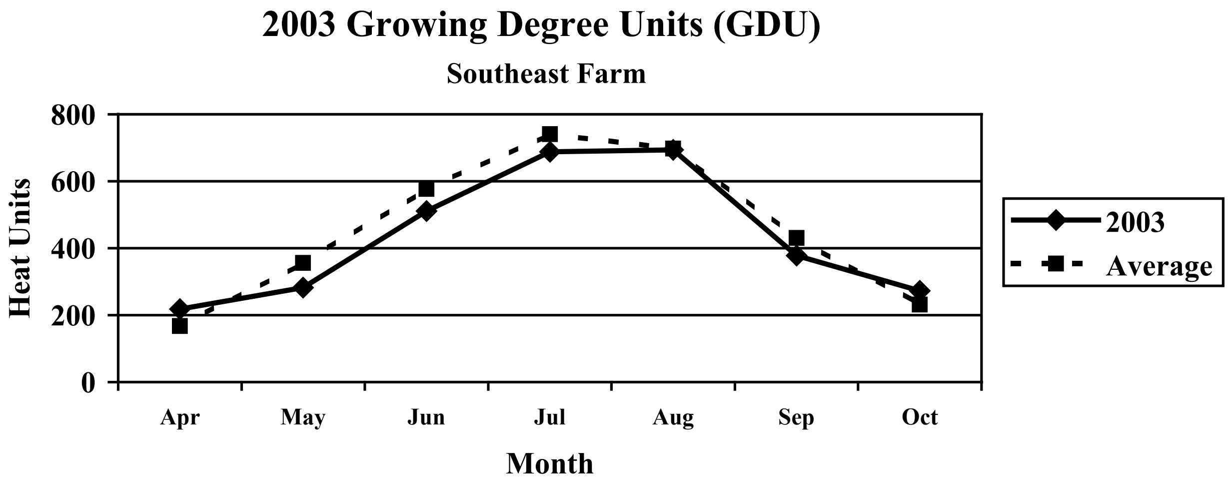


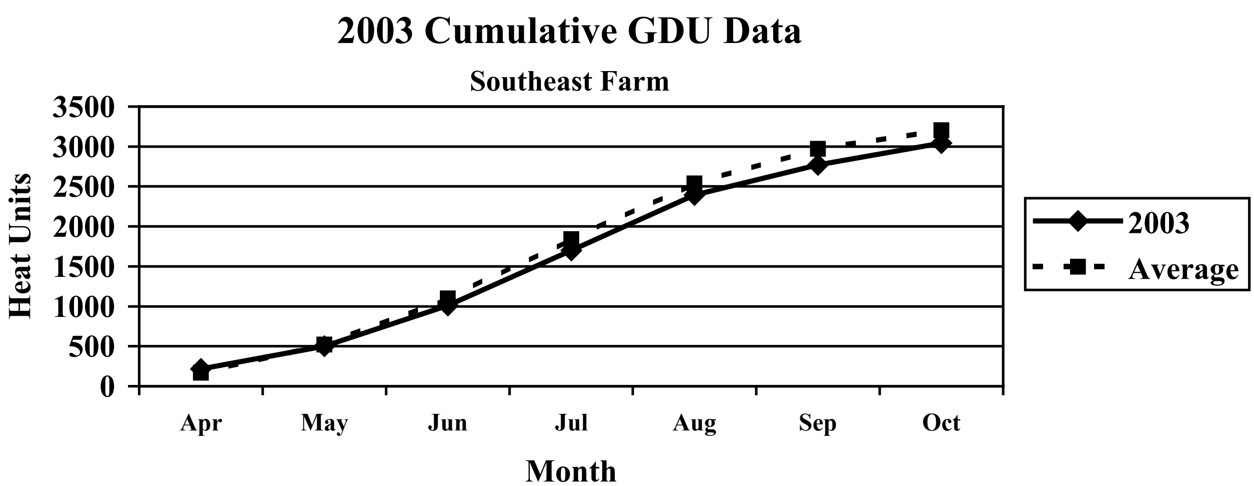

## 2003 Cumulative Precipitation
### Southeast Farm

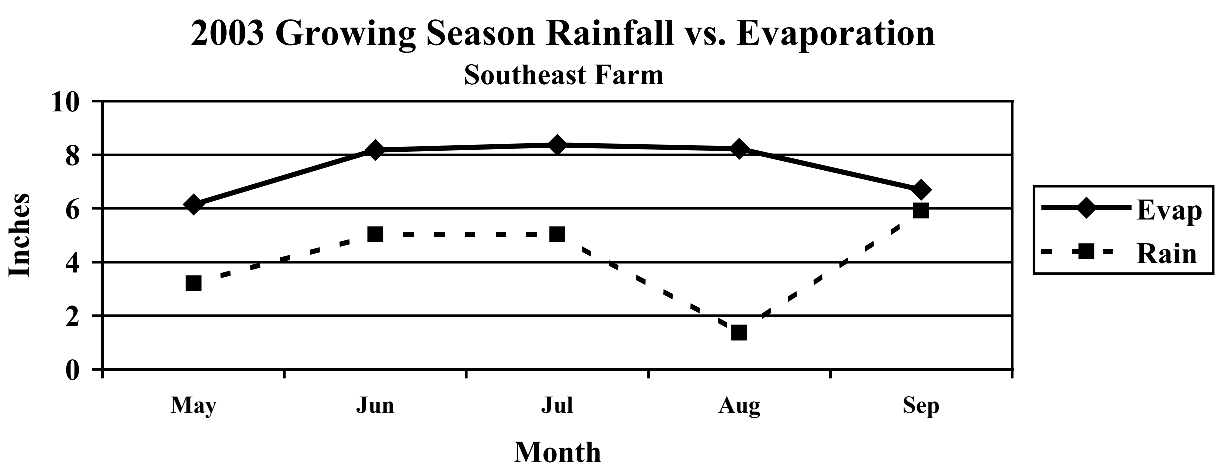



2003 Maximum Temperatures
Southeast Farm
100
80
60
40
20
0
Degrees F
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month
2003
51 yr Avg


2003 Minimum Temperatures
Southeast Farm
70
60
50
40
30
20
10
0
Degrees F
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month
2003
51 yr Avg


2003 Growing Degree Units (GDU)
Southeast Farm
Heat Units
800
600
400
200
0
Apr
May
Jun
Jul
Aug
Sep
Oct
Month
2003
Average


2003 Cumulative GDU Data
Southeast Farm
Heat Units
3500
3000
2500
2000
1500
1000
500
0
Apr
May
Jun
Jul
Aug
Sep
Oct
Month
2003
Average


2003 Growing Season Rainfall vs. Evaporation
Southeast Farm
Inches
10
8
6
4
2
0
May
Jun
Jul
Aug
Sep
Month
Evap
Rain

# TILLAGE AND CROP ROTATIONS FOR EASTERN SOUTH DAKOTA

R. Berg, R. Stevens, B. Jurgensen,
A. Wiebesiek, and G. Williamson

**Southeast Farm 0301**

## INTRODUCTION

A research project was established in 1990 to evaluate how crop rotations and tillage methods affect the long-term production and economics of cropping systems in southeast South Dakota. Results from six no-till and conventionally tilled systems tested in 2003 are summarized in this report. This year we began substituting an Aerway® tillage system in plance of the previous ridge-till system *(Aerway® Tillage System Comparison*, page 25). Soil nematode populations were also monitored for the third year (*Effect of Crop Rotation and Tillage on Nematode Populations*, page 13).

## METHODS

The overall project has seven cropping systems that compare no-till and conventional tillage in two-, three-, and four-crop rotations and measures how Aerway® tillage performs in a corn-soybean (C-S) rotation (Table 1).

**Table 1.** Cropping systems evaluated at Southeast Research Farm; Beresford, SD; 2003.

| System | Tillage | Crop Rotation |
|---|---|---|
| NT2 | No-Till | Corn-Soybean |
| AT2 | Aerway Tillage | (C-S) |
| CT2 | Conventional | (C-S) |
| NT3 | No-Till | Corn-Soybean-Wheat |
| CT3 | Conventional | (C-S-W) |
| NT4 | No-Till | Corn-Soybean-Wheat+Alfalfa |
| CT4 | Conventional | (C-S-W+A) |

Conventionally tilled wheat and soybean stubble were field cultivated once and corn stalks disked and field cultivated before planting. The CT row crops were cultivated once during the season. All corn stalks were chopped with a flail shredder after harvest; then CT corn, soybean, and wheat residues were disked and chiseled this fall.

Site-specific applications of liquid fertilizer were spring broadcast before planting and incorporated if tilled. Rates were based on soil test recommendations for individual plot yield goals of 50-bu/ac soybean and wheat, 160-bu/ac corn, and 5-ton/ac alfalfa (SDCES Fertilizer Recommendations Guide, EC 750).

All crops needing phosphorus received 10-34-0. Additional nitrogen for corn and wheat was broadcast separately as 28-0-0. Corn was also side dressed in early June by injecting liquid 28-0-0 between alternate rows.

Soil samples were collected after harvest this fall from every plot to help determine next year's fertilizer requirements and monitor soil nutrient levels. Apparent soil electrical conductivity data was collected again this year for the entire field using an EM meter and GPS receiver on April 2.

Spring wheat was drilled in 7.5-inch row widths with corn and soybean rows established on 30-inch centers. 'Forge' spring wheat was planted at approximately 1,292,000 seeds/ac (110 lb/ac) on April 15. DeKalb DKC58-24 corn was planted at about 30,000 seeds/ac on April 28 and Sands of Iowa SOI 226RR soybean at 166,400 seeds/ac on May 23. Pioneer 5454-N221 alfalfa was drilled without a nurse crop in 2001. Some NT alfalfa stands were erratic so a few spots were reseeded in 2002 and 2003.

Alfalfa was swathed on May 31, July 17, and August 28 then baled on June 12, July 24, and September 6. Three partially reseeded NT alfalfa plots were cut higher than normal at the first cutting and chopped but not baled at the second cutting. Windrows were raked before baling at the first two cuttings. Large round bales of sun-cured forage from entire plots were weighed then samples collected for quality laboratory analyses at every cutting from each plot that was baled.

Stand counts were measured for annual crops as well as mature plant height for wheat and soybean. Grain crops were harvested using a combine based on weigh wagon data from the middle of each plot. Wheat was straight cut without baling straw on July 31, soybean on October 2, and corn on October 17.

Whole farm performance is based on total harvested dry matter crop production. Grain yields reported for individual crops are adjusted to 15% moisture for corn, 13% for soybean, and 13.5% for wheat. Grain moisture content, test weight, and nutrient content (protein, oil, and/or starch) were determined. All crop nutrient levels are reported on a dry matter basis.

Gross revenue reflects posted hay auction (forage) or local elevator (grain) prices at harvest. Prices for 2003 are $1.78/bu for corn, $6.32/bu for soybean, $3.27/bu for wheat, and $50/ton for alfalfa. Partial economic returns are based on sun-cured large round bales and fresh weight grain yields by plot, less variable expenses for inputs (seed, fertilizer, pesticide), dockages (if any), and field operations (2000 Commercial Field Operation Rate Survey, SD Ag Statistics Service). Whole farm systems reflect one section (640 ac) of dryland crop enterprises with acreage equally divided among each crop.

These six cropping systems consist of 18 crop, tillage, and rotation combinations that are each replicated four times. All crops are raised in each system every year in 0.4-ac plots (60 ft x 300 ft). Statistical comparisons are based on analysis of variance with treatment means for whole farm systems and by crop in SAS (Statistical Analysis Software) with the General Linear Model as a split-plot design using Least Significant Differences (LSD) at the 90% probability level. Main plots are crop rotation with tillage method as subplots.

## RESULTS AND DISCUSSION

Crop production and market prices were generally good this year. Tillage and/or rotation influenced whole farm, soybean, and alfalfa but not corn or wheat performance this season. Corn and CT alfalfa yielded 115 and 120% of their respective yield goals. Soybean and wheat both yielded about 85% and NT alfalfa about 60% of their yield goals.

Market prices for grain crops at harvest were at (corn) or above (soybean and wheat) the USDA/FSA loan rates. Whole farm input costs averaged $79/ac across all systems (corn, $112/ac; soybean, $58/ac; wheat, $81/ac; and alfalfa, $22/ac). Whole farm field operation costs averaged $69/ac across all systems (corn, $64/ac; soybean, $56/ac; wheat, $54/ac; and alfalfa, $89/ac).

**Whole Farm**

Whole farm production and profitability varied this year depending on how their crops were rotated tilled. Total dry matter produced per system ranged from approximately 1,600 to 2,100 tons on a whole farm (640 acre) basis (Figure 1). Both tillage and rotation affected whole farm production, but these effects were not consistent among the systems.

More total production was harvested in two- and four-crop rotations than three-crop systems when they were conventionally tilled, but among NT rotations the two-crop systems were the most productive. An apparent whole farm advantage for CT vs. NT was observed, but only in the four-crop rotation.

All cropping systems generated a positive whole farm net economic return that ranged from $53,000 to 88,000 (Figure 2). Two-crop systems were the most profitable and generally had $25 to 50/ac more net economic return. Whole farm input costs were about $6/ac higher for NT systems which needed higher fertilizer N and averaged about $15/ac less for four-crop rotations because fewer inputs were needed for alfalfa. No-till systems also typically had $15 to 20/ac lower field operation costs than the CT systems. The net economic return averaged across all six systems was about $100/ac.

**By Crop**

Average dry matter yields were 6 ton/ac for corn and CT alfalfa, 3 ton/ac for NT alfalfa, and nearly 1.5 ton/ac for soybean and wheat (Figure 3). Soybean and alfalfa were the only crops whose yield was significantly affected by tillage and/or rotation in 2003.

All crops generated positive net economic returns, except wheat broke even in some systems (Figure 4). Soybean was the most profitable crop with a net economic return of $153/ac, followed by corn at $126/ac, then alfalfa at $86/ac, and wheat at - $3/ac.

**Soybean**

Averaged across all six systems, soybean yielded 44 bu/ac, with a range of 15 bu/ac between the highest and lowest yielding plots (Table 2). Plant population at harvest was 121,000 plants/ac and it was 36 inches tall with grain moisture content of 10% and 57.6 lb/bu test weight. Soybean generated $268/ac in gross income, input costs were $58/ac, field operation costs $56/ac, and net return was $153/ac.

Soybean yield was significantly affected by both tillage and rotation, but these effects were not consistent among the systems. No-till management dramatically increased soybean yield by 10 bu/ac, especially in the four-crop system. A similar but smaller trend was also observed in the three-crop, but not in the two-crop rotations. No-till soybean also produced 5 to 8 bu/ac more grain when raised in three- or four-crop rotations than in two-crop systems, but this rotation effect did not occur when soybean was conventionally tilled.

This yield response was not apparently directly related to plant height, because soybean plants were either similar in height or slightly taller in CT systems.

Net economic return was also greatly enhanced when soybean was not tilled and the systems contained more than two crops. Raising NT soybean was a lot more profitable in three- and four-crop rotations than in two-crop systems, and was consistently lower and more similar among rotations that were tilled.

**Alfalfa**

The NT alfalfa areas reseeded this spring appeared to be fully established by the middle of the growing season. Alfalfa yields in the NT system were 0.47 to 0.66 ton/ac at the first two cuttings, then increased three to four fold at the third cutting (Table 3). Each cutting of CT alfalfa yielded approximately 2 ton/ac and was actually a little less than NT alfalfa at the third cutting. For the season, perennial alfalfa in the CT system produced twice the amount of forage as the NT system (6 vs. 3 ton/ac).

The CT alfalfa generated $269/ac in gross income with expenses of $15/ac for inputs and $100/ac for field operations leaving a net return of $154/ac. The NT alfalfa generated $125/ac in gross income with expenses of $30/ac for inputs and $79/ac for field operations leaving a net return of $17/ac.

The well-established CT alfalfa was among the most profitable fields this year and was comparable to some of the NT soybean fields. No-till alfalfa was only a little better than growing wheat and dramatically reduced whole farm responses to both tillage and rotation. These responses reflect relative differences between alfalfa stands because this perennial crop was not actually tilled in either system this year. Tillage has played a major long-term role because a good CT seedbed in 2001 gave more successful stand establishment.

**Wheat**

Wheat yield averaged 41 bu/ac across the four systems with a range of 11 bu/ac between the highest and lowest yielding plots (Table 4). This crop produced 59 tillers/ft$^2$ at harvest and was 41 inches tall, with a grain moisture content of 11.3% and 58.2 lb/bu test weight. Spring wheat generated an average of $133/ac in gross income, had expenses of $81/ac for inputs and $54/ac for field operations, leaving a net return of - $3/ac. Tillage and rotation practices did not significantly impact yield or profitability of wheat. This crop barely generated enough revenue to recover most of the variable costs needed to produce it.

**Corn**

Corn yield averaged 184 bu/ac across all six systems with a range of 64 bu/ac between the highest and lowest yielding plots (Table 5). Plant population at harvest averaged 30,100 plants/ac with grain moisture content of 15.7% and 56.7 lb/bu test weight. Corn generated an average of $329/ac in gross income, had expenses of $112/ac for inputs and $84/ac for field operations, leaving a net return of $126/ac. Corn fields in these systems were the third most profitable crop in this study. Tillage and rotation practices did not significantly impact yield or profitability of corn.

**Crop Quality**

Crop nutrient compositions are summarized in Table 6. Soybean grain dry matter protein and oil concentrations were 39.5 and 17.6%, respectively. These are both approximately 1 to 3% below the recommended levels preferred for soybean processors and foreign export markets. The dry matter protein content for wheat was good at 16.9%. Laboratory results for corn are still pending at this time.

Forage quality was a little lower for the first cutting and slightly higher for the third cutting. Windrows received 1.24 inches of rain while the first cutting cured, compared to 0.3 inches for the second cutting, and none on the third cutting. Five inches of rain also fell on second-cutting bales, before they were moved from the field.

Forage moisture levels were 8.0% for the first cutting, 14.5% at the second cutting, and 18.5% at the third cutting. Crude protein was 15.0 to 18.5 %, crude fat averaged 0.6 to 1.3%, and non-fiber carbohydrate was 20 to 34%. Total digestible nutrients averaged 48 to 64%, relative feed values (RFV) were 86 to 149, and relative feed quality (RFQ) was 100 to 164. Corresponding alfalfa quality grades were low for the first cutting, good for the second harvest, and high good for the third cutting based on RFV - versus fair, low premium, and premium for corresponding RFQ values.

## SUMMARY

The C-S and C-S-W+A systems produced the most harvestable biomass as long as the alfalfa component performed well. No-till and CT produced similar levels of total crop within a given rotation, except for the four-crop rotation. Establishing alfalfa in a few spots was successful by the middle of the growing season, but contributed to lower performance in the NT4 system. As a result it failed to realize the full rotation benefit of a well-established perennial cool-season legume. This created an apparent advantage for CT in the four-crop rotation and caused total production of the NT4 system that was comparable to the lower producing three-crop systems.

Corn and CT alfalfa produced the greatest biomass. Biomass harvested from the NT2 and CT4 systems was 96 to 104% of what the CT2 (corn-soybean control) system produced. Cropping systems containing both wheat and soybean (NT3, CT3, and NT4) harvested about 80% as much crop as the CT2 system unless high yielding alfalfa was also grown (CT4). Half of the crops in the two- and four-crop systems are alfalfa and/or corn that yielded more than soybean and wheat and boosted production for these rotations.

All cropping systems generated positive whole farm net economic returns. Net economic return on a whole farm basis was highest for the two-crop systems. Rotations with more than two crops had 20 to 35% less net economic return than the CT2 control system.

Soybean and well established alfalfa were the most profitable crops followed by corn. Wheat and NT alfalfa were less profitable and barely recovered some of their variable expenses this year.

Soybean yield and net economic return benefited greatly from no-till management compared to conventional tillage in rotations having more than two crops. Raising soybean without tillage when rotations contained more than two crops was 30 to 50% more profitable than CT2 soybean. Net economic return for corn in these systems was within 5 to 10% of CT2 corn.

The net economic return ranked ($/ac basis) for individual crops within each system seem fell into three main groups this year. The most profitable group was NT soybean and CT alfalfa ($154 – 202/ac, range = $48/ac). The second most profitable group included all corn and the CT soybean systems ($114 – 136/ac, range = $22/ac). The least profitable group included all wheat systems and

NT alfalfa (- $10 to + $17/ac, range = $27/ac).

This research indicates that the way crops were tilled or rotated with other crops strongly influenced whole farm performance and that of the warm season legume crop (soybean), but not the performance of warm and cool season grass crops (corn and wheat) in a year with adequate moisture during most of the growing season.

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**ACKNOWLEDGEMENTS**

Laboratory analyses for soybean and wheat were provided by Kevin Kirby and Jesse Hall, Plant Science Department and alfalfa was analyzed by the Olson Biochemistry Laboratory, at South Dakota State University in Brookings, SD.

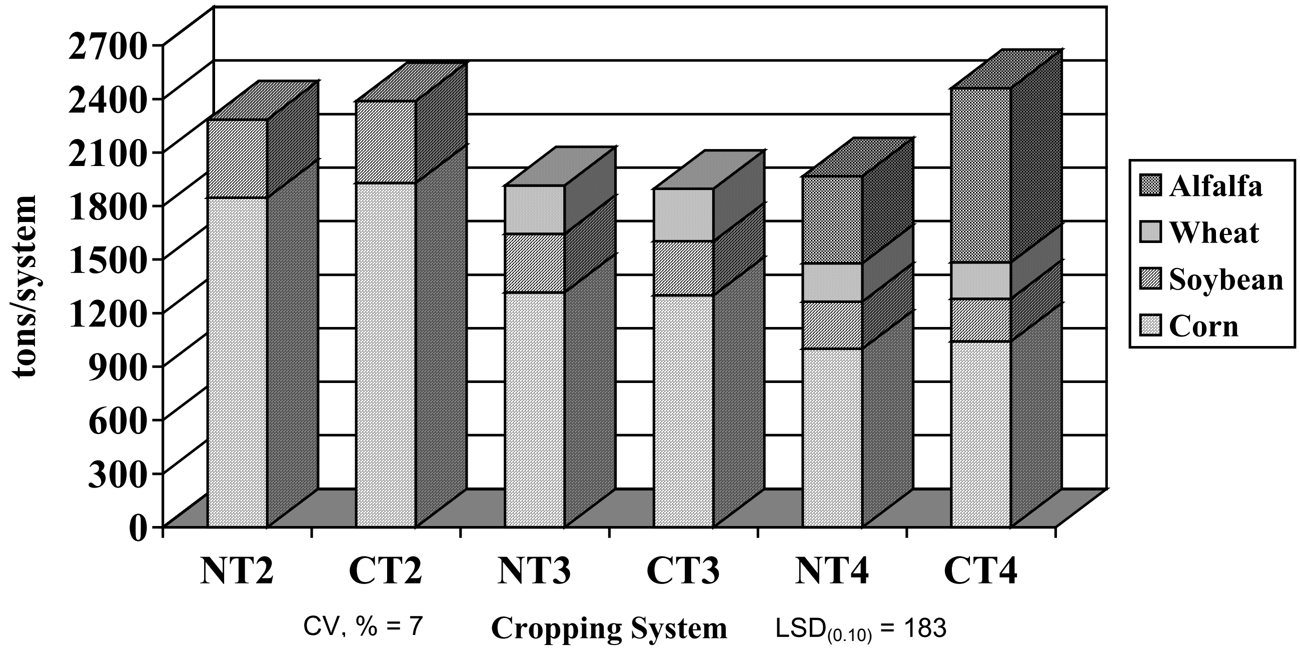


**Figure 1.** Total dry matter production for tillage cropping systems study. Southeast Research Farm; Beresford, SD; 2003.

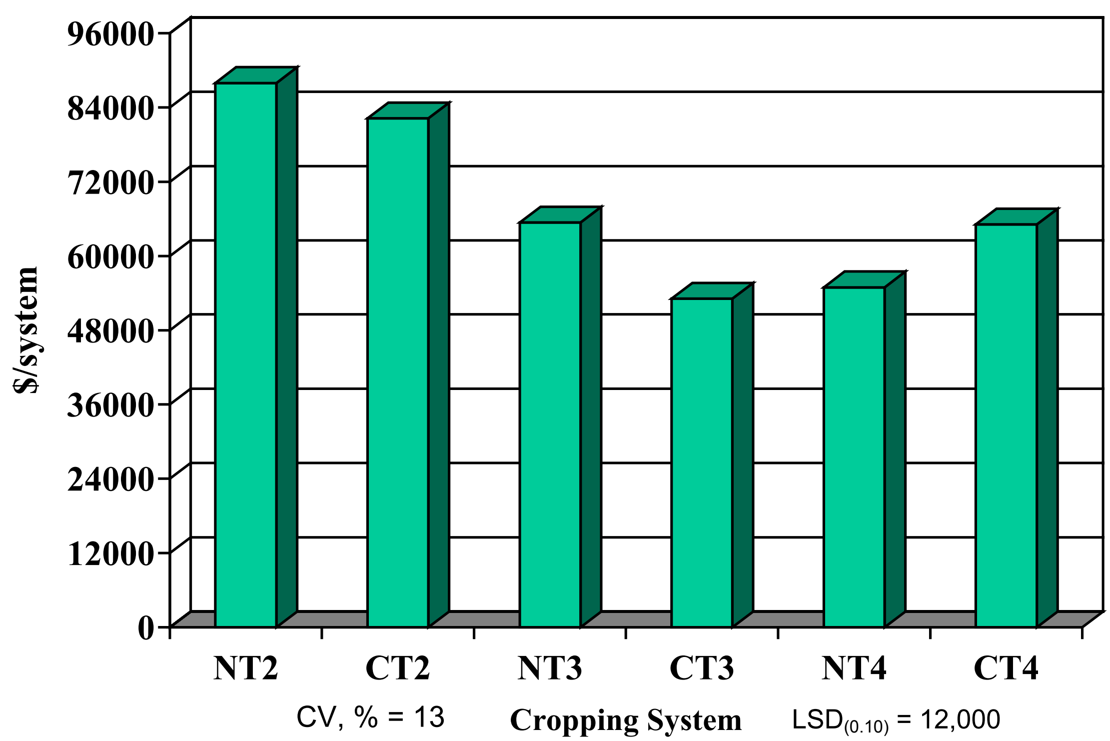


**Figure 2.** Whole farm net economic return for tillage cropping systems study. Southeast Research Farm; Beresford, SD; 2003.

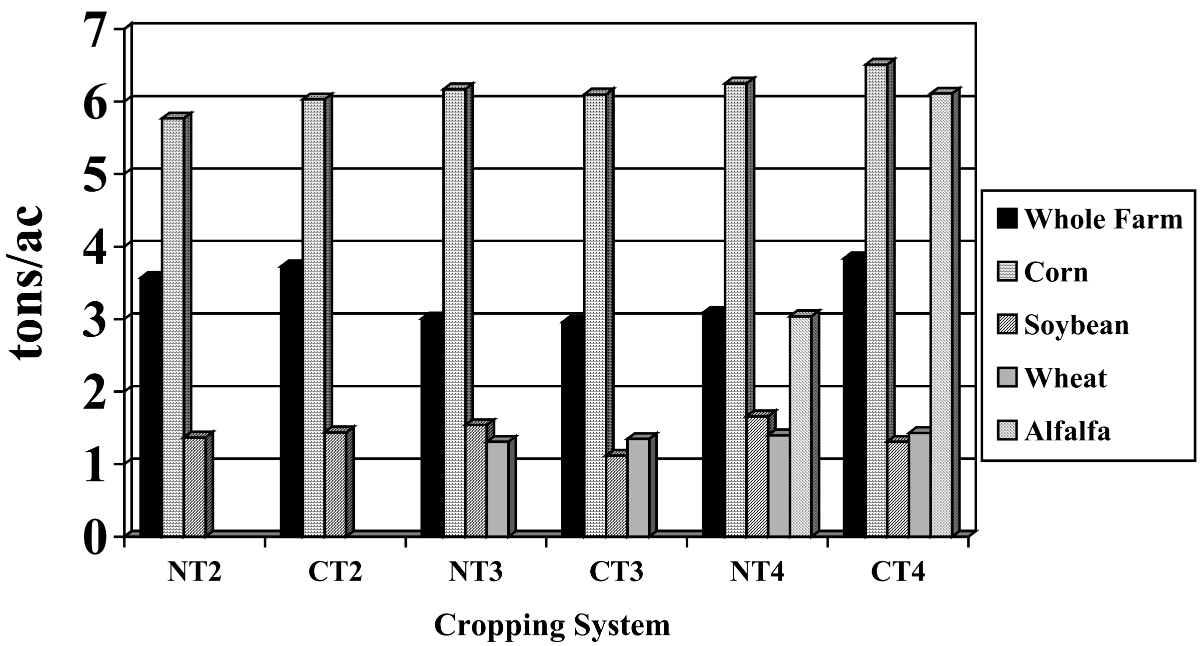


**Figure 3**. Dry matter yield by crop for tillage cropping systems study. Southeast Research Farm; Beresford, SD; 2003

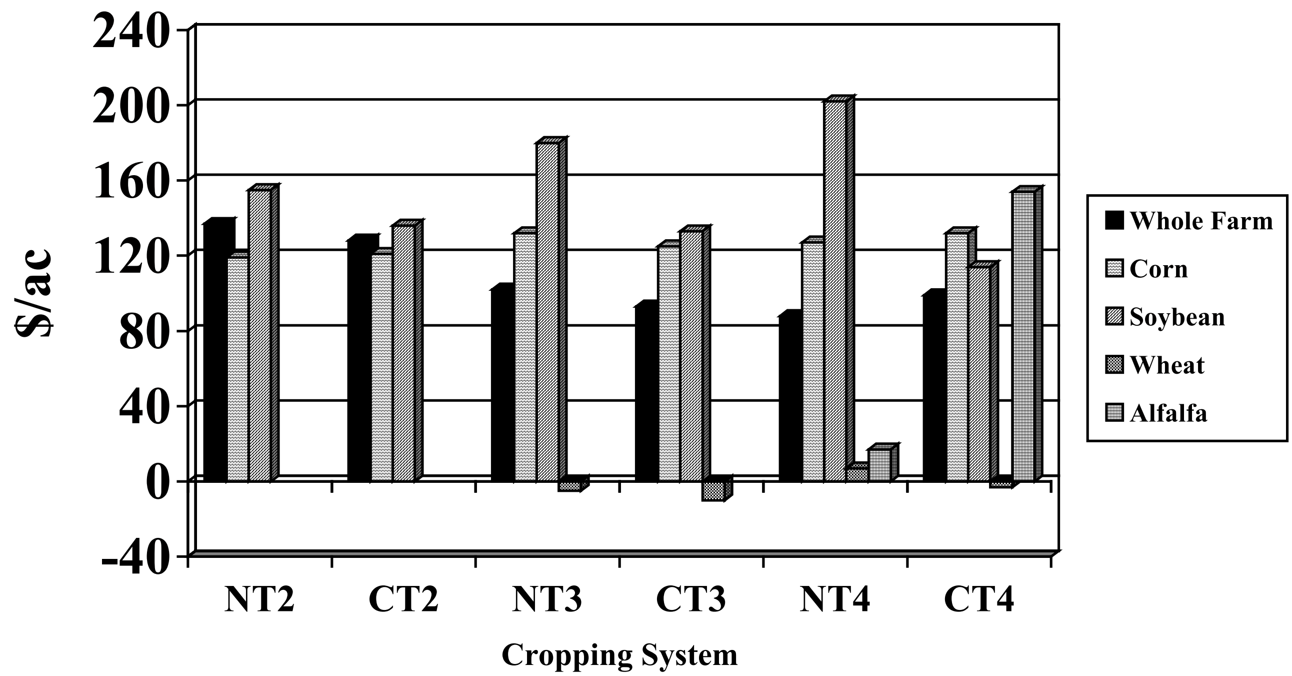


**Figure 4.** Net economic return by crop for tillage cropping systems study. Southeast Research Farm; Beresford, SD; 2003.

**Table 2**. Effect of rotation and tillage on soybean performance in tillage cropping systems study; Southeast Research Farm; Beresford, SD; 2003.

| Rotation | Tillage | Plant Height | Plant Population | Grain Yield[1] | Moisture | Test Weight | Gross Income | Net Economic Return | DM Protein | DM Oil |
|---|---|---|---|---|---|---|---|---|---|---|
| | | inch | plants/ac | bu/ac | % | lb/bu | ---------$/ac-------- | | % | % |
| | | | | | | | | | | |
| **C-S** | **NT** | 33.2 | 121,600 | 41 | 9.9 | 57.3 | 252 | 155 | 39.4 | 17.6 |
| | **CT** | 37.4 | 121,000 | 43 | 9.7 | 57.5 | 264 | 136 | 39.5 | 17.7 |
| | | | | | | | | | | |
| **C-S-W** | **NT** | 36.0 | 124,000 | 46 | 10.0 | 57.1 | 283 | 180 | 39.5 | 17.7 |
| | **CT** | 36.7 | 119,200 | 43 | 9.8 | 57.8 | 261 | 133 | 39.7 | 17.7 |
| | | | | | | | | | | |
| **C-S-W+A** | **NT** | 34.8 | 126,500 | 49 | 10.4 | 57.0 | 304 | 202 | 39.0 | 17.6 |
| | **CT** | 35.3 | 116,100 | 39 | 10.0 | 57.5 | 242 | 114 | 39.9 | 17.2 |
| | | | | | | | | | | |
| **Pooled** | **Avg.** | 35.6 | 121,400 | 44 | 10.0 | 57.3 | 268 | 153 | 39.5 | 17.6 |
| | | | | | | | | | | |
| **LSD $_{(0.10)}$** | | 1.8 | NS[2] | 4 | NS | NS | 24 | 25 | NS | 0.2 |
| **CV,%** | | 4 | 9 | 7 | 3 | 0.5 | 7 | 12.0 | 1.2 | 1.0 |

[1] Grain yield at 13% moisture and 60-lb/bu test weight.
[2] NS = not significant

**Table 3.** Effect of tillage on alfalfa[1] performance; tillage cropping systems study.
Southeast Research Farm; Beresford, SD; 2003.

| Rotation | Tillage | 1st cut | 2nd cut | 3rd cut | Total | Gross Income | Net Economic Return |
|---|---|---|---|---|---|---|---|
| | | ---------------------------ton/ac | | | -------------------- | $/ac | $/ac |
| | | | | | | | |
| **C-S-W+A** | **NT** | 0.66 | 0.47 | 1.94 | 3.04 | 125 | 17 |
| | **CT** | 2.31 | 2.13 | 1.67 | 6.11 | 267 | 154 |
| | **Avg.** | 1.49 | 1.30 | 1.81 | 4.58 | 197 | 86 |
| | | | | | | | |
| **LSD$_{(0.10)}$** | | 0.74 | ---- | 0.30 | 1.68 | 70 | 8.1 |
| **CV, %** | | | | | 22 | 21 | 57 |

[1]Dry matter yield

**Table 4**. Effects of tillage and crop rotation on wheat performance in tillage cropping systems study.
Southeast Research Farm; Beresford, SD; 2003.

| Rotation | Tillage | Plant Height | Tiller Density | Grain Yield[1] | Moisture | Test Weight | Gross Income | Net Economic Return | DM Protein |
|---|---|---|---|---|---|---|---|---|---|
| | | inch | tillers/ft$^2$ | bu/ac | % | lb/bu | $/ac | $/ac | % |
| | | | | | | | | | |
| **C-S-W** | **NT** | 41.0 | 59 | 39 | 11.7 | 57.7 | 126 | -5 | 16.9 |
| | **CT** | 41.5 | 58 | 41 | 11.2 | 58.3 | 131 | -10 | 17.1 |
| | | | | | | | | | |
| **C-S-W+A** | **NT** | 40.9 | 60 | 42 | 11.5 | 58.5 | 136 | +7 | 16.6 |
| | **CT** | 39.9 | 58 | 43 | 10.9 | 58.6 | 138 | -3 | 16.9 |
| | | | | | | | | | |
| **Pooled** | **Avg.** | 40.8 | 59 | 41 | 11.3 | 58.2 | 133 | -3 | 16.9 |
| | | | | | | | | | |
| **LSD $_{(0.10)}$** | | NS[2] | NS | NS | NS | NS | NS | NS | NS |
| **CV,%** | | 4 | 14 | 8 | 2 | 1.4 | 8 | 568 | 1.6 |

[1] Grain yield at 13.5% moisture and 60-lb/bu test weight [2] NS = not significant

**Table 5**. Effect of tillage and crop rotation on corn performance in tillage cropping systems study. Southeast Research Farm; Beresford, SD; 2003.

| Rotation | Tillage | Plant Population | Grain Yield[1] | Moisture | Test Weight | Gross Income | Net Economic Return |
|---|---|---|---|---|---|---|---|
| | | plants/ac | bu/ac | % | lb/bu | $/ac | $/ac |
| | | | | | | | |
| **C-S** | **NT** | 32,100 | 175 | 15.0 | 56.5 | 312 | 116 |
| | **CT** | 29,500 | 183 | 14.9 | 56.8 | 326 | 121 |
| | | | | | | | |
| **C-S-W** | **NT** | 29,800 | 185 | 15.7 | 57.1 | 331 | 132 |
| | **CT** | 29,800 | 183 | 15.5 | 57.0 | 327 | 125 |
| | | | | | | | |
| **C-S-W+A** | **NT** | 29,300 | 184 | 16.5 | 56.4 | 332 | 127 |
| | **CT** | 30,400 | 192 | 16.3 | 56.4 | 346 | 132 |
| | | | | | | | |
| **Pooled** | **Avg.** | 30,146 | 184 | 15.7 | 56.7 | 329 | 126 |
| | | | | | | | |
| **LSD $_{(0.10)}$** | | NS[2] | NS | NS | NS | NS | NS |
| **CV,%** | | 6 | 10 | 1.7 | 0.8 | 10 | 24 |

[1] Grain yield at 15% moisture and 56-lb/bu test weight.
[2] NS = not significant

**Table 6.** Crop quality for tillage cropping systems study (dry matter basis); Southeast Research Farm; Beresford, SD; 2003.

| Crop | | Protein | Oil | Starch | | | |
|---|---|---|---|---|---|---|---|
| | | % | % | % | | | |
| | | | | | | | |
| **Soybean** | **Avg** | 39.5 | 17.6 | --- | | | |
| | **Range** | 2.3 | 1.4 | --- | | | |
| | **Std. Dev.** | 0.6 | 0.3 | --- | | | |
| | | | | | | | |
| **Wheat** | **Avg** | 16.9 | --- | --- | | | |
| | **Range** | 1.2 | --- | --- | | | |
| | **Std. Dev.** | 0.3 | --- | --- | | | |
| | | | | | | | |
| **Alfalfa** | | **Crude Protein** | **Crude Fat** | **Non Fiber Carbo-hydrate** | **Total Digestible Nutrients** | **Relative Feed Value** | **Relative Feed Quality** |
| | | % | % | % | % | | |
| | | | | | | | |
| **1st cut** | **Avg** | 15.0 | 0.6 | 19.6 | 48 | 86 | 100 |
| | **Range** | 5.1 | 0.7 | 3.3 | 9 | 25 | 45 |
| | **Std. Dev.** | 1.9 | 0.2 | 1.1 | 3 | 9 | 15 |
| | | | | | | | |
| **2nd cut** | **Avg** | 15.6 | 1.0 | 33.6 | 62 | 139 | 153 |
| | **Range** | 1.1 | 0.2 | 3.1 | 3 | 16 | 22 |
| | **Std. Dev.** | 0.5 | 0.1 | 1.3 | 1 | 7 | 9 |
| | | | | | | | |
| **3rd cut** | **Avg** | 18.5 | 1.3 | 30.9 | 64 | 149 | 164 |
| | **Range** | 4.3 | 0.6 | 5.3 | 4 | 34 | 43 |
| | **Std. Dev.** | 1.5 | 0.2 | 1.9 | 2 | 13 | 16 |

Dry matter contents: 94.8% for soybean, 28 observations; 87.9% for wheat, 16 observations; 92.0% for 1st cut alfalfa, 8 observations; 85.5% for 2nd cut alfalfa, 5 observations; 81.5 for 3rd cut alfalfa, 8 observations; (corn lab data pending)

SE FARM REPORT
SDSU

# EFFECT OF CROP ROTATION AND TILLAGE ON NEMATODE POPULATIONS

J. D. Smolik

**Plant Science 0302**

For the third consecutive year, soil samples were collected in the fall from all crops in replications one and three. Nematodes were extracted from soil by the Christie-Perry method, identified, and counted. The first six taxa listed in Table 1 include the plant parasites, the next taxonomic grouping (dorylaims) are primarily predaceous, and the last group (microbial feeders) are associated with decaying organic material. The latter two taxa are generally considered to be beneficial. The predaceous nematodes aid in regulating populations of other soil animals including plant parasitic nematodes, and the microbial feeders aid in the breakdown of crop residue and the recycling of nutrients.

Crop rotation appeared to influence spiral nematode populations, and numbers were higher on corn or soybean than on spring wheat or alfalfa (Table 1). Pin nematode populations were generally higher in the four-crop rotations, and over the past three years have been highest in the CT4 rotation. Dagger nematode populations were again higher in the rotations that included alfalfa. Dagger nematode populations in excess of 100 per 100 cm3 soil cause significant plant injury, and it is likely that several of the crops in the various rotations were damaged by this nematode. Lesion nematode numbers were very low in all rotations. Crop rotation had no consistent effect on the dorylaims, but populations of microbial feeders were generally higher on soybean than corn (Table1).

Tillage had little consistent effect on plant feeding nematodes, however, populations of microbial feeders were highest in the conventionally tilled rotations. Higher numbers in the CT systems were noted in previous years, and over the past three years the average number of microbial feeding nematodes was 71% higher in the CT systems compared to NT. The incorporation of crop residues in the CT systems would increase the food supply for the microbial feeders, resulting in higher populations. These higher numbers would also aid in recycling crop nutrients. Conversely, less crop residue incorporated in the NT systems would reduce the food supply for the microbial feeders resulting in lower populations. The lower numbers may slow nutrient cycling, which could lead to increased fertilizer requirements in those systems.

**Table 1.** Fall nematode populations October 9, 2003

| | | Nematode Taxa, number/100 $cm^3$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Rotation[a] | Crop | Stunt | Spiral | Pin | Tylenchinae | Dagger | Lesion | Dorylaims | Microbial feeders |
| NT 2 | Corn | 0[b] | 676 | 32 | 16 | 16 | 0 | 110 | 168 |
| | Soybean | 16 | 375 | 200 | 101 | 100 | 16 | 235 | 1015 |
| AT 2 | Corn | 0 | 690 | 140 | 0 | 140 | 0 | 130 | 200 |
| | Soybean | 0 | 775 | 85 | 65 | 60 | 35 | 142 | 1035 |
| CT 2 | Corn | 0 | 390 | 75 | 65 | 160 | 0 | 135 | 385 |
| | Soybean | 0 | 450 | 92 | 75 | 0 | 42 | 150 | 2065 |
| NT 3 | Corn | 85 | 175 | 200 | 8 | 0 | 0 | 16 | 185 |
| | Soybean | 0 | 1116 | 110 | 16 | 142 | 0 | 60 | 475 |
| | Sp. Wht | 0 | 110 | 62 | 0 | 0 | 0 | 100 | 210 |
| CT 3 | Corn | 0 | 68 | 68 | 50 | 100 | 0 | 190 | 525 |
| | Soybean | 0 | 285 | 65 | 50 | 0 | 16 | 16 | 1815 |
| | Sp. Wht | 0 | 32 | 82 | 0 | 0 | 0 | 110 | 525 |
| NT 4 | Corn | 0 | 860 | 242 | 16 | 67 | 0 | 290 | 385 |
| | Soybean | 35 | 416 | 635 | 65 | 0 | 16 | 135 | 300 |
| | Sp. Wht | 0 | 0 | 535 | 0 | 390 | 0 | 250 | 960 |
| | Alfalfa | 0 | 0 | 35 | 16 | 16 | 0 | 150 | 900 |
| CT 4 | Corn | 0 | 1125 | 165 | 16 | 16 | 0 | 0 | 435 |
| | Soybean | 0 | 825 | 490 | 87 | 75 | 16 | 200 | 1725 |
| | Sp. Wht | 0 | 16 | 850 | 100 | 192 | 0 | 115 | 685 |
| | Alfalfa | 0 | 16 | 3266 | 0 | 725 | 0 | 185 | 142 |

[a]/ NT = No-till, AT = Ridge-till, CT = Conventional tillage
[b]/ Average of two replications October 9, 2003

SE FARM REPORT
SDSU

# ALTERNATIVE CROPPING SYSTEMS

R. Berg, R. Stevens, B. Jurgensen,
G. Williamson, and A. Wiebesiek

**Southeast Farm 0303**

## INTRODUCTION

Some people feel that crop yields in our area seem to have reached a plateau in recent years. This may be caused by greater pest pressure, climatic factors, market fluctuations, and other causes.

Diversifying rotations to include more crops or changing the intervals between crop types may help prevent or reduce problems with various pests. Profitably using small grains in rotations is challenging, but they may be able to help us prevent or better manage pest problems in our area. Demand for corn is increasing to supply ethanol for our nation's energy needs. As a result it is important to look at the impact of growing corn more often than we have in the past. Crop quality is also becoming increasingly important to those who process and consume our all of our crops.

A new field trial was established this year to evaluate the long-term performance of eight alternative cropping systems. Various combinations of four warm and cool season grass and legume crops (corn, soybean, wheat, and alfalfa) are evaluated in this study. Our goal is to see what effect changing cropping patterns from a traditional corn-soybean rotation has on whole-farm production, crop quality, and profitability for farmers in eastern South Dakota.

A modified corn-soybean rotation simply looks at adding another year of corn to the system. A three-crop "stacked" rotation plants each crop for two years in a row. This may reduce pest problems and provide other opportunities by not returning to the same crop for four consecutive years. Another system is designed to document whether soybean performs better when grown after a small grain than it does following corn. Monocultures of each crop are also tested.

It will take six years just for the stacked rotation to complete one cycle – so we need to continue this project at least through the 2008 cropping season. This also allows two or three cycles for the other cropping systems that use more than one crop. Preliminary results from the first year are outlined in this report.

## METHODS

Eight cropping systems were established using 12 treatments in a 30-acre field of soybean stubble in the spring of 2003 as outlined in Table 1. All crops were no-till planted (without spring tillage). Alfalfa was established without a nurse crop.

Liquid fertilizer as 10-34-0 and 28-0-0 was used in this study. All crops received a broadcast application of phosphorus before planting as well as nitrogen for wheat. Corn received popup with the seed at planting then was side dressed in early June.

**Table 1.** Alternative cropping systems research study; Southeast Research Farm; Beresford, SD; 2003 to 2008.

| Cropping System | Six-year Sequence * |
|---|---|
| Corn - Soybean | **C** – S – C – S – C - S |
| | **S** – C – S – C – S - C |
| Wheat - Soybean | **S** – W – S – W – S - W |
| | **W** – S – W – S – W - S |
| Modified Corn - Soybean | **C** – C – S – C – C - S |
| Stacked | **C** – C – S – S – W - W |
| | **S** – S – W – W – C - C |
| | **W** – W – C – C – S - S |
| Continuous Corn | **C** – C – C – C – C - C |
| Continuous Soybean | **S** – S – S – S – S - S |
| Continuous Wheat | **W** – W – W – W – W - W |
| Continuous Alfalfa | **A1** – A2 – A3 – A4 – A5 – A6 |

*Bold underlined letters indicate crops measured during the 2003 growing season for each system.

Glyphosate was applied post emerge one time on corn and two times on soybean. It was also used two times after wheat harvest to control volunteer and late season weeds. Alfalfa was sprayed once with Pounce to control potato leafhoppers.

Plant population was measured for each grain crop as well as plant height for wheat and soybean. Yield was measured at maturity by harvesting grain from the center 20 ft of plot for soybean and wheat and 30 ft for corn with a Case-IH 2144 combine and weighing it with a weigh wagon. Test weight and moisture content were recorded using a grain subsample from each plot the day it was harvested. Two cuttings of alfalfa were swathed, then sun-cured and put up in large round bales. Windrows were raked before baling in July and yield at each cutting was measured from the entire plot.

This fall soil samples were collected from every plot; corn stalks were shredded, and all corn, soybean, and wheat plots were Aerway tilled.

Crop quality was tested in the laboratory for each plot after harvest and is expressed on a dry matter basis. Representative grain samples were analyzed for protein (wheat, soybean, and corn), oil (soybean and corn), and/or starch (corn) by NIR analysis. Alfalfa forage quality was also measured from bales sampled after every cutting.

Whole-farm productivity is expressed as tons of dry matter harvested using a farm size of 640 acres per system. Grain yields by crop are standardized to uniform moisture contents of 13.5% for wheat, 13% for soybean, and 15% for corn.

A partial economic return was calculated on a fresh weight basis using local market prices at harvest of \$3.27/bu for wheat, \$6.51/bu for soybean, \$1.78/bu for corn, and \$50/ton for alfalfa. Net economic return represents partial net income after subtracting a few variable costs for inputs like seed, fertilizer, and herbicide; dockages, if any; and field operation costs (2000 Commercial Field Operation Rate Survey, SD Ag Statistics Service). Aerway tillage was charged at \$10/ac.

Each treatment was replicated four times in a split-plot design with crop rotation as the main plot and individual crops within each system as subplots. Plot dimensions are 60-ft wide by 310-ft long (0.42 ac). Additional management information is summarized in Table 2.

**Table 2**. Management information for alternative crop rotation trial (year 1). Southeast Research Farm; Beresford, SD; 2003.

| | **Soybean** | **Wheat** | **Alfalfa** | **Corn** |
|---|---|---|---|---|
| Variety/Hybrid | Sands of Iowa SOI226 | 'Forge' | Garst 6420 | DeKalb DKC58-24 |
| Traits | Roundup Ready | Spring | | Roundup Ready / Yield Guard Corn Borer |
| Planting Date | May 23 | April 29 | May 8 | May 7 |
| Seeding Rate | 166,400 seeds/ac | 110 lb/ac | 17 lb/ac | 33,000 seeds/ac |
| Fertilizer ($N\text{-}P_20_5\text{-}K_20$, lb/ac) | 14-50-0 | 89-50-0 | 14-50-0 | 117-50-0 + 9-32-0 popup with seed |
| Harvest Date | October 2 | August 12 | July 17, August 24 | October 20 |
| Market Price @ Harvest | \$6.51/bu | \$3.27/bu | \$50/ton | \$1.78/bu |

## RESULTS AND DISCUSSION

This first year's results simply reflect how each crop performed when planted into 2002 soybean stubble. It primarily gives benchmark information about the variability among these crops while our treatments are being established. It is still too early to confidently make very meaningful comparisons among these systems – so caution is needed when interpreting these preliminary results.

In general, production was good for corn and alfalfa, average or a little better for soybean, and below average for wheat this year. Input costs were \$118/ac for corn, \$92/ac for alfalfa, and \$70 to 71/ac for soybean and wheat. Field operation costs were \$78/ac for corn and alfalfa, \$67/ac for wheat, and \$50/ac for soybean.

## Whole Farm

Whole farm (640 acre) total dry matter production for the eight systems tested ranged from a low of 500 tons for the continuous wheat rotation to 3,000 tons when corn was the only crop raised (modified C-S and continuous corn rotations) as shown in Figure 1. The stacked rotation produced nearly as much crop (90%) as the corn-soybean rotation and the first year alfalfa produced a little more tonnage (120%). Cropping systems comprised of wheat and/or soybean without corn produced the least amount of total crop (500 – 800 tons) - about a third as much crop as the C-S rotation.

Six of the eight cropping systems generated a positive whole farm net economic return that ranged from + $15,000 to 75,000 (Figure 2). Variable costs exceeded gross income for first year alfalfa and continuous wheat by approximately - $15,000 and - $35,000, respectively.

## By Crop

Crops with the largest dry matter yields were corn (4.5-5.5 ton/ac) and alfalfa (3.5 ton/ac) as shown in Figure 3. Soybean yielded a little more and wheat a little less than one ton of dry matter grain per acre.

Soybean and corn were the only crops that generated positive net economic returns (Figure 4). The soybean component of these cropping systems produced around $120 to 140/ac of net economic return and corn from $50 to 100/ac. First year alfalfa lost - $25/ac and wheat lost between - $50 to 75/ac.

## Soybean

Soybean yield averaged 40 bu/ac with a range of 12 bu/ac between the highest and lowest yielding plots (Table 3). Plant population at harvest averaged 122,000 plants/ac and was 35 inches tall with grain moisture content of 9.3% and 57.6 lb/bu test weight. Soybean generated $251/ac in gross income, with net return after field operation costs of $130/ac (range = $77/ac).

## Wheat

Wheat yield averaged 22 bu/ac with a range of 14 bu/ac between the highest and lowest yielding plots (Table 4). It was beginning to lodge a little just before harvest, but not enough to cause problems. This crop had 60 tillers/ft$^2$ at harvest and was 34 inches tall, with grain moisture content of 15.9% and 51.2-lb/bu test weight. Spring wheat generated an average of $76/ac in gross income was barely enough to recover the cost of inputs. As a result the net return after field operations averaged - $67/ac.

Wheat yield in this study was lower and moisture content measured wetter than some of our other wheat fields this year even though the same variety was planted in each field. This mainly reflects differences in planting dates and weed control. Wheat in this new rotation trial was planted about two weeks later than our other wheat fields. Very few if any early season weeds were observed because of the residual activity of the previous years herbicide - so a post emerge herbicide was not applied to wheat in this field.

## Corn

Corn yield averaged 148 bu/ac with a range of 78 bu/ac between the lowest and highest yielding plots (Table 5). Plant population at harvest averaged 32,000 plants/ac. Grain at harvest had a moisture content of 14.1% and test weight of 56.2 lb/bu. Gross income averaged $262/ac, with a net economic return after field operations of $66/ac.

**Alfalfa**

Alfalfa yielded a total of 3.5 ton/ac dry matter forage from the July and August cuttings (Table 6) with a range of 1.4 ton/ac between the highest and lowest yielding plots. The July cutting yield averaged 1.5 ton/ac and the August cutting averaged 2.0 ton/ac. Gross income was $144/ac, with net economic return of $25/ac after subtracting field operation costs. The first cutting received 0.3 inches of precipitation while curing in the windrow, then 5 inches of rain right after it was baled. The second cutting windrows cured without receiving precipitation.

Good stands of perennial alfalfa were established. We plan to maintain this stand and harvest approximately three cuttings per season in future years without rotating to other crops.

**Crop Quality**

Crop nutrient compositions are summarized in Table 7. Soybean grain dry matter protein and oil concentrations were 38.8 and 18.3%, respectively. These are both approximately 2 to 3% below the recommended levels preferred for soybean processors and foreign export. The dry matter protein content for wheat was good at 16.9%. Laboratory results for corn are not available yet at this time.

Forage quality was slightly higher for the July than the August cutting. Moisture content for the first cutting was 21.2% and 14.4% at the second cutting. Crude protein content was 17.9% for the first cutting and 16.9% at the second harvest. Crude fat content averaged 1.7 and 1.4% and non-fiber carbohydrate contents were 31 and 28%. Total digestible nutrients averaged 63 and 60%, relative feed values (RFV) averaged 145 and 129, and relative feed quality (RFQ) averaged 161 and 147. Quality grades for alfalfa were high good for the July harvest and low good in August based on RFV versus premium and low premium based on corresponding RFQ values.

**SUMMARY**

Things generally went well in terms of establishing eight new cropping systems in 2003. Six of these rotations (75%) generated positive whole farm net economic returns. Soybean and corn were the most profitable crops this year. The two systems that had negative whole farm net economic returns were first-year perennial alfalfa and a monoculture of wheat.

**ACKNOWLEDGEMENTS:** This project was partially funded by the South Dakota Soybean Research and Promotion Council and the South Dakota Wheat Commission. Laboratory analyses for soybean and wheat were provided by Kevin Kirby and Jesse Hall, Plant Science Department and alfalfa was analyzed by the Olson Biochemistry Laboratory, at South Dakota State University in Brookings SD

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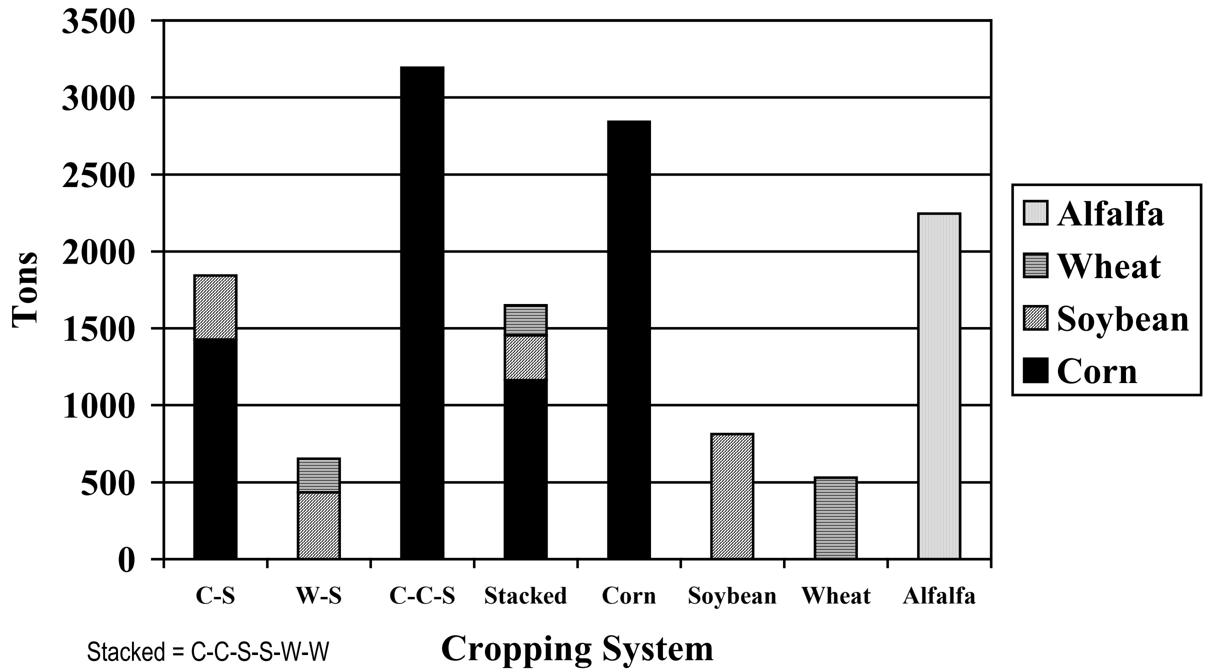


**Figure 1.** First year whole farm dry matter crop production for alternative cropping system study. Southeast Research Farm; Beresford, SD; 2003.

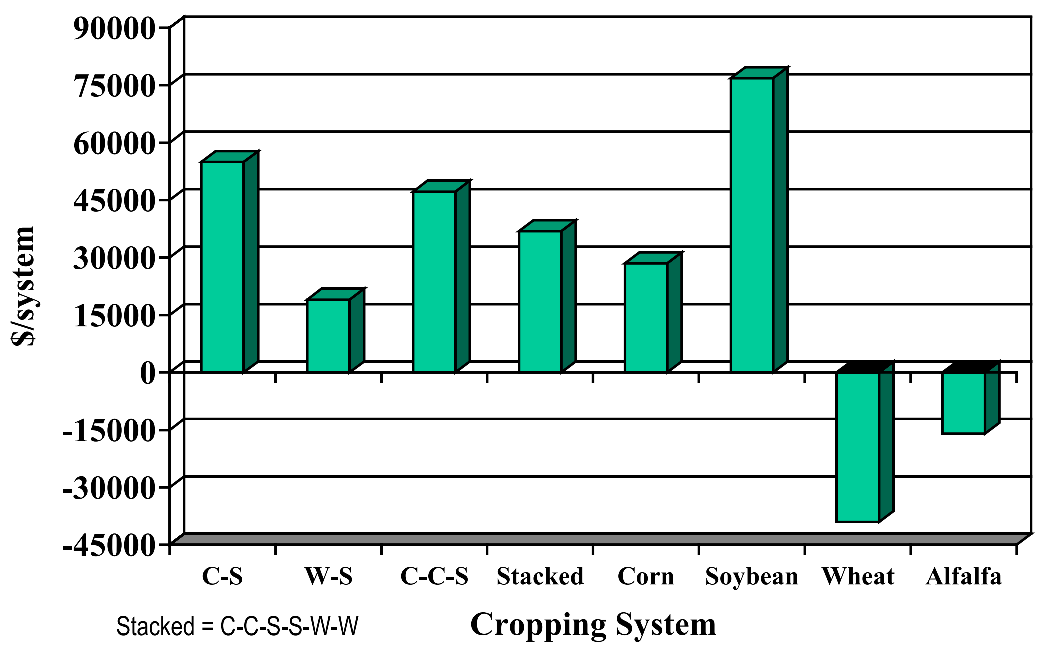


**Figure 2**. First year whole farm net economic return for alternative crop rotation system study. Southeast Research Farm; Beresford, SD; 2003

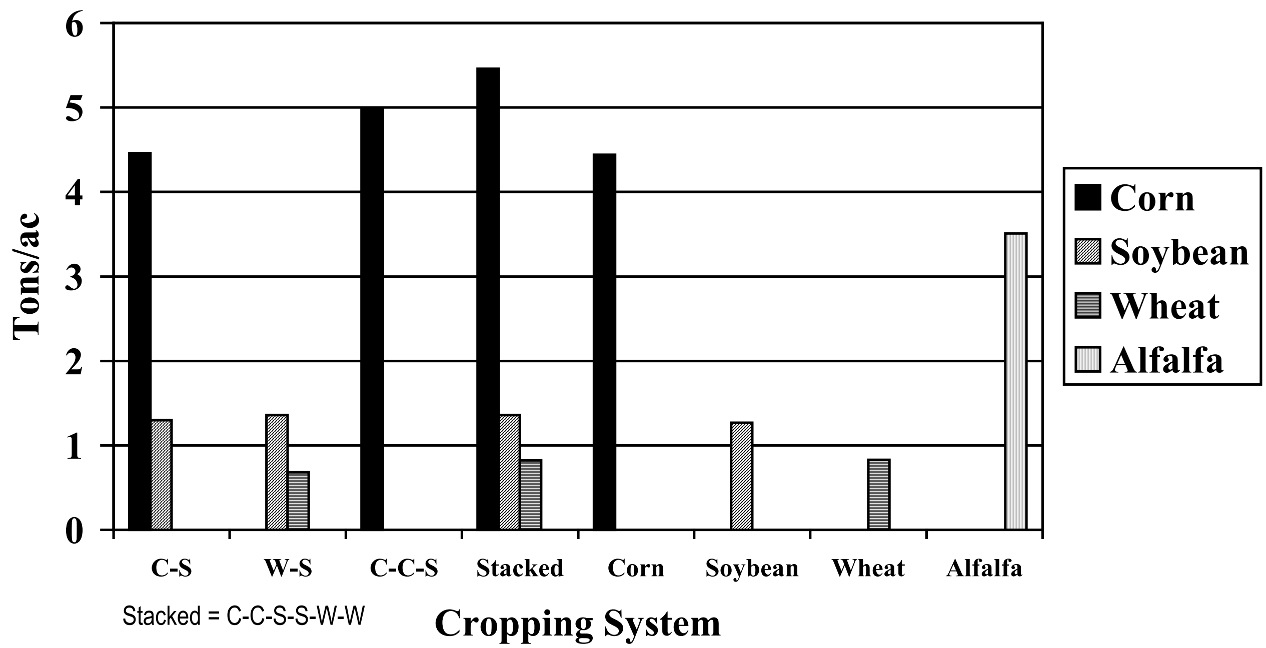


**Figure 3.** First year dry matter production by crop for alternative cropping systems. Southeast Research Farm; Beresford, SD; 2003

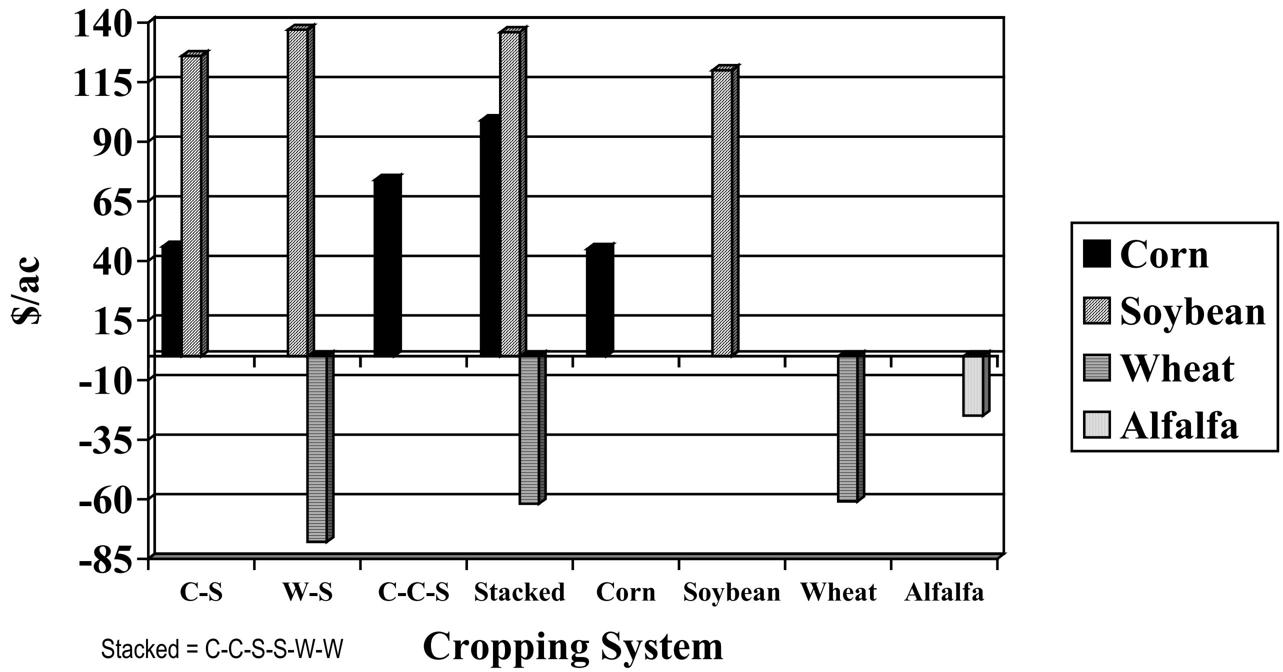


**Figure 4.** First year net economic return by crop for alternative cropping systems study. Southeast Research Farm; Beresford, SD; 2003.

**Table 3**. First year soybean performance in alternative cropping systems study; Southeast Research Farm; Beresford, SD; 2003.

| Rotation | Plant Height | Plant Population | Grain Yield [1] | Moisture | Test Weight | Gross Income | Net Economic Return |
|---|---|---|---|---|---|---|---|
| | inch | plants/ac | bu/ac | % | lb/bu | $/ac | $/ac |
| | | | | | | | |
| **Corn - Soybean** | 34.9 | 125,900 | 39 | 9.4 | 57.7 | 247 | 126 |
| **Soybean - Wheat** | 34.8 | 117,900 | 41 | 9.3 | 57.7 | 258 | 137 |
| **Stacked [2]** | 35.3 | 118,600 | 41 | 9.3 | 57.7 | 257 | 136 |
| **Continuous Soybean** | 34.5 | 119,200 | 38 | 9.2 | 57.4 | 241 | 120 |
| | | | | | | | |
| **Avg** | 35.0 | 122,200 | 40 | 9.3 | 57.6 | 251 | 130 |
| **Range** | 5.3 | 19,500 | 12 | 0.8 | 1.4 | 77 | 77 |
| **Std. dev.** | 1.4 | 6,300 | 3.2 | 0.2 | 0.4 | 20 | 20 |

Previous crop (2002) = soybean; Count = 16 observations
[1] At 13% moisture and 60 lb/bu
**[2]**Stacked = Corn–Corn–Soybean–Soybean–Wheat-Wheat

**Table 4.** First year wheat performance in alternative cropping systems study; Southeast Research Farm; Beresford, SD; 2003.

| Rotation | Plant Height | Tiller Density | Grain Yield | Moisture | Test Weight | Gross Income | Net Economic Return |
|---|---|---|---|---|---|---|---|
| | inch | tillers/ft$^2$ | bu/ac | % | lb/bu | $/ac | $/ac |
| | | | | | | | |
| **Soybean-Wheat** | 32.7 | 59 | 19 | 16.4 | 50.7 | 66 | - 78 |
| **Stacked [2]** | 33.8 | 59 | 23 | 15.7 | 51.5 | 81 | - 62 |
| **Continuous Wheat** | 35.2 | 60 | 23 | 15.7 | 51.4 | 82 | - 61 |
| | | | | | | | |
| **Avg** | 33.9 | 60 | 22.1 | 15.9 | 51.2 | 76 | - 67 |
| **Range** | 11.5 | 22 | 13.6 | 15.9 | 3.9 | 45 | 48 |
| **Std. dev.** | 3.5 | 7 | 4.4 | 0.8 | 1.2 | 15 | 16 |

Previous Crop (2002) = Soybean; Count = 12 observations
[1] At 13.5% moisture and 60 lb/bu
[2] Stacked = Corn-Corn-Soybean-Soybean-Wheat-Wheat

**Table 5**. First year corn performance in alternative cropping systems study; Southeast Research Farm; Beresford, SD; 2003.

| Rotation | Plant Population | Grain Yield [1] | Moisture | Test Weight | Gross Income | Net Economic Return |
|---|---|---|---|---|---|---|
| | plants/ac | bu/ac | % | lb/bu | $/ac | $/ac |
| | | | | | | |
| **Corn-Soybean** | 32,000 | 137 | 13.7 | 56.1 | 241 | 46 |
| **Corn-Corn-Soybean** | 31,800 | 153 | 14.3 | 56.3 | 270 | 74 |
| **Stacked [2]** | 32,100 | 167 | 14.2 | 56.7 | 295 | 99 |
| **Continuous Corn** | 33,100 | 136 | 14.2 | 55.7 | 240 | 45 |
| | | | | | | |
| **Avg** | 32,200 | 148 | 14.1 | 56.2 | 262 | 66 |
| **Range** | 3,800 | 78 | 1.8 | 2.7 | 143 | 143 |
| **Std. dev.** | 897 | 25 | 0.6 | 0.7 | 45.6 | 45.6 |

Previous crop (2002) = soybean; Count = 16 observations
[1] At 15% moisture and 56 lb/bu
**[2]** Stacked = Corn-Corn-Soybean-Soybean-Wheat-Wheat

**Table 6**. First year alfalfa performance in alternative cropping systems study; Southeast Research Farm; Beresford, SD; 2003

| Rotation | Total DM Annual Production [1] | Average Moisture Content | Gross Income | Net Economic Return |
|---|---|---|---|---|
| | ton/ac | % | $/ac | $/ac |
| | | | | |
| **Continuous Alfalfa – Avg.** | 3.51 | 17.3 | 145 | - 25 |
| **Range** | 1.38 | 12.1 | 53 | 53 |
| **Std. Dev.** | 0.56 | 4.2 | 22 | 22 |

Previous crop (2002) = soybean; Count = 4 observations
[1] At 0% moisture (total of two cuttings)

**Table 7.** Crop quality for alternative cropping systems study (dry matter basis); Southeast Research Farm; Beresford, SD; 2003.

| Crop | | Protein | Oil | Starch | | | |
|---|---|---|---|---|---|---|---|
| | | % | % | % | | | |
| | | | | | | | |
| **Soybean** | **Avg** | 38.8 | 18.3 | --- | | | |
| | **Range** | 2.5 | 1.4 | --- | | | |
| | **Std. Dev.** | 0.8 | 0.4 | --- | | | |
| | | | | | | | |
| **Wheat** | **Avg** | 16.9 | --- | --- | | | |
| | **Range** | 0.8 | --- | --- | | | |
| | **Std. Dev.** | 0.2 | --- | --- | | | |
| | | | | | | | |
| **Alfalfa** | | **Crude Protein** | **Crude Fat** | **Non Fiber Carbo-hydrate** | **Total Digestible Nutrients** | **Relative Feed Value** | **Relative Feed Quality** |
| | | % | % | % | % | | |
| | | | | | | | |
| **1st cut** | **Avg** | 17.7 | 1.7 | 31.0 | 62.9 | 145 | 161 |
| | **Range** | 4.0 | 0.2 | 3.3 | 2.9 | 21 | 11 |
| | **Std. Dev.** | 2.0 | 0.1 | 1.7 | 1.5 | 11 | 6 |
| | | | | | | | |
| **2nd cut** | **Avg** | 16.9 | 1.4 | 27.9 | 60.2 | 129 | 147 |
| | **Range** | 2.4 | 0.4 | 3.1 | 4.1 | 25 | 18 |
| | **Std. Dev.** | 1.2 | 0.2 | 1.4 | 1.8 | 11 | 7 |

Dry matter contents: 94.8% for soybean, 87.8% for wheat, 78.8% for 1st cut alfalfa, 85.6% for 2nd cut alfalfa, (corn lab data not available)

# AERWAY® TILLAGE SYSTEM COMPARISON

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**Southeast Farm 0304**

## INTRODUCTION

Two trials were conducted here this year to begin evaluating the Aerway® conservation tillage system. In this study we replaced the previously tested modified ridge-till system with Aerway tillage in our long-term *Tillage and Crop Rotations for Eastern South Dakota* trial (page 1). The second trial started testing whether Aerway tillage is more effective in the spring or fall (*Aerway® Tillage Timing Study*, page 31).

This report shows how using an Aerway tillage implement beginning this spring compares to no-till and conventional tillage systems when three tillage methods and both crops are monitored at the same time. Preliminary results shown here are whole farm and each crop's agronomic and economic performance for corn-soybean (C-S) rotations in 2003.

## METHODS

This experiment uses 24 corn-soybean plots from our long-term Tillage and Crop Rotation project. This spring we started testing an Aerway conservation tillage implement on the two treatments previously designated for modified ridge--till. Our goal is to directly compare Aerway tillage with no-till and conventional tillage systems.

All corn stalks were chopped in the fall after the 2002 harvest. The conventional till (CT) corn stalks were disked and chisel plowed that fall and disked and field cultivated before planting this spring. Conventional soybean stubble was field cultivated before planting this spring, then disked and chiseled after harvest this fall. Both crops in the CT system were cultivated on June 17.

Corn and soybean were both Aerway tilled (AT) just before planting this spring and again after harvest this fall. Soil was not disturbed in the no-till (NT) system, except slightly during planting.

Liquid fertilizer was applied according to yield goals of 50 bu/ac for soybean and 160 bu/ac for corn based on soil test results collected from each plot last fall (2002). Site-specific rates for phosphorus were applied as 10-34-0 and averaged by treatment for nitrogen as 28-0-0. Phosphorus was broadcast where needed before planting for both crops as well as part of the N needed for NT and AT corn then incorporated with a field cultivator for the CT system. Nitrogen for CT corn application in early June.

Soybean in all systems received an early post application of Roundup to control weeds. Roundup Ready volunteer corn was later controlled with Prestige. The NT and CT soybean also received a late post application of Roundup. Corn received a single post emerge applications of Roundup (CT) or a tank mix of Roundup, Clarity, and Accent (NT and AT).

Seed was planted in north-south rows spaced 30 inches apart with a 5700 White six-row planter. Grain was harvested at maturity using a Case/IH 2144 combine with a 20-ft wide soybean head and a 15-ft wide corn head. Grain yield was determined by harvesting the middle eight rows of soybean and 12 rows of corn and measured with a weigh wagon.

Test weight and moisture content were recorded for a grain sample from each plot the day it was harvested. These samples were later sent for laboratory analysis to determine dry matter, protein, and oil concentrations for both crops plus starch concentration for corn. Grain yields were standardized to a uniform moisture content of 13% for soybean and 15% for corn. Plant population at harvest for both crops and plant height for soybean were also measured.

Net economic return was calculated using the local market price at harvest of $6.32/bu for soybean and the remaining NT and AT corn's nitrogen was injected as a side dress and $1.78/bu for corn on a fresh weight basis less some of the variable costs of inputs (seed, fertilizer, and herbicide) and commercially hired field operation costs. These rates were $5/ac for each broadcast application of herbicide or fertilizer and for field cultivating, $6/ac for disking and cultivating rows, $7.50/ac for side dressing N, $8/ac for chisel plowing, $20/ac for shredding stalks (2000 Commercial Field Operation Rate Survey, SD Ag Statistics Service), and $10/ac for Aerway tillage.

Plot size was 60 ft wide by approximately 300 ft long (0.42 ac/plot). Each treatment was replicated four times as a split-plot design with tillage as the main plot and crop as the subplot. Inferences are based on analysis of variance by crop using the General Linear Model in SAS (Statistical Analysis Software). Differences among treatment means were compared using Least Significant Difference (LSD) at the 90% probability level. Additional management information is summarized in Table 1.

## RESULTS AND DISCUSSION

Only minor differences in crop performance among tillage methods were detected this season. Crop responses were generally more dramatic than tillage effects and no major crop by tillage interactions were noted among the traits measured.

Volunteer corn kernels that germinated in this year's soybean were more uniformly distributed with Aerway tillage instead of remaining clumped as in the NT and CT systems.

**Whole Farm**

Total whole farm dry matter harvested was about 2,300 ton per system and it was 81% corn (Figure 1). Total net economic return was nearly $82,000 per system with 56% generated by soybean (Figure 2). These three C-S rotations produced an average gross income of $288/ac. Input costs were $86/ac with field operation expenses of $72/ac, leaving a net economic return of $129/ac (data not shown).

**By Crop**

Soybean yield averaged 42 bu/ac and net economic return was $143/ac (Table 2). Aerway and conventionally tilled soybean were 3 to 4 inches (11%) taller than NT, but did not produce any better yield. Gross income for soybean averaged $255/ac with input costs of $55/ac and field operation charges of $57/ac.

Corn yield averaged 180 bu/ac with a net economic return of $114/ac (Table 3). Aerway and NT systems had about 2,000 more corn plants per acre than when conventionally tilled. Gross income for corn averaged $320/ac with input costs of $117/ac and $88/ac in field operation charges.

Input costs were similar among tillage systems for soybean. These expenses for NT and AT corn were about $10 to 20/ac more than CT at least partly because reduced tillage systems typically have higher fertilizer N recommended. The NT system had $15 to 25/ac lower field operation charges than the AT or CT systems associated with these crops.

**SUMMARY**

This preliminary study detected only minor benefits associated with spring Aerway tillage for one year compared to no-till or conventional tillage on a whole-farm basis or in either crop for C-S rotations. Soybean produced with AT and CT were 11% taller than NT and corn populations were 7% greater with AT and NT than CT. Neither of these improved whole farm yield or profitability of these cropping systems or either crop.

On a whole farm basis these systems produced an average of 3.5 ton/ac of dry matter grain with a net economic return of $129/ac. Corn produced four times more grain and had $65/ac more gross income than soybean, but soybean was nearly $30/ac more profitable.

Claims that this method of conservation tillage performs better than no-till and conventional tillage are not confirmed yet during the early establishment phase of this experiment. These results indicate that corn and soybean production and profitability were comparable to the

other tillage systems when Aerway tilling both crops for the first time in the spring at our location. We plan to continue this project to see if future benefits can be measured.

**Table 1.** Management summary for Aerway® tillage C-S rotation study (3-2). Southeast Research Farm, Beresford, SD; 2003.

| 2003 Crop | Soybean | Corn |
|---|---|---|
| **Variety/Hybrid** | SOI 226 RR | DKC58-24 |
| **Seeding Rate** | 166,400 (seeds/ac) | 32,000 seeds/ac |
| **Planting Date** | May 23 | April 28 |
| **Fertilizer [1]**<br>**NT avg (st dev)** | 2-6-0 (2-7-0) | 155-63-0 (5-21-0) |
| **AT** | 6-23-0 (6-20-0) | 160-80-0 (4-13-0) |
| **CT** | 5-19-0 (4-14-0) | 112-80-0 (4-13-0) |
| **Tillage: NT** | None | None |
| **AT** | May 23 (10º angle, 6.5 mph)<br>Nov. 14 (5º angle, 6 mph, with front disks) | April 28 (10º angle, 6.5 mph)<br>Nov. 14 (5º angle, 6 mph, with front disks) |
| **CT** | Field cultivate on May 22<br>Cultivate rows on June 17<br>Disk & chisel on Nov. 14 | Disk & Field cultivate on April 28<br>Cultivate rows on June 17<br>Disk & chisel on Nov. 14 |
| **Harvest Dates** | October 2 | October 17 |
| **Soil Test[2]** | 0 to 6 inch depth: Organic matter = 3.3%, Olsen P = 10 ppm, K = 302 ppm, pH = 5.9, salts = 0.3 mmho/cm<br>0 to 24 inch depth: $N0_3$-N = 38 lb/ac | |

[1] N – P2O5 – K2O in lb/ac; avg = average, st dev = standard deviation, NT = no-till, AT = Aerway® till, CT = conventional tillage
[2] Fall 2002

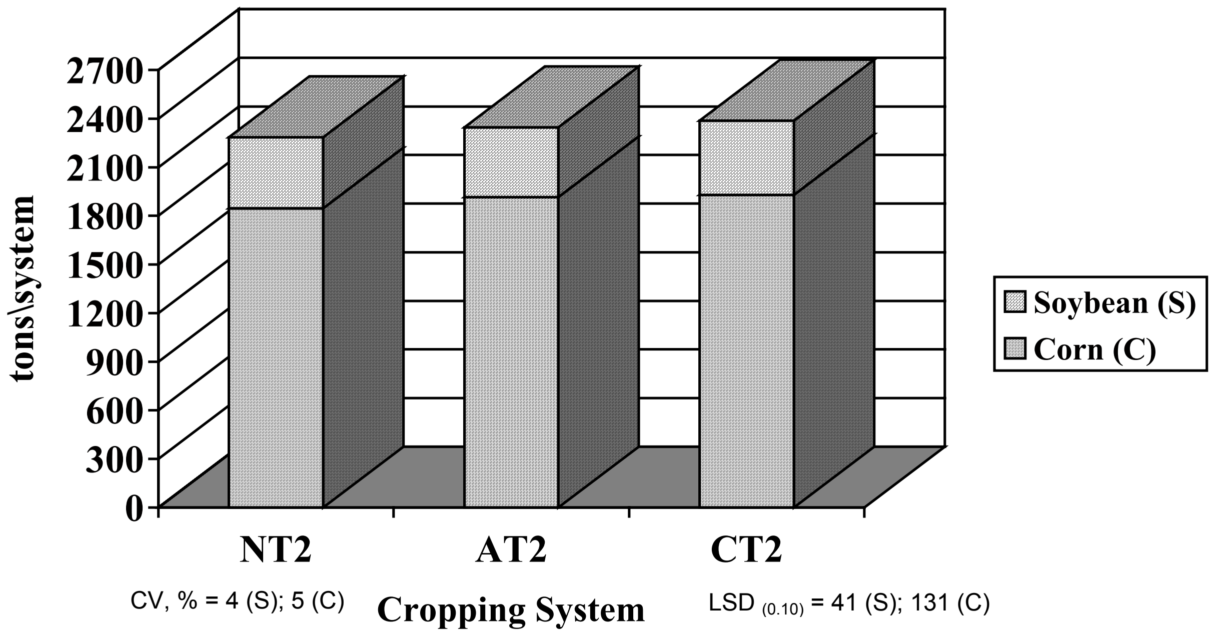


**Figure 1.** Total whole farm dry matter production for three tillage systems. Southeast Research Farm; Beresford, SD; 2003

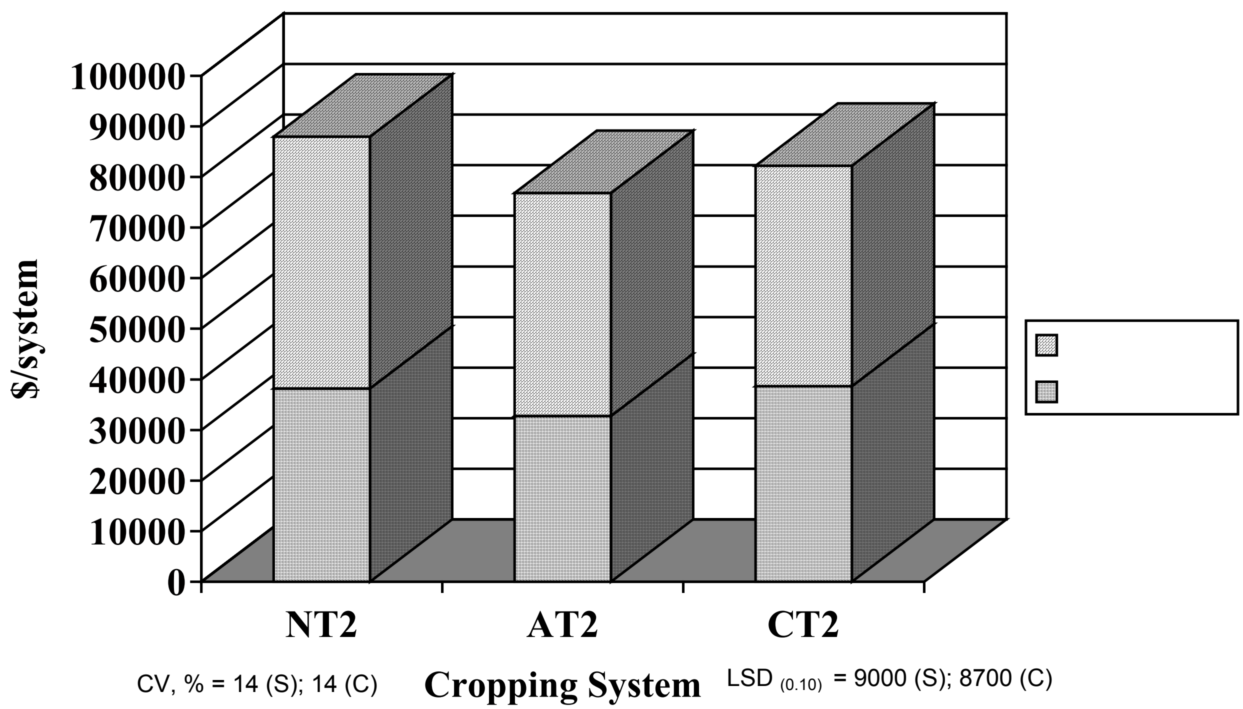


**Figure 2.** Whole farm net economic return for three tillage systems. Southeast Research Farm; Beresford, SD; 2003.

**Table 2**. Effect of three tillage systems on soybean performance; Southeast Research Farm; Beresford, SD; 2003.

| Tillage | Plant Height | Plant Population | Grain Yield[1] | Moisture | Test Weight | Gross Income | Net Economic Return |
|---|---|---|---|---|---|---|---|
| | inch | plants/ac | bu/ac | % | lb/bu | ---------- $/ac ------------ | |
| | | | | | | | |
| **NT** | 33.2 | 121,600 | 41 | 9.9 | 57.3 | 252 | 155 |
| **AT** | 35.7 | 105,800 | 41 | 9.7 | 56.9 | 249 | 138 |
| **CT** | 37.4 | 121,000 | 43 | 9.7 | 57.5 | 264 | 136 |
| | | | | | | | |
| **Avg.** | 35.4 | 116,100 | 42 | 9.8 | 57.2 | 255 | 143 |
| | | | | | | | |
| **LSD $_{(0.10)}$** | 1.7 | NS[2] | NS | NS | NS | NS | NS |
| **CV,%** | 4 | 10 | 7 | 2 | 0.5 | 7 | 14 |

[1] Grain yield at 13% moisture and 60-lb/bu test weight.
[2] NS = not significant

**Table 3**. Effect of three tillage systems on corn performance. Southeast Research Farm; Beresford, SD; 2003.

| Tillage | Plant Population | Grain Yield[1] | Moisture | Test Weight | Gross Income | Net Ecnomic Return |
|---|---|---|---|---|---|---|
| | plants/ac | bu/ac | % | lb/bu | $/ac | $/ac |
| | | | | | | |
| **NT** | 32,100 | 175 | 15.0 | 56.5 | 312 | 119 |
| **AT** | 32,300 | 182 | 14.9 | 56.6 | 324 | 102 |
| **CT** | 29,500 | 183 | 14.9 | 56.8 | 326 | 121 |
| | | | | | | |
| **Avg.** | 31,300 | 180 | 14.9 | 56.6 | 320 | 114 |
| | | | | | | |
| **LSD $_{(0.10)}$** | 1,400 | NS[2] | NS | NS | NS | NS |
| **CV,%** | 3 | 5 | 1 | 1 | 5 | 14 |

[1] Grain yield at 15% moisture and 56-lb/bu test weight.
[2] NS = not significant

# AERWAY® TILLAGE TIMING STUDY

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## INTRODUCTION

We established two research studies this year at our station to begin evaluating a unique type of conservation tillage system. It relies on an Aerway® tillage implement that uses adjustable rows of heavy metal shatter tines to aerate and fracture the topsoil. This reportedly boosts the productivity of various agricultural and horticultural enterprises including field and vegetable crops, pastures, orchards, vineyards, and golf courses. It can also incorporate livestock manure and help correct problems with soil compaction.

Our goals are to determine how Aerway tillage compares to other tillage systems (*Aerway® Tillage System Comparison*, page 25), and to see whether it is better to till in the spring or fall. This report highlights preliminary results for 2003 on soybean with and without spring Aerway tillage. It also evaluates soybean aphid control late in the growing season.

## METHODS

A 50-acre field with a history of more than a decade of no-till or modified ridge-till production as a corn-soybean rotation was used to establish four tillage treatments. This study evaluates Aerway tillage only in the spring (AT-S), only in the fall (AT-F), in both the spring and fall (AT-S+F), and no-till (NT) control. The first tillage treatments were performed this spring on last year's corn stalks before planting soybean. Fall Aerway tillage treatments were established after soybean harvest in 2003.

All tillage was performed with a 15 ft wide Aerway hydraulic implement pulled with a 165-hp tractor. This unit has a row of shatter tines that can be adjusted between angles ranging from 0 to $10^{\circ}$ to provide varying amounts of soil disturbance. It also has an optional row of cutting disks in front of the tines and a rear tine harrow. Corn stalks in the spring-tilled plots were worked two consecutive times on the same day by driving 6 mph with shatter tines positioned at a $7.5^{\circ}$ angle while using the disks and harrow.

The field was divided into 14 subplots that are 60 ft wide by approximately 2,500 ft long with 60-ft wide end rows on the north and south. End rows and eastern and western most subplots are considered border fill areas. The remaining middle 12 subplots were specifically designated to four tillage treatments - each replicated three times as a completely randomized block design. Even though specific areas were designated for all four treatments, only two tillage regimes were possible the first growing season (NT vs. AT-S) and both were replicated two times within each block.

Seed was planted in north-south rows spaced 30 inches apart with a 5700 White six-row planter. Soybean grain was harvested at maturity using a Case/IH 2144 combine with a 20 ft wide (eight row) head. Yield and moisture data were spatially recorded and continuously measured in the combine during harvest at one-second intervals using an AFS Universal Yield Monitor with DGPS signal correction. Grain yields were standardized to uniform moisture content of 13%.

Insecticide was commercially applied to half of the field in alternating 60 ft wide strips using 15 gal/ac of total volume at the R5.5 to 6-crop growth stage. The primary pest was moderate to heavy levels of soybean aphid. A few grasshoppers and bean leaf beetles were also observed, but were below threshold levels. Adjacent halves of each subplot (30 ft wide) were simultaneously treated plus all end rows. These two zones resulted in three separate 20 ft wide spray patterns (treatments) at harvest. One sprayed (+) zone, one unsprayed (-, control), and one blended (±) within each plot.

Responses measured at harvest included plant population; plant height; and the yield, moisture content, test weight, protein and oil concentrations of harvested grain. A partial economic return was calculated using the local market price at harvest of $6.41/bu on a fresh weight basis less some of the variable costs of inputs for seed and pesticides – including application charges for spraying – and a charge of $10/ac each time an area was Aerway tilled.

Inferences are based on analysis of variance using the SAS (Statistical Analysis Software) General Linear Model as a split-plot design with tillage treatment as the main plot and insecticide treatment as the subplot. Plant population and height were measured from the center harvest pass in each plot (±) and were analyzed with as a completely randomized block design. Differences among treatment means were compared based on Least Significant Difference (LSD). Additional management information is summarized in Table 1.

## RESULTS AND DISCUSSION

Soybean performed relatively well in this field (Tables 2 through 4). The population averaged 125,000 plants/ac, plants were nearly 28 inches tall, and grain yielded about 40 bu/ac. Moisture content of the grain was nearly 10% and test weights averaged a little over 57 lb/bu at harvest. Aerway tillage uniformly distributed volunteer corn across the areas tilled this spring.

Tilling corn stalks two times in the spring with the Aerway implement before planting had little or no effect on soybean plant height, population, or grain yield, but reduced net economic return by $20/ac (Table 2).

Controlling insects late in the growing season consistently enhanced grain yields about 1 bu/ac, barely enough to recover the cost of spraying with insecticide (Table 3).

The responses measured from Aerway tillage and insect control were consistently observed among the treatments and no significant tillage by spraying interactions were observed.

This method of conservation tillage reportedly performs better than no-till and/or conventional tillage. These preliminary results failed to document a benefit from Aerway tilling over wintered corn stalks in the spring during the establishment year on the following soybean crop. It also suggests that controlling soybean aphid probably needs to be done earlier in the growing season.

**Table 1.** Management summary for Aerway® tillage timing study. Southeast Research Farm, Beresford, SD; 2003.

| | |
|---|---|
| **Variety** | Prairie Brand 2141RR |
| **Seeding Rate** | 64 lb/ac (approximately 166,400 seeds/ac) |
| **Planting Date** | May 27, 2003 |
| **Fertilizer** | None |
| **Herbicide** | Gauntlet + Roundup, PRE; Roundup, Post |
| **Insecticide** | Asana, Post |
| **Tillage Treatments** | NT = No-till<br>AT-S = Aerway tilled spring only<br>AT-F = Aerway tilled fall only (= NT in 2003)<br>AT-S + F = Aerway tilled spring and fall (= AT-S in 2003) |
| **Insecticide Treatments** | + = 100% sprayed;<br>± = Blended (50% sprayed)<br>– = 0% sprayed |
| **Harvest Dates** | September 30 and October 1, 2003 |
| **Soil Test[1]** | 0 to 6 inch depth: Olsen P = 27 ppm, K = 320 ppm, pH = 6.3, salts = 0.5 mmho/cm, texture = medium;<br>0 to 24 inch depth: $NO_3$-N = 27 lb/ac |

[1] fall 2001

**Table 2.** Effect of spring Aerway® tillage on soybean production regardless of spray treatment. Southeast Research Farm; Beresford, SD; 2003.

| Tillage | Plant Population | Plant Height | Grain Yield[1] | Economic Return |
|---|---|---|---|---|
| | plants/ac | inches | bu/ac | $/ac |
| | | | | |
| **NT** | 124,800 [2] | 27.3 | 39.7 | 197 |
| **AT–S** | 125,600 | 28.2 | 39.5 | 175 |
| | | | | |
| **Avg** | 125,400 | 27.8 | 39.6 | 186 |
| **LSD $_{(0.10)}$** | NS[3] | NS | NS | 7 |
| **CV, %** | 7.0 | 6.7 | 2.6 | 4.3 |

[1]Grain yield at 13% and 60-lb/bu test weight
[2] Plant population and height are means of six observations per tillage treatment; yield and economic return are means of 18 observations per tillage treatment.
[3] NS = not significant

**Table 3.** Effect of late-season spraying for aphids on soybean production regardless of tillage treatments. Southeast Research Farm, Beresford, SD; 2003.

| Spray | Grain Yield[1] | Net Economic Return |
|---|---|---|
| | **bu/ac** | **$/ac** |
| – | 38.9 [2] | 185 |
| ± | 39.8 | 187 |
| **+** | 40.1 | 185 |
| | | |
| **LSD $_{(0.10)}$** | 0.6 | NS[3] |

[1]Grain yield at 13% and 60-lb/bu test weight
[2] Values are means of 12 observations per spray treatment
[3] NS = not significant

SE FARM REPORT

SDSU

# SOYBEAN ROW SPACING STUDY

R. Berg, R. Stevens, A. Wiebesiek, and G. Williamson

**Southeast Farm 0306**

## INTRODUCTION

This study was conducted to help answer crop row spacing questions our station receives each year. Previous research indicates that yield advantages of 10% can be achieved by raising soybean in narrow rows as long as pressure from diseases like white mold are not an issue.

All treatments in this trial were planted with our John Deere 750 drill to prevent differences between planters from confounding the results. This report summarizes preliminary results for 2003.

## METHODS

Soybean was planted at approximately 162,000 pure live seed/ac in five row widths of 7.5, 15, 22.5, 30, and 37.5 inches with a John Deere 750 drill. Plot size was 20 ft wide by 225 ft long. Each treatment was replicated four times as a randomized block design. Soybean aphids were controlled during pod fill by spraying perpendicular to the rows. Glyphosate was applied two times during the growing season.

Grain was harvested with a plot combine at maturity and weighed to measure yield. Moisture content, test weight, protein, oil, and plant population was also determined for each plot. Additional management information is summarized in Table 1.

**Table 1.** Management practices for soybean row spacing study; Southeast Research Farm; Beresford, SD; 2003.

| | |
|---|---|
| **Previous Crop** | Corn |
| **Tillage System** | Conventional |
| **Variety** | Sands of Iowa SOI 226RR |
| **Planting Date** | May 21 |
| **Herbicide, Post emerge** | Roundup & Prestige |
| **Insecticide** | Asana, Post |
| **Date Harvested** | October 2 |

## RESULTS AND DISCUSSION

Grain yield was the only response measured that differed significantly by row spacing (Table 2). Raising soybean in 7.5-inch rows produced 6 to 10 bu/ac more grain than any other row spacing tested, a 15% increase (Figure 1).

Plant population averaged 142,000 plants/ac among the row widths tested and was not directly correlated with yield responses. The 15-inch row spacing had both low yield and plant population (129,000 plants/ac). Soybean raised in 37.5-inch rows numerically had the highest plant population (156,000 plants/ac) but not the highest yield.

Individual plants in the narrowest rows produced grain more efficiently than those in the other row widths. Dry matter production was 12 lb/1,000 plants in 7.5-inch rows vs. 9 or 10 lb/1,000 plants in the other widths (data not shown).

Dry matter concentrations of protein and oil were 41 and 18%, respectively. This meets the criteria recommended for soybean processing and foreign export markets for protein, but oil content is 2 or 3% lower than recommended.

**Table 2.** Row spacing effect on soybean production. Southeast Research Farm; Beresford, SD; 2003.

| **Row Spacing** | **Plant Population** | **Grain Moisture** | **Test Weight** | **Protein, DM** | **Oil, DM** |
|---|---|---|---|---|---|
| inch | plants/ac | % | lb/bu | % | % |
| | | | | | |
| **7.5** | 150,000 | 9.7 | 56.8 | 41 | 17 |
| **15** | 129,000 | 9.7 | 57.1 | 42 | 17 |
| **22.5** | 134,000 | 9.8 | 56.2 | 40 | 18 |
| **30** | 142,000 | 9.8 | 57.8 | 40 | 18 |
| **37.5** | 156,000 | 9.9 | 56.0 | 39 | 18 |
| | | | | | |
| **Avg.** | 142,000 | 10 | 57 | 41 | 18 |
| | | | | | |
| **LSD $_{(0.10)}$** | NS[1] | NS | NS | NS | NS |
| **CV,%** | 14.8 | 2.3 | 1.9 | 2.6 | 4.9 |

[1]NS = not significant
Mean values each based on four observations

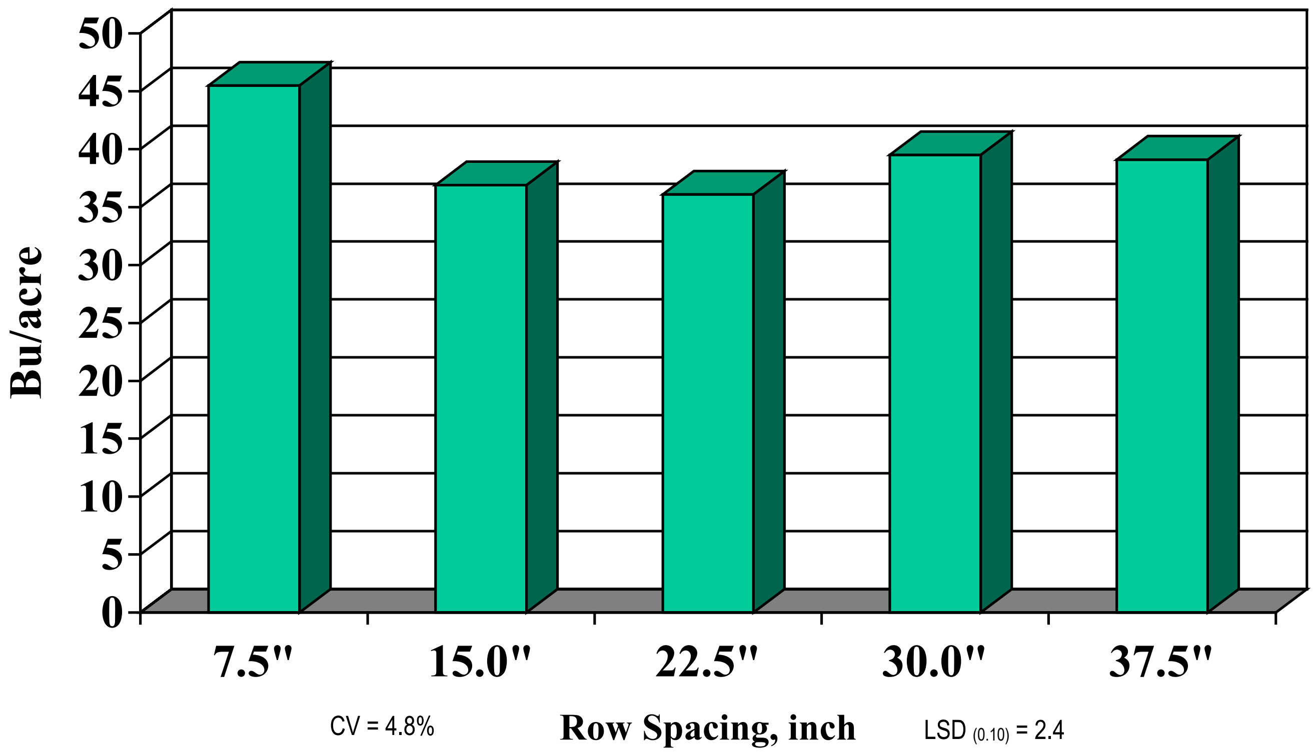


**Figure 1.** Row spacing effect on soybean yield at 13% moisture and 60 lb/bu test weight. Southeast Research Farm; Beresford, SD; 2003.


**SUMMARY**

This study confirms that a dramatic yield advantage of 15% (6 to 9 bu/ac) or more can be achieved by drilling soybean in narrow 7.5-inch row widths. There were little or no differences in soybean performance among the other widths with the variety used and growing conditions experienced this year.

The variety tested had acceptable grain protein levels but its oil content was lower than recommended for processing or foreign export markets.



**ACKNOWLEDGEMENTS**

Laboratory analyses for this trial were provided by Kevin Kirby and Jesse Hall; Plant Science Department; South Dakota State University; Brookings, SD.


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# 2003 NITROGEN AND PLANT POPULATION STUDIES IN CORN

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**Plant Science 0307**

## INTRODUCTION

Nitrogen and plant population are significant factors for corn (Zea mays L.) production. Accurate nitrogen fertilizer and seeding rate recommendations are essential for optimizing profitability for the farmer and minimizing nitrogen losses. Research and development of yield response curves provide important information that can be used to understand the relationships between these inputs (nitrogen fertilizer and corn seed) and output (grain yield).

With the movement of production agriculture into the information age, farm managers are better able to distinguish soil and plant variability within a field. Development of management zones to vary the application of crop inputs across variable fields may increase economic returns. Placing the "optimum" quantity of yield limiting inputs such as nitrogen and seed across a field increases the odds of success. However, accurate information and a clear understanding of the agronomic factors involved are necessary in order to develop sound site-specific recommendations.

The goals of this research were to determine: (i) corn yield response to varying nitrogen and plant population rates, and (ii) the economic optimum nitrogen and plant population for each site year given the value of output and the cost of inputs.

## METHODS

Strip trials were conducted at the Southeast Research Farm on Egan-Trent silty clay loams with 0-2 percent slopes. Strips were arranged in a randomized complete block design (RCBD) with 3 replications of 8 treatments (2 plant population rates x 4 nitrogen rates). Planter settings were 27,900 and 38,100 seeds/acre, with a goal of 25,000 and 35,000 standing plants/acre. Nitrogen was split applied as broadcast (10-34-0), starter fertilizer (10-34-0), and sidedress (28-0-0). Nitrogen rates were 0, 100, 150, and 200 lbs actual N/acre. Nitrogen check (0 lbs. N) treatments received approximately 8 lb N as starter and 18 lb N as broadcast. Treatments consisted of 12, 30-inch rows across approximately 1200 feet. Harvest methods included hand harvest and harvesting with a combine equipped with a DGPS receiver and yield monitor. Grain yield and moisture were measured and geo-referenced across each strip.

## RESULTS

Corn yields were very good at the Beresford farm in 2003. Average harvest plant populations for low and high planting rates were 25,020 and 33,340 plants/acre respectively (90% and 88% of planter setting). Economic analysis of hand-harvested yield data without modeling indicates that a nitrogen rate of 150 lb N/acre and planting rate of 27,900 seeds per acre had the greatest net return, given the costs of nitrogen ($0.21/lb N) and seed ($1.25/1000 seeds) and value of corn ($2.10/bu).

**Table 1.** Yields for nitrogen and planting rates and net return per acre; Southeast Research Farm; Beresford, SD; 2003.

| Nitrogen (lb/acre) | Planting Rate (seeds/acre) | Grain Yield (bu/acre) | Net Return* ($/acre) |
|---|---|---|---|
| 0 | 27,900 | 139.9 | $259.01 |
| 100 | 27,900 | 186.3 | $335.30 |
| 150 | 27,900 | 201.2 | $356.21 |
| 200 | 27,900 | 196.7 | $336.20 |
| 0 | 38,100 | 134.3 | $234.32 |
| 100 | 38,100 | 193.0 | $336.60 |
| 150 | 38,100 | 190.7 | $321.34 |
| 200 | 38,100 | 194.5 | $318.83 |
| | | | |
| *Net Return Assumptions: Costs: $0.21/lb N, $1.25/1000 seeds. Output: $2.10/bu. corn | | | |

# NITROGEN APPLICATION TIMING INFLUENCE ON CORN GRAIN YIELD AND RESIDUAL SOIL NITRATE-N, BERESFORD, 2003

J. Gerwing, R. Gelderman, A. Bly, and R. Berg

Plant Science 0308

## INTRODUCTION

Many opportunities for application of nitrogen occur during the year. It can be applied from the fall after soybean harvest until side-dress when corn has six leaves. During this time, conditions for N leaching and/or denitrification can occur. These losses reduce N availability to corn and may reduce yield potential. A research project was initiated to measure the affect of N application timing on N availability to corn in a corn soybean rotation.

## MATERIALS AND METHODS

A site was selected on the Southeast Research Farm near Beresford, SD. Five application timings and a 0 N check were included in a randomized complete block plot design with four replications. The intended N application timings were: 1) soon after soybean harvest (EF=early fall), 2) after soil temps cooled below 50 degrees F (LF=late fall), 3) during March or April (ES-early spring), 4) immediately before planting (LS-late spring), or 5) when the corn was at the six leaf stage (SD=side-dress). The EF application was not made in 2002, so these plots were used for an application at the V8 growth stage (V8). Application dates for each timing treatment can be found in Table 1. No Tillage was done after the LF and ES urea applications, but all plots were tilled after the LS application that prevented volatilization losses from that timing. Urea was used for all treatments except the side dress and V8. Ammonium nitrate was used in the sidedress and V8 treatment to prevent volatilization losses since plots were not cultivated. The late fall and early spring urea applications were not incorporated. It was assumed that cool conditions during the application times would result in minimal volatilization losses of N. The nitrogen rate for all timings was 140 lbs/ac. The previous crop was soybean. Roundup ready corn (DKC 58-24) was planted on April 29, 2003 at 27,900 seeds/ac. Roundup Ultra Max (26 oz/ac) was applied on June 4, 2003. Plots were harvested with a field plot combine on October 7, 2003. Soil samples were taken to a depth of 24 inches on May 29, 2003 and to a depth of 36 inches on June 19, 2003. Plot replications were composited for soil nitrate analysis.

## RESULTS AND DISCUSSION

Nitrogen application significantly increased grain yield (Table 1). N application timing did not significantly influence grain yield (Table 1). The dry winter and spring conditions should have prevented any leaching and denitrification losses. However, soil samples taken on June 20 show that the LF N application had less nitrate N in the top 3 feet (Table 2). The lower amount of N in the LF treatment did not limit yield when compared to the other application timings. Leaching losses in this treatment would have been minimal since the precipitation received during the time between the LF application and the ES application was only 2.15 inches (Table 3). The loss of N in this treatment was likely due to volatilization since there was not significant precipitation to move the urea into the soil for an extended period after application (Table 3). The loss of N in this treatment did not result in lower yield because the 140 lb rate was likely higher than needed, leaving enough N for maximum yield after losses.

**Table 1**. N Application Timing Effect on Corn Grain Yield at the Southeast Research Farm; Beresford, SD; 2003.

| N Application Timing | Date | Nitrogen Rate & Timing | Nitrogen Timing |
|---|---|---|---|
| | | ------------------------ bu/ac | ------------------------------ |
| Check | None | 121 | --- |
| Late Fall (LF) | 11/07/02 | 159 | 159 |
| Early Spring (ES) | 3/25/03 | 158 | 158 |
| Late Spring (LS) | 4/28/03 | 155 | 155 |
| Side-dress (SD) | 6/19/03 | 156 | 156 |
| V8 | 6/30/03 | 159 | 159 |
| | | | |
| Pr>F | | 0.01 | 0.84 |
| CV% | | 5.3 | 3.7 |
| LSD (.05) | | 12 | NS |

**Table 2.** June Soil Nitrate Levels from Nitrogen Timing Study, Beresford, 2003

| Sample Depth | N Application[1] Date | | | |
|---|---|---|---|---|
| | None | 11/7/03 | 3/25/03 | 4/28/03 |
| Inches | ---------------------------------lb $NO_3$-N[2]---------------------------------- | | | |
| 0-12 | 48 | 120 | 220 | 164 |
| 12-24 | 28 | 40 | 52 | 76 |
| 24-36 | 20 | 20 | 28 | 36 |
| Total | 76 | 160 | 272 | 240 |

[1]140 lb N

[2]sampled 6/20/03

**Table 3**. Rainfall at the SE Experiment Farm, Beresford, Nov. 1, 2002 to Oct. 31, 2003

| Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ------------------------------------------------------------ inches------------------------------------------------------------ | | | | | | | | | | | | |
| 0.12 | 0.12 | 0.29 | 0.62 | 1.00 | 2.88 | 3.21 | 5.03 | 5.04 | 1.37 | 5.92 | 0.80 | 0.39 |

## CROP NUTRIENT MANAGEMENT USING MANURE FROM RATIONS CONTAINING DISTILLERS GRAIN

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**Plant Science 0309**

## INTRODUCTION

The rapid growth of the ethanol industry in South Dakota has a benefit of producing large amounts of a feedstuff in the form of distillers' grain. Utilization of the wet distillers grain (WDG) may lead to concentrated animal feeding operations (CAFOs) near the ethanol plants. Feeding of dry distillers grain (DDG) could lead to more feeding operations (especially ruminants) through out the state.

Distillers' grain is essentially corn with the starch removed resulting in a higher concentration of phosphorus (P) when compared to the original grain. Research has shown as dietary P increases above the animals P needs, excreted P increases. Therefore, manure from animal diets utilizing distillers' grain may be higher in P.

Manure has been shown to be an excellent source of plant nutrients. However, over application of manure near some CAFOs can lead to ground water (nitrate-N) and surface water (P) contamination. South Dakota has regulated land application of manure from CAFOs for a number of years based on crop nitrogen needs. Since the ratio of N to P in manure is much narrower than in grain, this can lead to over application of P because more P will be applied than is needed by the crop. Recently (December, 2002), the EPA has directed states to also consider P management in land application of manure.

There is a need to agronomically evaluate the SD Department of Environment and Natural Resources (DENR) rules (February, 2003) pertaining to manure application rates that are based on nitrogen and phosphorus. The producer needs to be sure such rates will not limit yields when compared to commercial fertilizer application. In addition, buildup of soil nitrate-N and soil test P needs to be monitored.

Purpose:

To agronomically evaluate rates of distiller's grain derived manure based on nitrogen and phosphorus crop needs.

Objectives:

1) To determine if manure rates applied according to rules set by the SD DENR for CAFOs meet crop nutrient needs (grain yield and crop growth) as compared to commercial fertilizer.
2) To compare P buildup rates when manure is applied according to either the N or P needs of the crop.
3) To compare nitrate-N carryover from manure and commercial fertilizer.

## METHODS

Two field sites were established to evaluate the study objectives. A site is located on an Egan soil just south of the office building at the Southeast Farm near Beresford on which beef feedlot manure was applied. The other site is located on the east Agronomy Farm at Brookings on Vienna-Lamoure soils (Range D-1) on which daily-scrape solid dairy cow manure was applied.

Beginning soil tests can be found in Table 1. Nitrogen and phosphorus would be recommended for corn at the Beresford site with sulfur recommended on a trial basis only. No nutrient recommendation would be made for soybean with a 40 bu/ac yield goal at the Brookings site.

The manure was applied on April 3, 2003 and incorporated with a disc within a few hours at the Beresford site and applied on April 16, 2003 and incorporated with a disc within 48 hours at Brookings. The analysis of the beef feedlot manure and the dairy barn manure are given in Table 2. The treatments established and nutrients applied are listed in Table 3. Treatments were arranged in a randomized complete block design with four replications. Future fertilizer and manure nutrient rates from these studies will be based on a fall composite soil analysis from the respective treatment plots.

At Beresford, Dekalb DKC58-24 was planted at 27,900 seeds/ac on April 29, 2003 in 30-inch rows. Roundup (26 oz/ac) was applied on June 4. Harvest was completed with a plot combine on September 30. At Brookings, Asgrow AG 1401 soybeans were planted in 30-inch rows on May 23 and treated with Roundup Ultra Max on June 17 and July 22 (26 oz/ac).

Harvest was completed with a plot combine on September 30.

## RESULTS

In general, plants under the manure treatments at Beresford (except V6 weight under the "N" treatment) had greater early growth than plants under the fertilizer treatment (Table 4). Because of the excellent growing conditions, plant N needs may be higher and the manure treatments may be providing higher mineralizable N than estimated. In addition, potassium deficiency was noted on two of the four reps for the fertilizer treatment even though K soil tests were very high (>160 ppm). Since no K was applied with the fertilizer treatment, this may be the reason for the noted growth differences. It may be a combination of these two nutrients and possibly other effects as well that are producing these growth differences among treatments. There were no observable or measurable differences in early growth at the Brookings site (Table 4).

Grain yield was not influenced by treatment at either location (Table 4). The early growth differences seen at the Beresford site did not materialize into yield. Possibly the moderate water stress in August may have caused this. Soybean was very stressed at the Brookings site in August.

Post-harvest soil tests at both sites indicate increases in nitrate-N, sulfate-S, Olsen P, K, and zinc with the higher two rates of manure (Table 5 and 6).

## CONCLUSIONS

A number of years will be needed to draw conclusions for each of the objectives. The first year's data indicate the manure rates were equivalent to recommended fertilizer rates in producing grain yield. Soil test P increases are consistent with rate of applied P at the Beresford site. Carry-over nitrate-N levels were lower than expected on the high manure rate at both locations.

## ACKNOWLEDGEMENTS

These studies were funded in part by the South Dakota Corn Utilization Council.

**Table 1**. Beginning soil tests[1] from manure studies, Beresford and Brookings, 2003.

| Site | O.M | $NO_3$-N | $SO_4$-S | Olsen P | K | Zinc | pH | salts |
|---|---|---|---|---|---|---|---|---|
| | % | lb/ac in 2-feet | | --------- ppm --------- | | | | mmho/cm |
| Beresford | 3.6 | 64 | 16 | 6 | 182 | 1.16 | 6.3 | 0.7 |
| Brookings | 3.3 | 40 | 62 | 25 | 157 | 1.13 | 7.5 | 0.5 |

[1] 0-6 inches taken in fall of 2002

**Table 2**. Manure nutrient analysis for manure studies, spring, 2003.

| | | ------------- Manure (as-is-basis) ----------------- | |
|---|---|---|---|
| Analysis | units | Beef (from apron) | Dairy (daily scrape with straw bedding) |
| Total N | lb/ton | 17.1 | 8.0 |
| Ammonia-N[1] | lb/ton | 2.4 | 0.3 |
| Organic-N[2] | lb/ton | 14.4 | 7.7 |
| Total Available-N | lb/ton | 7.5 | 2.7 |
| $P_2O_5$ | lb/ton | 10 | 3.9 |
| $K_2O$ | lb/ton | 12.9 | 7.5 |
| Moisture | % | 55 | 75 |

[1] Percent ammonia-N retained is 90% and 20% if broadcast and incorporated within 24 hours and five days, respectively.
[2] Availability at 33, 50 and 67% for year 1, year 2 and year 3 of application, respectively

**Table 3.** Treatments and nutrients applied for manure studies, spring, 2003.

| Treatment | Manure applied | Fertilizer $N-P_2O_5-K_2O$ applied | Manure $N-P_2O_5-K_2O$ applied |
|---|---|---|---|
| | ton/ac | ---------------------- lb/ac ---------------------- | |
| ------------- Beresford site (Corn) ------------- | | | |
| check | 0 | 0-0-0 | 0-0-0 |
| Fertilizer | 0 | 64-61-0 | 0-0-0 |
| Manure - P[1] | 7.5 | 18-0-0 | 56-75-75 |
| Manure - N[2] | 10.4 | 0-0-0 | 78-104-104 |
| Manure - 2N[3] | 20.8 | 0-0-0 | 156-208-208 |
| ------------- Brookings site (Soybean) ------------- | | | |
| check | 0 | 0-0-0 | 0-0-0 |
| Fertilizer | 0 | 0-0-0 | 0-0-0 |
| Manure - P[1] | 7.7 | 0-0-0 | 21-30-58 |
| Manure - N[2] | 44.8 | 0-0-0 | 120-173-336 |
| Manure - 1.5N[3] | 67.2 | 0-0-0 | 180-260-504 |

[1] P manure rate based on P recommendation from soil test or on P removal from crop, which ever is greater
[2] N manure rate is based on N requirement of 1.2 lb/bu for corn or 3.8 lb/bu for beans minus soil test nitrate-N and legume credit.
[3] 2N manure rate of twice the N rate above (used 1.5 N at Brookings)

**Table 4**. Influence of manure and fertilizer on corn and soybean growth and yields, 2003.

| | ------------- Site ------------- | | | | |
|---|---|---|---|---|---|
| | Beresford – Corn | | | Brookings - Soybean | |
| Treatment | V6 weight | V9 height | Grain yield | R3 weight[1] | Grain yield |
| | grams - dry | inches | bu/ac | grams-wet | bu/ac |
| Check | 43.5 b | 42.4 c | 143 | 402 | 31.5 |
| Fertilizer | 57.5 a | 43.8 c | 139 | 421 | 30.3 |
| Manure – P | 54.5 a | 46.8 ab | 151 | 446 | 33.0 |
| Manure – N | 42.5 b | 46.1 b | 152 | 442 | 31.6 |
| Manure – 2N[3] | 57.0 a | 48.2 a | 142 | 397 | 31.7 |
| LSD | 3.2 | 1.8 | --- | --- | --- |
| Pr>F | 0.0001 | 0.0001 | 0.30 (NS) | 0.40 (NS) | 0.30 (NS) |
| C.V % | 11.0 | 7.0 | 7.2 | 10.1 | 5.1 |

[1] Fresh weight of 8 plants at R3 (beginning pod stage, July 25, 2003)
[2] Values in a column with the same letter are not significantly different at the 0.05 level.
[3] 1.5 N at Brookings

**Table 5**. Soil tests[1] after first year from manure study at Beresford, 2003.

| Treatment | O.M | $NO_3$-N | $SO_4$-S | Olsen P | K | Zinc | pH | salts |
|---|---|---|---|---|---|---|---|---|
| | % | lb/ac in 2-feet | | --------- ppm --------- | | | | mmho/cm |
| Check | | 30 | 24 | 5 | 225 | 0.75 | 6.7 | 0.5 |
| Fert | | 32 | 24 | 6 | 216 | 0.67 | 6.0 | 0.3 |
| P | | 36 | 26 | 5 | 231 | 1.33 | 6.0 | 0.3 |
| N | | 61 | 64 | 10 | 284 | 1.45 | 6.4 | 0.4 |
| 2N | | 61 | 60 | 17 | 284 | 1.24 | 6.5 | 0.5 |

[1]Samples taken 10/1/2003

**Table 6.** Soil tests[1] after first year from manure study at Brookings, 2003.

| Treatment | O.M | $NO_3$-N | $SO_4$-S | Olsen P | K | Zinc | pH | salts |
|---|---|---|---|---|---|---|---|---|
| | % | lb/ac in 2-feet | | --------- ppm --------- | | | | mmho/cm |
| Check | | 36 | 52 | 25 | 156 | 1.3 | 7.5 | 0.4 |
| Fert | | 30 | 62 | 17 | 138 | 0.9 | 7.6 | 0.4 |
| P | | 38 | 86 | 23 | 156 | 1.1 | 7.7 | 0.4 |
| N | | 54 | 128 | 30 | 199 | 1.4 | 7.7 | 0.4 |
| 2N | | 61 | 84 | 25 | 223 | 1.2 | 7.7 | 0.4 |

[1]Samples taken 10/2/2003

SE FARM REPORT
SDSU

# LONG-TERM RESIDUAL PHOSPHORUS STUDY

R. Gelderman and J. Gerwing

**Plant Science 0310**

## INTRODUCTION

This study was established in 1994 on a phosphorus (P) study site that was begun in 1964. The low soil test P treatment of this experiment has not received fertilizer P for over 30 years.

The objectives of this study are:

1. To determine optimum P soil test level under residual P management and under management where P is added each year.

2. To determine maintenance levels of P as affected by initial P soil test levels.

3. To compare the influence of annual P placements (broadcast vs. band) upon crop yields.

## METHODS

Four soil test levels (low, medium, high, and very high) were established by broadcasting phosphorus fertilizer (10-34-0) in the spring of 1993 and were incorporated with a chisel plow. Four replications with soil test P level as main blocks and annual P application rates (banded) as the split block were established. Another medium (M) soil test level was established to compare placement (broadcast vs. band) effects for annually applied P rates. Soybeans were planted in 1993. The stubble was moldboard plowed in the fall to further incorporate the applied P.

In 1994 the annual P rates for the medium broadcast block were incorporated before planting. Since that time they have been broadcast on the surface after planting. In 1994 five lb/ac zinc (as zinc sulfate) was applied on all plots. A no-till corn and soybean rotation has been established since 1995. In 1997 soybeans were drilled in 7.5-inch rows and the P row treatments were applied with the seed. Previously, soybeans had been planted on 30-inch rows with the banded P applied 2 x 2.

Asgrow 2403 RR soybean was planted on May 16 with a 10 foot JD 750 no-till drill (7.5” spacing). Annual band P treatments (0, 20, 40, 60 lb $P_2O_5$/ac) were applied with the seed. Broadcast P rates were hand applied to the soil surface immediately after planting. Plot size is 10’ X 45’. The P fertilizer used for all treatments was 0-46-0. The five-foot fill area between plots was seeded with a no-till plot planter on 30-inch rows. For weed control Roundup plus Poast Ultima was applied on June 4, and Prestige plus Roundup was applied on July 16. Aphids were controlled with 4 oz/ac Mustang on August 13.

**Table 1**. Phosphorus soil tests[1] and grain P removal from soil test treatments (no annual P) of the long-term P study, Southeast Farm, Beresford, SD. (Project no. 0603).

| Soil Test Level | Olsen P soil test | | | | | | | | | $P_2O_5$ removal by grain (9 yr.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Total | Ave. |
| | ppm | | | | | | | | | -- lb/ac -- | |
| 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 4 | 2 | 218 | 24 |
| 2 | 5 | 4 | 4 | 3 | 4 | 3 | 3 | 4 | 2 | 258 | 29 |
| 3 | 8 | 7 | 8 | 7 | 6 | 6 | 6 | 9 | 4 | 298 | 33 |
| 4 | 15 | 13 | 14 | 10 | 11 | 8 | 7 | 12 | 6 | 333 | 37 |

[1] Sampled (0-6") in the fall of each year from zero rate of each soil test level except for 1999 and 2000 which were sampled in the spring of following year.

## RESULTS AND DISCUSSION

Phosphorus soil tests have stayed almost constant since the fall of 1994 on the lower soil test level treatments. However, for the two high soil test levels, P tests have fallen since 1994 although there was a slight increase for the 2001 sample (Table 1). This decrease is because of grain removal of P with no additions of P.

Phosphorus soil tests appear to be increasing with annual broadcast applications of 40 or 60 lb $P_2O_5$/ac (Table 2). The $P_2O_5$ removed by grain (both corn and soybeans) is fairly constant from those broadcast treatments that had P applied (Table 2). Average $P_2O_5$ removals are very close to 40 lb/ac per year. Maximum P removal is occurring at the 20 – 40 lb $P_2O_5$ /ac broadcast rate.

Soybean yields were limited because of moderate drought stress that occurred in August. Phosphorus rates did not significantly influence soybean yields in 2003 (Table 3). Soil test levels did not influence soybean grain yields either. Placement of P had no influence on soybean grain yield (Table 3).

**Table 2**. Phosphorus soil tests[1] and grain P removal from broadcast rates of the long-term P study, Southeast Farm, Beresford SD. (Project no. 0603)

| $P_2O_5$ rate | Olsen P soil test | | | | | | | | | $P_2O_5$ removal by grain (9 yr.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Total | Ave. |
| lb/ac | ppm | | | | | | | | | -- lb/ac -- | |
| 0 | 6 | 5 | 5 | 4 | 4 | 3 | 4 | 5 | 3 | 269 | 30 |
| 20 | 6 | 8 | 9 | 8 | 7 | 6 | 9 | 11 | 6 | 333 | 37 |
| 40 | 7 | 8 | 12 | 11 | 13 | 12 | 11 | 20 | 15 | 340 | 38 |
| 60 | 8 | 12 | 16 | 16 | 18 | 16 | 19 | 26 | 22 | 344 | 38 |

[1] Sampled (0-6") in fall of every year from each annual rate of the broadcast treatment except in 1999 was sampled in spring of 2000.

**Table 3.** Soybean yield as influenced by P soil test, annual P application rate and placement from the long-term P study during 2003 at Southeast Farm, Beresford SD. (Project no. 0603)

| | ---------------- annual $P_2O_5$ rates - lb/ac ------------------- | | | | |
|---|---|---|---|---|---|
| Soil test category[1] | 0 | 20 | 40 | 60 | mean |
| | ------------------------------ Yield, bu/ac ---------------------------------- | | | | |
| 1 (band) | 32 | 36 | 37 | 35 | 35 |
| 2 (band) | 33 | 36 | 36 | 35 | 35 |
| 2 (bct.) | 34 | 35 | 34 | 34 | 34 |
| 3 (band) | 35 | 33 | 36 | 34 | 34 |
| 4 (band) | 34 | 33 | 37 | 35 | 35 |
| mean | 33 | 34 | 37 | 35 | |

[1]1,2,3,4,and 5 (Olsen P in 2002)= 2 ppm (v. low), 2 ppm (v.low), 3 ppm (v.low), 4 ppm (low), and 6 ppm (low), respectively.

Pr >F: All treatments but broadcast. Soil test level = 0.98(NS); annual rate = 0.15 (NS); soil test x rate = 0.51 (NS). C.V=7.3%.

Pr>F: Treatments 2 and 3. Placement = 0.53(NS); annual rate = 0.23(NS); placement x rate = 0.80(NS). C.V.= 10.1%

# N RATE INFLUENCE ON CORN HYBRID GRAIN YIELDS

A. Bly, H. Woodard, and D. Winther

**Plant Science 0311**

## INTRODUCTION

Nitrogen application recommendations for corn have been well determined by years of studies measuring yield response to applied N rates. It is good to evaluate these recommendations occasionally to determine if the new hybrids are responding to N rates as in the past. A study was conducted at the Southeast Research farm near Beresford, South Dakota, to evaluate the influence of applied N rate on six hybrids that have been recently released.

## MATERIALS AND METHODS

A site was selected on the Southeast Research Farm near Beresford that had been managed as a corn and soybean rotation. The previous crop was soybean. The soil series at this site is Chancellor silty clay loam, with 0-2% slopes. Preseason soil samples from the 0-6 and 6-24 inch depths were obtained on April 4, 2003 for determination of nitrogen and other nutrient recommendations. On May 7, 2003; 100 lbs $P_2O_5$/ac was applied as broadcast 0-46-0 and incorporated twice with a field cultivator. Six Monsanto hybrids (Table 1) were selected and planted in a Randomized Complete Block (RCB) plot design with hybrid as the main plot and N rate as the split. The hybrids were planted at a rate of 29,900 seeds/ac on May 16, 2003. Three N rates were broadcast surfaced applied as urea on June 4, 2003. The N rates that included a check were 46, 92, and 184 lbs N/ac. These rates represented 0.5, 1.0, and 2.0 X the N recommendations for a corn yield of 160 bu/ac. The 92 lb N/ac rate is the recommended rate obtained from EC 750, which is the fertilizer recommendation guide for South Dakota (Gerwing and Gelderman, 2001). Force 3G insecticide was applied in a T-band to all plots at planting.

Throughout the growing season the plots were monitored for weeds and other pests. Roundup Ultra Max was sprayed on the plots twice for weed control. After physiological maturity, grain moisture of the six hybrids was closely monitored. About every week, grain moisture samples were taken from the recommended N rate plots (92 lbs/ac) to determine the grain dry down rates of each hybrid. A composite grain sample was obtained by harvesting grain from each replicate plot. Grain was harvested with a small plot combine and adjusted to 15 percent moisture basis for yield determination on October 31, 2003. Yield means were calculated and statistically analyzed with SAS.

## RESULTS AND DISCUSSION

Ideal growing conditions hastened crop maturity in 2003. The hybrids reached physiological maturity in early September. The DKC 47-10 hybrid reached 20 percent grain moisture on September 25, DKC 44-46 and DKC 50-73 on October 1, and DKC 53-34, DKC 55-51, and DKC 58-24 by October 7 (Table 1). It was an excellent environment for grain drying in the field.

**Table 1**. Corn hybrids, relative maturity, and grain moisture at selected dates before harvest from the nitrogen influence on corn study at the Southeast Research Farm in 2003.

| | | Sample date | | | |
|---|---|---|---|---|---|
| Hybrid | RM[1] | 9-15-03 | 9-25-03 | 10-1-03 | 10-7-03 |
| | | ------------------- % grain moisture[2] ------------------- | | | |
| DKC 44-46 | 94 | 29 | 25 | 19 | na |
| DKC 50-73 | 100 | >30 | 26 | 20 | na |
| DKC 53-34 | 103 | >30 | 27 | 22 | 19 |
| DKC 47-10 | 97 | 26 | 20 | na | na |
| DKC 55-51 | 105 | >30 | 30 | 26 | 18 |
| DKC 58-24 | 108 | >30 | 29 | 24 | 20 |

[1] relative maturity (days)
[2] composite sample of 4 replications from the recommended N rate (92 lbs/a)
na – not available

Grain yields were very high (Table 2). N rate was the only source of variation to significantly influence grain yield. Neither hybrid (Pr>F=0.50) nor the hybrid X N rate interaction (Pr>F=0.34) significantly influenced grain yield. Grain yield significantly increased with N rate up to the recommended rate (Figure 1). Grain yield from the highest N rate, was not significantly greater than the recommended rate. We conclude that the maximum yield was obtained with the recommended N rate.

**Table 2**. Grain yield of six corn hybrids from the N influence on corn study at the Southeast Farm in 2003.

| Hybrid (Pr>F = 0.50) | RM[1] | Grain yield[2] |
|---|---|---|
| | | bu/ac |
| DKC 44-46 | 94 | 162 |
| DKC 50-73 | 100 | 159 |
| DKC 53-34 | 103 | 162 |
| DKC 47-10 | 97 | 163 |
| DKC 55-51 | 105 | 153 |
| DKC 58-24 | 108 | 160 |
| LSD (.05) | | ns |

[1] relative maturity (days)
[2] adjusted to 15 %
Hybrid X N rate Pr>F = 0.34

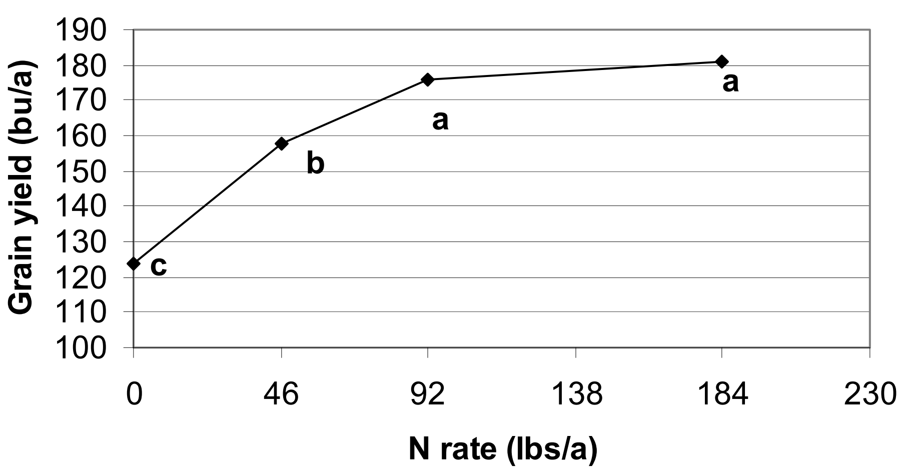


**Figure 1.** **Mean corn grain yield of 6 hybrids as influenced by N rate at the South East Farm in 2003.**


**ACKNOWLEDGMENTS**

This project partially funded by Monsanto and the South Dakota Agricultural Experiment Station.


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# INFLUENCE OF TILLAGE METHOD AND PREVIOUS CROP ON SOIL TEMPERATURE, EMERGENCE, PLANT POPULATION, GROWTH, AND YIELD FOR CORN

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**Plant Science 0312**

## INTRODUCTION

Farmers are confronted with many choices for tillage and planting methods. Reducing crop input costs is contributing to the discussions about reducing field operations, which reduces input costs and increases efficiency by enabling the farmer to cover more acres in the same amount of time. Changes that a farmer makes need to improve their bottom line. Even if a change doesn't result in a yield increase, efficiencies and cost savings can still lead to more profit. Therefore, a research study was initiated to determine the influence of tillage systems on corn production.

## MATERIALS AND METHODS

A site was selected in 2002 at the Southeast Research Farm that had not been tilled for a number of years. The crop growing was alfalfa. In preparation for the 2003 growing season, strips of corn, soybeans and wheat were planted in 2002 after the alfalfa had been desiccated with Roundup to set up the research plots for 2003. The plot design was Randomized Complete Block (RCB) with previous crop as the main block and tillage methods as the sub-blocks. The strips of corn, soybeans and wheat were harvested in preparation for plot establishment and planting for the 2003 growing season. The tillage methods included conventional tillage (CT), no-till (NT), and strip-till (ST). The CT was fall chisel plowed and spring cultivated. The ST was completed on selected plots Nov. 8, 2002. There were two ST methods with one receiving 46 lbs $P_2O_5$ as 0-46-0 with the ST operation. The ST P was applied approximately 7 inches beneath the soil surface. The NT plots had residue moved out of the row at planting with residue managers. Plots were 12-30 inch rows wide (30 feet), 48 feet in length, and included in four replications. Plots were planted on May 16, 2003 with a two-row planter to match the rows created by the 4-row strip till machine. At planting, 46 lbs/ac $P_2O_5$ was applied with the seed as 0-46-0 to all treatments but the ST that received $P_2O_5$ in the fall. The hybrid was DKC 58-24 and was planted at 29,991 seeds/ac. Soil temperature probes (Onset data loggers) were installed in the ST and NT plots of 3 replications on April 14. The probes were installed to measure temperatures at the 2.0 inch depth. Nitrogen (120 lbs N/ac) was side-dress applied as 28-0-0 at the 4-leaf stage. Two 10-foot sections of plot row were marked and emerged corn was counted at 11 and 13 days after planting. Final plant population was determined from the emerged corn plant counts. Eight plants from each plot were randomly selected at the V-6 growth stage (6-19-03), dried and weighed to determine the dry matter weight. Plant height was measured at V11 growth stage by measuring six plants in each plot. Grain from three center rows of each plot was harvested for determining yield. Dependent variable statistics was completed by SAS.

## RESULTS AND DISCUSSION

Soil temperatures were measured for 10 weeks and weekly means were calculated to make presentation of data easier. The general trend for soil temperatures was for the ST plots to have warmer soil temperatures when compared to the NT plots (Figure 1). Soil temperatures were generally warmer from plots following wheat as compared to plots following soybeans. There was much more residue cover on the soybean plots as compared to the wheat plots. The soybean yield in 2002 was 51.8 bu/ac while the spring wheat was not harvested due to late planting and hot mid-summer temperatures. The difference between soil temperatures of the ST and NT on previous crop wheat was probably due to weed canopies present in week 7 that got started on the NT plots and then subsequently died off from Roundup application (week 8), because the soil temperatures then came back up and were comparable with ST (Figure 1).

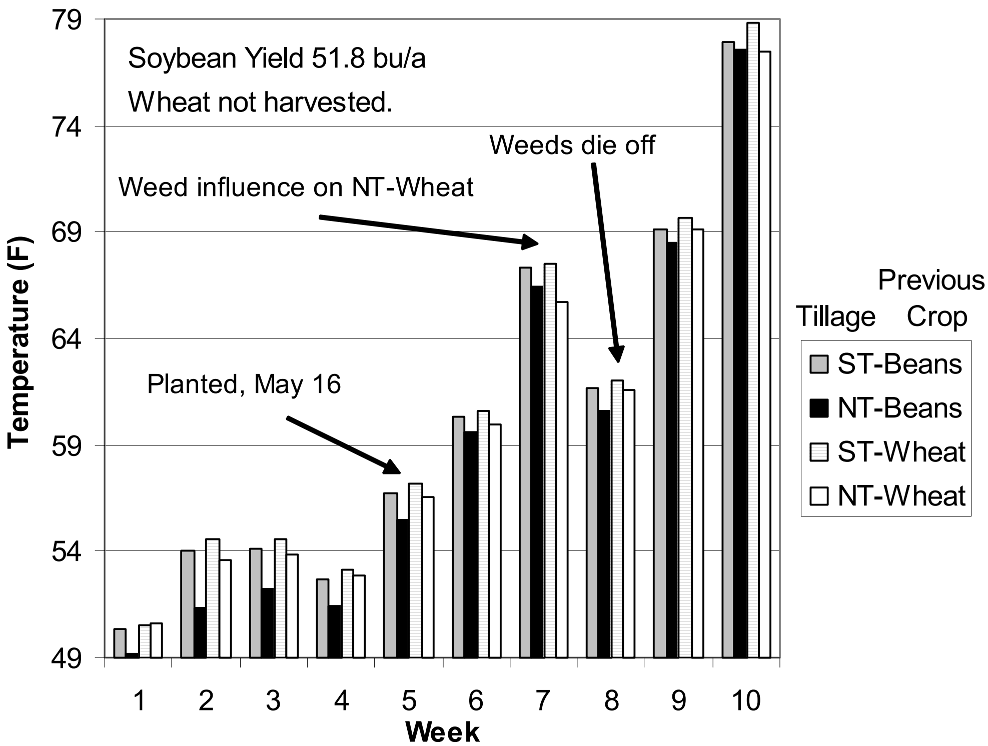


**Figure 1. Influence of tillage method and previous crop on 2 inch soil depth temperature at SE Research Farm in 2003.**

Tillage method did not significantly influence emerged corn 11 days after planting for either previous crop (Table 1). Previous crop did significantly influence corn emergence (Table 1). The soybean residue had significantly higher corn counts when compared to the wheat residue. Final plant populations were also not affected by tillage method but were influenced significantly by previous crop (Table 1).

**Table 1.** Corn emergence and final pant stand as influenced by tillage method and previous crop at the Southeast Research Farm; Beresford, SD; 2003.

| | Emerged Corn Plants[1] | | Final Plant Population[2] | |
|---|---|---|---|---|
| Tillage | Previous Crop | | Previous Crop | |
| Method | Soybean | Wheat | Soybean | Wheat |
| | % of final population | | plants/ac | |
| CT | 94 | 90 | 27,851 | 25,219 |
| ST | 90 | 85 | 28,728 | 26,535 |
| NT | 94 | 81 | 27,412 | 26,316 |
| $LSD_{(.05)}$ | ns | ns | ns | ns |
| Means | 93 | 85 | 27,997 | 26,023 |
| $LSD_{(.05)}$ (previous crop) | 5 | | 1493 | |

CT=conventional till, ST=strip till, NT=no-till
[1] measured 11 days after planting
[2] measured 13 days after planting

The V-6 plant sample weights showed what was seen in the field. The CT corn plants were much larger when compared to ST and NT (Table 2). The NT corn plants were significantly smaller when compared to ST and CT. This difference could have been due to the cooler soil temperatures in the NT plots. However, the soil temperature data does not show big differences between the ST and NT treatments. Perhaps the bulk soil temperature has more influence on corn development than just the temperature at the point where the seed is planted. There were no significant differences in V6 plant dry weights between the previous crops.

**Table 2.** Corn V6 dry weight as influenced by tillage method and P application timing at Southeast Farm; Beresford, SD; 2003.

| Tillage Method | P application[1] | V6 dry weight[2] |
|---|---|---|
| | | % of highest |
| CT | spring | 100 a |
| ST2 | spring | 86 b |
| ST1 | fall | 83 b |
| NT | spring | 68 c |
| LSD $_{(.05)}$ | | 10 |

CT = conventional tillage
ST = strip tillage, Nov. 8, 2002
NT = no-till
[1] applied at 46 lbs $P_2O_5$/ac as 0-46-0, applied with strip till applicator in fall or with seed at planting in the spring.
[2] means of both previous crops
Olsen P soil test 10 ppm (0-6 inch)

Plant height was not significantly different between the tillage methods with soybean as the previous crop. However, plant height was significantly less under wheat as intensity of tillage decreased (Table 3). Mean corn plant height of plants following spring wheat were significantly taller when compared to soybeans as the previous crop.

Tillage method did not significantly influence grain yield with either soybeans or wheat as the previous crop (Table 3). However, the corn grain yield means were less following soybeans compared to wheat. This could be due to storage of more soil moisture after wheat compared to soybean, especially since the wheat was not harvested.

**Table 3.** Corn plant height and grain yield as influenced by tillage method and previous crop at the Southeast Research Farm; Beresford, SD; 2003.

| Tillage Method | Corn Plant height[1] Previous Crop Soybean | Corn Plant height[1] Previous Crop Wheat | Corn Grain Yield[2] Previous Crop Soybean | Corn Grain Yield[2] Previous Crop Wheat |
|---|---|---|---|---|
| | ------- inches ------- | | bu/ac | |
| CT | 66 | 72 a | 135 | 166 |
| ST1 | 65 | 68 bc | 143 | 154 |
| ST2 | 66 | 69 ab | 149 | 160 |
| NT | 62 | 65 c | 141 | 158 |
| $LSD_{(.05)}$ | ns | 3 | ns | ns |
| Means | 64 | 68 | 142 | 159 |
| $LSD_{(.05)}$ (previous crop) | 3 | | 18[3] | |

CT=conventional till, ST1=strip till fall applied P, ST2=strip till spring applied P, NT=no-till

[1] measured at V11 growth stage

[2] adjusted to 15 % grain moisture

[3] LSD at the .10 probability level


## ACKNOWLEDGEMENTS

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SE FARM REPORT
SDSU

# FERTILIZER POTASSIUM, SULFUR, ZINC, PHOSPHORUS, BORON AND LIME EFFECTS ON SOYBEAN YIELD ON HIGH TESTING SOIL

J. Gerwing, R. Gelderman, A. Bly, and R. Berg

**Plant Science 0313**

## INTRODUCTION

Some farmers in South Dakota are using phosphorus, potassium, sulfur, zinc, or lime on soils with high soil tests. Research by soil fertility staff at South Dakota State University during the last 30 years has not shown consistent economical responses to these fertilizer nutrients or lime when soil test levels are high. Therefore, the SDSU Soil Testing Lab does not recommend fertilizer nutrient application unless soil test levels are lower. The studies reported here were established in 1988 and 1990 to determine the effects of each of these commonly used nutrients and lime on corn and soybean yields and soil test levels when applied to high testing soils.

## MATERIALS AND METHODS

Two experimental sites were established, one on the Southeast Research Farm near Beresford in 1988 and another on the Agronomy Farm near the SDSU campus in Brookings in 1990. Fertilizer treatments have continued at each location on the same plots since establishment. A corn-soybean rotation was followed at both locations. Soybean was the 2003 crop. The soil at the Southeast Farm site is an Egan silty clay loam. Egan soils are well drained soils formed in silty drift over glacial till. The soil at the Brookings Agronomy Farm is classified as a Vienna loam. Vienna soils are well-drained medium textured loam and clay loam soils formed from glacial till. Both soils are typical upland soils for their respective areas in the state. Fertilizer treatments were 50 lbs $K_2O$, 25 lbs sulfur (as gypsum), 5 lbs zinc (as zinc sulfate) and lime at both locations (Table 1). In addition, the Brookings site had a 40 lb $P_2O_5$ treatment and the Beresford site a boron treatment (2 lb/ac). The fertilizer treatments were applied each spring since the establishment year (1988 at Beresford and 1990 at Brookings) on the same plots. An exception is the boron treatment at Beresford, which was initiated in 1997. Lime was applied only twice (1988 & 2003) at the Southeast Farm location and twice (1990 & 1992) at Brookings. All fertilizer materials were broadcast and followed by either disking or field cultivation. Herbicides were applied as needed at both locations. A randomized complete block design with four replications was used at both sites. Plot size was 15 by 65 feet at Beresford and 20 by 40 feet at Brookings. Roundup ready soybeans were planted at both locations. Harvest was done with a field combine at Beresford and a plot combine at Brookings.

## RESULTS AND DISCUSSION

Soil test results from soil samples taken before 2003 fertilizer applications are presented in Table 2. Potassium soil tests were high at Brookings and in the very high range at Beresford. Adding 50 lb/ac of $K_2O$ per year since 1988 at Beresford and 1990 at Brookings raised the K soil test by 128 and 46 ppm respectively.

The sulfur soil test in the check plots was medium at Beresford and high at Brookings. Adding 25 lb/ac sulfur each year has had a residual effect of raising soil test 28 lb/ac at Beresford and 40 lb/ac at Brookings.

The zinc soil test in the check was medium at Beresford (0.63 ppm) and high at Brookings (0.96). Applying 5 lb/ac zinc each year raised the soil test to 6.60 and 10.50 ppm at Beresford and Brookings respectively.

The lime treatments made at the beginning of this study still had residual effect on pH this year. The check pH at Beresford was 5.8 and where lime was applied it was 6.0. At Brookings the check pH was 6.2 and limed treatments 6.6. At the Beresford site, 4000 pounds of lime (3800 lb calcium carbonate equivalent) was applied to the lime treatment in spring to raise the pH again. Fall 2003 soil sampling showed the pH increased to 6.8.

The phosphorus soil test level at the Brookings site was 11 ppm without the phosphorus applications. The 40-lb/ac annual phosphorus applications raised the Olson soil test level to 40 ppm. There was no phosphorus treatment at Beresford.

The 2 lb/ac boron treatment started at Beresford in 1997 raised the boron soil test from 0.91 ppm to 1.73 ppm. The check soil test was in the high range (>0.50 ppm) and no boron would have been recommended.

Soybean yields averaged 32 bu/ac at Beresford and 36 bu/ac at Brookings (Tables 3 and 4). Moisture stress in late July and August at both sites reduced potential yield. Fertilizer treatments did not significantly increase yield at either location. Since soil test levels were high or very high for the nutrients tested at these two locations, little or none of the nutrients in question would have been recommended and no response expected.

Yield results and soil test levels from previous years for these two studies can be found in the Southeast Farm Progress Reports (1988-2002) and in the 1988-2002 SDSU Plant Science Department Soil/Water Science Research annual report, Technical Bulletin Nos. 97 or 99.

**Table 1.** Fertilizer Treatments, Fertilizer and Lime Demonstration, Beresford and Brookings, 2003.

| Treatment | Fertilizer Rates | |
|---|---|---|
| | Beresford[1] | Brookings[2] |
| | - - - - - - - - - - - - - - - lb/ac - - - - - - - - - - - - - - - - - | |
| Check | 0 | 0 |
| Phosphorus ($P_2O_5$) | -----[3] | 40 |
| Potassium ($K_2O$) | 50 | 50 |
| Sulfur | 25 | 25 |
| Zinc | 5 | 5 |
| Boron | 2 | -----[3] |
| Lime | -----[4] | -----[5] |

[1] Applied each spring, 1988-2003 except boron applied only since 1997.
[2] Applied each spring, 1990-2003.
[3] Not a treatment at this location.
[4] 4000 lb and 3800 lb $CaCO_3$ equivalent applied spring 1988 and 2003 respectively.
[5]2500 lb and 2400 lb $CaCO_3$ equivalent applied spring 1990 and 1992 respectively.

**Table 2.** Soil Test Levels, Fertilizer and Lime Demonstration, Beresford and Brookings.

| Soil Test | Soil Test Level | | | |
|---|---|---|---|---|
| | Beresford[1] | | Brookings[2] | |
| | Check | Treatment | Check | Treatment |
| Potassium ppm | 183 | 311 | 127 | 173 |
| Sulfur, lb/ac, 0 - 6 in | 4 | 8 | 4 | 12 |
| lb/ac, 6 - 24 in | 18 | 42 | 28 | 60 |
| Zinc, ppm | 0.63 | 6.60 | 0.90 | 10.50 |
| pH | 5.8 | 6.0 | 6.2 | 6.6 |
| Olson Phosphorus, ppm | 17[3] | ----- | 11 | 40 |
| Boron | 0.91 | 1.73 | ----- | ----- |
| $NO_3$-N, lb/A 2 ft | 58 | ----- | 78 | ----- |
| Organic Matter, % | 3.0 | ----- | 3.0 | ----- |
| Salts, mmho/cm | 0.4 | ----- | 0.4 | ----- |

[1]Sampled 11/07/02
[2]Sampled 11/04/02
[3]160 lb $P_2O_5$ applied 11/19/01 and 4/01/03

**Table 3**. Fertilizer Effects on Soybean Yield, Beresford, 2003.

| Fertilizer Treatment | Yield |
|---|---|
| | bu/ac |
| Check | 31 |
| Potassium | 32 |
| Sulfur | 32 |
| Zinc | 31 |
| Boron | 32 |
| Lime | 32 |
| Prob of > F | 0.99 |
| C.V. % | 7.1 |
| LSD .05 | NS |

**Table 4.** Fertilizer Effects on Soybean Yield, Brookings, 2003.

| Fertilizer Treatment | Yield |
|---|---|
| | bu/ac |
| Check | 38 |
| Phosphorus | 34 |
| Potassium | 37 |
| Sulfur | 36 |
| Zinc | 36 |
| Lime | 36 |
| Prob of > F | 0.05 |
| C.V. % | 4.0 |
| LSD .05 | 2.2 |

SE FARM REPORT

SDSU

# NITROGEN MANAGEMENT IN A CORN SOYBEAN ROTATION

J. Gerwing, R. Gelderman, A. Bly, and R. Berg

**Plant Science 0314**

## INTRODUCTION

There is increasing concern about the effects of nitrogen fertilizer on the environment, especially ground water quality. This concern has been intensified by reports of $NO_3$ - N of greater than10 ppm in several locations in eastern South Dakota, especially where aquifers are shallow and soils are very coarse. In some instances, nitrogen fertilizer moving below the root zone has been implicated.

This nitrogen management experiment was established to study the effects of N rates in a corn-soybean rotation on nitrogen movement below the root zone. The typical rooting depth of corn, soybeans and wheat in South Dakota is four to five feet. In most situations in South Dakota, if nitrogen moves below the root zone it stays there and only rarely moves back up. Therefore, once out of reach of crop roots, nitrate has the potential to move down to the groundwater with percolating water during wet periods.

## MATERIALS AND METHODS

This nitrogen management experiment was established on the Southeast Research Farm near Beresford in 1988. It is located on an Egan silty clay loam soil. Egan soils are well drained soils formed in silty drift over glacial till.

Corn was planted on the site in even numbered years since 1988 and soybean was planted in the odd numbered years. The rates and timing of nitrogen fertilizer applied to the corn in 2002 are listed in Table 1. The treatments included a check (no N), the recommended rate applied in fall, spring or split between spring and 6 leaf stage and 200 and 400 lb rates spring applied regardless of the previous soil test. These treatments were applied to the same plots each year that corn was planted in the rotation. The recommended rate was adjusted according to the $NO_3$ - N soil test level and for credit given because of the previous years' soybeans (1 lb N credit for 1 bushel beans). The recommended nitrogen rate was 123, 62, 90, 95, 95, 110, 125, and 90 lb/ac respectively for the even numbered years 1988 through 2002. Nitrogen was broadcast as urea and immediately incorporated by tillage except the fall application was not incorporated until the following spring. The June portion of the split application was surface broadcast ammonium nitrate. Ammonium nitrate was used for this treatment to prevent volatilization losses. Years when soybeans were planted (odd numbered years) no nitrogen fertilizer was applied.

Phosphorus, potassium and pH soil test levels at the site are 17 and 247 ppm and 5.7 respectively. One hundred sixty pounds $P_2O_5$ was broadcast in the fall of 2001 and spring 2003 as 0-46-0 to raise the phosphorus soil test. A randomized complete block design was used on the experiment with four replications. Plot size was 15 feet by 65 feet. On May 22 roundup ready soybeans (DKB 21-51 RR) were planted in 30-inch rows after tillage with an airway. No fertilizer was applied at planting. Plots were harvested with a field combine. Soil samples were taken to a depth of six feet in one-foot increments on October 15, 2003. Only the 0, spring recommended (90 lb rate), 200 and 400 lb/ac N rates were soil sampled.

## RESULTS AND DISCUSSION

Hot dry conditions during the last half of July and August caused drought stress that reduced yields to an average of 32 bushels per acre (Tables 2 and 3). Nearly 6 inches of rain fell in September but it was too late for the soybeans. Yields were not influence by varying nitrate nitrogen carry over levels from the previous corn crop even though nitrate levels ranged from a low of 32 lb per acre two feet where so N had been applied to a high of 238 pounds where 400 lb of N had been applied to the previous corn crop. The lack of response was consistent with other nitrogen rate studies on soybeans in South Dakota.

Nitrate soil test levels from samples taken to a depth of 6 feet in the fall of 2002 and 2003 are listed in table 4. Nitrate soil test levels in the check where no N has been applied since 1986 increased 82 pounds in the 6 foot soil profile between the fall of 2002 and 2003. Mineralization of organic N during wet periods in early summer and September (Table 3) and lower than normal soybean yields were likely the cause of this increase. Similar increases in nitrate soil test were measured in the recommended N (90 lb rate) treatment. The higher carry-over N soil tests from the 200 and 400 pound fertilizer rates applied in 2002 were reduced dramatically during the 2003-growing season. The 238 lb/ac 2 foot soil test in the fall of 2002 from the high N treatment was reduced by 166 pounds during the 2003 growing season. Soybean crop removal (3.7 lb/bu gain) was likely responsible for much of the soil test reduction since soybeans do not fix N if soil nitrate is available. Some nitrate may also have been moved out of the top two feet by leaching. Soil samples taken in the 400 pound N treatment on May 29 after six inches of precipitation during April and May show 100 pounds of N moved out of the top foot into the 2nd and 3rd foot depths (Table 5). In addition, 10 inches of rain fell in June and July which may have also moved N down through the profile, however movement may have been minimal during this period since the fall soybean canopy likely transpired most of this water, reducing the leaching potential. Some nitrate did move below the root zone, however, since the fall 2003 nitrate soil test in the 4 to 6 foot depth was 74 pounds high than in the fall of 2002.

These plots will be rotated back to corn in 2004 with nitrogen fertilizer rates applied similar to previous corn years and soil samples taken in the fall to a depth of 6 feet to determine carry-over N levels and possible losses by leaching. Corn and Soybean yields and soil tests from previous years of this study can be found in the Southeast Farm Progress Reports and in the Plant Science Dept Soil/Water Science Research Annual Reports.

**Table 1**. Nitrogen Fertilizer Treatments Applied in 2002, Nitrogen Fertilizer Management Study, Beresford, SD.

| | Time of Application | | |
|---|---|---|---|
| Treatment | Spring[1] | Split[2] | Fall[3] |
| No. | ---------- lb N/ac ---------- | | |
| 1 | 0 | ----- | ----- |
| 2 | 90 | ----- | ----- |
| 3 | 30 | 60 | ----- |
| 4 | ----- | ----- | 90 |
| 5 | 200 | ----- | ----- |
| 6 | 400 | ----- | ----- |

[1] May 10, 2002
[2] June 20, 2002
[3] November 16, 2001

**Table 2.** Nitrogen Management Study Soybean Yields, Southeast Experiment Farm, Beresford, 2003

| Nitrogen | | Soybean |
|---|---|---|
| Time | Rate (2002) | Yield |
| | lb/ac | bu/ac |
| Check | 0 | 31 |
| Fall[1] | 90 | 32 |
| Spring[2] | 90 | 32 |
| Split[3] | 90 | 31 |
| Spring | 200 | 33 |
| Spring | 400 | 32 |
| Pr > F | | 0.94 |
| CV% | | 7.0 |
| LSD .05 | | NS |

[1] Fall = 11/16/02
[2] Spring = 5/10/02
[3] Split = 30 lb 5/10/02, 60 lb 6/20/02

**Table 3**. Rainfall at the Southeast Experiment Farm, Beresford, Nov. 1, 2002 to Oct. 31, 2003.

| Nov[1] | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ------inches------ | | | | | | | | | | | |
| 0.12 | 0.12 | 0.29 | 0.62 | 1.00 | 2.88 | 3.21 | 5.03 | 5.04 | 1.37 | 5.92 | 0.80 |

**Table 4**. Fall Nitrate Soil Test Levels, Nitrogen Management Study, Beresford, SD.

| | Fertilizer N Applied, lb/ac, even years, 1988 through 2002 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | - - - - 0 - - - - | | Recommended[1] | | - - - 200 - - - | | - - - 400 - - - | |
| Depth | 2002 | 2003 | 2002 | 2003 | 2002 | 2003 | 2002 | 2003 |
| feet | - - - Soil $NO_3$ - N, lb/ac[2] - - - | | | | | | | |
| 0 – 1 | 24 | 34 | 26 | 38 | 134 | 28 | 180 | 46 |
| 1 - 2 | 8 | 28 | 15 | 22 | 33 | 18 | 58 | 26 |
| 2 – 3 | 7 | 25 | 11 | 25 | 15 | 33 | 41 | 67 |
| 3 – 4 | 6 | 20 | 15 | 27 | 26 | 41 | 76 | 70 |
| 4 – 5 | 7 | 18 | 17 | 30 | 38 | 49 | 86 | 115 |
| 5 - 6 | 9 | 18 | 19 | 32 | 41 | 58 | 97 | 142 |

[1] Rates applied were 123, 62, 90, 95, 95, 110, 125, and 90 lb N/a in spring of 1988, 1990, 1992, 1994, 1996, 1998, 2000, and 2002 respectively.
[2] Soil sampling dates: Nov 7, 2002, Oct 15, 2003

**Table 5.** Nitrate Soil Test Levels from Various Dates for the 400 Pound Nitrogen Rate Treatment, Nitrogen Management Study Beresford, 2003

| | Soil Sampling Date | | | |
|---|---|---|---|---|
| Depth | Nov 7, 2002 | May 29, 2003 | July 10, 2003 | Oct 15, 2003 |
| ft | ------lb/ac------ | | | |
| 0-1 | 180 | 81 | 52 | 46 |
| 1-2 | 58 | 129 | 72 | 26 |
| 2-3 | 41 | 104 | 76 | 67 |
| 3-4 | 76 | 73 | 64 | 70 |
| 4-5 | 86 | - | 72 | 115 |
| 5-6 | 97 | - | - | 142 |

# FOLIAR NUTRIENT APPLICATION INFLUENCE ON SOYBEAN YIELD, AURORA AND BERESFORD, 2003

J. Gerwing, A. Bly, R. Gelderman, and R. Berg

**Plant Science 0315**

## INTRODUCTION

Foliar application of macronutrients such as nitrogen, phosphorus and potassium on soybeans has been tried numerous times in experiments without consistent success. In recent years, however, there has been renewed interest by growers in foliar nutrient applications, especially micronutrients. The interest is likely fostered, in part, by the movement to Roundup Ready soybeans. With the Roundup program, the producer will probably have to spray his soybeans a second time anyway, making the addition of nutrients to the spray appealing since there would be no real cost for the application, only for the added nutrients. In some cases, the materials come as a package, consisting of two or more micronutrients and are applied regardless of soil test levels for the nutrients in the material or an identified need. The objective of the study was to determine if one of these materials would have an effect on soybean yield.

## MATERIAL AND METHODS

A site on each SDSU experiment farm near Aurora and Beresford was selected. Both sites were in a corn soybean rotation. Soil at the Aurora site was medium to coarse textured overlying gravel at four feet. It is typical of the irrigated soils in Brookings County, however this experiment was not irrigated. Soil at Beresford was fine textured heavy soil typical of upland glacial till derived soil in Southeast SD. Composite soil samples from the 0-6 inch depth were taken from both sites and analyzed for nitrate-N, P, K, pH, salts, zinc (Zn), iron (Fe), manganese (Mn), copper (Cu), sulfur (S), chloride (Cl), calcium (Ca), magnesium (Mg), sodium (Na), boron (B) and cation exchange capacity (CEC). Asgrow 1401 RR soybeans were no till planted with a drill at Aurora. The site at Beresford was fall chiseled and finished with field cultivation in spring prior to planting DKB 24-51 RR soybeans in 30-inch rows. All plots at both locations were sprayed with roundup at the V1-V2 stage for early weed control. Foliar micronutrients were not applied at this time since very little foliage was present to intercept the fertilizer.

Micronutrient foliar treatments were applied at R-2 growth stage that was July 15 at Aurora and June 30 at Beresford. The micronutrient fertilizers used were Crop Booster, a product sold by Agriliance and Foliar Plus sold by Profit Pro (Albert Lea, MN). The Crop Booster contained 3.20% manganese, 2.10% zinc, 0.30% iron, 0.20% boron, and 0.01% molybdenum and was sprayed at a rate of 1 qt/ac. Foliar Plus was applied at 2 gpa and contained 2 % nitrogen, 3 % phosphorus, 2 % potassium, and micro-nutrients (copper, iron, manganese, molybdemum and zinc). Before adding the Foliar Plus to the spray tank, table vinegar (1 gal/100 gal spray) was added to adjust the pH of the spray water. The normal pH of the water used was 8.3 with 0.6 mmohs salts. Two common fertilizers (9-18-9 and 7-21-7) were also included in the treatments and applied at 2 gpa. The last treatment was herbolyte, which is sold by Profit Pro (Albert Lea, MN). It replaces the AMS that would be added to the spray water with Roundup Ultra Max. It was mixed with the spray water at 1% concentration. Treatments were applied in the afternoon at both locations with a hooded sprayer using 20 psi with a 10 gallon per acre spray rate. Water was the carrier for all treatments. Air temperatures were in the mid to upper 80's with a clear sky. Although soil moisture conditions were getting dry, soybeans were growing well at the time of application and showed no visible sign of wilting. The dry conditions after the first roundup application to all plots and the micronutrient treatments prevented further weed germination. Plots at Beresford were harvested with a field combine. At Aurora, the middle five feet of each plot was harvested with a plot combine. Plot size was15 feet by 55 feet at Beresford and 15 feet by 35 feet at Aurora. All treatments were replicated four times in a randomized complete block design.

## RESULTS AND DISCUSSION

Soil test results did not reveal any nutrient that would severely limit soybean growth and yield except P at Aurora (Table 1). This is evident in that the grain yields are quite respectable for 2003, a year in which soybeans yielded below average. However, if there was going to be a response to applied nutrients it would have been at the Aurora site, because the P soil test was in the very low soil test category (Table 1). Applications of 7-21-7, 9-18-9 and Foliar Plus could result in increased soybean yield at the Aurora site because they contain P.

Visual observation in the weeks following the Roundup and micronutrient application did not reveal any obvious increases in plant growth or changes in plant color. No injury from the applications was noted. Soybean grain yields averaged 37 bu/ac at each location (Table 2) and were not influenced by the foliar application of nutrients or herbolyte at either location.

**Table 1**. Soil test results for 0-6 inch soil samples from the foliar feeding research projects at the Southeast Farm (Beresford) and Aurora in 2003.

| | Soil Parameter | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Site | pH | EC | $NO_3$-N | Olsen P | K | S | Zn | Ca |
| | | mmho/cm | ppm | | | | | |
| Beresford | 6.6 | 0.5 | 17[a] | 19 VH | 533 VH | 2[a] | 0.99 H | 2030 VH |
| Aurora | 5.4 | 0.4 | 20[a] | 3 VL | 147 H | 12[a] | 0.90 H | 1697 VH |
| | Soil Parameter | | | | | | | |
| | Fe | Mn | Cu | Cl | Mg | Na | B | CEC |
| | ppm | | | | | | | |
| Beresford | 93 H | 43 H | 1.2 H | 1[a] | 444 VH | 5[b] | 0.74 H | 20[b] |
| Aurora | 77 H | 38 H | 0.9 H | 4[a] | 414 VH | 5.8[b] | 0.58 H | 21[b] |

a requires a 2 foot soil sample
b no soil test categories
VL=very low, H=high, VH=very high soil test categories

**Table 2.** Influence of Foliar Nutrient Application on Soybean Yield, Near Aurora and Beresford, SD, 2003.

| | Grain Yield | |
|---|---|---|
| Treatment[1] | Aurora | Beresford |
| | bu/ac | |
| Check | 37 | 37 |
| 9-18-9[2] | 38 | 37 |
| 7-21-7[3] | 37 | 36 |
| Crop boost (1 qt/a)[4] | 39 | 34 |
| Foliar Plus[5] | 39 | 38 |
| Herbolyte[6] | 35 | 39 |
| Statistics: | | |
| Pr>F | 0.70 | 0.43 |
| CV | 8.3 | 8.9 |
| LSD .05 | NS | NS |

[1] all plots except herbolyte sprayed with 26 oz/a Roundup Ultra Max before treatment application.
[2] 2 gpa 9-18-9 sprayed as 10 gpa with water.
[3] 2 gpa 7-21-7 sprayed as 10 gpa with water.
[4] 1 qt/a crop boost sprayed as 10 gpa with water.
[5] 2 gpa foliar plus sprayed as 10 gpa with water. 10 oz table vinegar added first to adjust pH.
[6] 1% herbolyte instead of AMS sprayed with Roundup Ultra Max (26 oz/a)

SE FARM REPORT
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# INFLUENCE OF GYPSUM ON CROP YIELDS

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**Plant Science 0316**

## INTRODUCTION

Gypsum, calcium sulfate ($CaSO_4 .2H_2O$), is a naturally occurring mineral that is mined for many purposes. Gypsum has a calcium content of 23% and a sulfur content of 19%. In agriculture it is used for treating sodium affected soils. The calcium in the applied gypsum will displace sodium on the soil cation exchange capacity. This is a mass action process; therefore large amounts of calcium are required. Drainage within the soil profile must also occur for the displaced sodium to be leached out of the soil profile. Sodium is part of soil salt compounds (NaCl, $Na_2SO_4$ and $Na_2CO_3$). Many other forms of soil salts also exist (KCl, $MgCl_2$, $CaCl_2$, $MgSO_4$, and $CaSO_4$). Gypsum can also be used to supply sulfur although this is usually an expensive source. Questions about the effectiveness of gypsum in alleviating salt effects are common as well as its efficacy for typical soils. Therefore this study was conducted to determine if gypsum could significantly increase crop yields on saline and non-saline soils.

## MATERIALS AND METHODS

Long term Studies
Southeast Farm – West, corn:

A research site was selected on the northwest quarter of the Southeast Research Farm located near Beresford SD. This is the second year for the experiment. The 2002 crop was soybean. Conventional tillage practices have been used on this site whenever possible. Areas of this site have wet soils in some years and there is significant white salt formation on the soil surface of the lower areas when the soil dries. During some years, crop emergence is affected by the salty soil conditions. Gypsum rates including a control were randomized in four replications. The gypsum rates were 0, 300, and 1500 lbs/ac and applied in a pellet form with a Gandy Orbit Air applicator and incorporated with a field cultivator in 2002. In spring of 2003 soil samples (0-6 and 6-12”) were taken from each plot to compare effects of 2002 treatments on selected soil tests (Table 1). After sampling, the 300 lb/ac gypsum treatment was reapplied. Plots measured 15 x 300 feet. No phosphorus or potassium was applied, because soil tests indicated these nutrients were not limiting. Dekalb corn hybrid DKC58-24 was planted on April 29 at 27,900 seeds/ac. Recommended nitrogen for 150-bu/ac yield goal was knife applied as UAN (28-0-0) at the five-leaf stage of growth. The whole plot was harvested with a field scale combine on October

14. The salt effect on plant growth was extremely variable and resulted in many areas where little or no corn grain was produced especially in reps 3 and 4 (east side).

Southeast Farm – East, soybeans:

A research site was selected on the northeast quarter of the Southeast Research Farm located near Beresford SD. This site has been managed as a corn/soybean rotation. Conventional tillage practices have been used on this site that consists of chisel plowing in the fall and field cultivation in the spring. There is some white salt formation at the soil surface after the surface dries. Gypsum rates including a control were randomized in three replications. The gypsum rates were 0, 300 and 1500 lbs/ac and applied in a pellet form with a Gandy Orbit Air applicator and incorporated with a field cultivator in 2002. In spring of 2003, composite soil samples from the 0-6, and 6-12 inch soil depths were obtained to compare effects of 2002 treatments on selected soil tests (Table 1). The soybean variety SOI 226RR was drilled in 7.5-inch rows on May 22. Plot size is 15 x 40 feet. No phosphorus or potassium was applied because soil tests were not limiting for these nutrients. Roundup was applied on June 11 and 5.8 oz/ac of Asana was used to control soybean aphid on August 29. The center 12.5 feet of the plot was harvested with a field scale plot combine on October 10.

Other sites

Two spring wheat sites (Brookings and Brown Co.) and two corn sites in Brown Co. were selected to determine the influence of broadcast gypsum on grain yields. The sites had typical soil test levels for nutrients and salts (Table 2). Standard production practices were used at all sites.

## RESULTS

Gypsum application increased calcium and sulfate levels in the Southeast study soils (Table 1). In addition the 1500 lb/ac gypsum rate increased soil salt concentrations one year after application. Gypsum had no effect on soil pH or sodium adsorption ratio. Sodium in the 0-6 inch depth was not high enough to be a problem (SAR > 15). The SAR is high in the 6-12 inch sample; however added gypsum had no effect here either (data not shown). Added gypsum would not be expected to lower sodium levels as calcium levels are already very high. The problem at this site is high water tables that keep sodium from moving down out of the soil profile.

Corn grain yield was not influenced by added gypsum (Table 3). Soybean grain yield was also not influenced by added gypsum (Table 3). There was no influence of gypsum on grain yields at the other sites (Tables 4 and 5). In five of the six sites, there appears to be a slight decrease to added gypsum. This is probably not a real affect. The lack of response to added gypsum in 2003 agrees with the results of four study sites in 2002.

## CONCLUSIONS

Gypsum applications are not recommended for typical soils or for salt-affected soils. For gypsum to be effective for sodium-affected soils, adequate subsurface drainage must be present.

**Table 1.** Influence of 2002 gypsum treatments on soil test results, Beresford SD, 2003.

| Gypsum Rates | Soil Test[1] Parameter | | | | |
|---|---|---|---|---|---|
| | pH | Salts[2] | SAR[3] | Calcium | Sulfate-S |
| lb/ac | | mmho/cm | | ppm | lbs/ac in 2' |
| | ------------ Southeast Farm – West ------------ | | | | |
| 0 | 7.4 | 3.27 | 2.2 | 2345 | 145 |
| 300 | 7.5 | 3.21 | 2.6 | 2583 | 158 |
| 1500 | 7.6 | 4.07 | 2.5 | 2803 | 195 |
| | ------------ Southeast Farm – East ----------- | | | | |
| 0 | 6.1 | 0.86 | 0.3 | 2262 | 240 |
| 300 | 5.9 | 0.86 | 0.3 | 2414 | 460 |
| 1500 | 6.0 | 1.60 | 0.2 | 2707 | 674 |

[1] 0-6 inches, sampled on 4/1/03

[2] saturated paste method (electrical conductivity)

[3] sodium adsorption ratio

**Table 2.** Soil tests for gypsum sites, 2003.

| Site | OM | Nitrate-N | Sulfate-S | Olsen P | K | pH | Salts 1:1 |
|---|---|---|---|---|---|---|---|
| | % | ----lb/ac in 2 feet ----- | | ---------- ppm ----- | | | mmho/cm |
| Brookings-wheat | 3.5 | 16 | 32 | 23 | 211 | 5.4 | 0.3 |
| Brown - wheat | 4.5 | 135 | -- | 59 | 999 | 6.7 | 0.5 |
| Brown corn site1 | 3.4 | 123 | 514 | 11 | 555 | 6.7 | 0.6 |
| Brown corn site2 | 3.6 | 122 | 24 | 22 | 521 | 6.6 | 0.6 |

**Table 3.** Influence of gypsum rate on corn and soybean grain yield near Beresford SD; 2003.

| Gypsum Rate | SE - West Corn grain yield | SE - East Soybean grain yield |
|---|---|---|
| lbs/ac | --------bu/ac ------- | |
| 0 | 108 | 39 A |
| 600[1] | 101 | 34 B |
| 1500[2] | 98 | 35 AB |
| Statistics | | |
| Pr > F | 0.56 | 0.08 |
| LSD (.05) | NS | 4.6 |
| C. V. % | 12.3 | 10.4 |

[1] 300 lb applied in 2002 and 2003
[2] applied in 2002

**Table 4**. Gypsum Influence on Spring Wheat yield, South Dakota, 2003

| Gypsum Rate | Brookings Co. | Brown Co |
|---|---|---|
| lb/ac | ——— bu/ac ——— | |
| 0 | 74 | 67 |
| 140 | 67 | -- |
| 300 | -- | 65 |
| Sig .05 | NS | NS |

**Table 5.** Gypsum Influence on Corn grain yield, Brown Co., South Dakota, 2003

| Gypsum Rate | Site 1 | Site 2 |
|---|---|---|
| lb/ac | ——— bu/ac ——— | |
| 0 | 204 | 181 |
| 300 | 189 | 184 |
| Sig .05 | NS | NS |

# SOYBEAN CYST NEMATODE STUDIES, 2003

J. D. Smolik

**Plant Science 0317**

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## OBJECTIVES

Continue survey for soybean cyst nematode (SCN) in South Dakota.
Determine effect of SCN on soybean yields.
Evaluate experimental lines for sources of SCN resistance.

## RESULTS

**Survey:**

Approximately 750 samples were processed for SCN over the 2003 season, and 32% of the samples were positive for SCN. The majority of the samples were received from southeastern SD, especially Union, Clay, Lincoln, and Turner counties. The nematode was not detected in any new counties and the number of counties where SCN has been found remains at eighteen. Several new locations for SCN were detected this year, and in several instances the populations of SCN were very high and crop damage was noted.

**Field Plots:**

A field heavily infested with SCN was planted to alfalfa in 1998. Population density of SCN was measured each fall (Table 1). Numbers of SCN dropped by a third over the first growing season. Over the next two seasons numbers remained at about 90% less than the original population. Six years after planting alfalfa, populations of SCN had dropped below the detection level (Table 1).

A field scale irrigated strip test was conducted in a cooperator's field in Turner County. Yields of the resistant varieties were significantly higher than the susceptible (Table 2). Yield increases ranged from 25 to 48%, and population densities of SCN were greatly reduced on all of the resistant entries.

A second strip trial was conducted in a non-irrigated field in Clay County. The susceptible variety was severely damaged by SCN (Table 3). Population development of SCN was suppressed by all the resistant entries.

**Table 1.** Populations of SCN in an infested field rotated to alfalfa in 1998, Turner County.

| ------------- Year ------------- | | | | | |
|---|---|---|---|---|---|
| 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
| 1880\[a] | 317 | 330 | 75 | 100 | 0 |

[a]/ No. of SCN eggs + J-2/100cm$^3$ soil. Average of 3 replications. Population density of SCN at planting (spring 1998) was 3130 eggs + J-2/100 cm$^3$ soil.

**Table 2**. Soybean yields and SCN populations—Tri-Ag Plot, Turner County.

| **Entry** | **Response to SCN** | **Yield (Bu/ac)** | **No. of SCN eggs + J-2 per 100cm$^3$ soil at harvest\[a]** |
|---|---|---|---|
| Pioneer 92 B74 | S | 39.6\[b] | 16,500 |
| Pioneer Exp I | R | 58.8 | 300 |
| Pioneer 92 M50 | R | 58.3 | 600 |
| Mustang Exp I | R | 57.7 | 200 |
| DeKalb 27-51 | R | 57.7\[c] | 325 |
| Mustang Exp II | R | 57.5 | 50 |
| Pioneer 92 B95 | R | 57.2 | 250 |
| Prairie Brand 2592 | R | 56.9 | 50 |
| Pioneer 92 B62 | R | 56.3\[b] | 200 |
| Mustang Exp III | R | 56.3 | 100 |
| DeKalb 24-51 | R | 56.0\[c] | 175 |
| Garst 2812 | R | 55.6 | 50 |
| Pioneer 92M70 | R | 55.4 | 400 |
| Mustang 194N RR | R | 55.1 | 250 |
| Pioneer Exp II | R | 55.0 | 100 |
| Asgrow 2705 | R | 52.0 | 350 |
| Pioneer 92M30 | R | 49.5 | 200 |
| | | lsd .05= 4.5\[d] | |

\[a] Population density of SCN at planting was 2760 eggs + J-2 per 100 cm$^3$ soil.
\[b] Average of three replications.
\[c] Average of two replications.
\[d] Based on the replicated entries.

**Table 3.** Soybean yields and SCN populations—Vermillion Fertilizer plot, Clay County.

| Entry | Response to SCN | Yield (Bu/ac) | No. of SCN eggs + J-2 per 100cm$^3$ soil at harvest[a] |
|---|---|---|---|
| Garst 2677 | S | 2.8 | 28,200 |
| Garst 3112 | R | 23.7 | 2000 |
| Garst 2812 | R | 21.4 | 950 |
| Garst 2912 | R | 20.9 | 600 |
| Golden Harvest 2991 | R | 20.8 | 1950 |
| SOI 2858 | R | 20.7 | 850 |
| Golden Harvest 2748 | R | 19.8 | 1150 |
| Latham 957 | R | 18.5 | 1750 |
| NK 26-H2 | R | 18.5 | 1100 |
| Latham Exp. | R | 18.4 | 1700 |
| SOI 2642 | R | 18.1 | 1200 |
| DeKalb 26-52 | R | 18.0 | 1675 |
| Garst 2612 | R | 17.6 | 1050 |
| DeKalb 26-51 | R | 17.4 | 1500 |
| SOI 2042 | R | 16.1 | 1450 |
| SOI 2221 | R | 15.3 | 1350 |

[a] Average population density of SCN at planting was 1350 eggs + J-2 per 100 cm$^3$ soil.

Soybean yields and SCN populations were measured in a third strip trial in Union County. The performance of the resistant varieties was variable. Several of the resistant entries yielded significantly higher than the susceptible, whereas others did not (Table 4). The effects of the resistant entries on population densities of SCN were also variable. Populations of SCN on the resistant varieties were lower than the susceptible at harvest, but in many instances were still at high levels.

**Table 4.** Soybean yields and SCN populations—Ray Hall test, Union County.

| Entry | Response to SCN | Yield (Bu/ac) | No. of SCN eggs + J-2 per $100 cm^3$ soil at harvest[a] |
|---|---|---|---|
| Asgrow 2602 | S | 38.6[b] | 15,280 |
| Garst 2812N | R | 41.3 | 1467 |
| DeKalb 26-52 | R | 46.1 | 950 |
| Shillinger 300R | R | 50.2[c] | 1100 |
| SOI 2642N | R | 47.8 | 4200 |
| Stine 2342 | R | 44.8 | 950 |
| Golden Harvest 2811 | R | 43.9 | 6350 |
| Prairie Brand 2821 | R | 43.8 | 1650 |
| Stine 1902-4 | R | 43.0 | 1450 |
| Prairie Brand 2520N | R | 42.7 | 2350 |
| Jacobsen 823N | R | 42.1 | 2700 |
| Pioneer 92B52 | R | 42.0 | 800 |
| Great Lakes 2709 | R | 41.6 | 950 |
| Schillinger 272RC1 | R | 41.5 | 550 |
| Pro Partners 3322N | R | 41.3 | 3100 |
| Garst 2612N | R | 40.6 | 2150 |
| Pioneer 92B62 | R | 40.1 | 3350 |
| Stine 1962 | R | 40.0 | 1250 |
| Garst 2912N | R | 38.6 | 3600 |
| Latham Exp. | R | 37.3 | 3550 |
| Great Lakes 2419 | R | 36.9 | 2650 |
| Jacobsen 272N | R | 36.1 | 3150 |
| Golden Harvest H3453 | R | 36.0 | 7350 |
| Pioneer 92B38 | R | 35.8 | 3500 |
| SOI 248 | R | 34.9 | 2900 |
| | | lsd .05= 3.9[d] | |

[a] Average population density of SCN at planting was 1465 eggs + J-2 per 100 $cm^3$ soil.
[b] Average of three replications.
[c] Non-replicated entries
[d] Based on replicated entries.

In cooperation with Roy Scott, SDSU soybean breeder, experimental lines were evaluated for sources of resistance to SCN. Approximately 75 lines were evaluated in a greenhouse experiment in late winter. Several promising lines were identified in the greenhouse trial, and those plus additional experimental materials were evaluated in a field study at the SE Farm. Several of the SD entries appear to possess a useful degree of SCN resistance (Table 5).

**Table 5.** Reproduction of SCN on experimental and public lines at Southeast Farm.

| Test I | | Test II | |
|---|---|---|---|
| **Entry** | **#SCN eggs + J-2 per 100 cm$^3$ soil at harvest\[a]** | **Entry** | **#SCN eggs + J-2 per 100 cm$^3$ soil at harvest** |
| SDX00R-026-32 | 250\[b] | IA1008 (I) SCN | 150 |
| AR02-101011 | 350 | LD00-1900 | 250 |
| M95-255 017 | 450 | SDX00R-046-28 | 950 |
| Freeborn (SCN) | 800 | SDX00R-046-22 | 1325 |
| IA1008 (SCN) | 1700 | LD00-4970 | 1600 |
| SDX00R-026-42 | 1825 | SDX00R-032-40 | 2600 |
| SCX00R-020-41 | 1875 | Loda (SCN) | 3250 |
| SDX00R-026-43 | 1975 | Dwight (L) (SCN) | 3700 |
| AR02-101 027 | 2300 | SDX00R-032-34 | 3850 |
| AR02-101 005 | 2650 | LD00-1938 | 5500 |
| AR02-101007 | 4350 | SD1091RR SCN-19 | 5575 |
| AR02-101002 | 4975 | AR02-201002 | 9250 |
| AR02-101001 | 5125 | SD1091RR SCN-16 | 11,600 |
| SDX00R-046-29 | 6925 | LD00-4965 | 12,175 |
| M98-121073 | 7250 | F2 | 12,850 |
| AR02-101019 | 9250 | AR02-201012 | 12,950 |
| AR02-101003 | 10,750 | SD1091RR SCN-15 | 17,375 |
| M98-118006 | 10,775 | AR02-201017 | 24,825 |
| M97-158083 | 22,450 | SD1091RR SCN-3 | 28,775 |
| SD1091RR SCN-2 | 24,175 | SD1091RR SCN-5 | 34,650 |
| AR02-101023 | 25,975 | AR02-201007 | 35,175 |
| M97-164 239 | 28,625 | AR02-201018 | 38,200 |
| Parker (I) | 32,900 | SD1091RR SCN-4 | 39,175 |
| M97-159 146 | 33,000 | IA 2021(II) | 69,425 |

[a]/ Population density of SCN at planting was: Test I= 900 eggs + J-2/100 cm$^3$, Test II = 1700 eggs + J-2/100 cm$^3$
[b]/ Average of two replications

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SE FARM REPORT
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# TRANSGENIC BT-ROOTWORM CORN VERSUS PONCHO-TREATED SEED: YIELD AND MYCOTOXIN CONTENT

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**Plant Science 0318**

## INTRODUCTION

A new kind of Bt-corn was grown on South Dakota cornfields in 2003. This new Bt-corn contains the MON 863 or YieldGard Rootworm gene that enables the corn plant to produce so-called Cry 3Bb1 toxic proteins in the corn roots. Corn rootworm larvae that ingest these toxic proteins die of gut paralysis.

This new Bt-corn will be called "Bt-rootworm" to identify it from the "Bt-corn borer" hybrids that have been available to SD corn growers since 1996. "Bt-corn borer" corn hybrids do not control corn rootworm larvae. Conversely, "Bt-rootworm" corn does not control corn borers or western bean cutworms. Corn rootworm larvae live in the soil and feed on roots. European corn borers tunnel into the stalks, ear shanks, and ear. Western bean cutworms feed on developing kernels in the corn ear.

Thus, although protected against corn rootworms, the Bt-rootworm corn hybrids in 2003 were vulnerable to the European corn borer and western bean cutworm because separate and very specific transgenes are needed to defend the corn plant against corn borers and western bean cutworms. Transgenic corn hybrids containing both the YieldGard Corn Borer and YieldGard Rootworm genes may become available for commercial production in 2004. However, even this stacked-gene corn will still be vulnerable to the western bean cutworm because only the Herculex I gene (expressing Cry 1F protein) works against western bean cutworm larvae in South Dakota. And the Herculex I gene and the YieldGard genes are owned and marketed by separate biotechnology companies.

The Bt-rootworm corn, although protected against corn rootworm larvae, also is vulnerable to secondary soil insect pests such as white grubs, wireworms, seedcorn maggots, and seedcorn beetles. Thus, all Bt-rootworm corn also comes treated with seed treatments such as Guacho (imidacloprid), Poncho (clothianidin) or Cruiser (thiamethoxam) for protection against secondary soil insect pests. Current insecticidal seed treatments are systemic neonicotinoids (i.e., derived from nicotine) that are coated onto the seed corn before planting.

This research was conducted to obtain initial data on the field performances of Bt-rootworm corn, and conventional corn with and without seed treatments. We looked at both the quantity (yield) and quality (mycotoxin content) of grains harvested from the corn hybrids tested.

## MATERIALS AND METHODS

All experiments were conducted at the SDSU Southeast Experiment Farm near Beresford during the 2003 growing season. The different corn hybrids were planted on a field that was also planted with corn in 2001 and 2002 (third-year corn). The experimental design was a randomized complete block with each treatment replicated four times. The treatments were a) Bt-rootworm corn, b) Poncho-treated conventional corn, and c) untreated conventional corn. Monsanto Company provided corn seeds.

The corn seeds were planted using a 6-row White 5700 planter on May 21, 2003. Plant population was at 27,900 per acre. Each treatment listed in Table 1 was replicated 4 times and assigned in a randomized complete block fashion on each experimental unit. Each experimental unit was composed of six rows of corn plants spaced 30 inches apart, 50 feet long. Two rows per plot was destroyed and dissected for corn borer injuries. Three rows were kept intact then harvested at the end of season (October 15, 2003). Ten consecutive plants on one row were examined from September 20-29 for injuries in the ears due to western bean cutworm and European corn borer larvae.

A two-pound sample of grain was taken from each plot during harvest then submitted for mycotoxin analyses at the SDSU Olson Biochemistry Laboratory. The fumonisin and aflatoxin contents of the grains were quantified using the Verotox quantitative ELISA system.

Data were analyzed using SAS after appropriate data transformations to normalize the data (Gomez and Gomez .1984).

Activities of corn borer and western bean cutworm moths at night were monitored with a light trap equipped with a 15-watt “black light” fluorescent bulb. An insecticide-impregnated rubber strip (dichlorvos) was placed in the collection container of the trap to quickly kill all insects attracted to the light trap. The light trap operated 24 hours a day from May 14 to September 14 during the growing season. Corn borer moths collected by the trap were counted regularly.

## RESULTS AND DISCUSSION

**Moth flights.** The first-brood European corn borer moth flight peaked on June 13 while the second brood moth flight peaked on August 18 (Figure 1). The peak first-brood moth number of 160 European corn moths was lower than the 425 moths per night recorded the previous season (2002).

The number of western bean cutworm moths peaked on July 26 and also was relatively lower in number than the 2002 moth flight.

Historical moth flights at the Southeast Research Farm can be found online at the Extension Entomology Web site (http://plantsci.sdstate.edu/ent).

**Yield.** The Bt-rootworm corn hybrid (DKC 5329) yielded 17.3 bushels per acre more than the untreated conventional hybrid (Figure 3A). It must be noted that DKC 5329 was also seed-treated with Gaucho. The conventional corn (DK 537) treated with just a low rate of Poncho provided an almost identical yield advantage of 17 bushels per acre.

No lodging of corn plants was observed on the field. Slight "goose necking" was observed in some untreated plants. Roots were not rated for injuries.

**Mycotoxin content.** The Bt-rootworm corn hybrid had higher fumonisin and aflatoxin contents (Figures 3B-3C). All of the corn hybrids tested were not protected against insects that fed directly on the corn ears such as western bean cutworms and European corn borers. Thus, the relatively higher mycotoxin content in the Bt-rootworm corn was unexpected and hard to explain.

**Insect injuries.** About 40% of the corn ears of the Bt-rootworm hybrid was infested with western bean cutworm larvae compared with 8% in the untreated conventional corn, and 30% in the Poncho-treated conventional corn (Figure 3D).

Close to 80% of the corn ears in the untreated conventional corn was infested with European corn borer larvae (Figure 3E). The corn borer infestations in the ears of the Bt-rootworm, and Poncho-treated conventional corn were 18-23% lower.

Only the Bt-rootworm had simultaneous infestations of western bean cutworm and corn borer larvae in the ears (Figure 3F). In the other treatments, the infested ears contained only either one of the insect species, but not both.

## SUMMARY

The Bt-rootworm corn hybrid, which also was seed-treated with Gaucho, produced about 17 bushels advantage in yield. However, it also had the highest fumonisin and aflatoxin content in the grain at harvest. Western bean cutworm injury in the corn ears was highest in the Bt-rootworm corn compared with untreated and Poncho-treated conventional corn. Poncho-treated conventional corn provided similar yield advantage as the Bt-rootworm corn.

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## ACKNOWLEDGMENTS

Corn seed was provided by Monsanto Company through Nate Kemp and Ron Christiansen. The staff at the Southeast Research Farm provided agronomic and technical support.

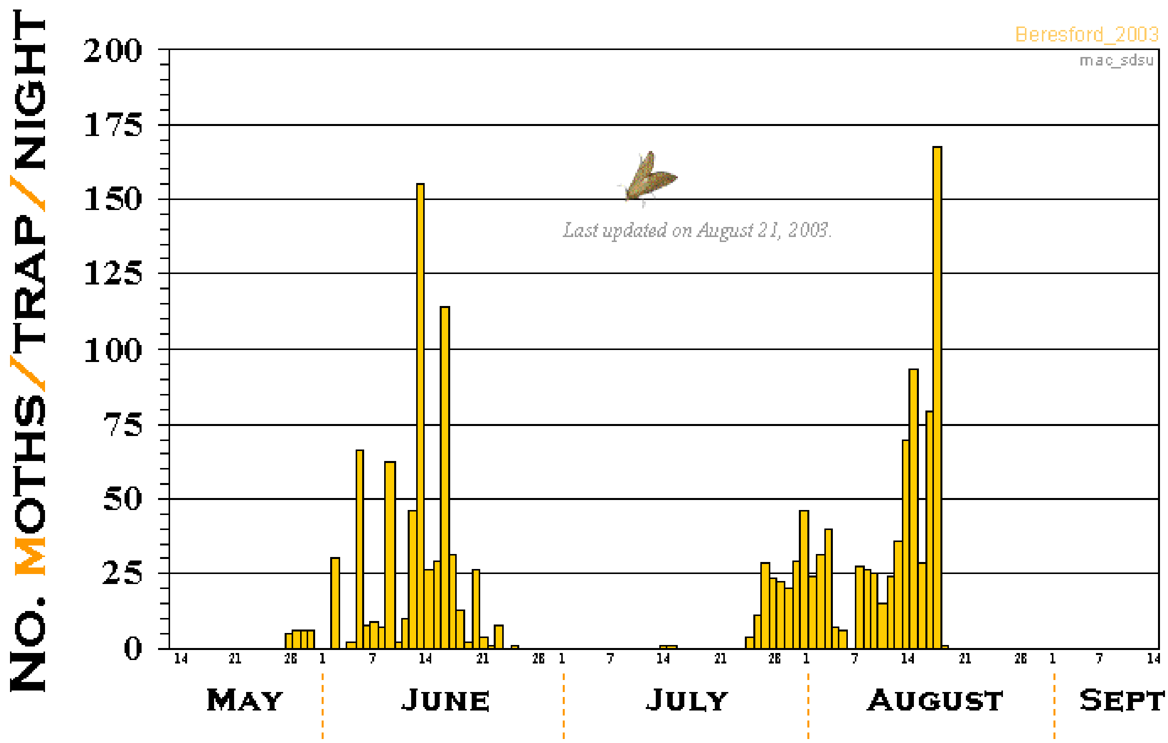
**Figure 1.** European corn borer moth flight at the Southeast Experiment Station during the 2003 season.

COOPERATIVE EXTENSION SERVICE SDSU

# Corn Borer Moth Flight in Beresford, SD 2003


*Bob Berg*
*Assoc. Professor / Research Manager*
***South Dakota State University***
*Phone: (605) 563-2989*


| SD Corn Borer Moth Flights | SDSU Corn Borer Home Page | SEE Home | Flight History: | 1996-1997 | 1999 | 2000 | 2001 | 2002 |




| SD Corn Borer Moth Flights | SDSU Corn Borer Home Page | SDSU Extension Entomology Home Page |

*M.A.C. 2003*

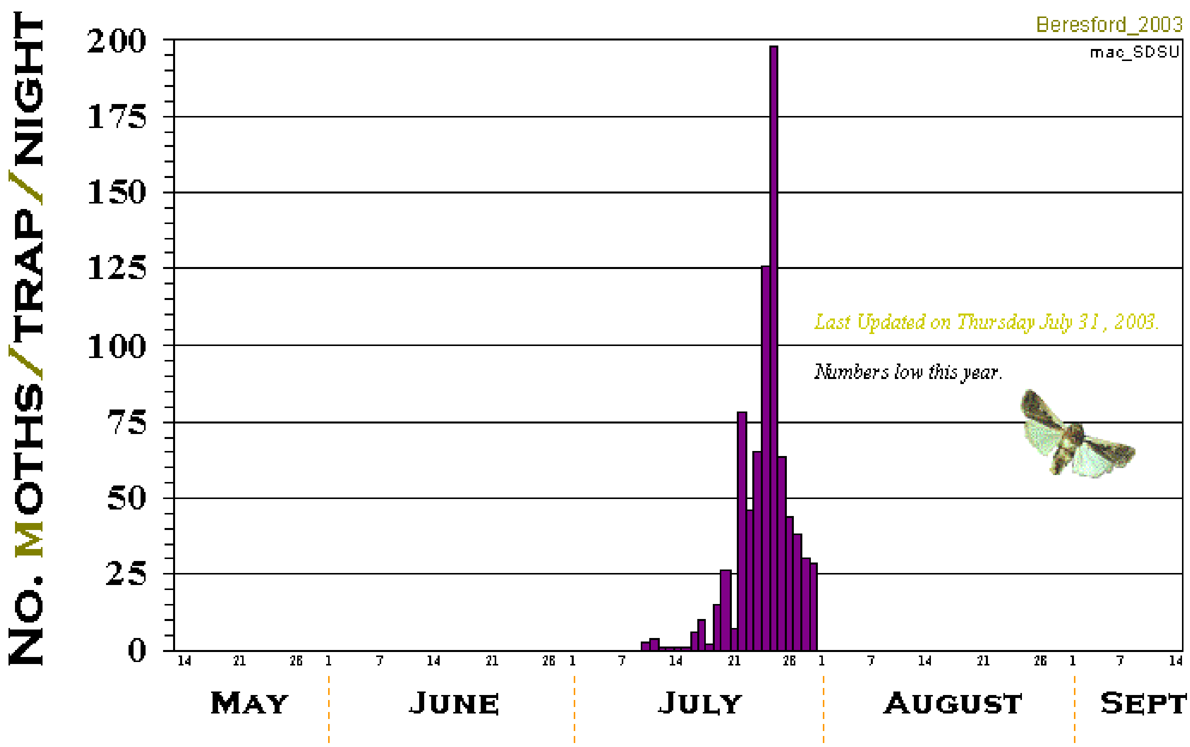
On the Internet: http://plantsci.sdstate.edu/ent/ecb/ecb2003_bere.htm

**Figure 2.** Western bean cutworm moth flight at the Southeast Experiment Station during the 2003 season.

# Western Bean Cutworm in Beresford, SD 2003


Bob Berg
Assoc. Professor / Research Manager
South Dakota State University
Phone: (605) 563-2989

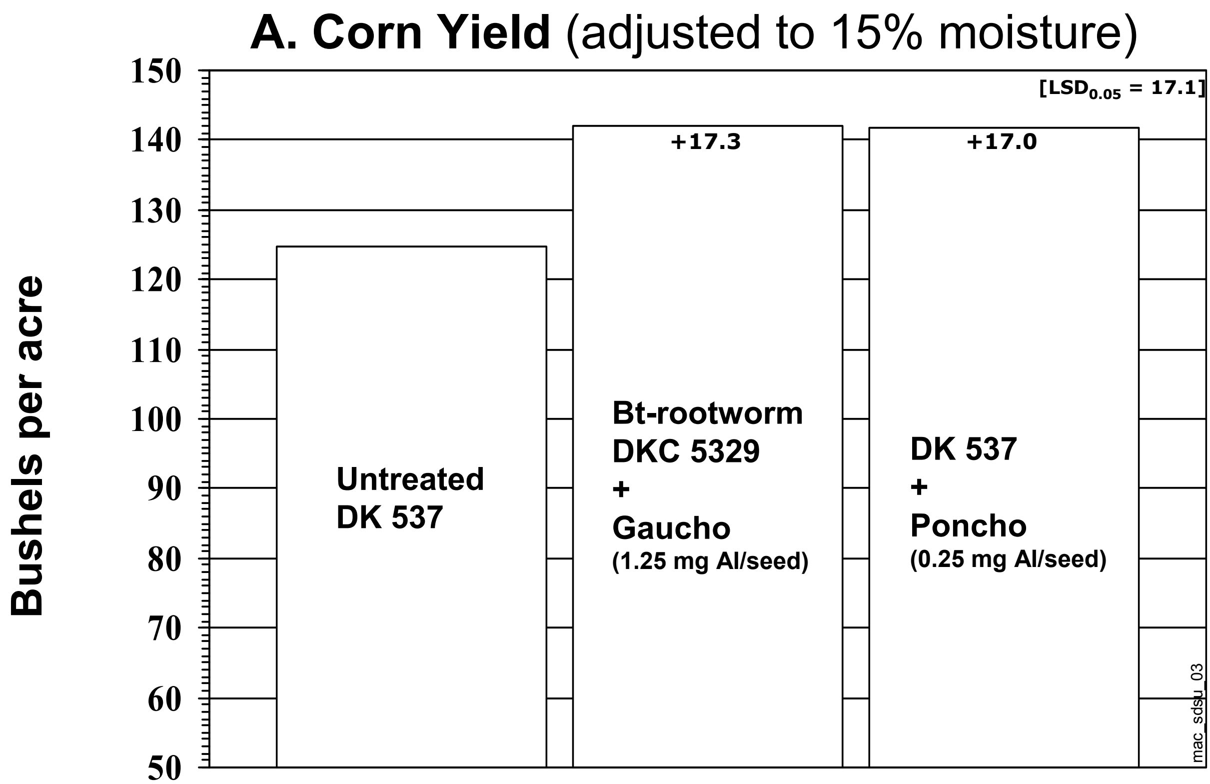

| WBC Tracking Project | SEE Home | Western Bean Cutworm Management | Flight History: | 2002 |




| WBC Tracking Project | SDSU Extension Entomology Home Page | Western Bean Cutworm Management | M.A.C. 2003

On the Internet: http://plantsci.sdstate.edu/ent/entpubs/wbc2003_bere.htm

**Figure 3.** Yield, mycotoxin content, and insect infestation of Bt-rootworm and seed-treated corn at the Southeast Research Farm during the 2002 season.



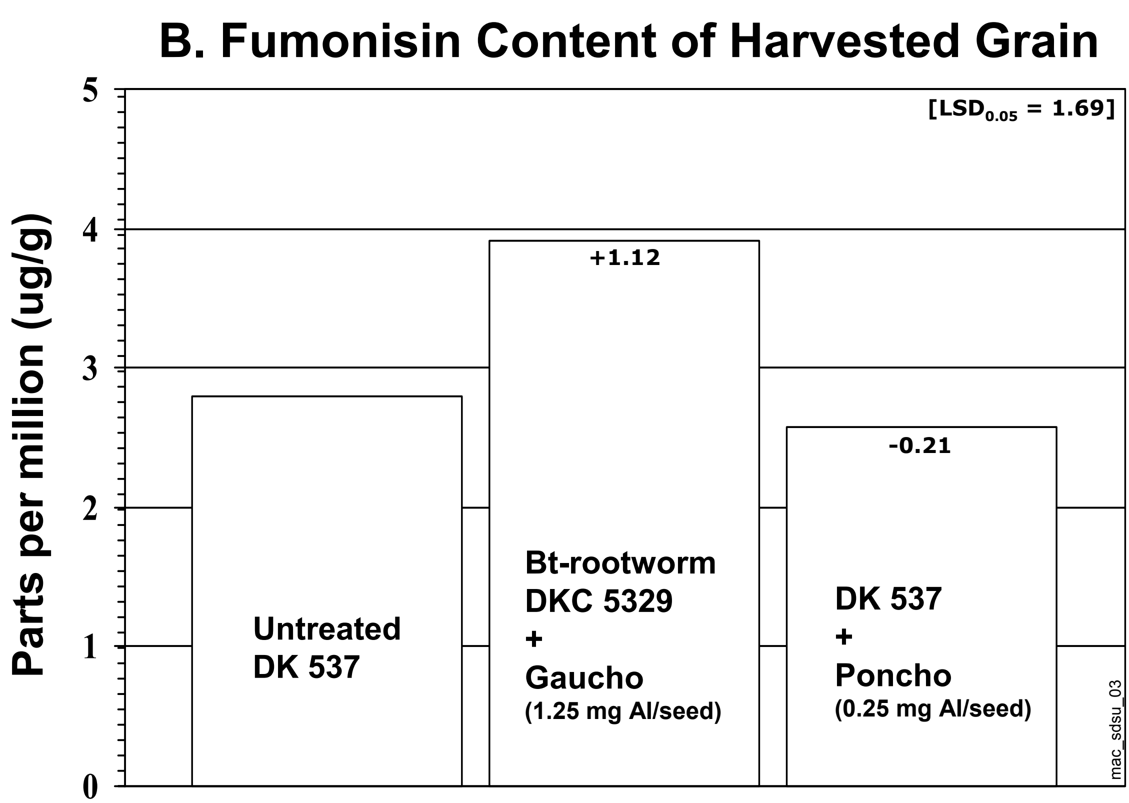
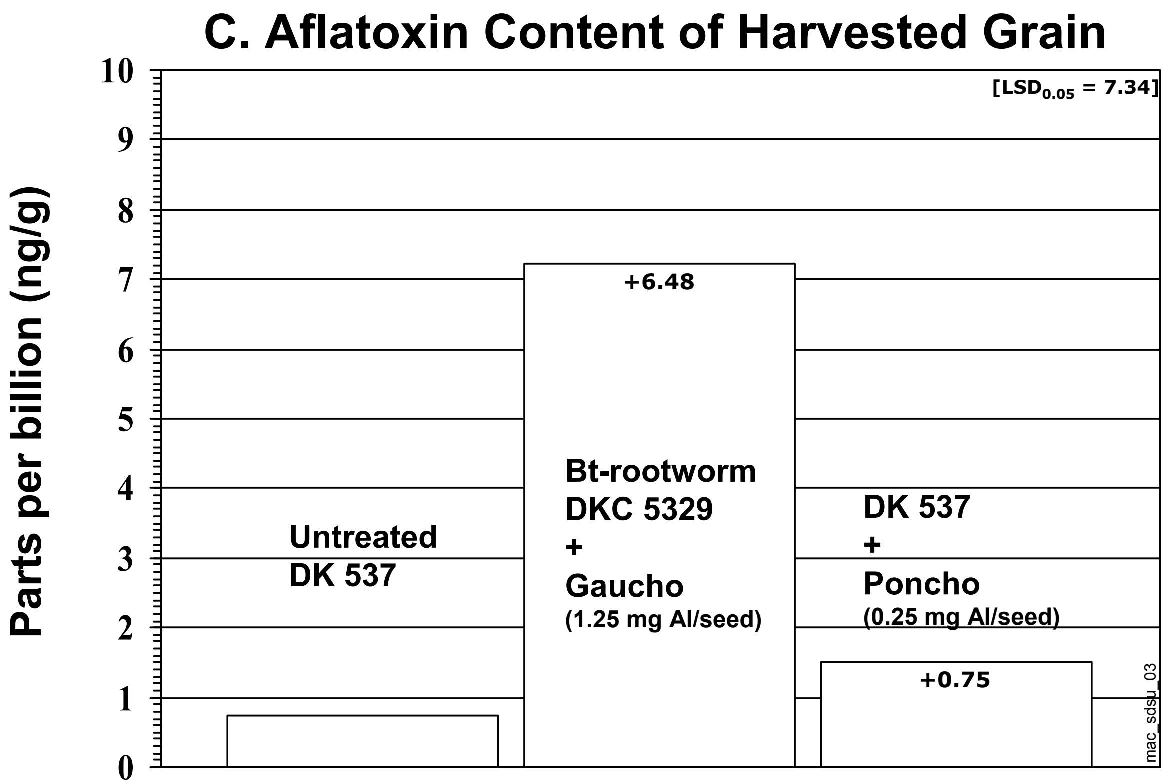



**Figure 3.** Yield and mycotoxin content of Bt-rootworm and seed-treated corn at the Southeast Research Farm during the 2002 season.



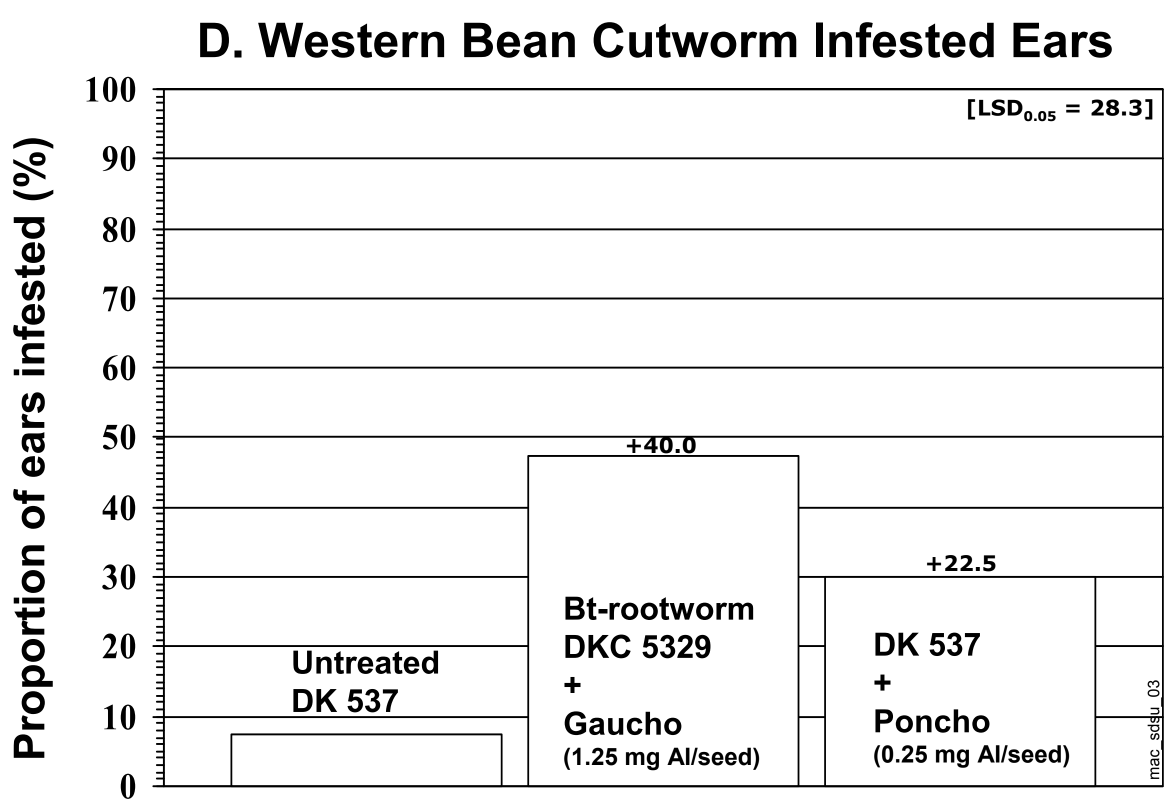
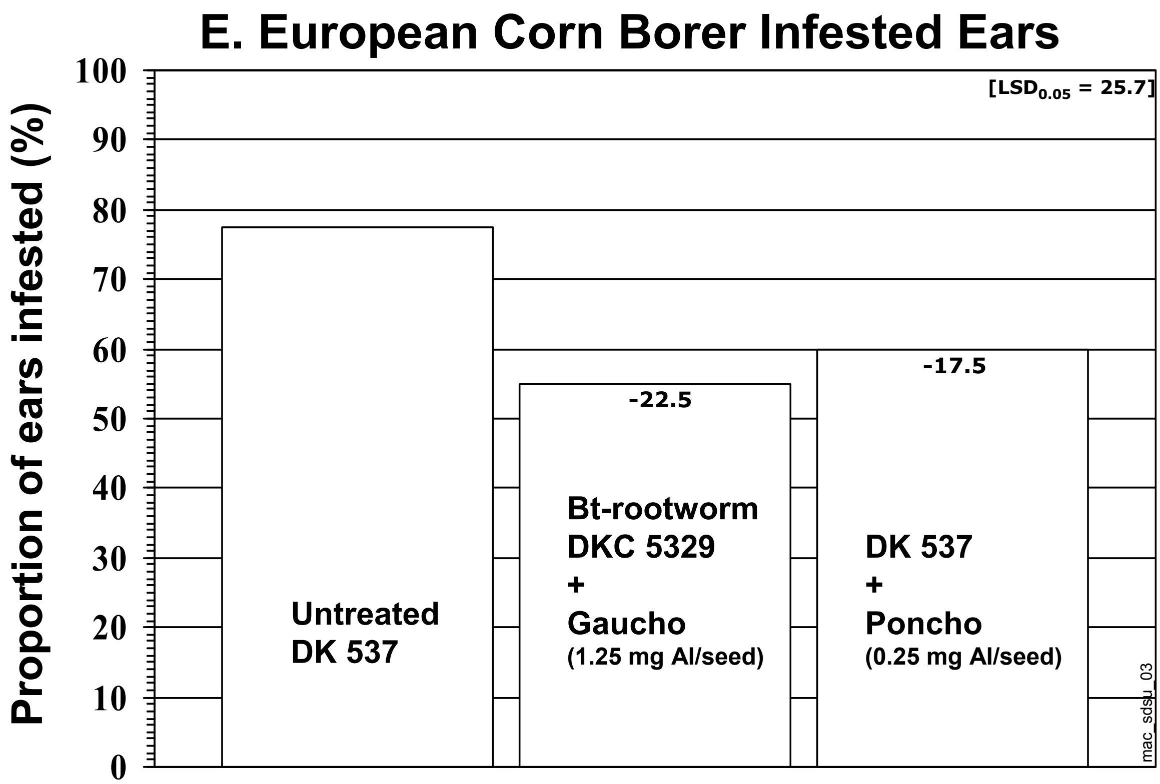
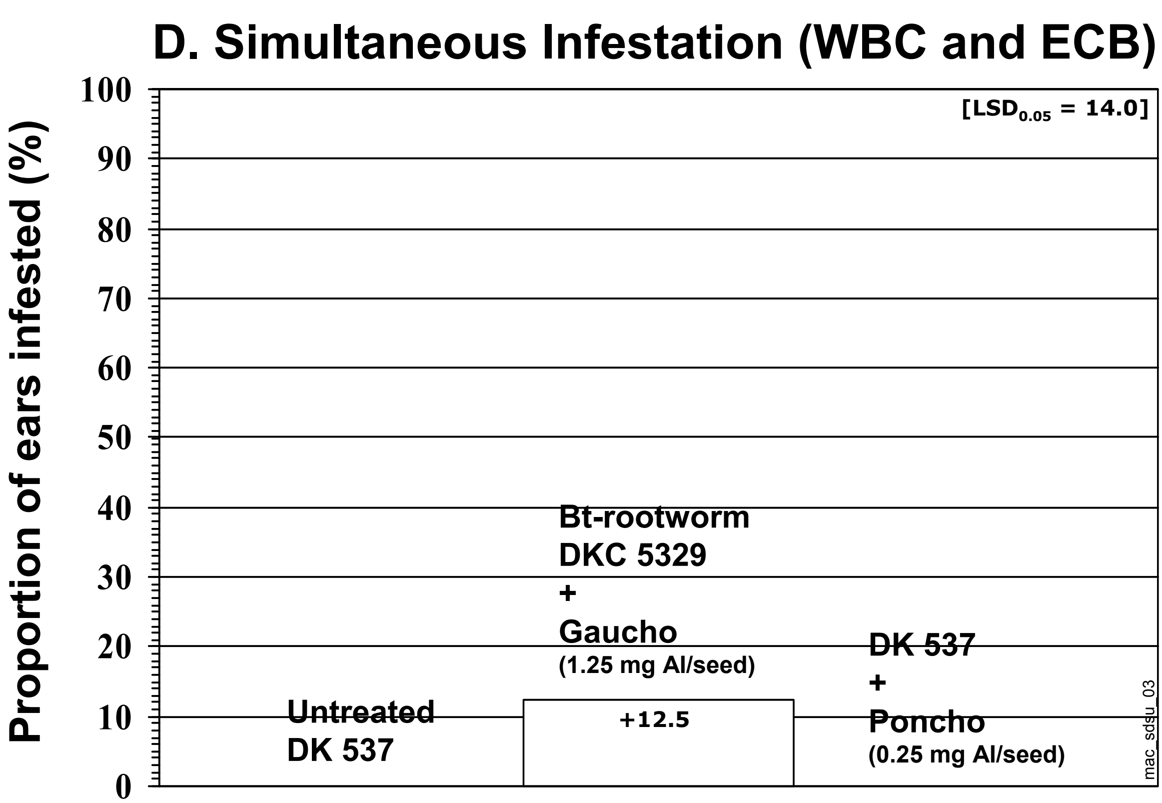



**Figure 3.** Yield and mycotoxin content of Bt-rootworm and seed-treated corn at the Southeast Research Farm during the 2002 season.



SE FARM REPORT SDSU

# SEED TREATMENTS FOR SOYBEAN APHID CONTROL

M. Catangui, B. Carsrud, R. Krantz,
D. Mills, and R. Berg

**Plant Science 0319**

## INTRODUCTION

The soybean aphid is a new pest of soybeans in South Dakota. During the 2002 growing season at the Southeast Research Farm, the aphids infested soybeans at the R5 or beginning seed stage in early August. The aphids have not been found in significant numbers earlier than August at the Southeast Research Farm, and the southeastern South Dakota counties in general. Our 2002 field studies indicated that soybeans that were sprayed on August 9 for the soybean aphids yielded from 2.4 to 11.1 bushels per acre or 8-27% more than unsprayed soybeans (Catangui et al. 2003).

Seed treatments are fast becoming a popular tactic for controlling certain insect pests of corn such as rootworms, white grubs, wireworms, and seedcorn maggots. As the name implies, seed treatments are insecticides coated onto the seeds before they are planted on the field in May. Although seed treatments have been shown to be relatively effective against early-season soil insects, there are questions about their efficacy against late-season insects that do not inhabit the soil.

We conducted this study to see whether seed treatments coated onto the soybean seed before planting in May can still work against the soybean aphids that infest R5 soybeans in August.

## MATERIALS AND METHODS

All experiments were conducted at the Southeast Research Farm near Beresford during the 2003 growing season.

The experimental design was a randomized complete block with each treatment replicated four times. Each experimental unit was a plot of soybean plants measuring 15 feet (6 rows, 30-inch row space) wide by 50 feet long. The variety of soybean utilized in the research was Syngenta S19-V2RR (a Roundup Ready variety).

The various seed treatments were coated on the seeds by their respective manufacturers (Table 1). Soybean seeds were sent to Syngenta's seed treatment facility Minnesota to be treated with Cruiser. The Poncho and Gaucho treatments were applied on the seeds in Texas at Gustafson's seed treatment facility. The treated seeds were sent back to us then planted at the SE Research Farm on June 13.using a cone planter.

The aphid population was monitored by thoroughly inspecting soybean plants for aphids. Four soybean plants were inspected per plot and the total number of aphids counted using a tally counter on August 18 when the soybean plants were at the R5 or beginning seed stage.

Soybean yields were taken from four rows of each plot on October 8, 2003 using a Hege 125 combine.

Data were analyzed using SAS (SAS Institute 1989, Gomez and Gomez 1984).

## RESULTS AND DISCUSSION

**Aphid Infestation:** An average of 1,051 aphids per plant was observed on the untreated soybeans on August 18, 2003 in the experimental plots (Figure 1B). An average of 200 soybean aphids per plant is currently considered economically damaging to soybeans (Catangui 2002) so the aphid population on the untreated plots was above the economic threshold level.

None of the seed treatments significantly reduced the number of aphids. This indicates that the various active ingredients applied on the seeds before the May planting were already ineffective when the soybean aphids showed up in August.

**Effect on Yield:** None of the seed treatments significantly increased soybean yields (Figure 1A). This may be due to the fact that none of the seed treatments was able to protect the soybean plants at the time when they were actively producing pods and seeds in August.

For the 2004 growing season and the near future, growers will still need to rely on insecticidal sprays to control soybean aphids. In 2002, sprays performed very well against the aphids and were able to improve yields by up to 2.4 to 11.1 bushels per acre (Catangui et al 2003).

## ACKNOWLEDGMENTS

This study was supported in part by the SD Soybean Research and Promotion Council, Bayer CropScience, and Syngenta. We thank the staff at the Southeast Research Farm for agronomic and technical support. Thanks also to Duane Auch (Dakota Ag. Service, Inc.) for planting and harvesting the soybeans.

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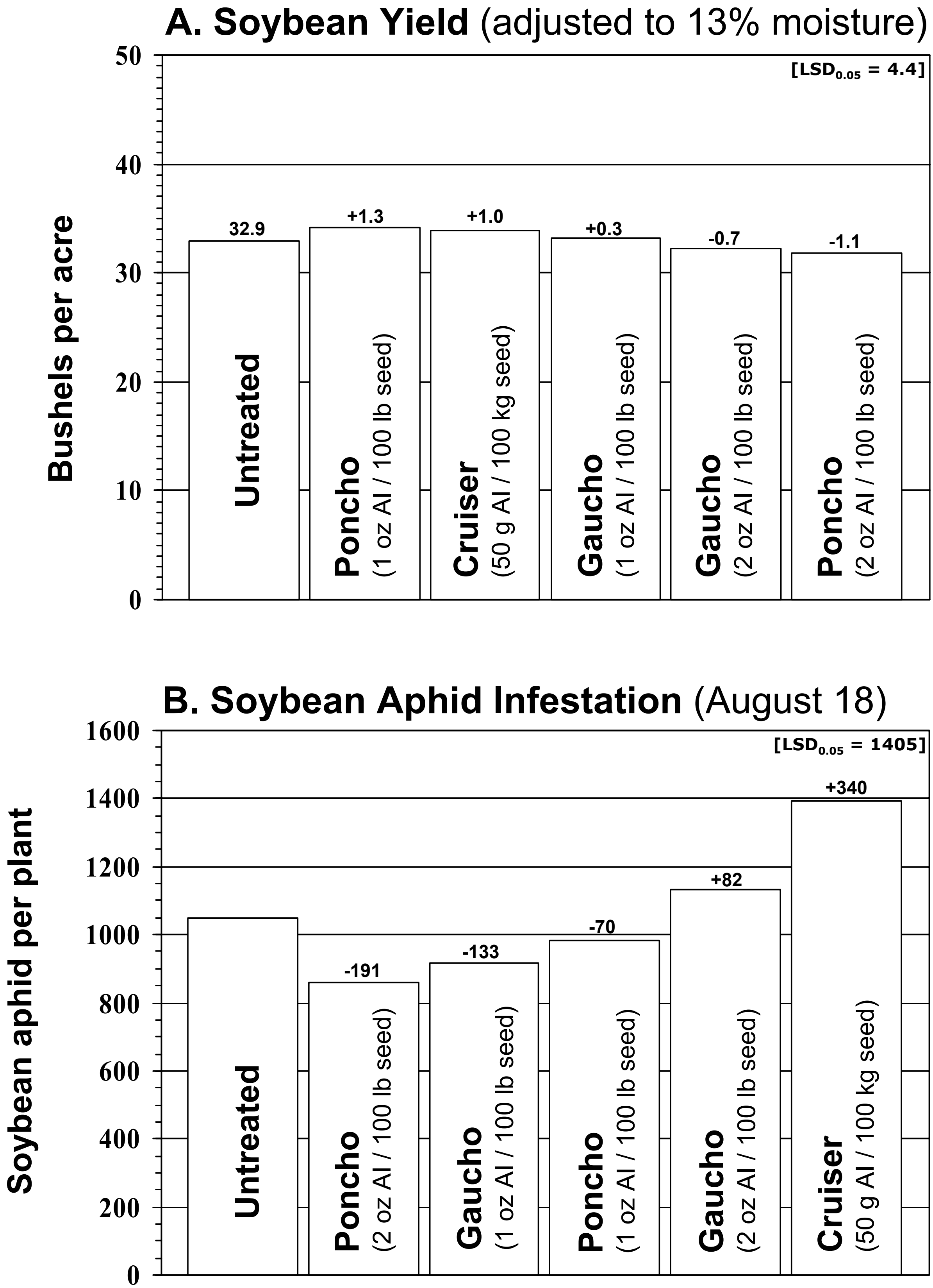
**Table 1. Seed treatments tested against the soybean aphid (*Aphis glycines*) at the Southeast Research Farm during the 2003 growing season**.

| Treatment | Company | Rate |
|---|---|---|
| Untreated | ----- | ----- |
| Cruiser | Syngenta | 50 g AI / 100 kg seed |
| Gaucho | Gustafson / Bayer | 1 oz AI / 100 lb seed |
| Gaucho | Gustafson / Bayer | 2 oz AI / 100 lb seed |
| Poncho | Gustafson / Bayer | 1 oz AI / 100 lb seed |
| Poncho | Gustafson / Bayer | 2 oz AI / 100 lb seed |

**Figure 1.** Efficacy of soybean seed treatments against the soybean aphid (*Aphis glycines*) during the 2003 season in South Dakota.



SE FARM REPORT

SDSU

# OAT RESEARCH

Lon Hall

Plant Science 0320

Yield, yield stability, and test weight are the most important characteristics associated with the identification and eventual release of oat varieties. There are, however, several additional factors that contribute to the expression of these primary characteristics. Resistance to lodging, Barley Yellow Dwarf Virus (BYDV), stem rust, and crown rust all affect yield potential and test weight. Other traits that are considered prior to varietal release include: hull, protein, and oil percentages, as well as maturity, hull color, plant height, and whether it is hulled or hulless.

Consumers desire different characteristics for specific needs. Millers generally want oats with high protein, high beta-glucan content, and low oil, whereas, livestock producers prefer tall varieties with high levels of protein and oil. The racehorse industry demands a high quality, white-hulled or hulless oat variety. Tall varieties, such as Loyal, are popular forage oats.

The main emphasis of the oat breeding programs is development of hulled varieties. Market demand for milling and feed oats isn't affected by hull color; however, the racehorse industry desires white-hulled varieties. Therefore, emphasis is placed on development of white hulled varieties with desirable traits for milling and/or feed. Recently there has been interest in hulless oats for feed and other specialty uses, therefore, we have increased our effort to develop a high oil hulless oat.

Plant breeding is a long drawn out process. The bulk breeding method takes, on average, at least 10 years from the initial cross to variety release. This process may be shortened by two years by using the single seed descent method, which involves two extra generations in the greenhouse. Each year there are approximately 37,000 non-segregating plants and head rows observed within this program. In 2003, there were 3902 unique non-segregating lines yield tested. Out of a project total of 6570 yield plots, 888 were grown at the Southeast Research Farm.

Data collected from regional nurseries provides valuable information for variety release and germplasm selection for crossing in our program. The Tri-State regional nursery is made up of 30 hulled lines and 6 checks. The 30 lines consist of 10 advanced lines each from Minnesota, North Dakota, and South Dakota. Advanced increase lines are entered in the Uniform Early Nursery, Uniform Midseason Nursery, Quaker Uniform Oat Nursery, and/or South Dakota Standard Variety Oat Trials (SVO). Hulless lines are tested in the Cooperative Naked Oat Trial and/or SVO.

SD96024A, a white-tan hulled line, had the highest average yield and placed second in the top yield group percentage rating in the 2003 SVO. Along with exceptional yield potential, it has an average test weight, good disease resistance, and excellent milling qualities. It has been increased with the intent to release for the 2004-growing season pending approval. SD000366 was the second highest yielder and it had the highest yield group percentage rating. SD000366 has a very high-test weight, a white hull, large seed size, and excellent crown rust and BYD resistance. Four out of 96 purified derivations from SD000366 were selected for increase in New Zealand. They were screened in the field for BYD resistance and for crown rust resistance in the greenhouse. These four lines will be increased to approximately 150 bushels and tested in the 2004 Standard Variety Oat Test.

Production research included a naked oat herbicide test at the Brookings location and a successful dormant seeding test at Northeast farm.

# 2003 ALFALFA PRODUCTION
# SOUTHEAST RESEARCH FARM

V. Owens and E. Omdahl

**Plant Science 0321**

Alfalfa cultivars are tested at several South Dakota research stations. Our objective is to provide producers with yield data from currently available alfalfa cultivars to aid them in their selection process. Even though our yield trial does not contain all available cultivars, it should be a helpful tool in identifying those suitable for the area.

Data from two separate trials was gathered in 2003. Table 1 provides forage production data for 15 alfalfa cultivars planted in 2000. Tons of dry matter yield are shown for four cuttings in 2003, total production in 2002, 2001, 2000, and a cumulative total for 2000-03. Table 2 contains data from 25 alfalfa cultivars planted in a new trial established in 2003. Cultivars are ranked from highest to lowest based on the cumulative yield. We were able to harvest two cuttings from the new trial. The least significant difference (LSD) listed at the bottom of Tables 1 and 2 is used to identify significant differences between the cultivars. If the difference in yield between two cultivars exceeds the given LSD, then they are significantly different.

Six replications of each cultivar were planted at 15 lbs pure live seed/ac in 2000 and 18 lbs PLS/ac in 2003. Fifty pounds of super phosphate ($P_2O_5$) was applied before planting each trial. Later fertilizer application was made when necessary as recommended by the South Dakota State Soil Testing Laboratory.

Forage was harvested with a sickle-type harvester equipped with a weigh bin for obtaining fresh plot weights. Random subsamples from the fresh herbage were taken to determine percent dry matter. Alfalfa cultivars were evaluated for maturity prior to harvest. Yield differences among cultivars were tested using the LSD at the 0.05 level of probability when significant F-tests were detected by analysis of variance (Table 1 and 2).

**Table 1.** Forage yield of 15 alfalfa cultivars entered in the South Dakota State University alfalfa testing program. Trial is located at the Southeast Research Station near Beresford, SD. Alfalfa was planted 28 April 2000 into plots arranged in a randomized complete block design with six replications.

| | 2003 | | | | | 2002 | 2001 | 2000 | 00-03 |
|---|---|---|---|---|---|---|---|---|---|
| Entry | 29-May | 3-Jul | 31-Jul | 1-Sep | Total | Total | Total | Total | Total |
| | --------------------------------Tons Dry Matter/Acre-------------------------------- | | | | | | | | |
| Excel | 4.48 | 1.74 | 1.99 | 0.93 | 9.14 | 4.33 | 7.06 | 3.57 | 24.11 |
| 6420 | 4.44 | 1.75 | 1.79 | 0.72 | 8.69 | 3.95 | 6.75 | 3.79 | 23.18 |
| GH 750 | 4.04 | 1.89 | 1.78 | 0.88 | 8.59 | 3.95 | 6.59 | 3.69 | 22.82 |
| Shaw | 4.25 | 1.74 | 1.62 | 0.65 | 8.26 | 3.96 | 6.36 | 3.88 | 22.47 |
| 645-II | 4.18 | 1.74 | 1.73 | 0.62 | 8.28 | 3.97 | 6.24 | 3.85 | 22.33 |
| | | | | | | | | | |
| GoldRush 747 | 4.18 | 1.65 | 1.57 | 0.62 | 8.02 | 3.91 | 6.61 | 3.78 | 22.32 |
| Husky Supreme | 3.96 | 1.67 | 1.61 | 0.63 | 7.87 | 3.87 | 6.53 | 3.77 | 22.04 |
| Frontier 2000 | 4.10 | 1.63 | 1.46 | 0.61 | 7.81 | 3.80 | 6.36 | 3.61 | 21.58 |
| Multiplier 3 | 3.96 | 1.72 | 1.81 | 0.68 | 8.15 | 3.76 | 6.19 | 3.39 | 21.49 |
| 6410 | 3.87 | 1.63 | 1.51 | 0.57 | 7.58 | 3.56 | 6.13 | 3.59 | 20.86 |
| | | | | | | | | | |
| 53H81 | 3.91 | 1.70 | 1.54 | 0.59 | 7.74 | 3.47 | 6.06 | 3.48 | 20.75 |
| 53V08 | 3.87 | 1.50 | 1.50 | 0.45 | 7.32 | 3.27 | 6.08 | 3.30 | 19.96 |
| Vernal | 3.85 | 1.56 | 1.48 | 0.42 | 7.31 | 3.22 | 5.91 | 3.35 | 19.78 |
| Legend Gold | 3.81 | 1.50 | 1.45 | 0.37 | 7.13 | 3.42 | 5.79 | 3.15 | 19.48 |
| Maverick | 3.56 | 1.45 | 1.34 | 0.42 | 6.77 | 3.18 | 5.70 | 3.43 | 19.09 |
| | | | | | | | | | |
| Average | 4.03 | 1.66 | 1.61 | 0.61 | 7.91 | 3.71 | 6.29 | 3.58 | 21.48 |
| Maturity (Kalu & Fick) | 4.0 | 5.4 | 4.5 | 4.5 | | | | | |
| LSD (P=0.05) | 0.46 | NS | 0.22 | 0.28 | 1.02 | 0.52 | 0.68 | 0.43 | 2.22 |
| CV (%) | 10.0 | 14.7 | 11.8 | 39.7 | 11.3 | 12.4 | 9.6 | 10.5 | 9.1 |

NS Not significant at 0.05 level of probability.

**Table 2**. Forage yield of 25 alfalfa cultivars entered in the South Dakota State University alfalfa testing program. Trial is located at the Southeast Research Station near Beresford, SD. Alfalfa was planted 29 April 2003 into plots arranged in a randomized complete block design with six replications.

| | 2003 | | |
|---|---|---|---|
| Entry | 15-Jul | 1-Sep | Total |
| 6420 | 1.18 | 1.53 | 2.72 |
| Bullseye | 1.42 | 1.27 | 2.68 |
| Rugged | 1.35 | 1.28 | 2.62 |
| Hybriforce-420/Wet | 1.25 | 1.27 | 2.52 |
| Gold Rush 747 | 1.22 | 1.28 | 2.50 |
| A 30-06 | 1.23 | 1.25 | 2.48 |
| Alfastar II | 1.35 | 1.15 | 2.48 |
| Rebel | 1.30 | 1.17 | 2.48 |
| FSG 406 | 1.18 | 1.28 | 2.43 |
| 54V46 | 1.22 | 1.20 | 2.42 |
| Husky Supreme | 1.27 | 1.15 | 2.42 |
| Journey Brand 204 | 1.18 | 1.20 | 2.40 |
| Extreme | 1.23 | 1.15 | 2.37 |
| 54Q25 | 1.23 | 1.13 | 2.35 |
| Evermore | 1.37 | 0.95 | 2.33 |
| 420 | 1.13 | 1.17 | 2.32 |
| FSG 505 | 1.22 | 1.05 | 2.30 |
| WL 319HQ | 1.20 | 1.08 | 2.28 |
| Vernal | 1.13 | 1.15 | 2.25 |
| FSG 351 | 1.03 | 1.22 | 2.23 |
| Notice II | 1.15 | 1.05 | 2.23 |
| WL 357HQ | 1.13 | 1.10 | 2.23 |
| 4500 | 1.17 | 1.05 | 2.18 |
| Somerset | 1.12 | 1.05 | 2.17 |
| Abundance | 0.98 | 1.07 | 2.03 |
| Average | 1.21 | 1.17 | 2.38 |
| Maturity (Kalu & Fick) | 5.0 | 4.0 | |
| LSD (P=0.05) | NS | NS | NS |
| CV (%) | 18.1 | 21.1 | 14.6 |

NS Not significant at 0.05 level of probability.

SE FARM REPORT
SDSU

# 2003 CORN HYBRID, SOYBEAN AND OAT VARIETY PERFORMANCE TRIALS

R. G. Hall, K. K. Kirby, and L. Hall

**Plant Science 0322**

This reports the 2003 SE Research Farm performance trials for both non-Roundup-Ready and Roundup-Ready corn hybrids and soybean varieties conducted by the South Dakota State University Crop Performance Testing (CPT) program. In addition, the oat variety trial was seeded and harvested by L. Hall, Research associate, SDSU Oat Breeding Project.

**CORN**:
**Experimental Procedures**

Entries were placed into either an early or late maturity trial according to ratings reported by a given seed company. The break between the early and late test was 110-day for the non-Roundup Ready and Roundup Ready hybrid trials.

Entries were seeded in three replications with each hybrid randomly located within a replication. Plots consisted of four 30-inch rows, 20 feet long. Plots were seeded on May 5, 2003 into a Trent silt loam previously cropped to soybeans. A Monosem precision row crop planter was used for seeding plots. During seeding a starter fertilizer of 100 pounds/acre of 37-18-00 was applied 2" below and 2" to the side (2x2) of the seed row. The precision planter was calibrated and delivered 29,260 seeds per acre, regardless, of seed quality and germination percentage. Therefore, the harvest population is an indication of initial seed quality and the ability of the seed to cope with the production environment from seeding to harvest. Force insecticide was applied down the seed tube at its label rate for corn rootworm control this year. In addition, Pounce granular was applied at its label rate down the whorl with a tractor mounted granular applicator just prior to canopy closure.

The experimental procedures described above apply both to the conventional and the Roundup Ready hybrid corn trials with one exception: Weed control in the Roundup Ready trials consisted of two post emergence applications of Roundup Ultra (32 oz/ac). The first when weeds were 2-4 inches tall, followed by a second application when weed growth was again 2-4 inches tall. In the non-Roundup Ready test trials, post-emergence weed control consisted of a tank mix of Steadfast (0.75 oz/ac)/Callisto (3.0 oz /ac).

**Measurements of Performance**

Yield values are an average of three replicates (plots), and are expressed as bushels per acre, adjusted to 15.5% moisture on a dry-matter basis and a bushel weight of 56 pounds.

Moisture content is expressed as the percentage of moisture in the shelled corn at harvest. Moisture is inversely related to maturity. Because maturity is of prime importance in South Dakota, moisture figures are important in the evaluation of the trial entries. Hybrids with satisfactory yields and low harvest moisture values need little if any need for additional drying.

Check for the "least significant difference" (LSD) value at the bottom of each column of data values. The reported LSD values can be used in two ways. First, the LSD value indicates how much a variable such as yield must differ between two hybrids before there is a real yield difference. For example, in the early non-Roundup Ready test (Table

1), the year 2003 LSD value of 17 bu/ac can be used to compare the yields of any two hybrids in the early maturity trial. If hybrid A yields 190 bu/ac and hybrid B yields 177 bu/ac the yield difference is 13 bu/ac (190 - 177 = 13). In this case the two hybrids do not differ in yield because their yield difference of 13 bu/ac is less than the reported LSD value of 17 bu/ac. In contrast, if hybrid C yields 171 bu/ac the yield difference between hybrid A and hybrid C would be 19 bu/ac (190 - 171 = 19). In this case the yield difference of 19 bu/ac is more than the reported LSD value of 17 bu/ac and therefore hybrid A would have a significantly higher yield than hybrid C.

The second use for the LSD value is to identify the top group for the current year yield, two-year yield, bushel weight, grain moisture at harvest, green snap percentage, and stalk lodging below the ear percentage. For example, in the non-Roundup Ready hybrid early maturity trial (Table 1) the highest current year yield was 195 bu/ac. In order to determine whether it is the only top yielding hybrid in this trial use the LSD value of 17 bu/ac at the bottom of the 2003-yield column. In order for hybrids to be in the top yield group they must yield 178 bu/ac (195-17 = 178) or higher. Technically, a yield of 179 bu/ac would be in the top yield group while a yield of 178 bu/ac would not be in the top yield group. However, since all yields and LSD values are rounded to the nearest whole number. We can say 178 bu/ac, because of the rounding-off, is the more appropriate minimum value for top yield hybrids in this early maturity test in 2003. This value is indicated as the minimum top yield group value at the bottom of the 2003 yield column. Top yield hybrids for 2003 are those hybrids that are equal or higher than the minimum top yield group value. In addition, the minimum top yield group value is indicated for the 2 yr. (2002-03) average unless there were no significant yield differences.

Similarly, the top group for other performance factors like bushel weight, grain moisture at harvest, green snap percentage, and stalk lodging below the ear percentage can be determined. For example, in the early maturity test (Table 1), the minimum bushel weight value to qualify for the top group was 59 lbs. Bushel weights of 59 lbs. or higher are in the top group for bushel weight. Note that yield and bushel weight values needed to qualify for the top group are reported as a minimum top group value. In contrast, the grain moisture, green snap, and lodging below the ear percentages needed to qualify for the top-group are reported as a maximum top group value. In other words, yield and bushel weight top-group values must exceed a certain percentage while grain moisture, green snap, and lodging below ear percentages must be equal to or less than certain percentage to qualify for the top group depending on the performance factor being considered. In the early maturity test (Table 1), current year yields must equal 178 bu/ac or higher, bushel weight must equal 59 lbs. or higher, grain moisture must be 14% or lower, and stalk lodging below the ear must equal 2% or lower to be in the top group for these factors .

**<u>Performance Trial Results</u>**

<u>Note</u>: If variety differences are not significant (NS) for a factor, then all varieties are in the top group.

<u>Non-Roundup Ready hybrids</u>: Results for two years (2002-03) and one year (2003) are summarized below:

**Early Maturity Trial (Table 1), 42 hybrid entries.** The 2-year average was 171 bu/ac; but hybrid yield differences were not significant. The 2003 average was 172 bu/ac, hybrids had to average 178 bu/ac or higher to be in the top yield group, 14 hybrids qualified for the top yield group, and hybrids had to differ by 17 bu/ac to be significantly different in yield. In addition, bushel weight had to equal 59 lbs. or higher (13 hybrids), grain moisture had to equal 14% or less (6 hybrids), and stalk lodging below the ear had to equal 2% or less (42 hybrids) to be in the top group for these factors. Hybrid differences for acre harvest population were not significant. The lowest population of 24,248 plants per acre or 83% of the seeding population was not significantly different from the highest harvest population of 29,040 plants per acre.

**Late Maturity Trial (Table 2), 24 hybrid entries.** The 2-year average was 172 bu/ac; but yield differences among the hybrids tested were not significant. The 2003 average was 165 bu/ac; but again the yield differences among the hybrids tested were not significant. In addition, bushel weight had to equal 59 lbs. or higher (5 hybrids), grain moisture had to equal 17% or less (10 hybrids), and stalk lodging below the ear had to equal 1% or less (24 hybrids) to be in the top group for these factors. The acre harvest population had to equal 27,729 plants per acre or 95% of the seeding population to be in the top group (13 hybrids) for harvest population.

Roundup Ready hybrids: The performance trial results for two years (2002-03) and one year (2003) are summarized below:

**Early Maturity Trial (Table 3), 20 hybrid entries.** The 2-year average was 162 bu/ac; but yield differences among the hybrids tested were not significant. Therefore, all 6 hybrids tested qualified for the top yield group because their yield differences were not significant. The 2003 average was 169 bu/ac, hybrids had to average 164 bu/ac or higher to be in the top-yield group, 15 hybrids qualified for the top yield group, and hybrids had to differ by 26 bu/ac to be significantly different in yield. In addition, bushel weight had to equal 59 lbs. or higher (10 hybrids) and grain moisture had to equal 16% or less (13 hybrids) to be in the top group for these factors. Stalk lodging was non-significant. The acre harvest population had to equal 27,291 plants per acre or 93% of the seeding population to be in the top group (17 hybrids) for harvest population.

**Late Maturity Trial (Table 4), 12 hybrid entries.** None of the hybrids tested this year were tested last year; hence, no 2-year averages are reported. The 2003 average was 163 bu/ac, hybrids had to average 161 bu/ac or higher to be in the top-yield group, 6 hybrids qualified for the top-yield group, and hybrids had to differ by 18 bu/ac to be significantly different in yield. In addition, bushel weight had to equal 58 lbs. or higher (10 hybrids) and grain moisture had to equal 17% or less (5 hybrids) to be in the top-group for these factors. Stalk lodging was non-significant because there was no lodging in this test. Hybrid differences for acre harvest population were not significant. The lowest population of 25,846 plants per acre or 88% of the seeding population was not significantly different from the highest harvest population of 27,879 plants per acre.

**SOYBEAN**:
**Experimental Procedures**

Soybean entries were placed in either a maturity group-I or group-II test trial according to maturity ratings reported by a given seed company. The number of replications, plot size, and seeder used were previously described under the corn experimental procedures. Plots were seeded on May 21, 2003 at 165,000 pure-live-seed to obtain a final population of about 150,000 plants per acre following emergence. Soybean inoculation was accomplished by applying granular Nitragin brand Soybean Soil Implant down the seed tube, according to label, during seeding. Use of the Monosem precision planter resulted in very uniform seed spacing within the seed row. The center two rows of each plot were harvested for yield.

**NOTE**: Each company selects the appropriate maturity group trial (I, or II) for their entries at a location. Generally, each company has one or more maturity group checks for the varieties they market. However, there are no standard regional or national check varieties for maturity. Consequently, a late group-I variety from one company may be similar in maturity to an early group-II variety from another company because they use different check varieties for maturity. As a result, this testing program cannot guarantee that all entries are placed in the proper maturity trial. In some trials, borderline entries with maturity group ratings at or near the arbitrary breaks between the late group-I's and early-group-II's may crossover. When evaluating the performance of any entry in a given trial it is strongly suggested that one also note the reported maturity of the entry. Since, all entries at a given location are seeded the same day then one can compare the relative difference in maturity (days after maturity) between varieties. If the maturity rating for an entry in a group-I test is similar to the rating for a variety in the group-II test, at the same test location, then one might conclude they are similar in maturity regardless of their company maturity rating. It is recommended that one use caution when comparing the maturity rating of a given variety from one location to the rating obtained at other locations. Should early season soil moisture and soil temperature values differ greatly, then maturity rating may differ between locations; therefore, maturity comparisons of a variety over many locations may be misleading.

## Measurements of Performance

Yield values (bu/ac) are an average of three replications, adjusted to 13% moisture (dry-matter basis) and a bushel weight of 60 pounds. Yield, least significant difference (LSD), and minimum top-yield values are rounded off to the nearest whole bushel per acre. Protein and oil content values are for the 2002 season. One replication of every variety in each trial was tested using near-infrared-reflectance-spectroscopy (NIRS). Plant Height was measured from the soil surface to the top node of the main stem. Lodging scores are an average of how erect the main stem of all the plants are at maturity. 1 = all plants erect, 2 = slight lodging, 3 = lodging at a 45$^o$ angle, 4 = severe lodging, and 5 = all plants flat.

Least significant difference (LSD) values can be used to (1) identity the top-yield group in a test and (2) to determine if varieties differ in yield potential. See previous discussion on use of LSD in the corn Measurements of Performance section.

Entries at each location are numerically sorted from highest to lowest yields according to whether they have been tested for a 3-year, 2-year, and 1-year time period. Entries tested for three years may also have a top-yield group value in the 2-year (2002-03) and 2003 year yield columns. Likewise, entries tested for two years may also have a top-yield group value in the 2003 year yield column.

## Soybean Variety Performance Results

Note: Yields are reported as 3-year (2001-03), 2-year (2002-03), or 1-year (2003) averages. If variety differences are not significant (NS) for a factor, then all varieties are in the top group for that factor.

## Non-Roundup Ready varieties

Group - I (Table 5): Yield averages for the 3-year, 2-year, and 1-year data were 47, 45, and 49 bushels per acre, respectively. There were no significant differences among the varieties tested for any of the 1-year, 2-year, or 3-year time periods; hence, all varieties tested for a given period were in the top-yield group for that period. The top-yield groups for the 3-year, 2-year, and 1-year periods include 3, 3, and 6 entries, respectively.

Group - II (Table 6): Yield averages for the 3-year, 2-year, and 1-year data were 49, 46, and 46 bushels per acre, respectively. Varieties had to average at least 48 bushels for the 3-year period to be in the top-yield group. There were no significant differences among the varieties tested for either the 1-year or 2-year time periods. The top-yield groups for the 3-year, 2-year, and 1-year periods include 5, 12, and 23 entries, respectively.

**Roundup Ready varieties**

Group - I (Table 7): Yield averages for the 3-year, 2-year, and 1-year data were 54, 52, and 49 bushels per acre, respectively. Varieties had to average at least 51 bushels per acre for both the 2-year and 1-year periods to be in the top-yield group. There were no significant differences among the varieties tested for the 3-year period. The top-yield groups for the 3-year, 2-year, and 1-year periods include 5, 11, and 11 entries, respectively.

Group - II (Table 8): Yield averages for the 3-year, 2-year, and 1-year data were 50, 47, and 45 bushels per acre, respectively. Varieties had to average at least 49 bushels for the 3-year, 47 bushels for the 2-year, or 51 bushels per acre for the 1-year period to be in the top-yield group. The top-yield groups for the 3-year, 2-year, and 1-year periods include 14, 26, and 14 entries, respectively.
insert table 5-8

**OAT**:
**Experimental Procedures**

Nine oat varieties and seven experimental lines from the South Dakota State University Oat Breeding project were tested. The results from all test locations in the state are reported here. These plots were seeded and harvested by Lon Hall, Research associate in the SDSU Oat Breeding project.

Each entry (four replicates or plots) was seeded into plots measuring 5 X 20 feet were seeded and later cut back to 5 x12 feet at harvest. A cone drill seeder with a spinner directing seed to seven seed tubes spaced on 7-inch seed rows was used to seed all plots. The pure-live-seed for each entry was determined and all plots were seeded at 1.2 million PLS seeds per acre. Plots were seeded on April 14, 2003 into a Trent silt loam previously cropped to soybeans. Weed control consisted of one application of Bronate at 1.0 pint per acre.

**Measurements of Performance**

Yield (bu/ac) values are adjusted to 13.5% moisture (dry-matter basis) and a bushel weight of 32 pounds.

**Performance trial results**

At Beresford (Table 9) the varieties HiFi and Jerry and the experimental lines SD366, SD915, and SD96024 were in the top yield group for 2003. Over the longer 3-year period the varieties Don, Jerry, and Reeves and the experimental lines SD96024 were in the top yield group. On a statewide-basis, the top yield percentages for year 2003 and the last 3-year period are indicated in the last two columns of table 9. For year 2003, the varieties Don, HiFi, and Jerry were in the top yield group 50% of the time while the experimental lines SD744, SD96024, and SD744 were in the top yield group 88%, 75%, and 63% of the time, respectively. For the longer 3-year term, the varieties Don, Jerry, Loyal, and Reeves were in the top yield group at least 60% of the time while the experimental line SD96024 was in the top yield group 100% of the time.

Likewise, on a statewide-basis, Table 9 indicates above average grain protein values were obtained from the hulless varieties Paul and Buff; the standard varieties Hytest, and Reeves; the hulless experimental line SD580; and the standard experimental lines SD813 and SD015. Above average bushel weight values were obtained from the standard variety, Hytest; the two hulless varieties, Buff and Paul; and the hulless experimental line SD 580. The lowest test weight variety in the test trial was HiFi.

Table 1. Non-Roundup Ready, early corn test, maturity is 110-day or less.

| Brand / Hybrid | +Rel. Mat. | Yield- bu/ac @15.5% mst. 2-yr | Yield- bu/ac @15.5% mst. 2003 | 2003 Bu. wt. lb | 2003 Grain moist. pct | 2003 Acre harvest pop. | 2003 Green snap pct | 2003 Lodged below ear pct |
|---|---|---|---|---|---|---|---|---|
| | | Entries tested two years | | | | | | |
| WENSMAN/W 4437 | 109 | 184 | 188 | 58 | 16 | 26,136 | 0 | 0 |
| HEINE/H745YGCB | 106 | 183 | 195 | 61 | 12 | 27,733 | 0 | 0 |
| DAIRYLAND/STEALTH1507BT | 108 | 182 | 191 | 58 | 17 | 28,895 | 0 | 0 |
| WENSMAN/W 4418 | 106 | 174 | 178 | 58 | 15 | 24,539 | 0 | 1 |
| WENSMAN/W 5417BT | 107 | 172 | 176 | 57 | 15 | 27,152 | 0 | 0 |
| MERSCHMAN/M-20108 | 108 | 169 | 177 | 58 | 16 | 28,169 | 0 | 0 |
| JACOBSEN/JS4645BT | 110 | 167 | 164 | 58 | 17 | 26,862 | 0 | 0 |
| JACOBSEN/JS4637 | 110 | 167 | 166 | 58 | 15 | 27,733 | 0 | 1 |
| SANDS/SOI 9102 | 110 | 164 | 175 | 59 | 16 | 28,459 | 0 | 1 |
| HEINE/H790YGCB | 108 | 163 | 155 | 58 | 17 | 28,048 | 0 | 1 |
| EPLEY/E2470 | 110 | 160 | 156 | 58 | 14 | 27,878 | 0 | 1 |
| | | Entries tested one year | | | | | | |
| KRUGER/K-9111 YGCB | 110 | . | 195 | 58 | 18 | 27,152 | 0 | 0 |
| KRUGER/K-9411 YGCB | 109 | . | 190 | 59 | 18 | 24,248 | 0 | 1 |
| CROW'S/438 B | 108 | . | 190 | 58 | 17 | 27,878 | 0 | 0 |
| SABRE/4800BT | 108 | . | 189 | 58 | 16 | 27,298 | 0 | 0 |
| GARST/8566YG1 | 109 | . | 187 | 58 | 16 | 27,443 | 0 | 0 |
| ASGROW/RX702YG | 110 | . | 186 | 60 | 18 | 26,862 | 0 | 1 |
| EPLEY/E2490BT | 110 | . | 184 | 57 | 16 | 27,879 | 0 | 1 |
| DEKALB/DKC57-84 (YGCB | 107 | . | 182 | 60 | 15 | 28,024 | 0 | 0 |
| GARST/8552YG1 | 108 | . | 182 | 56 | 16 | 27,152 | 0 | 0 |
| MIDWEST/G 7716 B | 110 | . | 180 | 58 | 17 | 28,024 | 0 | 0 |
| WENSMAN/W 5437BT | 110 | . | 177 | 58 | 16 | 27,152 | 0 | 1 |
| GARST/8545 | 109 | . | 177 | 59 | 16 | 27,588 | 0 | 1 |
| EPLEY/E1420BT | 101 | . | 173 | 59 | 15 | 29,040 | 0 | 2 |
| SABRE/4760 | 107 | . | 171 | 58 | 16 | 27,007 | 0 | 0 |
| EPLEY/E2410BT | 107 | . | 171 | 61 | 17 | 28,605 | 0 | 1 |
| KAYSTAR/KX-766 | 110 | . | 170 | 59 | 16 | 27,733 | 0 | 0 |
| DAIRYLAND/STEALTH-1606 | 106 | . | 169 | 58 | 14 | 27,878 | 0 | 0 |
| HEINE/H763YGCB | 107 | . | 164 | 58 | 17 | 27,007 | 0 | 2 |
| KRUGER/EXP112 YGCB | 110 | . | 164 | 56 | 17 | 27,733 | 0 | 1 |

Table 1. Non-Roundup Ready, early corn test (continued).

| Brand / Hybrid | +Rel. Mat. | Yield- bu/ac @15.5% mst. 2-yr | Yield- bu/ac @15.5% mst. 2003 | 2003 Bu. wt. lb | 2003 Grain moist. pct | 2003 Acre harvest pop. | 2003 Green snap pct | 2003 Lodged below ear pct |
|---|---|---|---|---|---|---|---|---|
| | Entries tested one year | | | | | | | |
| HEINE/H792YGCB | 109 | . | 164 | 57 | 15 | 27,588 | 0 | 1 |
| AGSOURCE SEEDS/5713BT | 108 | . | 163 | 59 | 16 | 26,572 | 0 | 0 |
| MERSCHMAN/M-9104 | 104 | . | 162 | 58 | 14 | 28,895 | 0 | 1 |
| EPLEY/E1442 | 104 | . | 160 | 58 | 14 | 28,459 | 0 | 0 |
| JACOBSEN/JS4440BT | 108 | . | 159 | 59 | 16 | 27,878 | 0 | 2 |
| PFISTER/2656BT | 110 | . | 159 | 58 | 15 | 26,862 | 0 | 1 |
| MIDWEST/G 7622 B | 108 | . | 159 | 56 | 16 | 28,017 | 0 | 0 |
| MERSCHMAN/M-21104 | 104 | . | 157 | 59 | 15 | 26,862 | 0 | 1 |
| JACOBSEN/JS4339BT | 106 | . | 156 | 58 | 14 | 26,862 | 0 | 0 |
| HEINE/H810YGCB | 110 | . | 156 | 58 | 16 | 26,136 | 0 | 0 |
| CROW'S/4911 B | 110 | . | 152 | 58 | 15 | 28,023 | 0 | 0 |
| KRUGER/EXP412 YGCB | 110 | . | 150 | 59 | 18 | 25,846 | 0 | 0 |
| Test average: | | 171 | 172 | 58 | 16 | 27,446 | 0 | 0 |
| LSD (5%) values: | | NS | 17 | 2 | 2 | NS | . | NS |
| Top group value*- Minimum: | | 160 | 178 | 59 | | 24,248 | | |
| Maximum: | | | | | 14 | | . | 2 |
| No. entries in top group: | | 11 | 14 | 13 | 6 | 42 | . | 42 |
| Coef. of variation#: | | 8 | 6 | 2 | 9 | 6 | . | . |

+ Relative maturity of hybrid as reported by seed company.
* Value is within one LSD value of the highest yield, bushel weight, or harvest population values; or the lowest grain moisture, green snap or lodging value.
NS indicates values within a column are not significantly different.

Table 2. Non-Roundup Ready,late corn test,relative maturity is 111-day or more.

| Brand / Hybrid | +Rel. Mat. | Yield- bu/ac @15.5% mst. 2-yr | Yield- bu/ac @15.5% mst. 2003 | 2003 Bu. wt. lb | 2003 Grain moist. pct | 2003 Acre harvest pop. | 2003 Green snap pct | 2003 Lodged below ear pct |
|---|---|---|---|---|---|---|---|---|
| | | | Entries tested two years | | | | | |
| AGSOURCE SEEDS/6183BT | 111 | 183 | 176 | 57 | 20 | 27,152 | 0 | 1 |
| SANDS/SOI 9132 | 113 | 175 | 168 | 59 | 16 | 24,394 | 0 | 1 |
| EPLEY/E3630BT | 113 | 165 | 169 | 58 | 18 | 28,604 | 0 | 0 |
| AGSOURCE SEEDS/6203BT | 112 | 164 | 144 | 58 | 18 | 26,717 | 0 | 0 |
| | | | Entries tested one year | | | | | |
| DEKALB/DKC63-79 (YGCB | 113 | . | 176 | 60 | 20 | 28,314 | 0 | 0 |
| JACOBSEN/JS4757BT | 112 | . | 174 | 57 | 21 | 27,443 | 0 | 1 |
| GARST/8454YG1 | 112 | . | 171 | 58 | 16 | 28,605 | 0 | 1 |
| CROW'S/5366 B | 114 | . | 170 | 58 | 18 | 27,588 | 0 | 0 |
| KRUGER/K-9114+ YGCB | 115 | . | 169 | 58 | 17 | 27,879 | 0 | 1 |
| KRUGER/K-9212 YGCB | 113 | . | 169 | 58 | 15 | 27,878 | 0 | 0 |
| KRUGER/K-9115 YGCB | 115 | . | 168 | 59 | 18 | 27,878 | 0 | 0 |
| HEINE/H827YGCB | 111 | . | 166 | 58 | 18 | 26,717 | 0 | 0 |
| KRUGER/K-9415 | 114 | . | 165 | 56 | 17 | 27,588 | 0 | 0 |
| HEINE/H851YGCB | 113 | . | 165 | 58 | 19 | 27,878 | 0 | 0 |
| MIDWEST/G 8125 B | 114 | . | 164 | 58 | 20 | 26,862 | 0 | 0 |
| HEINE/H838YGCB | 113 | . | 163 | 58 | 14 | 28,169 | 0 | 0 |
| KAYSTAR/KX-890BT | 112 | . | 163 | 58 | 17 | 27,152 | 0 | 1 |
| DAIRYLAND/STEALTH-5112 | 111 | . | 162 | 58 | 16 | 27,588 | 0 | 0 |
| KRUGER/EXP116 YGCB | 114 | . | 161 | 58 | 24 | 27,878 | 0 | 0 |
| GARST/8331YG1 | 114 | . | 161 | 59 | 22 | 28,314 | 0 | 0 |
| EPLEY/E3641 | 114 | . | 160 | 58 | 16 | 29,185 | 0 | 0 |
| HEINE/H824YGCB | 112 | . | 160 | 60 | 20 | 27,152 | 0 | 1 |
| CROW'S/5202 B | 113 | . | 157 | 57 | 20 | 28,459 | 0 | 0 |
| MIDWEST/G 8070 B | 113 | . | 151 | 58 | 17 | 28,459 | 0 | 0 |
| Test average: | | 172 | 165 | 58 | 18 | 27,661 | 0 | 0 |
| LSD (5%) values: | | NS | NS | 1 | 3 | 1,456 | . | 1 |
| Top group value*- Minimum: | | 164 | 144 | 59 | | 27,729 | | |
| Maximum: | | | | | 17 | | . | 1 |
| No. entries in top group: | | 4 | 24 | 5 | 10 | 13 | . | 24 |
| Coef. of variation#: | | 6 | 7 | 1 | 9 | 3 | . | . |

Note: Seed bottom of table 1 for explanation of any footnotes.

Table 3. Roundup Ready, early corn test, relative maturity is 110-day or less.

| Brand / Hybrid | +Rel. Mat. | Yield- bu/ac @15.5% mst. 2-yr | Yield- bu/ac @15.5% mst. 2003 | Bu. wt. lb | Grain moist. pct | Acre harvest pop. | Green snap pct | Lodged below ear pct |
|---|---|---|---|---|---|---|---|---|
| | | | | -------------- 2003 -------------- | | | | |
| | Entries tested two years | | | | | | | |
| PFISTER/2656 RR | 109 | 168 | 161 | 58 | 14 | 27,443 | 0 | 2 |
| DEKALB/DKC58-24 RRYGCB | 108 | 167 | 184 | 61 | 16 | 27,879 | 0 | 0 |
| DEKALB/DKC60-09 RRYGCB | 110 | 167 | 175 | 61 | 16 | 28,169 | 0 | 0 |
| ASGROW/RX601RR/YG | 105 | 162 | 171 | 60 | 15 | 28,750 | 0 | 1 |
| TRIUMPH/1120BTRR | 108 | 154 | 155 | 58 | 19 | 26,136 | 0 | 0 |
| JACOBSEN/JS4637R | 110 | 151 | 148 | 57 | 14 | 25,700 | 0 | 1 |
| | Entries tested one year | | | | | | | |
| WENSMAN/W 6421RR | 106 | . | 190 | 59 | 17 | 27,733 | 0 | 0 |
| KAYSTAR/KX-6500RRBT | 104 | . | 182 | 60 | 16 | 27,443 | 0 | 0 |
| KALTENBERG/K6788RR | 108 | . | 179 | 58 | 17 | 28,459 | 0 | 0 |
| DEKALB/DKC60-17 (RR) | 110 | . | 179 | 59 | 17 | 27,878 | 0 | 1 |
| GARST/8553RR | 107 | . | 177 | 57 | 17 | 28,459 | 0 | 1 |
| INTEGRA/INT 6208RRYGCB | 108 | . | 171 | 58 | 16 | 27,443 | 0 | 0 |
| GARST/8510YG1/RR | 110 | . | 169 | 58 | 18 | 29,040 | 0 | 0 |
| AGSOURCE/5986RR/BT | 110 | . | 169 | 59 | 17 | 27,588 | 0 | 0 |
| KALTENBERG/K5711RR | 105 | . | 168 | 59 | 15 | 28,024 | 0 | 1 |
| CHANNEL/7624RB | 108 | . | 167 | 58 | 16 | 27,443 | 0 | 0 |
| CHANNEL/7806RB | 110 | . | 164 | 59 | 15 | 25,845 | 0 | 1 |
| HEINE/H8490RR/YGCB | 110 | . | 164 | 55 | 16 | 28,024 | 0 | 0 |
| AGSOURCE/5921RR | 110 | . | 161 | 59 | 15 | 27,588 | 0 | 1 |
| KAYSTAR/KX-780RR | 109 | . | 148 | 57 | 15 | 27,588 | 0 | 1 |
| Test average: | | 162 | 169 | 58 | 16 | 27,632 | 0 | 0 |
| LSD (5%) values: | | NS | 26 | 2 | 2 | 1,749 | . | NS |
| Top group value*- Minimum: | | 151 | 164 | 59 | | 27,291 | | |
| Maximum: | | | | | 16 | | . | 2 |
| No. entries in top group: | | 6 | 15 | 10 | 13 | 17 | . | 20 |
| Coef. of variation#: | | 8 | 9 | 2 | 9 | 4 | . | . |

+ Relative maturity of hybrid as reported by seed company.
* Value is within one LSD value of the highest yield, bushel weight, or harvest population values; or the lowest grain moisture, green snap or lodging value.
NS indicates values within a column are not significantly different.

Table 4. Roundup Ready, late corn test, relative maturity is 111-day or more.

| Brand / Hybrid | +Rel. Mat. | Yield- bu/ac @15.5% mst. 2-yr | Yield- bu/ac @15.5% mst. 2003 | 2003 Bu. wt. lb | 2003 Grain moist. pct | 2003 Acre harvest pop. | 2003 Green snap pct | 2003 Lodged below ear pct |
|---|---|---|---|---|---|---|---|---|
| | | Entries tested one year | | | | | | |
| AGSOURCE/6166BTR | 111 | . | 179 | 59 | 19 | 26,281 | 0 | 0 |
| AGSOURCE/6886BTR | 112 | . | 176 | 59 | 20 | 26,717 | 0 | 0 |
| CHANNEL/8127RB | 114 | . | 169 | 58 | 21 | 27,879 | 0 | 0 |
| CHANNEL/8075RB | 113 | . | 169 | 60 | 21 | 27,153 | 0 | 0 |
| INTEGRA/INT 6312RRYGCB | 112 | . | 164 | 57 | 14 | 25,846 | 0 | 0 |
| KAYSTAR/KX-8770RRBT | 114 | . | 162 | 58 | 20 | 27,588 | 0 | 0 |
| KRUGER/K-9212 RR/YGCB | 113 | . | 160 | 58 | 14 | 26,717 | 0 | 0 |
| KAYSTAR/KX-8551RR | 112 | . | 159 | 58 | 14 | 26,717 | 0 | 0 |
| JACOBSEN/JS4615RBT | 112 | . | 156 | 58 | 17 | 27,588 | 0 | 0 |
| GARST/8487YG1/RR | 112 | . | 154 | 58 | 17 | 27,588 | 0 | 0 |
| KRUGER/K-9115 RR/YGCB | 115 | . | 152 | 59 | 18 | 27,588 | 0 | 0 |
| JACOBSEN/JS4655RBT | 112 | . | 151 | 56 | 18 | 27,298 | 0 | 0 |
| Test average: | | . | 163 | 58 | 18 | 27,080 | 0 | 0 |
| LSD (5%) values: | | . | 18 | 2 | 3 | NS | . | . |
| Top group value*- Minimum: | | . | 161 | 58 | | 25,846 | | |
| Maximum: | | | | | 17 | | . | . |
| No. entries in top group: | | . | 6 | 10 | 5 | 12 | . | . |
| Coef. of variation#: | | . | 7 | 2 | 10 | 5 | . | . |

+ Relative maturity of hybrid as reported by seed company.
* Value is within one LSD value of the highest yield, bushel weight, or harvest population values; or the lowest grain moisture, green snap or lodging value.
NS indicates values within a column are not significantly different.

Table 5. Maturity group-I, non-Roundup Ready soybean results, seeded May 21.

| Brand / Entry | Yield - bu/ac (13% moisture) 3yr | 2yr | 2003 | 2002 Prot. pct+ | 2002 Oil pct+ | 2003 Ht. in. | 2003 Ldg. Sc.~ | 2003 Maturity: Days after seeding |
|---|---|---|---|---|---|---|---|---|
| | Entries tested three years | | | | | | | |
| LATHAM/392 | 49 | 47 | 48 | 36.4 | 17.7 | 33 | 1 | 128 |
| THOMPSON/T-3182 | 49 | 46 | 49 | 33.3 | 19.8 | 35 | 1 | 120 |
| PUBLIC/STRIDE | 43 | 41 | 48 | 33.9 | 19.5 | 31 | 1 | 114 |
| | Entries tested one year | | | | | | | |
| LATHAM/EXP-E1840T | . | . | 54 | . | . | 33 | 1 | 122 |
| LATHAM/280 | . | . | 51 | . | . | 32 | 1 | 123 |
| THOMPSON/T-3189 | . | . | 50 | . | . | 34 | 1 | 121 |
| Test average: | 47 | 45 | 49 | 34.5 | 19.0 | 32 | 1 | 119 |
| LSD(5%) value ($): | NS | NS | NS | | | | | |
| Min.top yield value ($): | 43 | 41 | 44 | | | | | |
| Coef. of variation (#): | 5 | 7 | 9 | | | | | |

$ See yield section.
~ Lodging: 1= all plants erect, 3= some at 45 degrees, 5= all plants flat.
NS - Indicates differences between values within a column are not significant.

Table 6. Maturity group-II, non-Roundup Ready soybean results, seeded May 21.

| Brand / Entry* | Yield - bu/ac (13% moisture) 3yr | 2yr | 2003 | 2002 Prot. pct+ | 2002 Oil pct+ | 2003 Ht. in. | 2003 Ldg. Sc.~ | 2003 Maturity: Days after seeding |
|---|---|---|---|---|---|---|---|---|
| | Entries tested three years | | | | | | | |
| SANDS/SOI 288 | 52 | 47 | 44 | 35.7 | 17.4 | 32 | 1 | 126 |
| PRAIRIE BR./PB278 | 52 | 49 | 50 | 36.4 | 17.6 | 31 | 1 | 128 |
| PRAIRIE BR./PB202 | 50 | 46 | 47 | 36.3 | 18.5 | 35 | 1 | 125 |
| PRAIRIE BR./PB230 | 49 | 45 | 48 | 36.3 | 18.3 | 33 | 1 | 123 |
| PRAIRIE BR./PB256 | 49 | 46 | 46 | 35.7 | 18.7 | 33 | 1 | 125 |
| COYOTE/9525 | 47 | 44 | 45 | 33.9 | 19.4 | 45 | 3 | 126 |
| COYOTE/9123 | 47 | 46 | 44 | 34.1 | 19.7 | 38 | 1 | 122 |
| PUBLIC/TURNER-SCN | 44 | 42 | 42 | 35.5 | 19.5 | 37 | 3 | 123 |
| | Entries tested two years | | | | | | | |
| THOMPSON/T-3288 | . | 49 | 49 | 34.0 | 18.0 | 39 | 2 | 131 |
| SANDS/SOI 256 | . | 46 | 48 | 34.9 | 18.9 | 28 | 1 | 124 |
| COYOTE/9723 | . | 45 | 46 | 35.7 | 18.9 | 33 | 1 | 123 |
| SANDS/SOI 247N | . | 45 | 47 | 35.7 | 19.3 | 33 | 1 | 130 |
| | Entries tested one year | | | | | | | |
| JACOBSEN/J826 | . | . | 51 | . | . | 32 | 1 | 129 |
| JACOBSEN/J814 | . | . | 49 | . | . | 34 | 1 | 125 |
| GARST/2918 | . | . | 47 | . | . | 33 | 1 | 130 |
| LATHAM/690 | . | . | 47 | . | . | 30 | 1 | 125 |
| LATHAM/EXP-E2478T | . | . | 46 | . | . | 34 | 1 | 129 |
| SANDS/SOI 234 | . | . | 46 | . | . | 30 | 1 | 124 |
| THOMPSON/T-3263 | . | . | 46 | . | . | 32 | 1 | 130 |
| JACOBSEN/J772 | . | . | 46 | . | . | 36 | 1 | 124 |
| SANDS/EXP281 | . | . | 46 | . | . | 39 | 2 | 130 |
| LATHAM/830 | . | . | 46 | . | . | 31 | 1 | 130 |
| SANDS/SOI 284N | . | . | 41 | . | . | 37 | 1 | 131 |
| Test average: | 49 | 46 | 46 | 35.4 | 18.7 | 34 | 1 | 126 |
| LSD(5%) value ($): | 4 | NS | NS | | | | | |
| Min.top yield value ($): | 48 | 42 | 41 | | | | | |
| Coef. of variation (#): | 6 | 7 | 7 | | | | | |

* SCN = Soybean cyst nematode resistant. $ See yield section.
~ Lodging: 1= all plants erect, 3= some at 45 degrees, 5= all plants flat.
NS - Indicates differences between values within a column are not significant.

Table 7. Maturity group-I, Roundup Ready soybean results, seeded May 21.

| Brand / Entry | Yield - bu/ac (13% moisture) 3yr | 2yr | 2003 | 2002 Prot. pct+ | 2002 Oil pct+ | 2003 Ht. in. | 2003 Ldg. Sc.~ | 2003 Maturity: Days after seeding |
|---|---|---|---|---|---|---|---|---|
| | Entries tested three years | | | | | | | |
| THOMPSON/T-7205RR | 56 | 55 | 54 | 35.3 | 18.8 | 31 | 1 | 123 |
| DEN BESTEN/DB1902RR | 55 | 55 | 53 | 34.6 | 18.8 | 30 | 1 | 123 |
| KRUGER/199+RR | 54 | 53 | 50 | 35.5 | 18.9 | 31 | 1 | 122 |
| KRUGER/223+RR | 54 | 51 | 50 | 35.4 | 18.9 | 31 | 1 | 124 |
| LATHAM/418RR | 52 | 49 | 49 | 36.7 | 18.5 | 34 | 1 | 122 |
| | Entries tested two years | | | | | | | |
| DESOY/191+RR | . | 56 | 53 | 33.9 | 19.4 | 28 | 1 | 120 |
| STINE/S1918-4 | . | 56 | 56 | 36.2 | 18.4 | 34 | 1 | 123 |
| KRUGER/202+RR | . | 55 | 54 | 34.6 | 19.1 | 30 | 1 | 123 |
| THOMPSON/T-7214RR | . | 55 | 51 | 36.5 | 18.2 | 30 | 1 | 122 |
| MERSCHMAN/MARS VIIRR | . | 53 | 53 | 36.6 | 18.2 | 31 | 1 | 123 |
| KRUGER/211+RR | . | 52 | 52 | 35.8 | 18.5 | 32 | 1 | 122 |
| PRAIRIE BR./PB-2112RR | . | 51 | 53 | 36.0 | 18.1 | 32 | 1 | 122 |
| KRUGER/191RR | . | 50 | 48 | 34.6 | 18.9 | 33 | 1 | 123 |
| KRUGER/222+RR | . | 50 | 48 | 37.3 | 18.0 | 35 | 1 | 124 |
| DAIRYLAND/DSR-199/RR | . | 50 | 47 | 36.1 | 18.5 | 33 | 1 | 122 |
| ZILLER/BT 7193R | . | 48 | 45 | 35.9 | 19.1 | 33 | 1 | 123 |
| MERSCHMAN/VENUS RR | . | 47 | 44 | 37.2 | 19.1 | 34 | 1 | 123 |
| | Entries tested one year | | | | | | | |
| KRUGER/223RR | . | . | 52 | . | . | 30 | 1 | 122 |
| PRAIRIE BR./PB-1943RR | . | . | 51 | . | . | 30 | 1 | 123 |
| LATHAM/EXP-E1800R | . | . | 50 | . | . | 36 | 2 | 122 |
| LATHAM/EXP-E1750R | . | . | 49 | . | . | 30 | 1 | 122 |
| THOMPSON/EXP7213RR | . | . | 49 | . | . | 36 | 1 | 123 |
| BIO GENE/BG1700RR | . | . | 47 | . | . | 31 | 1 | 120 |
| DEKALB/DKB19-52 | . | . | 47 | . | . | 31 | 1 | 118 |
| KRUGER/222A | . | . | 45 | . | . | 36 | 1 | 125 |
| DAIRYLAND/DSR-101/RR | . | . | 44 | . | . | 32 | 1 | 111 |
| Test average: | 54 | 52 | 49 | 35.8 | 18.7 | 33 | 1 | 121 |
| LSD(5%) value ($): | NS | 5 | 5 | | | | | |
| Min.top yield value ($): | 52 | 51 | 51 | | | | | |
| Coef. of variation (#): | 6 | 7 | 6 | | | | | |

Note: See bottom of table 6 for explanation of footnotes.

Table 8. Maturity group-II, Roundup Ready soybean results, seeded May 21.

| Brand / Entry | Yield - bu/ac (13% moisture) 3yr | 2yr | 2003 | 2002 Prot. pct+ | 2002 Oil pct+ | 2003 Ht. in. | 2003 Ldg. Sc.~ | 2003 Maturity: Days after seeding |
|---|---|---|---|---|---|---|---|---|
| | Entries tested three years | | | | | | | |
| PRAIRIE BR./PB-2421RR | 54 | 53 | 52 | 36.1 | 19.0 | 33 | 1 | 123 |
| LATHAM/497RR | 54 | 50 | 51 | 35.0 | 18.9 | 30 | 1 | 123 |
| MUSTANG/M-201RR | 53 | 51 | 47 | 35.9 | 18.7 | 29 | 1 | 123 |
| PRAIRIE BR./PB-2397RR | 52 | 50 | 45 | 35.8 | 18.8 | 38 | 1 | 123 |
| LATHAM/647RR | 52 | 50 | 49 | 35.5 | 19.3 | 31 | 1 | 123 |
| KRUGER/262-2RR | 51 | 49 | 44 | 35.6 | 19.4 | 31 | 1 | 120 |
| SANDS/SOI 226RR | 51 | 49 | 52 | 36.3 | 18.2 | 38 | 2 | 125 |
| PRAIRIE BR./PB-2821RR | 51 | 50 | 46 | 36.6 | 19.1 | 38 | 2 | 127 |
| DEN BESTEN/DB2601RR | 51 | 45 | 45 | 36.2 | 18.1 | 35 | 1 | 126 |
| ASGROW/AG2302 | 50 | 48 | 47 | 35.9 | 19.0 | 34 | 1 | 122 |
| DAIRYLAND/DSR-221/RR | 49 | 46 | 44 | 35.9 | 19.0 | 23 | 1 | 123 |
| DEKALB/DKB26-52 | 49 | 46 | 42 | 37.2 | 18.7 | 41 | 3 | 127 |
| KRUGER/269RR | 49 | 44 | 42 | 37.9 | 18.0 | 33 | 1 | 126 |
| KRUGER/250RR | 49 | 46 | 44 | 36.5 | 18.5 | 36 | 1 | 125 |
| KALTENBERG/KB261RR | 47 | 45 | 39 | 37.4 | 18.6 | 41 | 3 | 127 |
| COYOTE/9626RR | 46 | 45 | 44 | 36.4 | 17.8 | 34 | 1 | 126 |
| | Entries tested two years | | | | | | | |
| COYOTE/9524RR | . | 54 | 52 | 33.7 | 19.6 | 35 | 1 | 125 |
| MIDWEST SEED/GR2037 | . | 52 | 51 | 35.1 | 18.9 | 31 | 1 | 122 |
| SANDS/SOI 2143RR | . | 52 | 54 | 35.0 | 18.9 | 32 | 1 | 123 |
| KRUGER/211RR | . | 51 | 51 | 35.8 | 18.6 | 30 | 1 | 122 |
| KRUGER/270RR | . | 51 | 49 | 36.6 | 18.6 | 35 | 3 | 128 |
| PRAIRIE BR./PB-2832RR | . | 51 | 45 | 36.4 | 18.6 | 30 | 1 | 130 |
| DEKALB/DKB25-51 | . | 51 | 49 | 34.2 | 19.5 | 34 | 1 | 124 |
| SANDS/SOI 2642NRR | . | 50 | 48 | 36.5 | 18.5 | 39 | 3 | 127 |
| LATHAM/457RR | . | 49 | 44 | 36.5 | 19.0 | 37 | 1 | 125 |
| RENK/RS212RR | . | 49 | 47 | 35.5 | 18.7 | 33 | 1 | 122 |
| MUSTANG/M-243RR | . | 49 | 46 | 34.5 | 18.9 | 33 | 1 | 124 |
| MERSCHMAN/SIOUX IIRR | . | 49 | 46 | 38.6 | 17.9 | 30 | 1 | 128 |
| DYNA-GRO/DG 38K28RR | . | 49 | 44 | 36.3 | 18.4 | 38 | 3 | 129 |
| SANDS/SOI 2872RR | . | 48 | 45 | 36.4 | 18.3 | 40 | 2 | 128 |
| MUSTANG/M-203RR | . | 48 | 51 | 36.3 | 18.3 | 30 | 1 | 121 |

Table 8. Maturity group-II, Roundup Ready test results (continued).

| Brand / Entry | Yield - bu/ac (13% moisture) 3yr | 2yr | 2003 | 2002 Prot. pct+ | 2002 Oil pct+ | 2003 Ht. in. | 2003 Ldg. Sc.~ | 2003 Maturity: Days after seeding |
|---|---|---|---|---|---|---|---|---|
| | Entries tested two years | | | | | | | |
| PRAIRIE BR./PB-2352RR | . | 47 | 45 | 35.5 | 18.7 | 34 | 1 | 123 |
| DYNA-GRO/DG 3200RR | . | 47 | 46 | 36.2 | 18.4 | 28 | 1 | 124 |
| MERSCHMAN/APACHE VIIIR | . | 46 | 43 | 37.1 | 18.1 | 33 | 1 | 127 |
| PRAIRIE BR./PB-2552RR | . | 44 | 42 | 36.9 | 18.0 | 33 | 1 | 126 |
| DEN BESTEN/DB2303RR | . | 44 | 44 | 36.7 | 18.3 | 32 | 1 | 127 |
| DEN BESTEN/DB2803RR | . | 43 | 39 | 35.1 | 18.8 | 35 | 2 | 127 |
| COYOTE/9728RR | . | 43 | 37 | 35.1 | 19.1 | 36 | 1 | 126 |
| DEN BESTEN/DB2503RR | . | 43 | 37 | 37.1 | 17.7 | 33 | 1 | 126 |
| MUSTANG/M-273RR | . | 39 | 34 | 35.4 | 18.9 | 38 | 2 | 126 |
| | Entries tested one year | | | | | | | |
| LATHAM/L2136R | . | . | 56 | . | . | 31 | 1 | 123 |
| PRAIRIE BR./PB-2243RR | . | . | 54 | . | . | 33 | 1 | 122 |
| STINE/S2116-4 | . | . | 53 | . | . | 29 | 1 | 123 |
| JACOBSEN/EXP J733R | . | . | 52 | . | . | 30 | 1 | 123 |
| PRAIRIE BR./PB-2643RR | . | . | 51 | . | . | 36 | 1 | 130 |
| SANDS/SOI 2141ARR | . | . | 51 | . | . | 31 | 1 | 121 |
| HY-VIGOR/H-223RR | . | . | 50 | . | . | 33 | 1 | 124 |
| ASGROW/AG2403 | . | . | 50 | . | . | 30 | 1 | 125 |
| KRUGER/251RR | . | . | 49 | . | . | 39 | 3 | 127 |
| MERSCHMAN/MUNSEE IVRR | . | . | 49 | . | . | 29 | 1 | 123 |
| RENK/RS223RR | . | . | 49 | . | . | 31 | 1 | 122 |
| RENK/RS253RR | . | . | 49 | . | . | 34 | 1 | 129 |
| PRAIRIE BR./PB-2732RR | . | . | 48 | . | . | 32 | 1 | 127 |
| SABRE/282RR | . | . | 48 | . | . | 38 | 4 | 127 |
| MUSTANG/M-284RR | . | . | 48 | . | . | 32 | 1 | 129 |
| SANDS/SOI 2749RR | . | . | 48 | . | . | 31 | 1 | 126 |
| LATHAM/EXP-E2300R | . | . | 48 | . | . | 32 | 1 | 124 |
| LATHAM/EXP-E2145R | . | . | 48 | . | . | 36 | 1 | 125 |
| KALTENBERG/KB275RR | . | . | 48 | . | . | 37 | 2 | 127 |
| COYOTE/EXP527RR | . | . | 47 | . | . | 34 | 2 | 130 |
| PRAIRIE BR./PB-2343RR | . | . | 47 | . | . | 33 | 2 | 125 |

Table 8. Maturity group-II, Roundup Ready test results (continued).

| Brand / Entry | Yield - bu/ac (13% moisture) 3yr | 2yr | 2003 | 2002 Prot. pct+ | 2002 Oil pct+ | 2003 Ht. in. | 2003 Ldg. Sc.~ | 2003 Maturity: Days after seeding |
|---|---|---|---|---|---|---|---|---|
| | Entries tested one year | | | | | | | |
| GARST/2834RR | . | . | 46 | . | . | 33 | 1 | 129 |
| KALTENBERG/KB244RR | . | . | 46 | . | . | 34 | 1 | 126 |
| JACOBSEN/J828R | . | . | 46 | . | . | 37 | 2 | 129 |
| KRUGER/230RR | . | . | 46 | . | . | 32 | 1 | 123 |
| EXCEL/8236NRR | . | . | 46 | . | . | 31 | 1 | 124 |
| DYNA-GRO/DG 3218RR | . | . | 46 | . | . | 36 | 1 | 124 |
| KRUGER/289+RR | . | . | 46 | . | . | 36 | 1 | 129 |
| THOMPSON/T-7284RR | . | . | 46 | . | . | 38 | 3 | 128 |
| DAIRYLAND/DSR-234/RR | . | . | 46 | . | . | 31 | 1 | 124 |
| EXCEL/8226RR | . | . | 45 | . | . | 33 | 1 | 124 |
| STINE/S2400-4 | . | . | 45 | . | . | 32 | 1 | 123 |
| THOMPSON/EXP7239RR | . | . | 45 | . | . | 32 | 1 | 124 |
| SANDS/SOI 2353RR | . | . | 45 | . | . | 35 | 1 | 124 |
| DESOY/270ARR | . | . | 45 | . | . | 39 | 2 | 127 |
| GOLD COUNTRY/2424RR | . | . | 45 | . | . | 33 | 1 | 123 |
| SABRE/238RR | . | . | 45 | . | . | 36 | 1 | 125 |
| HY-VIGOR/2R44 | . | . | 45 | . | . | 33 | 1 | 127 |
| SANDS/SOI 2541RR | . | . | 45 | . | . | 36 | 2 | 127 |
| LATHAM/EXP-E2530R | . | . | 45 | . | . | 38 | 2 | 127 |
| DYNA-GRO/DG 3223RR | . | . | 45 | . | . | 32 | 1 | 124 |
| MIDWEST SEED/GR2627 | . | . | 44 | . | . | 35 | 1 | 128 |
| ZILLER/BT 7213R | . | . | 44 | . | . | 32 | 1 | 121 |
| DYNA-GRO/DG 3232RR | . | . | 44 | . | . | 35 | 1 | 128 |
| COYOTE/EXP625RR | . | . | 44 | . | . | 33 | 1 | 128 |
| ASGROW/AG2801 | . | . | 44 | . | . | 33 | 2 | 130 |
| SANDS/SOI 2501RR | . | . | 44 | . | . | 34 | 1 | 124 |
| THOMPSON/T-7293RR | . | . | 43 | . | . | 31 | 1 | 128 |
| CROWS/C2506R | . | . | 43 | . | . | 33 | 1 | 126 |
| DEKALB/DKB28-52 | . | . | 43 | . | . | 36 | 2 | 128 |
| MUSTANG/M-234RR | . | . | 43 | . | . | 34 | 1 | 123 |

Table 8. Maturity group-II, Roundup Ready test results (continued).

| Brand / Entry | Yield - bu/ac (13% moisture) 3yr | 2yr | 2003 | 2002 Prot. pct+ | 2002 Oil pct+ | 2003 Ht. in. | 2003 Ldg. Sc.~ | 2003 Maturity: Days after seeding |
|---|---|---|---|---|---|---|---|---|
| | Entries tested one year | | | | | | | |
| THOMPSON/T-7252RR | . | . | 43 | . | . | 31 | 1 | 126 |
| HY-VIGOR/EXP-2R55 | . | . | 42 | . | . | 35 | 1 | 128 |
| SANDS/EXP 2856NRR | . | . | 42 | . | . | 37 | 3 | 130 |
| THOMPSON/EXP7259RR | . | . | 42 | . | . | 37 | 3 | 125 |
| JACOBSEN/EXP J839R | . | . | 42 | . | . | 31 | 1 | 128 |
| SANDS/SOI 2858NRR | . | . | 42 | . | . | 36 | 1 | 130 |
| DESOY/260RR | . | . | 42 | . | . | 36 | 1 | 126 |
| JACOBSEN/J725R | . | . | 42 | . | . | 34 | 2 | 126 |
| KRUGER/292RR | . | . | 41 | . | . | 31 | 1 | 127 |
| EXCEL/8237RR | . | . | 41 | . | . | 34 | 2 | 124 |
| MUSTANG/M-253RR | . | . | 41 | . | . | 34 | 1 | 127 |
| DYNA-GRO/DG 3263RR | . | . | 41 | . | . | 38 | 1 | 127 |
| DAIRYLAND/DSR-245/RR | . | . | 41 | . | . | 34 | 1 | 127 |
| STINE/S2640-4 | . | . | 40 | . | . | 33 | 1 | 127 |
| LATHAM/EXP-E2200R | . | . | 40 | . | . | 36 | 2 | 124 |
| MERSCHMAN/CHICKASAW 8R | . | . | 39 | . | . | 35 | 1 | 130 |
| LATHAM/EXP-E2780R | . | . | 39 | . | . | 35 | 1 | 127 |
| MERSCHMAN/MOHAWK RR | . | . | 39 | . | . | 32 | 1 | 123 |
| THOMPSON/T-7243RR | . | . | 39 | . | . | 34 | 2 | 124 |
| MUSTANG/M-224RR | . | . | 39 | . | . | 33 | 1 | 123 |
| EXCEL/8258RR | . | . | 38 | . | . | 36 | 1 | 125 |
| THOMPSON/EXP7221RR | . | . | 38 | . | . | 34 | 1 | 118 |
| KRUGER/252RR | . | . | 37 | . | . | 44 | 1 | 123 |
| GARST/2903RR | . | . | 37 | . | . | 39 | 1 | 129 |
| HY-VIGOR/2720NR | . | . | 35 | . | . | 35 | 1 | 126 |
| Test average: | 50 | 47 | 45 | 36.0 | 18.7 | 34 | 1 | 125 |
| LSD(5%) value ($): | 5 | 7 | 5 | | | | | |
| Min.top yield value ($): | 49 | 47 | 51 | | | | | |
| Coef. of variation (#): | 8 | 8 | 8 | | | | | |

$/See yield section.
~ Lodging: 1= all plants erect, 3= some at 45 degrees, 5= all plants flat.

Table 9. Oat variety testing - S.E. Research Farm, Beresford and and state-wide averages.

| | Beresford | | State wide | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2003 | | | Yield | | Top Yield Group | |
| | -- bu/ac -- | | Prot. | Bu. Wt. | Ht. | -- bu/ac -- | | --- % --- | |
| Variety | '03 | 3-yr | % | lb. | in. | '03 | 3-yr | '03 | 3-yr |
| <u>Conventional varieties</u>: | | | | | | | | | |
| Don | 99 | 109+ | 15.9 | 36 | 30 | 91 | 86 | 50 | 60 |
| HiFi | 101+ | . | 15.2 | 35 | 34 | 87 | . | 50 | . |
| Hytest | 80 | 83 | 18.4 | 40 | 37 | 76 | 74 | 13 | 20 |
| Jerry | 109+ | 108+ | 16.4 | 38 | 35 | 93 | 88 | 50 | 80 |
| Loyal | 96 | 98 | 16.6 | 36 | 36 | 84 | 87 | 25 | 60 |
| Morton | 96 | . | 16.3 | 36 | 36 | 86 | . | 0 | . |
| Reeves | 94 | 100+ | 17.7 | 38 | 36 | 84 | 82 | 13 | 60 |
| <u>Hulless varieties</u>: | | | | | | | | | |
| Buff | 82 | 80 | 17.8 | 43 | 32 | 73 | 69 | 13 | 0 |
| Paul | 61 | 51 | 19.4 | 41 | 34 | 52 | 49 | 0 | 0 |
| <u>Experimental lines</u>: | | | | | | | | | |
| SD 366 | 110+ | . | 16.5 | 38 | 36 | 96 | . | 88 | . |
| SD 580 Hls | 69 | . | 19.1 | 43 | 36 | 57 | . | 0 | . |
| SD 731 | 94 | . | 17.0 | 38 | 34 | 85 | . | 38 | . |
| SD 744 | 98 | . | 15.9 | 37 | 33 | 94 | . | 63 | . |
| SD 813 | 97 | . | 17.1 | 38 | 30 | 82 | . | 25 | . |
| SD 915 | 102+ | . | 17.4 | 37 | 38 | 89 | . | 25 | . |
| SD96024 | 107+ | 114+ | 15.8 | 36 | 35 | 99 | 98 | 75 | 100 |
| Test avg.: | 93 | 93 | 17.0 | 38 | 35 | 83 | 80 | | |
| Lsd (5%) : | 11 | 16 | | | | | | | |
| Cv (%) : | 8 | 6 | | | | | | | |

+ Entry is in top-yield group.

* Percent of time a variety appears in the top-yield group across eight (2003) or five (2001-2003) test sites.

SE FARM REPORT
SDSU

# WEED CONTROL DEMONSTRATIONS and EVALUATION TESTS for 2003

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**Plant Science 0323**

## *INTRODUCTION:*

Evaluation and extension demonstration plots provide weed control data for the area served by the Southeast Experiment Farm. Plots provide side-by-side comparisons reflecting local conditions. The station is the major site for corn and soybean weed control studies. Tests at the station focus on common waterhemp, velvetleaf, cocklebur, and foxtail.

## *2003 TESTS:*

Spring precipitation was optimal for early soil applied herbicides. Cold conditions slowed late emerging weed flushes and affected some postemergence control of grassy weeds. Very heavy precipitation at the time of postemerge application affected timing and may have affected results.

Preemergence control of waterhemp was excellent and held into the season. Weed pressure in plot areas was moderate or heavy, providing for clear evaluation differences and substantial yield response for weed control.

The cooperation and direct assistance from station personnel is acknowledged. Field equipment and management of the plot areas are important contributions to the project. Extension educators provide assistance with tours and utilize the data in direct producer programs.

***NOTE:*** ***Data reported in this publication are results from field tests that include product uses, experimental products or experimental rates, combinations or other unlabeled uses for herbicide products. Tradenames of products used are listed; there frequently are other brand products available in the market. Users are responsible for applying herbicide according to label directions. Refer to the appropriate weed control fact sheet available from county extension offices for herbicide recommendations.***

Studies listed below are summarized in the following tables. Information for each study is included as part of the summary.

1. Corn Herbicide Demonstration
2. Herbicide Tolerant Corn Demonstration
3. Waterhemp Control in Corn
4. Roundup Programs for Waterhemp in Corn
5. Cocklebur Control in Corn
6. Field Sandbur Control in No-Till Corn
7. Two-Pass Weed Programs
8. Weed Programs in RR Corn
9. Lumax and Camix Comparisons
10. Postemerge Grass Comparisons
11. Aim Tank-Mix in RR Corn
12. Weed Control with KIH-Experimental
13. Strip Till Herbicide Demonstration
14. Tillage Systems and Herbicide Programs in Corn
15. 1X and 2X Herbicide Response in Corn
16. Soybean Herbicide Demonstration
17. Herbicide Tolerant Soybean
18. No-Till Soybean Herbicide Demonstration
19. Cocklebur Soybean Demonstration
20. Common Waterhemp in Soybeans
21. Roundup Tank-Mixes for Waterhemp
22. Late Waterhemp in Soybeans
23. 1X and 2X Soybean Herbicide Rates

Additional evaluation plots include initial tests with experimental herbicides, additives, tests with specific products or rate comparisons. Data collected for these tests are reported in the W.E.E.D. Project Data Reports.

1. Roundup/PGR Mixes in Corn
2. No-Till Corn Demonstration
3. X & 2X POST Soybeans to Corn
4. X & 2X PRE Soybeans to Corn
5. X & 2X PRE Corn to Soybeans
6. X & 2X POST Corn to Soybeans
7. Glyphosate Timing in Waterhemp - Soybeans
8. Weed Control in LL Corn
9. Velvetleaf Control in Corn
10. Callisto Comparisons
11. Roundup WeatherMax Adjuvants
12. Waterhemp Control in Soybeans with Glyphosate
13. No-Till vs. Conventional-Till in Corn
14. Velvetleaf Control in Soybeans

## Table 1. Corn Herbicide Demonstration

| | | | | |
|---|---|---|---|---|
| Demonstration | Precipitation: | | | |
| Variety: DeKalb DKC 53-34 | PRE: | 1st week | 1.42 inches | |
| Planting Date: 5/7/03 | | 2nd week | 0.43 inches | |
| PRE: 5/7/03 | LPRE: | 1st week | 0.24 inches | |
| LPRE: 5/21/03 | | 2nd week | 0.20 inches | |
| EPOST: 6/3/03 | EPOST: | 1st week | 0.91 inches | |
| POST: 6/11/03 | | 2nd week | 0.00 inches | |
| POST: 6/11/03 | POST: | 1st week | 0.00 inches | |
| Soil: Silty clay loam; 3.2% OM; 5.9 pH | | 2nd week | 1.03 inches | |

Grft=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Uniform, moderate weed pressure. Heavy waterhemp history. Tilled seedbed. Optimal spring conditions for early herbicide performance. Cool temperatures may have affected postemerge grass results. Excellent waterhemp control; limited extended flush. Excellent comparative test. Yield samples indicated check yield of 62 bu and best treatment 180 to 200 bu/ac.

| ***Treatment*** | ***Rate/ac*** | ***% Grft 7/11/03*** | ***% Cowh 7/11/03*** | ***% Grft 10/3/03*** | ***% Cowh 10/3/03*** |
|---|---|---|---|---|---|
| Check | ---- | 0 | 0 | 0 | 0 |
| ***SHALLOW PREPLANT INCORPORATED*** | | | | | |
| Surpass | 2.5 pt | 92 | 93 | 89 | 91 |
| Lumax | 3 qt | 97 | 99 | 93 | 98 |
| ***LATE PREEMERGENCE*** | | | | | |
| Harness Xtra | 2.1 qt | 99 | 99 | 97 | 99 |
| Harness | 2.3 pt | 96 | 97 | 89 | 97 |
| ***PREEMERGENCE*** | | | | | |
| Harness | 2.3 pt | 95 | 91 | 87 | 91 |
| Harness | 1.5 pt | 85 | 88 | 81 | 80 |
| Dual II Magnum | 2 pt | 95 | 84 | 95 | 85 |
| Outlook | 21 oz | 96 | 91 | 95 | 90 |
| Degree | 4.25 pt | 92 | 94 | 93 | 92 |
| Exp. | 6.7 oz | 96 | 87 | 95 | 90 |
| Define SC | 21 oz | 87 | 79 | 85 | 80 |
| Axiom | 22 oz | 90 | 94 | 89 | 95 |
| Balance Pro | 2.25 oz | 92 | 96 | 85 | 96 |
| Epic | 13 oz | 96 | 99 | 91 | 98 |
| Balance Pro+atrazine | 2.25 oz+.75 qt | 90 | 98 | 81 | 97 |
| Balance Pro+Define SC+atrazine | 2.25 oz+12 oz+.75 qt | 94 | 99 | 92 | 98 |
| Lumax | 3 qt | 96 | 99 | 95 | 99 |
| Camix | 2.4 qt | 94 | 98 | 90 | 98 |



| ***Treatment*** | ***Rate/ac*** | ***% Grft 7/11/03*** | ***% Cowh 7/11/03*** | ***% Grft 10/3/03*** | ***% Cowh 10/3/03*** |
|---|---|---|---|---|---|
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Dual II Magnum&Callisto+ | 1.67 pt&3 oz+ | | | | |

| | | | | | |
|---|---|---|---|---|---|
| COC+28% N | 1%+2 qt | 92 | 97 | 88 | 97 |
| Check | ---- | 0 | 0 | 0 | 0 |
| ***PREEMERGENCE*** | | | | | |
| Python+Surpass | 1.25 oz+2.5 pt | 97 | 97 | 95 | 96 |
| Bicep Lite II Magnum | 2 qt | 94 | 98 | 93 | 97 |
| G-Max Lite | 3.5 pt | 98 | 99 | 97 | 99 |
| Harness Xtra | 2.1 qt | 97 | 99 | 96 | 99 |
| Keystone LA | 2.2 qt | 93 | 99 | 92 | 99 |
| Surpass+atrazine+2,4-D ester | 1.67 pt+1 qt+1 qt | 89 | 98 | 82 | 98 |
| Balance Pro+Callisto | 2.25 oz+6 oz | 79 | 98 | 75 | 98 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Balance Pro&Callisto+ | 2.25 oz&3 oz+ | | | | |
| COC+28% N | 1%+2 qt | 77 | 99 | 71 | 98 |
| Balance Pro&Option+ | 2 oz&1.5 oz+ | | | | |
| MSO+28% N | 1.5 pt+2 qt | 92 | 99 | 86 | 99 |
| Balance Pro+Buctril/Atrazine | 2.25 oz&1 qt | 83 | 99 | 79 | 99 |
| Check | ---- | 0 | 0 | 0 | 0 |
| Outlook&Distinct+ | 21 oz&6 oz+ | | | | |
| NIS+28% N | .25%+2 qt | 95 | 99 | 96 | 99 |
| Outlook&Distinct+ | 21 oz&4 oz+ | | | | |
| NIS+28% N | .25%+2 qt | 94 | 99 | 93 | 99 |
| Outlook&Distinct+atrazine+ | 21 oz&4 oz+1.5 pt+ | | | | |
| NIS+28% N | .25%+2 qt | 94 | 99 | 93 | 99 |
| G-Max Lite&Clarity+ | 3.5 pt&1 pt+ | | | | |
| NIS+28% N | .125%+2 qt | 92 | 99 | 90 | 99 |
| Outlook&Marksman+ | 21 oz&2 pt+ | | | | |
| NIS+28% N | .125%+2 qt | 93 | 99 | 87 | 99 |
| Surpass&2,4-D amine | 2.5 pt&1 pt | 89 | 97 | 86 | 98 |
| Surpass&Shotgun | 2.5 pt&3 pt | 92 | 98 | 88 | 98 |
| Surpass&Aim EW+atrazine+ | 2.5 pt&.5 oz+1 qt+ | | | | |
| COC+28% N | 1%+2 qt | 95 | 99 | 90 | 99 |
| Surpass&Aim EW+Hornet WDG+ | 2.5 pt&.5 oz+3 oz+ | | | | |
| NIS+28% N | .25%+2 qt | 93 | 98 | 88 | 97 |
| Surpass&Hornet WDG+ | 2.5 pt&3 oz+ | | | | |
| NIS+28% N | .25%+2 qt | 94 | 97 | 85 | 98 |

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| Treatment | Rate/ac | % Grft 7/11/03 | % Cowh 7/11/03 | % Grft 10/3/03 | % Cowh 10/3/03 |
|---|---|---|---|---|---|
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Keystone LA&Hornet WDG+ | 2 qt&3 oz+ | | | | |
| Clarity+NIS+AMS | 4 oz+.25%+2.5 lb | 92 | 98 | 84 | 98 |
| Surpass&Hornet WDG+ | 2.5 pt&3 oz+ | | | | |
| atrazine+COC+AMS | 1.33 pt+1%+2.5 lb | 90 | 97 | 81 | 95 |
| Surpass&Hornet WDG+ | 2.5 pt&3 oz+ | | | | |
| Callisto+COC+AMS | .75 oz+1%+2.5 lb | 92 | 99 | 91 | 99 |
| Surpass&Accent+ | 2.5 pt&.33 oz+ | | | | |
| atrazine+COC+28% N | 1.5 pt+1%+2 qt | 97 | 98 | 93 | 95 |
| Surpass&Accent+ | 1.25 pt&.67 oz+ | | | | |
| atrazine+COC+28% N | 1.5 pt+1%+2 qt | 97 | 98 | 92 | 98 |
| Surpass&Accent+ | 1.25 pt&.33 oz+ | | | | |
| atrazine+COC+28 %N | 1.5 pt+1%+2 qt | 97 | 94 | 93 | 99 |
| Dual II Magnum&Northstar+ | 1.67 pt&5 oz+ | | | | |
| atrazine+COC+28% N | 1.5 pt+.25%+2 qt | 95 | 98 | 95 | 99 |
| Dual II Magnum&Callisto+ | 2 pt&3 oz+ | | | | |
| atrazine+COC+28% N | 1 pt+1%+2 qt | 96 | 99 | 96 | 99 |
| Cinch&Steadfast+Callisto+ | 1 pt&.75 oz+2 oz+ | | | | |
| atrazine+COC+28% N | 1 pt+1%+2 qt | 95 | 98 | 98 | 99 |
| Cinch&Steadfast+Marksman+ | 1 pt&.75 oz+1 pt+ | | | | |
| COC+28% N | 1%+2 qt | 94 | 95 | 91 | 92 |
| Harness&Yukon+ | 2.3 pt&4 oz+ | | | | |
| NIS+AMS | .25%+2 lb | 92 | 97 | 88 | 98 |
| Check | ---- | 0 | 0 | 0 | 0 |
| ***EARLY POSTEMERGENCE*** | | | | | |
| Lumax+COC+28% N | 2.5 qt+1%+2 qt | 82 | 98 | 80 | 98 |
| Option+MSO+28% N | 1.5 oz+1.5 pt+2 qt | 84 | 80 | 82 | 80 |
| Option+atrazine+ | 1.5 oz+1.5 pt+ | | | | |
| MSO+28% N | 1.5 pt+2 qt | 89 | 99 | 88 | 98 |
| Option+Distinct+ | 1.5 oz+4 oz+ | | | | |
| MSO+28% N | 1.5 pt+2 qt | 88 | 99 | 84 | 97 |
| Option+Callisto+atrazine+ | 1.5 oz+1.5 oz+1.5 pt+ | | | | |
| MSO+28% N | 1.5 pt+2 qt | 92 | 99 | 90 | 98 |
| Define SC+Option+atrazine+ | 5 oz+1.5 oz+1.5 pt+ | | | | |
| MSO+28% N | 1.5 pt+2 qt | 96 | 99 | 95 | 99 |
| Steadfast+COC+28% N | .75 oz+1%+2 qt | 90 | 83 | 93 | 80 |
| Steadfast+Priority+ | .75 oz+1 oz+ | | | | |
| COC+AMS | 1%+2.5 lb | 87 | 96 | 86 | 97 |
| Steadfast+Marksman+ | .75 oz+1 pt+ | | | | |
| COC+AMS | 1%+2.5 lb | 89 | 98 | 80 | 98 |

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| % Grft | % Cowh | % Grft | % Cowh |
|---|---|---|---|

| *Treatment* | *Rate/ac* | *7/11/03* | *7/11/03* | *10/3/03* | *10/3/03* |
|---|---|---|---|---|---|
| ***EARLY POSTEMERGENCE*** | | | | | |
| Cinch ATZ Lite+Steadfast+ Callisto+NIS+AMS | 2 pt+.75 oz+ 2 oz+.25%+2.5 lb | 92 | 99 | 83 | 99 |
| Steadfast+atrazine+ Callisto+COC+AMS | .75 oz+1.5 pt+ 2 oz+1%+2.5 lb | 88 | 98 | 78 | 98 |
| Accent+COC+28% N | .67 oz+1%+2 qt | 81 | 79 | 78 | 71 |
| Accent+Northstar+ atrazine+NIS+28% N | .67 oz+5 oz+ 1.5 pt+.25%+2 qt | 90 | 97 | 74 | 98 |
| Exp+Hornet WDG+ atrazine+COC+28% N | .5 oz+3 oz+ 1.5 pt+1%+2 qt | 97 | 99 | 97 | 99 |
| Celebrity Plus+atrazine+ COC+28% N | 4.7 oz+1.5 pt+ 1%+2 qt | 86 | 98 | 79 | 98 |
| Basis Gold+COC+28% N | 14 oz+1%+2 qt | 79 | 97 | 73 | 97 |

## Table 2. Herbicide Tolerant Corn Demonstration

Demonstration
Variety: DKC 53-34 (Roundup Ready)
Pio 37H27 (Liberty Link)
Pio 38A23 (Clearfield)
Planting Date: 5/7/03
PRE: 5/7/03
EPOST: 6/3/03
POST: 6/11/03
Soil: Silty clay loam; 3.2% OM; 5.9 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 1.42 inches |
| | 2nd week | 0.43 inches |
| EPOST: | 1st week | 0.91 inches |
| | 2nd week | 0.00 inches |
| POST: | 1st week | 0.00 inches |
| | 2nd week | 1.03 inches |
| POST1: | 1st week | 0.12 inches |
| | 2nd week | 3.08 inches |

Grft=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Uniform site. Heavy waterhemp history. Treatments provided excellent control. Yield sample showed 80 bu/ac for the check and 150 to 170 bu/ac for most treatments.

| | | 7/11/03 | | 10/3/03 | |
|---|---|---|---|---|---|
| ***Treatment*** | ***Rate/ac*** | ***% Grft*** | ***% Cowh*** | ***% Grft*** | ***% Cowh*** |
| ***Check - LIBERTY LINK*** | — | 0 | 0 | 0 | 0 |
| ***EARLY POSTEMERGENCE*** | | | | | |
| Liberty+atrazine+AMS | 32 oz+1 pt+3 lb | 91 | 98 | 90 | 98 |
| Define SC+Liberty+ atrazine+AMS | 5 oz+32 oz+ 1 pt+3 lb | 94 | 98 | 94 | 98 |
| ***POSTEMERGENCE1*** | | | | | |
| Liberty+atrazine+AMS | 32 oz+1 pt+3 lb | 86 | 95 | 89 | 97 |
| ***EARLY POSTEMERGENCE & POSTEMERGENCE1*** | | | | | |
| Liberty+atrazine+AMS& Liberty+AMS | 24 oz+1 pt+3 lb& 24 oz+3 lb | 98 | 99 | 98 | 99 |
| ***PREEMERGENCE & POSTEMERGENCE1*** | | | | | |
| Define SC&Liberty+ atrazine+AMS | 12 oz&32 oz+ 1 pt+3 lb | 97 | 99 | 97 | 99 |
| Balance Pro&Liberty+ atrazine+AMS | 1.5 oz&32 oz+ 1 pt+3 lb | 96 | 99 | 98 | 99 |
| ***Check - CLEARFIELD*** | — | 0 | 0 | 0 | 0 |
| ***EARLY POSTEMERGENCE*** | | | | | |
| Lightning+NIS+28% N | 1.28 oz+.25%+2 qt | 96 | 60 | 97 | 50 |
| Lightning+atrazine+ NIS+28% N | 1.28 oz+1.5 pt+ .25%+2 qt | 91 | 97 | 89 | 96 |
| Lightning+Marksman+ NIS+28% N | 1.28 oz+2 pt+ .25%+2 qt | 89 | 99 | 89 | 99 |

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| Treatment | Rate/ac | 7/11/03 | | 10/3/03 | |
|---|---|---|---|---|---|
| | | % Grft | % Cowh | % Grft | % Cowh |
| ***PREEMERGENCE & POSTEMERGENCE1*** | | | | | |
| Outlook&Lightning+ | 12 oz&1.28 oz+ | | | | |
| Marksman+NIS+28% N | 2 pt+.25%+2 qt | 99 | 99 | 99 | 99 |
| ***Check - ROUNDUP READY*** | — | 0 | 0 | 0 | 0 |
| ***EARLY POSTEMERGENCE*** | | | | | |
| Roundup UltraMax+AMS | 26 oz+2.5 lb | 84 | 95 | 85 | 96 |
| Harness+ | 2.3 pt+ | | | | |
| Roundup UltraMax+AMS | 26 oz+2.5 lb | 99 | 99 | 99 | 99 |
| Prowl $H_2O$+ | 33.8 oz+ | | | | |
| Roundup Original+ | 24 oz+ | | | | |
| NIS+AMS | .25%+2.5 lb | 98 | 99 | 98 | 99 |
| Outlook+Distinct+ | 12 oz+4 oz+ | | | | |
| Roundup UltraMax+AMS | 16 oz+2.5 lb | 99 | 99 | 99 | 98 |
| ***POSTEMERGENCE*** | | | | | |
| Roundup UltraMax+AMS | 26 oz+2.5 lb | 92 | 82 | 91 | 80 |
| Glyphomax Plus+ | 1 qt+ | | | | |
| Curtail+AMS | 1 pt+2.5 lb | 98 | 87 | 97 | 91 |
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | | |
| Roundup UltraMax+AMS& | 26 oz+2.5 lb& | | | | |
| Roundup UltraMax+AMS | 26 oz+2.5 lb | 89 | 82 | 85 | 79 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Atrazine& | 1.5 qt& | | | | |
| Roundup UltraMax+AMS | 26 oz+2.5 lb | 95 | 98 | 93 | 99 |
| Harness& | 2.3 pt& | | | | |
| Roundup UltraMax+AMS | 26 oz+2.5 lb | 98 | 99 | 98 | 99 |
| Harness& | 1 pt& | | | | |
| Roundup UltraMax+AMS | 26 oz+2.5 lb | 99 | 98 | 97 | 97 |
| Dual II Magnum& | 1.67 pt& | | | | |
| Touchdown+AMS | 1 qt+2.5 lb | 93 | 81 | 91 | 88 |
| Surpass& | 1.75 pt& | | | | |
| Glyphomax Plus+AMS | 1 qt+2.5 lb | 96 | 98 | 96 | 98 |
| Keystone LA& | 1.3 qt& | | | | |
| Warrant+AMS | 24 oz+2.5 lb | 96 | 97 | 95 | 97 |
| Outlook&Distinct+ | 12 oz&4 oz+ | | | | |
| Roundup Original+ | 1 pt+ | | | | |
| NIS+AMS | .25%+2.5 lb | 99 | 97 | 98 | 96 |
| Outlook& | 12 oz& | | | | |
| Roundup UltraMax+AMS | 24 oz+2.5 lb | 99 | 96 | 98 | 96 |
| Outlook&Roundup Original+ | 12 oz&1 pt+ | | | | |
| Clarity+NIS+AMS | 8 oz+.25%+2.5 lb | 99 | 96 | 97 | 95 |

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| Treatment | Rate/ac | 7/11/03 | | 10/3/03 | |
|---|---|---|---|---|---|
| | | % Grft | % Cowh | % Grft | % Cowh |

| | | | | | |
|---|---|---|---|---|---|
| ***POSTEMERGENCE*** | | | | | |
| Outlook+Roundup Original+ Clarity+NIS+AMS | 12 oz+1 pt+ 8 oz+.25%+2.5 lb | 99 | 86 | 96 | 85 |
| Roundup Original+Clarity+ NIS+AMS | 1 qt+8 oz+ .25%+2.5 lb | 99 | 81 | 98 | 87 |
| Roundup UltraMax+ Clarity+AMS | 24 oz+ 8 oz+2.5 lb | 98 | 92 | 98 | 96 |
| Roundup UltraMax+ atrazine+AMS | 24 oz+ 1 pt+2.5 lb | 98 | 95 | 97 | 96 |
| Roundup UltraMax+ Aim EW+atrazine+AMS | 24 oz+.5 oz+ .5 oz+1 pt+2.5 lb | 99 | 97 | 98 | 97 |
| Roundup UltraMax+ Resource+AMS | 24 oz+ 4 oz+2.5 lb | 99 | 97 | 99 | 96 |
| Roundup UltraMax+ Callisto+AMS | 24 oz+ 3 oz+2.5 lb | 98 | 86 | 98 | 86 |
| Roundup UltraMax+ 2,4-D amine+AMS | 24 oz+ .5 pt+2.5 lb | 98 | 95 | 96 | 94 |

## Table 3. Waterhemp Control in Corn

RCB; 3 reps
Variety: DeKalb DKC53-34
Planting Date: 5/7/03
PRE: 5/7/03
EPOST: 6/3/03
POST: 6/11/03
Soil: Silty clay loam; 3.0% OM; 6.8 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 1.42 inches |
| | 2nd week | 0.43 inches |
| EPOST: | 1st week | 0.91 inches |
| | 2nd week | 0.00 inches |
| POST: | 1st week | 0.00 inches |
| | 2nd week | 1.03 inches |

Grft=Green foxtail, yellow foxtail escapes
Cowh=Common waterhemp

***COMMENTS:*** Heavy waterhemp history in plot area. Aim treatments provided nearly complete waterhemp control. Precipitation was optional for preemergence activity; treatments were more variable for grass. Weed competition effect on yield.

| Treatment | Rate/ac | % Grft 9/9/03 | % Cowh 9/9/03 | Yield bu/ac |
|---|---|---|---|---|
| Check | — | 0 | 0 | 137 |
| **PREEMERGENCE** | | | | |
| Dual II Magnum | 2 pt | 91 | 97 | 212 |
| Harness | 2.3 pt | 95 | 98 | 214 |
| Outlook | 21 oz | 96 | 98 | 206 |
| Balance Pro | 2.25 oz | 70 | 99 | 202 |
| Balance Pro+atrazine | 2.25 oz+1 qt | 83 | 99 | 217 |
| Lumax | 3 qt | 87 | 99 | 211 |
| Camix | 2.4 qt | 96 | 99 | 222 |
| Harness+atrazine | 2.3 pt+2 qt | 95 | 99 | 220 |
| **PREEMERGENCE & POSTEMERGENCE** | | | | |
| Surpass&Aim EW+atrazine+ NIS+28% N | 2.5 pt&.5 oz+1 qt+ .25%+2 qt | 94 | 99 | 214 |
| Surpass&Distinct+ NIS+28% N | 2.5 pt&4 oz+ .25%+1 qt | 92 | 99 | 205 |
| Surpass&Marksman+28% N | 2.5 pt&3.5 pt+2 qt | 89 | 99 | 215 |
| **POSTEMERGENCE** | | | | |
| Option+Marksman+ MSO+28% N | 1.5 oz+3.5 pt+ 1.5 pt+2 qt | 80 | 99 | 202 |
| Option+atrazine+ MSO+28% N | 1.5 oz+1 qt+ 1.5 pt+2 qt | 83 | 98 | 214 |

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| ***Treatment*** | ***Rate/ac*** | ***% Grft 9/9/03*** | ***% Cowh 9/9/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|
| ***POSTEMERGENCE*** | | | | |
| Steadfast+Callisto+ | .75 oz+3 oz+ | | | |
| COC+28% N | 1%+2 qt | 78 | 99 | 211 |
| Steadfast+Callisto+ | .75 oz+1.5 oz+ | | | |
| COC+28% N | 1%+2 qt | 76 | 98 | 214 |
| Steadfast+Callisto+atrazine+ | .75 oz+3 oz+.75 qt+ | | | |
| COC+28% N | 1%+2 qt | 91 | 99 | 215 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Harness&Callisto+COC+28% N | 2.3 pt&1.5 oz+1%+2 qt | 96 | 99 | 220 |
| Harness&Callisto+atrazine+ | 2.3 pt&1.5 oz+.75 qt+ | | | |
| COC+28% N | 1%+2 qt | 96 | 99 | 232 |
| LSD (.05) | | 9 | 1 | 18 |

## Table 4. Roundup Programs for Waterhemp in Corn

RCB; 3 reps
Variety: DeKalb DKC53-34
Planting Date: 5/7/03
PRE: 5/7/03
EPOST/2WK: 6/3/03
POST/3WK: 6/11/03
4WK: 6/16/03
5WK: 6/27/03
6WK: 7/3/03
Soil: Silty clay loam; 3.0% OM; 6.8 pH

FXTL=Green foxtail
Cowh=Common waterhemp

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 1.42 inches |
| | 2nd week | 0.43 inches |
| EPOST/2WK: | 1st week | 0.91 inches |
| | 2nd week | 0.00 inches |
| POST/3WK: | 1st week | 0.00 inches |
| | 2nd week | 1.03 inches |
| 4WK: | 1st week | 0.12 inches |
| | 2nd week | 3.08 inches |
| 5WK: | 1st week | 0.91 inches |
| | 2nd week | 3.30 inches |
| 6WK: | 1st week | 4.01 inches |
| | 2nd week | 0.00 inches |

COMMENTS: Comparison of control programs using glyphosate. Uniform, moderate waterhemp pressure. Cool temperatures delayed early waterhemp emergence. Late season control was maintained at 95% for several combinations or split programs. The 6 week timing was the least effective. Yields were highest for the split/combination treatments and were reduced for single treatments at 4 to 6 weeks after planting.

| ***Treatment*** | ***Rate/ac*** | ***% FXTL 9/9/03*** | ***% Cowh 9/9/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|
| Check | — | 0 | 0 | 137 |
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS& Roundup UltraMax+AMS | 12.8 oz+2.5 lb& 12.8 oz+2.5 lb | 87 | 94 | 219 |
| Roundup UltraMax+AMS& Roundup UltraMax+AMS | 25.6 oz+2.5 lb& 25.6+2.5 lb | 90 | 93 | 213 |
| Roundup UltraMax+AMS& Roundup UltraMax+AMS | 12.8 oz+2.5 lb& 25.6 oz+2.5 lb | 88 | 95 | 214 |
| Roundup UltraMax+AMS& Roundup Ultramax+AMS | 25.6 oz+2.5 lb& 12.8 oz+2.5 lb | 87 | 95 | 216 |
| ***2 WEEKS*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 68 | 61 | 199 |
| ***3 WEEKS*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 92 | 93 | 205 |
| ***4 WEEKS*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 97 | 94 | 187 |
| ***5 WEEKS*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 96 | 90 | 167 |
| ***6 WEEKS*** | | | | |
| Roundup UltraMax+AMS | 32 oz+2.5 lb | 97 | 82 | 176 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Harness&Roundup UltraMax+AMS | 2.3 pt&25.6 oz+2.5 lb | 98 | 99 | 232 |

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| ***Treatment*** | ***Rate/ac*** | ***% FXTL 9/9/03*** | ***% Cowh 9/9/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Harness+atrazine& | 2.3 pt+1 qt& | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 97 | 98 | 213 |
| Harness& | 2.3 pt& | | | |
| Atrazine+Roundup UltraMax+AMS | 25.6 oz+1 qt+2.5 lb | 98 | 99 | 219 |
| LSD (.05) | | 7 | 17 | 33 |

## Table 5. Cocklebur Control in Corn

RCB; 2 reps
Variety: DeKalb DKC53-34
Planting Date: 5/7/03
POST: 6/11/03
Soil: Loam; 2.4% OM; 7.0 pH

| Precipitation: | | |
|---|---|---|
| PRE: | 1st week | 1.42 inches |
| | 2nd week | 0.43 inches |
| POST: | 1st week | 0.00 inches |
| | 2nd week | 1.03 inches |

Cocb=Common cocklebur

***COMMENTS:*** Heavy cocklebur pressure. Lumax was the most effective PRE; POST treatments were effective.

| ***Treatment*** | ***Rate/ac*** | ***% Cocb 9/9/03*** | ***Yield bu/ac*** |
|---|---|---|---|
| Check | ---- | 0 | 64 |
| ***PREEMERGENCE*** | | | |
| Python+Dual II Magnum | 1.25 oz+1.67 pt | 75 | 158 |
| Lumax | 3 qt | 90 | 186 |
| Harness+atrazine | 2.5 pt+1 qt | 78 | 159 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | |
| Surpass&Buctril/Atrazine | 2.75 pt&2.25 pt | 91 | 160 |
| Surpass&Clarity | 2.75 pt&.5 pt | 96 | 173 |
| Surpass&Marksman+28% N | 2.75 pt&2.75 pt+2 qt | 95 | 160 |
| Surpass&Shotgun | 2.75 pt&3 pt | 96 | 161 |
| Surpass&Yukon+NIS+AMS | 2.75 pt&4 oz+.25%+2.5 lb | 97 | 167 |
| Surpass&Hornet WDG+NIS+28% N | 2.75 pt&3 oz+.25%+2 qt | 98 | 177 |
| Surpass&2,4-D ester | 2.75 pt&8 oz | 95 | 175 |
| Surpass&Northstar+NIS+28% N | 2.75 pt&5 oz+.25%+2 qt | 96 | 181 |
| Surpass&Distinct+NIS+28% N | 2.75 pt&4 oz+.25%+2 qt | 90 | 157 |
| Surpass&Callisto+COC+28% N | 2.75 pt&3 oz+1%+2 qt | 96 | 173 |
| LSD (.05) | | 14 | 35 |

## Table 6. Field Sandbur Control in No-Till Corn

RCB; 3 reps
Varieties: DKC 58-29 (Roundup Ready)
Pio 38H23CF (Clearfield)
Pio 37H27LL (Liberty Link)
Planting Date: 5/28/03
PRE: 5/28/03
EPOST: 6/16/03
POST: 6/27/03
Soil: Clay; 3.1% OM; 6.9 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 0.20 inches |
| | 2nd week | 0.87 inches |
| EPOST: | 1st week | 0.12 inches |
| | 2nd week | 3.08 inches |
| POST: | 1st week | 0.91 inches |
| | 2nd week | 3.30 inches |

Fisb=Field sandbur
Grft=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** No-till corn. Split programs appeared to be most effective for sandbur. Precipitation inadequate for early foxtail control. Some late grass emergence; heavy precipitation associated with POST timing.

| ***Treatment*** | ***Rate/ac*** | ***% Fisb 8/5/03*** | ***% Fisb 9/9/03*** | ***% Grft 9/9/03*** | ***% Cowh 9/9/03*** |
|---|---|---|---|---|---|
| ***Roundup Ready - Check*** | ---- | 0 | 0 | 0 | 0 |
| ***PREEMERGENCE*** | | | | | |
| Harness | 2.3 pt | 74 | 69 | 60 | 98 |
| Lumax | 3 qt | 83 | 78 | 73 | 98 |
| Balance Pro | 2.25 oz | 92 | 83 | 66 | 98 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Surpass&Accent+ COC+28% N | 1.25 pt&.67 oz+ 1%+2 qt | 93 | 91 | 93 | 95 |
| Fultime&Steadfast+ COC+28% N | 2.5 qt&.75 oz+ 1%+2 qt | 96 | 92 | 93 | 97 |
| Balance Pro&Option+ MSO+28% N | 1.87 oz&1.5 oz+ 1.5 pt+2 qt | 80 | 72 | 77 | 96 |
| ***EARLY POSTEMERGENCE*** | | | | | |
| Accent+COC+28% N | .67 oz+1%+2.5% | 82 | 79 | 68 | 87 |
| Steadfast+COC+28% N | .75 oz+1%+2 qt | 88 | 88 | 86 | 88 |
| Option+MSO+28% N | 1.5 oz+1.5 pt+2 qt | 86 | 85 | 79 | 88 |
| Steadfast+Accent+ COC+28% N | .75 oz+.25 oz+ 1%+2 qt | 89 | 86 | 92 | 94 |
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | | |
| Accent+COC+28% N& Accent+COC+28% N | .5 oz+1%+2 qt& .67 oz+1%+2 qt | 83 | 87 | 96 | 95 |
| ***POSTEMERGENCE*** | | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 91 | 76 | 81 | 83 |

| ***Treatment*** | ***Rate/ac*** | ***% Fisb 8/5/03*** | ***% Fisb 9/9/03*** | ***% Grft 9/9/03*** | ***% Cowh 9/9/03*** |
|---|---|---|---|---|---|
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | | |
| Roundup UltraMax+AMS& | 25.6 oz+2.5 lb& | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 88 | 89 | 64 | 90 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Harness& | 2.75 pt& | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 89 | 88 | 78 | 83 |
| Balance Pro& | 2.25 oz& | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 87 | 85 | 91 | 94 |
| ***Clearfield - Check*** | ---- | 0 | 0 | 0 | 0 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Surpass&Lightning+ | 1.5 pt&1.28 oz+ | | | | |
| X-77+28% N | .25%+2 qt | 96 | 94 | 97 | 95 |
| ***EARLY POSTEMERGENCE*** | | | | | |
| Lightning+X-77+28% N | 1.28 oz+.25%+2 qt | 95 | 91 | 95 | 94 |
| ***Liberty Link - Check*** | ---- | 0 | 0 | 0 | 0 |
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | | |
| Liberty+AMS& | 28 oz+3 lb& | | | | |
| Liberty+AMS | 24 oz+3 lb | 87 | 89 | 75 | 94 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Balance Pro&Liberty+AMS | 2.25 oz&24 oz+3 lb | 89 | 81 | 87 | 97 |
| Define SC&Liberty+ | 12 oz&20 oz+ | | | | |
| atrazine+AMS | 1 lb+3 lb | 87 | 84 | 90 | 92 |
| LSD (.05) | | 10 | 9 | 14 | 9 |

## Table 7. Two-Pass Weed Programs

RCB; 3 reps
Variety: DeKalb DKC 53-34
Planting Date: 5/7/03
PRE: 5/7/03
POST: 6/11/03
Soil: Silty clay loam; 3.0% OM; 6.8 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 1.42 inches |
| | 2nd week | 0.43 inches |
| POST: | 1st week | 0.00 inches |
| | 2nd week | 1.03 inches |

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

Grft=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Light early grass pressure mostly in wheel track; late ratings reflect emergence after post application. Treatments provided excellent waterhemp control; plot area history for heavy pressure. Yields similar for treatments; 60-70 bu/ac increase over check for several treatments.

| Treatment | Rate/ac | % VCRR 6/11/03 | % Grft 6/11/03 | % VCRR 8/8/03 | % Grft 8/8/03 | % Cowh 8/8/03 | % Grft 9/19/03 | % Cowh 9/19/03 | Yield bu/ac |
|---|---|---|---|---|---|---|---|---|---|
| Check | ---- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 116 |
| ***PREEMERGENCE*** | | | | | | | | | |
| Lumax | 3 qt | 0 | 96 | 0 | 88 | 99 | 84 | 96 | 199 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | | | | | |
| Dual II Magnum& Callisto+atrazine+ COC+28% N | 2 pt& 3 oz+1 pt+ 1%+2.5% | 0 | 95 | 0 | 91 | 99 | 92 | 99 | 208 |
| Bicep Lite II Magnum& Callisto+atrazine+ COC+28% N | 2 qt& 3 oz+.5 pt+ 1%+2.5% | 0 | 96 | 0 | 94 | 99 | 96 | 99 | 207 |
| Degree&Yukon+ COC+28% N | 5 pt&4 oz+ 1%+2.5% | 0 | 91 | 0 | 85 | 99 | 90 | 99 | 207 |
| Outlook& Marksman+NIS | 21 oz& 3.5 pt+.125% | 0 | 94 | 0 | 93 | 99 | 95 | 99 | 202 |
| G-Max Lite&Distinct+ NIS+28% N | 3.5 pt&6 oz+ .25%+2.5% | 0 | 96 | 0 | 96 | 98 | 97 | 99 | 203 |
| Keystone LA& Hornet WDG+ NIS+28% N | 4.5 pt& 3 oz+ .25%+2.5% | 0 | 94 | 0 | 93 | 99 | 93 | 99 | 212 |
| Cinch ATZ Lite& Steadfast+Clarity+ COC+28% N | 1.5 pt& .75 oz+4 oz+ 1%+2.5% | 0 | 90 | 0 | 87 | 99 | 93 | 99 | 214 |
| Harness Xtra& Roundup WeatherMax+ AMS | 2 pt& 21.3 oz+ 17 lb/100 gal | 0 | 94 | 0 | 92 | 99 | 94 | 99 | 214 |
| LSD (.05) | | 0 | 4 | 0 | 6 | 1 | 3 | 1 | 21 |

## Table 8. Weed Control Programs in Roundup Ready Corn

RCB; 3 reps
Variety: DeKalb DKC 53-34
Planting Date: 5/7/03
PRE: 5/7/03
EPOST: 6/3/03
POST: 6/16/03
Soil: Silty clay loam; 3.0% OM; 6.8 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 1.42 inches |
| | 2nd week | 0.43 inches |
| EPOST: | 1st week | 0.91 inches |
| | 2nd week | 0.00 inches |
| POST: | 1st week | 0.12 inches |
| | 2nd week | 3.08 inches |

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

FXTL=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Uniform, moderate weed pressure. Preemergence programs provided highest waterhemp control. Clarity did not antagonize grass control. Adequate crop tolerance for all treatments based on yield; treatments with tank-mix combination produced similar yield.

| ***Treatment*** | ***Rate/ac*** | ***% VCRR 6/27/03*** | ***% VCRR Ht. Red. 7/13/03*** | ***% FXTL 8/8/03*** | ***% Cowh 8/8/03*** | ***% VCRR Root 9/19/03*** | ***% FXTL 9/19/03*** | ***% Cowh 9/19/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|---|---|---|---|---|
| Check | — | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 165 |
| ***EARLY POSTEMERGENCE*** | | | | | | | | | |
| Prowl $H_2O$+ | 33.7 oz+ | | | | | | | | |
| Roundup Original+ | 24 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 0 | 0 | 97 | 93 | 0 | 97 | 88 | 235 |
| Outlook+Clarity+ | 12 oz+8 oz+ | | | | | | | | |
| Roundup Original+ | 16 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 2 | 0 | 97 | 93 | 3 | 97 | 98 | 217 |
| ***PREEMERGENCE & EARLY POSTEMERGENCE*** | | | | | | | | | |
| Outlook&Clarity+ | 12 oz&8 oz+ | | | | | | | | |
| Roundup Original+ | 16 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 0 | 2 | 98 | 98 | 2 | 98 | 98 | 225 |
| ***EARLY POSTEMERGENCE*** | | | | | | | | | |
| Clarity+ | 8 oz+ | | | | | | | | |
| Roundup Original+ | 16 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 2 | 0 | 95 | 91 | 5 | 94 | 88 | 214 |
| Distinct+ | 4 oz+ | | | | | | | | |
| Roundup Original+ | 16 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 0 | 0 | 94 | 95 | 0 | 92 | 86 | 222 |
| Roundup | | | | | | | | | |
| WeatherMax+ | 22 oz+ | | | | | | | | |
| AMS | 2.5 lb | 0 | 0 | 86 | 89 | 0 | 90 | 81 | 211 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | | | | | |
| Outlook&Clarity+ | 12 oz&8 oz+ | | | | | | | | |
| Roundup Original+ | 16 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 8 | 8 | 98 | 99 | 3 | 98 | 99 | 226 |
| Outlook&Distinct+ | 12 oz&2 oz+ | | | | | | | | |
| Roundup Original+ | 16 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 2 | 3 | 99 | 99 | 0 | 99 | 99 | 230 |

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| Treatment | Rate/ac | % VCRR 6/27/03 | % VCRR Ht. Red. 7/13/03 | % FXTL 8/8/03 | % Cowh 8/8/03 | % VCRR Root 9/19/03 | % FXTL 9/19/03 | % Cowh 9/19/03 | Yield bu/ac |
|---|---|---|---|---|---|---|---|---|---|
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | | | | | |
| Outlook&Distinct+ | 12 oz&4 oz+ | | | | | | | | |
| Roundup Original+ | 16 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 5 | 8 | 98 | 98 | 3 | 98 | 99 | 227 |
| Outlook& | 12 oz& | | | | | | | | |
| Roundup | | | | | | | | | |
| WeatherMax+ | 22 oz | | | | | | | | |
| NIS | +2.5 lb | 0 | 0 | 99 | 98 | 0 | 98 | 98 | 219 |
| ***POSTEMERGENCE*** | | | | | | | | | |
| Prowl $H_2O$+ | 33.7 oz+ | | | | | | | | |
| Roundup Original+ | 24 oz+ | | | | | | | | |
| NIS+AMS | .25%+2.5 lb | 0 | 7 | 99 | 91 | 0 | 98 | 97 | 210 |
| LSD (.05) | | 3 | 5 | 5 | 7 | 4 | 3 | 4 | 19 |

## Table 9. Lumax and Camix Comparisons

RCB; 3 reps
Variety: DeKalb DKC 44-46
Planting Date: 5/21/03
PRE: 5/21/03
EPOST: 6/3/03
Soil: Silty clay loam; 3.0% OM; 6.8 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 0.24 inches |
| | 2nd week | 0.20 inches |
| EPOST: | 1st week | 0.91 inches |
| | 2nd week | 0.00 inches |

Grft=Green foxtail
Cowh=Common waterhemp
Colq=Common lambsquarters

***COMMENTS:*** Comparison of Lumax rates and application timing. Early post timing tended to be most effective on foxtail. All treatments provided excellent broadleaf control.

| ***Treatment*** | ***Rate/ac*** | ***% Grft 8/8/03*** | ***% Cowh 8/8/03*** | ***% Colq 8/8/03*** |
|---|---|---|---|---|
| Check | --- | 0 | 0 | 0 |
| ***PREEMERGENCE*** | | | | |
| Lumax | 2 qt | 91 | 99 | 97 |
| ***EARLY POSTEMERGENCE*** | | | | |
| Lumax+NIS | 2 qt+.25% | 95 | 98 | 99 |
| ***PREEMERGENCE*** | | | | |
| Lumax | 2.5 qt | 88 | 98 | 96 |
| ***EARLY POSTEMERGENCE*** | | | | |
| Lumax+NIS | 2.5 qt+.25% | 96 | 99 | 99 |
| ***PREEMERGENCE*** | | | | |
| Lumax | 3 qt | 90 | 99 | 99 |
| ***EARLY POSTEMERGENCE*** | | | | |
| Lumax+NIS | 3 qt+.25% | 98 | 99 | 99 |
| ***PREEMERGENCE*** | | | | |
| Camix | 1.6 qt | 84 | 99 | 99 |
| Camix | 2 qt | 84 | 99 | 97 |
| Camix | 2.4 qt | 89 | 98 | 96 |
| Bicep Lite II Magnum | 2 qt | 95 | 98 | 97 |
| LSD (.05) | | 7 | 1 | 4 |

## Table 10. Postemerge Grass Comparisons

RCB: 3 reps
Variety: DeKalb DKC 44-46
Planting Date: 5/27/03
POST: 6/16/03
Soil: Silty clay; 3.5% OM; 6.6 pH

Precipitation:
POST: 1st week 0.12 inches
2nd week 3.08 inches

Grft=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Evaluation of post grass herbicides applied at 50, 75, and 100% of full rate in combination with 1 lb/A atrazine. Control and yield tended to be highest with full rates.

| ***Treatment*** | ***Rate/ac*** | ***% Grft 9/9/03*** | ***% Cowh 9/9/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|
| Check | — | 0 | 0 | 106 |
| ***POSTEMERGENCE*** | | | | |
| Accent+atrazine+MSO+28% N | .33 oz+1 qt+1.5 pt+2 qt | 74 | 86 | 130 |
| Accent+atrazine+MSO+28% N | .5 oz+1 qt+1.5 pt+2 qt | 78 | 81 | 134 |
| Accent+atrazine+MSO+28% N | .67 oz+1 qt+1.5 pt+2 qt | 70 | 94 | 146 |
| Steadfast+atrazine+MSO+28% N | .375 oz+1 qt+1.5 pt+2 qt | 73 | 93 | 138 |
| Steadfast+atrazine+MSO+28% N | .56 oz+1 qt+1.5 pt+2 qt | 81 | 94 | 142 |
| Steadfast+atrazine+MSO+28% N | .75 oz+1 qt+1.5 pt+2 qt | 91 | 98 | 150 |
| Option+atrazine+MSO+28% N | .75 oz+1 qt+1.5 pt+2 qt | 67 | 82 | 138 |
| Option+atrazine+MSO+28% N | 1.125 oz+1 qt+1.5 pt+2 qt | 71 | 83 | 142 |
| Option+atrazine+MSO+28% N | 1.5 oz+1 qt+1.5 pt+2 qt | 78 | 87 | 150 |
| LSD (.05) | | 19 | 10 | 15 |

## Table 11. Aim Tank-Mix in Roundup Ready Corn

RCB; 3 reps
Variety: DeKalb DKC 53-34
Planting Date: 5/7/03
POST: 6/11/03
Soil: Silty clay loam; 3.5% OM; 6.6 pH

Precipitation:
POST: 1st week 0.00 inches
2nd week 1.03 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)
Grft=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Weed control similar for treatments. No adverse crop response associated with the tank-mix compared to glyphosate alone in this test.

| ***Treatment*** | ***Rate/ac*** | ***% VCRR 8/8/03*** | ***% Grft 8/8/03*** | ***% Cowh 8/8/03*** | ***% Grft 9/19/03*** | ***% Cowh 9/19/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|---|---|---|
| Check | ---- | 0 | 0 | 0 | 0 | 0 | 117 |
| ***POSTEMERGENCE*** | | | | | | | |
| Aim EW+ | .5 oz+ | | | | | | |
| Roundup WeatherMax+ | 16 oz+ | | | | | | |
| AMS | 17 lb/100 gal | 0 | 93 | 91 | 91 | 92 | 216 |
| Aim EW+ | .5 oz+ | | | | | | |
| Roundup WeatherMax+ | 21 oz+ | | | | | | |
| AMS | 17 lb/100 gal | 0 | 90 | 91 | 92 | 93 | 208 |
| Roundup WeatherMax+ | 16 oz+ | | | | | | |
| AMS | 17 lb/100 gal | 0 | 94 | 85 | 92 | 92 | 209 |
| Roundup WeatherMax+ | 21 oz+ | | | | | | |
| AMS | 17 lb/100 gal | 0 | 96 | 90 | 95 | 96 | 217 |
| LSD (.05) | | 0 | 8 | 14 | 6 | 6 | 42 |

## Table 12. Weed Control with KIH-Experimental

RCB; 3 reps
Variety: DeKalb DKC 53-34 RR
Planting Date: 5/7/03
PRE: 5/7/03
Soil: Silty clay loam; 3.5% OM; 6.6 pH

Precipitation:
PRE: 1st week 1.42 inches
2nd week 0.43 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)
Grft=Green foxtail
Cowh=Common waterhemp
Colq=Common lambsquarter

***COMMENTS:*** Favorable conditions for preemergence herbicides. KIH-Exp. provided excellent control at two high rates; rates generally compare equally to the standard.

| ***Treatment*** | ***Rate/ac*** | ***% VCRR 6/3/03*** | ***% Grft 6/15/03*** | ***% Cowh 6/15/03*** | ***% Grft 8/8/03*** | ***% Cowh 8/8/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|---|---|---|
| Check | ---- | 0 | 0 | 0 | 0 | 0 | 129 |
| ***PREEMERGENCE*** | | | | | | | |
| KIH-Exp. | 4 oz | 0 | 89 | 93 | 58 | 95 | 201 |
| KIH-Exp. | 6.7 oz | 0 | 93 | 95 | 91 | 98 | 189 |
| KIH-Exp. | 8 oz | 0 | 94 | 98 | 89 | 95 | 204 |
| KIH-Exp. | 9.6 oz | 0 | 96 | 98 | 89 | 98 | 195 |
| Dual II Magnum | 1 pt | 0 | 85 | 86 | 54 | 93 | 192 |
| Dual II Magnum | 1.67 pt | 0 | 97 | 97 | 77 | 97 | 196 |
| Dual II Magnum | 2 pt | 0 | 97 | 97 | 87 | 98 | 191 |
| KIH-Exp.+atrazine | 6.4 oz+1 qt | 0 | 93 | 98 | 71 | 98 | 188 |
| Bicep Lite II Magnum | 1.6 qt | 0 | 94 | 98 | 70 | 98 | 201 |
| LSD (.05) | | 0 | 4 | 6 | 22 | 6 | 23 |

## Table 13. Strip-Till Herbicide Demonstration

RCB; 4 reps
Variety: DeKalb DKC 58-24
Planting Date: 5/28/03
PRE: 5/28/03
EPOST: 6/16/03
POST: 6/27/03
Soil: Silty clay; 3.5% OM; 6.5 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 0.20 inches |
| | 2nd week | 0.87 inches |
| EPOST: | 1st week | 0.12 inches |
| | 2nd week | 3.08 inches |
| POST: | 1st week | 0.91 inches |
| | 2nd week | 3.30 inches |

Fisb=Field sandbur
Cowh=Common waterhemp

***COMMENTS:*** Comparison of herbicide programs in strip-tillage systems. Residual required for waterhemp. Yield variability across plot.

| ***Treatment*** | ***Rate/ac*** | ***% Fisb 9/5/03*** | ***% Cowh 9/5/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|
| Check | ---- | 0 | 0 | 74 |
| ***PREEMERGENCE*** | | | | |
| Harness Xtra | 2.1 qt | 91 | 97 | 152 |
| Harness Xtra | 1.25 qt | 85 | 95 | 136 |
| Balance Pro+atrazine | 2.25 oz+1 qt | 84 | 96 | 135 |
| Lumax | 2.5 qt | 85 | 97 | 146 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Outlook&Distinct+NIS+28% N | 21 oz&4 oz+.25%+1 qt | 91 | 95 | 149 |
| Atrazine&Roundup UltraMax+AMS | 1 qt&25.6 oz+2.5 lb | 98 | 97 | 159 |
| ***EARLY POSTEMERGENCE*** | | | | |
| Option+Marksman+ MSO+28% N | 1.5 oz+2 pt+ 1.5 pt/100 gal+2 qt | 87 | 97 | 147 |
| Steadfast+atrazine+ COC+28% N | .75 oz+1 qt+ 1%+2 qt | 96 | 98 | 157 |
| Steadfast+Callisto+atrazine+ COC+28% N | .75 oz+2 oz+1 qt+ 1%+2 qt | 96 | 98 | 146 |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 88 | 69 | 140 |
| ***POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 96 | 92 | 144 |
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS& Roundup UltraMax+AMS | 25.6 oz+2.5 lb& 25.6 oz+2.5 lb | 96 | 82 | 153 |
| ***PREEMERGENCE & EARLY POSTEMERGENCE*** | | | | |
| Harness Xtra& Roundup UltraMax+AMS | 2.1 qt& 25.6 oz+2.5 lb | 95 | 93 | 140 |
| LSD (.05) | | 9 | 5 | 20 |

## Table 14. Tillage Systems and Herbicide Programs in Corn

RCB; 4 reps
Variety: DeKalb DKC 58-24
Planting Date: 5/28/03
PRE: 5/28/03
POST: 6/16/03
Soil: Silty clay; 3.7% OM; 6.6 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 0.20 inches |
| | 2nd week | 0.87 inches |
| POST: | 1st week | 0.12 inches |
| | 2nd week | 3.08 inches |

Grft=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Comparison of full pre, split pre/post and post herbicide programs in no-till, chiseled, and strip till seedbed. Moderate waterhemp pressure. Weed control was similar for all tillage systems. One-pass post tended to have lowest weed ratings. No statistical differences between tillage systems.

| *Treatment* | *Rate/ac* | *% Grft 9/5/03* | *% Cowh 9/5/03* | *Yield bu/ac* |
|---|---|---|---|---|
| ***Check - CHISELED*** | — | 0 | 0 | 115 |
| ***PREEMERGENCE*** | | | | |
| Harness+atrazine | 2.3 pt+1 qt | 96 | 97 | 139 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Harness&Roundup UltraMax+AMS | 2.3 pt&25.6 oz+2.5 lb | 99 | 98 | 140 |
| ***POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 97 | 93 | 132 |
| ***Check - NO-TILLAGE*** | — | 0 | 0 | 101 |
| ***PREEMERGENCE*** | | | | |
| Harness+atrazine | 2.3 pt+1 qt | 88 | 97 | 135 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Harness&Roundup UltraMax+AMS | 2.3 pt&25.6 oz+2.5 lb | 95 | 95 | 137 |
| ***POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 95 | 92 | 134 |
| ***Check - STRIP TILLAGE*** | — | 0 | 0 | 97 |
| ***PREEMERGENCE*** | | | | |
| Harness+atrazine | 2.3 pt+1 qt | 89 | 94 | 129 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Harness&Roundup UltraMax+AMS | 2.3 pt&25.6 oz+2.5 lb | 98 | 98 | 129 |
| ***POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 95 | 94 | 121 |
| LSD (.05) | | 3 | 4 | 8 |

## Table 15. 1X and 2X Herbicide Response in Corn

RCB: 4 reps
Variety: DeKalb DKC 58-24
Planting Date: 5/28/03
PRE: 5/28/03
EPOST: 6/16/03
POST: 6/27/03
Soil: Silty clay; 3.7% OM; 6.7 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 0.20 inches |
| | 2nd week | 0.87 inches |
| EPOST: | 1st week | 0.12 inches |
| | 2nd week | 3.08 inches |
| POST: | 1st week | 0.91 inches |
| | 2nd week | 3.30 inches |

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

| | | 1X Rate | | 2X Rate | |
|---|---|---|---|---|---|
| ***Treatment*** | ***Rate/ac*** | ***% VCRR 9/9/03*** | ***Yield bu/ac*** | ***% VCRR 9/9/03*** | ***Yield bu/ac*** |
| ***PREEMERGENCE*** | | | | | |
| Check | ---- | 0 | 103 | — | — |
| Atrazine | 2 qt | 0 | 113 | 0 | 117 |
| Axiom | 23 oz | 0 | 116 | 0 | 108 |
| Balance Pro | 2.25 oz | 0 | 113 | 0 | 101 |
| Callisto | 6 oz | 0 | 120 | 0 | 114 |
| LSD (.05) | | 0 | 12 | | |

| | | 1X Rate | | | 2X Rate | | |
|---|---|---|---|---|---|---|---|
| ***Treatment*** | ***Rate/ac*** | ***% VCRR Root 9/19/03*** | ***% VCRR Stunt 9/19/03*** | ***Yield bu/ac*** | ***% VCRR Root 9/19/03*** | ***% VCRR Stunt 9/19/03*** | ***Yield bu/ac*** |
| Check | ---- | 5 | 0 | 112 | — | — | — |
| ***EARLY POSTEMERGENCE*** | | | | | | | |
| 2,4-D amine | 1 pt | 0 | 0 | 115 | 3 | 3 | 119 |
| Clarity | 1 pt | 3 | 0 | 112 | 0 | 3 | 110 |
| Distinct+NIS+28% N | 6 oz+.25%+1.25% | 1 | 0 | 113 | 0 | 0 | 122 |
| ***POSTEMERGENCE*** | | | | | | | |
| Buctril | 1.5 pt | 4 | 3 | 115 | 0 | 5 | 113 |
| Hornet WDG+NIS+28% N | 5 oz+.25%+2.5% | 5 | 0 | 114 | 5 | 1 | 112 |
| Callisto+COC+28% N | 3 oz+1%+2 qt | 3 | 0 | 121 | 4 | 0 | 118 |
| Aim EW+NIS | .5 oz+.25% | 0 | 4 | 115 | 8 | 0 | 115 |
| Steadfast+COC+28% N | .75 oz+1%+2 qt | 4 | 6 | 113 | 6 | 3 | 110 |
| Option+MSO+28% N | 1.5 oz+1.5 pt+2 qt | 3 | 3 | 111 | 0 | 3 | 111 |
| LSD (.05) | | 8 | 5 | 11 | | | |

***Comments:*** Crop response with X and 2X rates. No significant response for herbicides when comparing rates within herbicide. VCRR rating roots/lodging apparently not related to treatment (note check).

## Table 16. Soybean Herbicide Demonstration

Demonstration
Variety: Garst 2612RR
Planting Date: 5/28/03
PPI/PRE: 5/28/03
POST: 7/3/03
Soil: Silty clay; 3.4% OM; 6.6 pH

Precipitation:

| | | |
|---|---|---|
| PPI/PRE: | 1st week | 0.20 inches |
| | 2nd week | 0.87 inches |
| POST: | 1st week | 4.01 inches |
| | 2nd week | 0.00 inches |

Grft=Green foxtail
Cowh=Common waterhemp
Pesw=Pennsylvania smartweed

***Comments:*** Moderate weed pressure. Grass control is less consistent than expected; noted in past years. Very heavy rain at POST timing appears to have triggered considerable late grass flush. Smartweed variable but sufficient for guideline evaluation.

| ***Treatment*** | ***Rate/ac*** | ***% Grft 9/19/03*** | ***% Cowh 9/19/03*** | ***% Pesw 9/19/03*** |
|---|---|---|---|---|
| Check | ---- | 0 | 0 | 0 |
| ***PREPLANT INCORPORATED*** | | | | |
| Treflan | 1.5 pt | 78 | 90 | 98 |
| Sonalan | 2.67 pt | 65 | 92 | 98 |
| Prowl $H_2O$ | 2.17 pt | 50 | 90 | 98 |
| Treflan+Authority | 1.5 pt+5.3 oz | 75 | 95 | 98 |
| ***PREPLANT INCORPORATED & PREEMERGENCE*** | | | | |
| Treflan&Authority | 1.5 pt&5.3 oz | 84 | 95 | 98 |
| ***PREPLANT INCORPORATED & POSTEMERGENCE*** | | | | |
| Prowl $H_2O$&Pursuit DG+Flexstar+ MSO+28% N | 2.17 pt&.72 oz+10 oz+ 1 qt+1 qt | 91 | 98 | 99 |
| ***PREEMERGENCE & EARLY POSTEMERGENCE*** | | | | |
| Prowl $H_2O$&Aim EW+NIS | 2.17 pt&.25 oz+.25% | 10 | 85 | 95 |
| ***PREEMERGENCE*** | | | | |
| Gauntlet | 7.9 oz | 20 | 90 | 90 |
| Command 3ME+sulfentrazone 4L | 1.6 pt+.6 pt | 15 | 85 | 88 |
| Boundary | 2.5 pt | 10 | 80 | 85 |
| Valor+FirstRate | 3 oz+.6 oz | 25 | 80 | 82 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Valor&Poast Plus+COC | 3 oz&1.5 pt+1 qt | 88 | 70 | 20 |
| Authority&Assure II+COC | 4 oz&7 oz+1 qt | 89 | 62 | 25 |
| Authority&Assure II+COC | 5.3 oz&7 oz+1 qt | 90 | 74 | 20 |
| Gauntlet&Select+COC | 7.9 oz&7 oz+1 qt | 94 | 88 | 35 |
| Valor+FirstRate&Select+COC | 3 oz+.6 oz&7 oz+1 qt | 95 | 87 | 20 |

| Treatment | Rate/ac | % Grft 9/19/03 | % Cowh 9/19/03 | % Pesw 9/19/03 |
|---|---|---|---|---|
| **POSTEMERGENCE & POSTEMERGENCE | | | | |
| Poast Plus+COC& | 1.5 pt+1 qt& | | | |
| Ultra Blazer+NIS | 1.5 pt+.25% | 68 | 40 | 25 |
| Poast Plus+COC& | 1.5 pt+1 qt& | | | |
| Phoenix+COC | .8 pt+1 pt | 50 | 78 | 30 |
| Poast Plus+COC& | 1.5 pt+1 qt& | | | |
| Flexstar+MSO+28% N | 16 oz+1 qt+1 qt | 25 | 45 | 78 |
| Poast Plus+COC& | 1.5 pt+1 qt& | | | |
| FirstRate+MSO+28% N | .3 oz+1 qt+1 qt | 40 | 25 | 78 |
| Poast Plus+COC& | 1.5 pt+1 qt& | | | |
| Harmony GT+NIS | .083 oz+.25% | 65 | 30 | 82 |
| POSTEMERGENCE | | | | |
| FirstRate+Flexstar+Select+ | .3 oz+10 oz+6 oz+ | | | |
| MSO+28% N | 1 qt+1 qt | 20 | 68 | 85 |
| Raptor+MSO+28% N | 5 oz+1 qt+1 qt | 82 | 30 | 75 |
| Pursuit DG+MSO+28% N | 1.44 oz+1 qt+1 qt | 80 | 20 | 75 |
| Raptor+Flexstar+MSO+28% N | 4 oz+8 oz+1 qt+1 qt | 45 | 84 | 80 |

** Applied separately same day.

## Table 17. Herbicide Tolerant Soybeans

Demonstration
Variety: Garst 2612RR
Planting Date: 5/28/03
PRE: 5/28/03
EPOST: 6/30/03
POST: 7/3/03
LPOST: 8/8/03
Soil: Silty clay; 2.4% OM; 6.6 pH

Precipitation:

| | | |
|---|---|---|
| PRE: | 1st week | 0.20 inches |
| | 2nd week | 0.87 inches |
| EPOST: | 1st week | 1.73 inches |
| | 2nd week | 2.28 inches |
| POST: | 1st week | 4.01 inches |
| | 2nd week | 0.00 inches |
| LPOST: | 1st week | 0.08 inches |
| | 2nd week | 0.08 inches |

Grft=Green foxtail
Cowh=Common waterhemp
Pesw=Pennsylvania smartweed

***COMMENTS:*** Heavy waterhemp history. Purpose to compare glyphosate sources and combinations. Most treatments provided excellent control. Antagonism in tank-mixes and product source differences were not apparent in this test.

| ***Treatment*** | ***Rate/ac*** | ***% Grft 9/19/03*** | ***% Cowh 9/19/03*** | ***% Pesw 9/19/03*** |
|---|---|---|---|---|
| Check | ---- | 0 | 0 | 0 |
| ***EARLY POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS | 12.8 oz+2.5 lb | 55 | 50 | 85 |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 65 | 60 | 90 |
| ***POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 70 | 85 | 70 |
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | |
| Roundup UltraMax+AMS& | 12.8 oz+2.5 lb& | | | |
| Roundup UltraMax+AMS | 12.8 oz+2.5 lb | 98 | 98 | 95 |
| Roundup UltraMax+AMS& | 25.6 oz+2.5 lb& | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 99 | 99 | 99 |
| Touchdown 3L+AMS& | 32 oz+2.5 lb& | | | |
| Touchdown 3L+AMS | 32 oz+2.5 lb | 99 | 99 | 99 |
| GlyphoMax Plus+AMS& | 32 oz+2.5 lb& | | | |
| Glyphomax Plus+AMS | 32 oz+2.5 lb | 99 | 99 | 99 |
| ClearOut 41+AMS& | 32 oz+2.5 lb& | | | |
| ClearOut 41+AMS | 32 oz+2.5 lb | 99 | 99 | 99 |
| Roundup WeatherMax+AMS& | 21 oz+2.5 lb& | | | |
| Roundup WeatherMax+AMS | 21 oz+2.5 lb | 99 | 99 | 99 |
| Roundup UltraMax+AMS& | 25.6 oz+2.5 lb& | | | |
| Roundup UltraMax+AMS | 51.2 oz+2.5 lb | 99 | 99 | 99 |
| Touchdown 3L+AMS& | 32 oz+2.5 lb& | | | |
| Touchdown 3L+AMS | 64 oz+2.5 lb | 99 | 99 | 99 |

| Treatment | Rate/ac | % Grft 9/19/03 | % Cowh 9/19/03 | % Pesw 9/19/03 |
|---|---|---|---|---|
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | |
| GlyphoMax+AMS& | 32 oz+2.5 lb& | | | |
| GlyphoMax+AMS | 64 oz+2.5 lb | 95 | 99 | 99 |
| ClearOut 41+AMS& | 32 oz+2.5 lb& | | | |
| ClearOut 41+AMS | 64 oz+2.5 lb | 99 | 99 | 99 |
| Roundup WeatherMax+AMS& | 21 oz+2.5 lb& | | | |
| Roundup WeatherMax+AMS | 42 oz+2.5 lb | 99 | 99 | 99 |
| ***PREPLANT INCORPORATED & POSTEMERGENCE*** | | | | |
| Treflan&Roundup UltraMax+AMS | 24 oz&12.8 oz+2.5 lb | 91 | 92 | 99 |
| Prowl $H_2O$&Extreme+NIS+AMS | 2.17 pt&1.5 qt&.25%+2.5 lb | 97 | 98 | 99 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | |
| Python&Glyphomax Plus+AMS | 1 oz&24 oz+2.5 lb | 94 | 98 | 99 |
| Authority&Roundup UltraMax+AMS | 4 oz+19.2 oz+2.5 lb | 95 | 98 | 99 |
| Axiom&Roundup UltraMax+AMS | 13 oz&19.2 oz+2.5 lb | 97 | 99 | 99 |
| Domain&Roundup UltraMax+AMS | 12 oz&19.2 oz+2.5 lb | 95 | 90 | 99 |
| Valor+FirstRate& | 1.5 oz+.3 oz& | | | |
| Roundup UltraMax+AMS | 19.2 oz+2.5 lb | 98 | 98 | 99 |
| Boundary&Touchdown 3L+AMS | 1.5 pt&24 oz+2.5 lb | 96 | 97 | 99 |
| Valor&Roundup UltraMax+AMS | 2 oz&19.2 oz+2.5 lb | 97 | 99 | 99 |
| ***EARLY POSTEMERGENCE*** | | | | |
| Extreme+NIS+AMS | 1.5 qt+.25%+2.5 lb | 98 | 92 | 99 |
| ***POSTEMERGENCE*** | | | | |
| Roundup UltraMax+Resource+AMS | 12.8 oz+4 oz+2.5 lb | 88 | 86 | 99 |
| Roundup UltraMax+Flexstar+AMS | 12.8 oz+8 oz+2.5 lb | 90 | 97 | 99 |
| Roundup UltraMax+Phoenix+AMS | 12.8 oz+10 oz+2.5 lb | 92 | 98 | 99 |
| Roundup UltraMax+Aim EW+AMS | 12.8 oz+.25 oz+2.5 lb | 93 | 96 | 99 |
| Roundup UltraMax+ | 12.8 oz+ | | | |
| Harmony GT XP+AMS | .083 oz+2.5 lb | 93 | 98 | 99 |
| GlyphoMax Plus+FirstRate+AMS | 24 oz+.3 oz+2.5 lb | 97 | 99 | 99 |
| Roundup UltraMax+Supporrt+AMS | 12.8 oz+.5 oz+2.5 lb | 96 | 96 | 99 |

## Table 18. No-Till Soybean Herbicide Demonstration

Demonstration
Variety: Garst 2612
Planting Date: 5/30/03
FALL: 11/21/02
PRE: 6/3/03
POST: 6/30/03
Soil: Silty clay loam; 3.4% OM; 6.4 pH

Precipitation:

| | | |
|---|---|---|
| FALL: | 1st week | 0.00 inches |
| | 2nd week | 0.00 inches |
| PRE: | 1st week | 0.91 inches |
| | 2nd week | 0.00 inches |
| POST: | 1st week | 1.73 inches |
| | 2nd week | 2.28 inches |

FXTL=Robust green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Established in no-till corn stubble filler. Waterhemp data provides a comparison of fall and spring preemergence programs. Residual treatments with postemerge glyphosate program were consistent.

| ***Treatment*** | ***Rate/ac*** | ***% FXTL 9/19/03*** | ***% Cowh 9/19/03*** |
|---|---|---|---|
| Check | — | 0 | 0 |
| ***FALL & POSTEMERGENCE*** | | | |
| Valor&Roundup UltraMax+AMS | 3 oz&25.6 oz+2.5 lb | 85 | 80 |
| Authority&Roundup UltraMax+AMS | 5.33 oz&25.6 oz+2.5 lb | 85 | 90 |
| Authority&Poast Plus+COC | 5.33 oz&1.5 pt+1 qt | 90 | 30 |
| ***FALL & PREEMERGENCE & POSTEMERGENCE*** | | | |
| Authority&Authority&Poast Plus+COC | 3 oz&3 oz&1.5 pt+1 qt | 85 | 90 |
| ***FALL & POSTEMERGENCE*** | | | |
| Canopy&Poast Plus+COC | 6 oz&1.5 pt+1 qt | 95 | 30 |
| Boundary&Poast Plus+COC | 2.5 pt&1.5 pt+1 qt | 95 | 30 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | |
| Valor+COC&Poast Plus+COC | 3 oz+1 qt&1.5 pt+1 qt | 90 | 92 |
| Authority+COC&Poast Plus+COC | 5.33 oz+1 qt&1.5 pt+1 qt | 85 | 95 |
| Gauntlet+COC&Poast Plus+COC | 7.9 oz+1 qt&1.5 pt+1 qt | 95 | 93 |
| Command 3ME+sulfentrazone 4L+COC& Poast Plus+COC | 2 pt+.75 pt+1 qt& 1.5 pt+1 qt | 83 | 92 |
| Boundary+COC&Poast Plus+COC | 2.5 pt+1 qt&1.5 pt+1 qt | 88 | 88 |
| Valor+COC&Roundup UltraMax+AMS | 3 oz+1 qt&25.6 oz+2.5 lb | 95 | 98 |
| Valor+COC&Roundup UltraMax+AMS | 2 oz+1 qt&25.6 oz+2.5 lb | 95 | 98 |
| Authority+COC& Roundup UltraMax+AMS | 5.33 oz+1 qt& 25.6 oz+2.5 lb | 92 | 98 |
| Authority+COC&Touchdown 3L+AMS | 4 oz+1 qt&32 oz+2.5 lb | 92 | 98 |
| Python&GlyphoMax Plus+AMS | 1.25 oz&32 oz+2.5 lb | 95 | 97 |
| Frontier+Roundup UltraMax+AMS& Roundup UltraMax+AMS | 2 pt+25. 6 oz+2.5 lb& 25.6 oz+2.5 lb | 97 | 92 |

| ***Treatment*** | ***Rate/ac*** | ***% FXTL 9/19/03*** | ***% Cowh 9/19/03*** |
|---|---|---|---|
| ***PREEMERGENCE*** | | | |
| Prowl $H_2O$+Authority+ | 2.17 pt+4 oz+ | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 88 | 92 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | |
| Domain&Roundup UltraMax+AMS | 10 oz&25.6 oz+2.5 lb | 95 | 78 |
| Boundary+COC& | 2.5 pt+1 qt& | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 95 | 70 |
| Command 3ME+sulfentrazone 4L+COC& | 2 pt+.75 pt+1 qt& | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 90 | 98 |
| Gauntlet+COC& | 7.9 oz+1 qt& | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 90 | 98 |
| Outlook&Flexstar+MSO+28% N | 19 oz&16 oz+1 qt+1 qt | 88 | 85 |
| Outlook&Phoenix+COC | 19 oz&.8 pt+1 pt | 70 | 82 |
| Prowl $H_2O$&Pursuit DG+ | 2.17 pt&1.44 oz+ | | |
| Ultra Blazer+MSO+28% N | 12 oz+1 qt+1 qt | 95 | 82 |
| ***POSTEMERGENCE*** | | | |
| Extreme+NIS+AMS | 1.5 qt+.25%+2.5 lb | 98 | 78 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | |
| Authority&Select+Flexstar+ | 4 oz&7 oz+12 oz+ | | |
| MSO+28% N | 1 qt+1 qt | 95 | 98 |
| ***POSTEMERGENCE*** | | | |
| Select+Flexstar+MSO+28% N | 7 oz+16 oz+1 qt+1 qt | 95 | 85 |
| Select+FirstRate+Flexstar+ | 7 oz+.3 oz+12 oz+ | | |
| MSO+28% N | 1 qt+1 qt | 95 | 78 |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 98 | 95 |
| Roundup+Resource+AMS | 25.6 oz+6 oz+2.5 lb | 98 | 82 |
| Roundup UltraMax+FirstRate+ | 25.6 oz+.3 oz+ | | |
| Flexstar+AMS | 12 oz+2.5 lb | 98 | 90 |
| Check | --- | 0 | 0 |

## Table 19. Cocklebur Soybean Demonstration

RCB; 2 reps
Variety: Asgrow AG2302
Planting Date: 5/27/03
PPI&PRE: 5/27/03
POST: 6/27/03
Soil: Loam; 2.9% OM; 6.8 pH

Precipitation:

| | | |
|---|---|---|
| PPI&PRE: | 1st week | 0.16 inches |
| | 2nd week | 0.91 inches |
| POST: | 1st week | 0.91 inches |
| | 2nd week | 3.3 inches |

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)
Cocb=Common cocklebur

***COMMENTS:*** Cocklebur evaluation with long-term averages. Variable yields; waterhemp variable may be factor in yields. Very heavy cocklebur pressure.

| ***Treatment*** | ***Rate/ac*** | ***% VCRR 9/9/03*** | ***% Cocb 9/9/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|
| Check | ---- | 0 | 0 | 16 |
| ***PREPLANT INCORPORATED*** | | | | |
| Python | 1 oz | 0 | 65 | 26 |
| ***PREPLANT INCORPORATED & PREEMERGENCE*** | | | | |
| Sencor&Sencor | .5 lb&.33 lb | 0 | 45 | 28 |
| ***PREEMERGENCE*** | | | | |
| Gauntlet | 7.9 oz | 0 | 50 | 27 |
| Gangster | 3.6 oz | 0 | 66 | 29 |
| ***POSTEMERGENCE*** | | | | |
| Basagran+COC | 1 pt+1 qt | 0 | 96 | 24 |
| Phoenix+COC+28% N | .8 pt+.5 qt+4 qt | 3 | 75 | 27 |
| Ultra Blazer+NIS | 1.5 pt+.5% | 0 | 69 | 27 |
| Pursuit DG+MSO+28% N | 1.44 oz+1 qt+1 qt | 0 | 99 | 35 |
| Extreme+AMS | 3 pt+2.5 lb | 0 | 84 | 33 |
| Classic+NIS | .33 oz+.125% | 0 | 91 | 29 |
| Harmony GT+NIS | .083 oz+.125% | 0 | 60 | 22 |
| Raptor+MSO+28% N | 5 oz+1.5 pt+1 qt | 0 | 98 | 21 |
| FirstRate+NIS+28% N | .3 oz+.125%+2 qt | 0 | 99 | 31 |
| Flexstar+MSO+28% N | 16 oz+1%+2 qt | 0 | 78 | 32 |
| Roundup UltraMax+AMS | 12.8 oz+2.5 lb | 0 | 83 | 33 |
| Roundup UltraMax+Supporrt+AMS | 19.2 oz+.5 oz+2.5 lb | 0 | 71 | 29 |
| Roundup UltraMax+AMS | 19.2 oz+2.5 lb | 0 | 69 | 21 |
| LSD (.05) | | 2 | 15 | 10 |

## Table 20. Common Waterhemp in Soybeans

RCB; 3 reps
Variety: Asgrow AG 2302
Planting Date: 5/21/03
PPI/PRE: 5/21/03
EPOST: 6/16/03
POST: 6/27/03
Soil: Silty clay loam; 3.0% OM; 6.8 pH

Precipitation:

| | | |
|---|---|---|
| PPI/PRE: | 1st week | 0.24 inches |
| | 2nd week | 0.20 inches |
| EPOST: | 1st week | 0.12 inches |
| | 2nd week | 3.08 inches |
| POST: | 1st week | 0.91 inches |
| | 2nd week | 3.30 inches |

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

Cowh=Common waterhemp
Colq=Common lambsquarter

***COMMENTS:*** Heavy weed pressure. Lambsquarter became dominant in plots with good waterhemp control if there was no residual for lambsquarters. Seven treatments provided at least 95% control of both species; with an average yield of 46 bu/ac.

| ***Treatment*** | ***Rate/ac*** | ***% VCRR 9/9/03*** | ***% Cowh 9/9/03*** | ***% Colq 9/9/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|---|
| Check | --- | 0 | 0 | 0 | 19 |
| ***PREPLANT INCORPORATED*** | | | | | |
| Treflan | 2 pt | 3 | 87 | 91 | 37 |
| Treflan+Python | 1.5 pt+1 oz | 0 | 92 | 97 | 39 |
| Sonalan | 3 pt | 0 | 84 | 97 | 37 |
| Treflan+Authority | 1.5 pt+5.3 oz | 2 | 92 | 98 | 48 |
| ***PREPLANT INCORPORATED & PREEMERGENCE*** | | | | | |
| Treflan&Authority | 1.5 pt&5.3 oz | 0 | 99 | 97 | 44 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Authority&Poast Plus+COC | 4 oz&1.5 pt+1 qt | 0 | 70 | 93 | 34 |
| Authority&Poast Plus+COC | 5.33 oz&1.5 pt+1 qt | 0 | 81 | 97 | 38 |
| Gauntlet&Poast Plus+COC | 7.9 oz&1.5 pt+1 qt | 0 | 85 | 92 | 42 |
| Valor+FirstRate& Poast Plus+COC | 2.5 oz+.5 oz& 1.5 pt+1 qt | 0 | 93 | 71 | 44 |
| Boundary&Poast Plus+COC | 2.5 pt&1.5 pt+2 qt | 0 | 96 | 33 | 41 |
| Valor&Poast Plus+COC | 2 oz&1.5 pt+1 qt | 5 | 67 | 33 | 28 |
| Valor&Poast Plus+COC | 3 oz&1.5 pt+1 qt | 0 | 89 | 76 | 36 |
| ***EARLY POSTEMERGENCE*** | | | | | |
| Pursuit DG+MSO+28% N | 1.44 oz+1 qt+1 qt | 7 | 27 | 72 | 19 |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 2 | 89 | 96 | 42 |
| ***EARLY POSTEMERGENCE & POSTEMERGENCE*** | | | | | |
| Roundup UltraMax+AMS& Roundup UltraMax+AMS | 12.8 oz+2.5 lb& 12.8 oz+2.5 lb | 0 | 88 | 95 | 44 |

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| Treatment | Rate/ac | % VCRR 9/9/03 | % Cowh 9/9/03 | % Colq 9/9/03 | Yield bu/ac |
|---|---|---|---|---|---|
| ***PREPLANT INCORPORATED & POSTEMERGENCE*** | | | | | |
| Treflan& | 1.5 pt& | | | | |
| Roundup UltraMax+AMS | 12.8 oz+2.5 lb | 0 | 92 | 98 | 43 |
| ***PREEMERGENCE & POSTEMERGENCE*** | | | | | |
| Boundary& | 1.5 pt& | | | | |
| Roundup UltraMax+AMS | 12.8 oz+2.5 lb | 0 | 98 | 97 | 45 |
| Valor+FirstRate& | 2.5 oz+.5 oz& | | | | |
| Roundup UltraMax+AMS | 12.8 oz+2.5 lb | 0 | 97 | 99 | 47 |
| Axiom& | 13 oz& | | | | |
| Roundup UltraMax+AMS | 12.8 oz+2.5 lb | 5 | 92 | 96 | 50 |
| Valor& | 2 oz& | | | | |
| Roundup UltraMax+AMS | 19.2 oz+2.5 lb | 0 | 94 | 97 | 47 |
| Outlook& | 21 oz& | | | | |
| Roundup UltraMax+AMS | 19.2 oz+2.5 lb | 0 | 98 | 97 | 46 |
| Authority& | 4 oz& | | | | |
| Roundup UltraMax+AMS | 19.2 oz+2.5 lb | 0 | 99 | 99 | 46 |
| ***PREPLANT INCORPORATED & POSTEMERGENCE*** | | | | | |
| Treflan&Ultra Blazer+NIS | 1.5 pt&12 oz+.5% | 2 | 96 | 94 | 46 |
| Treflan&Phoenix+COC | 1.5 pt&.8 p+1 pt | 3 | 99 | 93 | 39 |
| Treflan&FirstRate+ | 1.5 pt&.3 oz+ | | | | |
| NIS+28% N | .125%+2 qt | 0 | 83 | 88 | 43 |
| Treflan&Flexstar+ | 1.5 pt&12 oz+ | | | | |
| COC+28% N | 1%+2 qt | 0 | 99 | 97 | 46 |
| Treflan&Synchrony+ | 1.5 pt&.25 oz+ | | | | |
| NIS+28% N | .25%+1 qt | 0 | 88 | 97 | 43 |
| LSD (.05) | | 3 | 9 | 14 | 8 |

## Table 21. Roundup Tank-Mixes for Waterhemp

RCB; 4 reps
Variety: Asgrow AG 2302
Planting Date: 5/27/03
4-6 INCH: 6/27/03
12-16 INCH: 7/3/03
Soil: Silty clay; 3.5% OM; 6.6 pH

Precipitation:

| | | |
|---|---|---|
| 4-6 INCH: | 1st week | 0.91 inches |
| | 2nd week | 3.30 inches |
| 12-16 INCH: | 1st week | 4.01 inches |
| | 2nd week | 0.00 inches |

Grft=Green foxtail
Cowh=Common waterhemp

***COMMENTS:*** Objective to evaluate waterhemp control and soybean response to tank-mix combinations with glyphosate applied at two crop stages. Control was higher at late timing. Yields and weed control were similar within timings when comparing tank-mixes and glyphosate alone.

| ***Treatment*** | ***Rate/ac*** | ***% Grft 9/19/03*** | ***% Cowh 9/19/03*** | ***Yield bu/ac*** |
|---|---|---|---|---|
| Check | — | 0 | 0 | 7 |
| ***4-6 INCH:*** | | | | |
| Roundup UltraMax+AMS | 19.2 oz+2.5 lb | 95 | 76 | 21 |
| Roundup UltraMax+AMS+Phoenix | 19.2 oz+2.5 lb+10 oz | 94 | 63 | 14 |
| Roundup UltraMax+AMS+Resource | 19.2 oz+2.5 lb+4 oz | 94 | 68 | 19 |
| Roundup UltraMax+AMS+ Harmony GT XP | 19.2 oz+2.5 lb+ .083 oz | 93 | 70 | 20 |
| Roundup UltraMax+AMS+FirstRate | 19.2 oz+2.5 lb+.3 oz | 96 | 81 | 23 |
| ***12-16 INCH:*** | | | | |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 97 | 86 | 21 |
| Phoenix+Roundup UltraMax+AMS | 10 oz+25.6 oz+2.5 lb | 97 | 88 | 24 |
| Resource+Roundup UltraMax+AMS | 4 oz+25.6 oz+2.5 lb | 97 | 86 | 23 |
| Harmony GT XP+ Roundup UltraMax+AMS | .083 oz+ 25.6 oz+2.5 lb | 98 | 95 | 23 |
| FirstRate+Roundup UltraMax+AMS | .3 oz+25.6 oz+2.5 lb | 98 | 96 | 23 |
| Roundup UltraMax+AMS | 51.2 oz+2.5 lb | 97 | 92 | 20 |
| LSD (.05) | | 2 | 9 | 5 |

## Table 22. Late Waterhemp in Soybeans

Demonstration
Variety: Garst 2612
Planting Date: 5/30/03
POST: 8/8/03
Soil: Silty clay loam; 3.1% OM; 7.1 pH

Precipitation:
POST: 1st week 0.08 inches
2nd week 0.08 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)
Cowh=Common waterhemp

***COMMENTS:*** Rescue application to evaluate crop response and waterhemp control at late stages using Roundup UltraMax at 25.6 oz as base treatment. All treatments controlled waterhemp. Leaf burn/stunting recorded for crop response.

| ***Treatment*** | ***Rate/ac*** | ***% Cowh 9/9/03*** | ***% VCRR 9/9/03*** |
|---|---|---|---|
| Check | --- | 0 | 0 |
| ***POSTEMERGENCE*** | | | |
| Roundup UltraMax | 25.6 oz | 99 | 0 |
| Roundup UltraMax+Indicate | 25.6 oz | 99 | 0 |
| Roundup UltraMax+AMS | 25.6 oz+2.5 lb | 99 | 0 |
| Roundup UltraMax+AMS | 25.6 oz+10 lb | 99 | 0 |
| Roundup UltraMax+Preference | 25.6 oz+4 pt/100 gal | 99 | 0 |
| Roundup UltraMax+Preference | 25.6 oz+12 pt/100 gal | 99 | 15 |
| Roundup UltraMax+LandOil | 25.6 oz | 99 | 15 |
| Roundup UltraMax+MSO | 25.6 oz+1.5 pt | 99 | 0 |
| Roundup UltraMax+Minnesota Stuff | 25.6 oz | 99 | 0 |
| Roundup WeatherMax | 21 oz | 99 | 0 |
| Roundup UltraMax+Preference+AMS | 25.6 oz+8 pt/100 gal+5 lb | 99 | 0 |
| Roundup Ultramax+AMS | 19.2 oz+2.5 lb | 99 | 0 |
| Extreme+AMS | 3 pt+2.5 lb | 99 | 0 |
| Roundup UltraMax+Harmony GT XP+AMS | 19.2 oz+.083 oz+2.5 lb | 99 | 5 |
| Roundup UltraMax+Harmony GT XP+AMS | 19.2 oz+.166 oz+2.5 lb | 99 | 10 |
| Roundup UltraMax+Harmony GT XP+ COC+AMS | 19.2 oz+.083 oz+ 1 qt+2.5 lb | 99 | 0 |
| Roundup UltraMax+Phoenix+AMS | 19.2 oz+10 oz+2.5 lb | 99 | 20 |
| Roundup UltraMax+Phoenix+AMS | 19.2 oz+20 oz+2.5 lb | 99 | 25 |
| Roundup UltraMax+Supporrt+AMS | 19.2 oz+.5 oz+2.5 lb | 99 | 0 |
| Roundup UltraMax+Aim EW+AMS | 19.2 oz+.5 oz+2.5 lb | 99 | 20 |
| Roundup UltraMax+Resource+AMS | 19.2 oz+4 oz+2.5 lb | 98 | 10 |

## Table 23. 1X and 2X Soybean Herbicide Rates

RCB; 4 reps
Variety: Asgrow 2302
Planting Date: 5/30/03
PRE: 6/3/03
Soil: Silty clay; 2.7% OM; 6.6 pH

Precipitation:
PRE: 1st week 0.91 inches
2nd week 0.00 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

***COMMENTS:*** Roundup Ready soybeans. Evaluate crop response to 1X and 2X use rates. No treatment effect on yield when comparing across rates for each treatment.

| | | ***1X Rate*** | | ***2X Rate*** | |
|---|---|---|---|---|---|
| | | ***% VCRR*** | | ***% VCRR*** | |
| | | ***Delay*** | ***Yield*** | ***Delay*** | ***Yield*** |
| ***Treatment*** | ***Rate/ac*** | ***9/9/03*** | ***bu/ac*** | ***9/9/03*** | ***bu/ac*** |
| Check | — | 0 | 34 | — | — |
| ***PREEMERGENCE*** | | | | | |
| Command 3ME | 2.6 pt | 0 | 34 | 0 | 34 |
| Authority | 5.33 oz | 0 | 33 | 0 | 33 |
| Sencor | .67 lb | 0 | 34 | 0 | 34 |
| Valor | 3 oz | 0 | 35 | 10 | 34 |
| Authority+FirstRate | 5.3 oz+.6 oz | 0 | 33 | 0 | 35 |
| Valor+FirstRate | 3 oz+.6 oz | 0 | 33 | 0 | 32 |
| LSD (.05) | | | | 2.6 | |

SE FARM REPORT

SDSU

# THE EFFECT OF FEEDING 20% DDGS TO GROW-FINISH PIGS HOUSED IN A HOOP BARN: A DEMONSTRATION

R. C. Thaler[1] and B. D. Rops[2]

**Animal Science 0324**

## INTRODUCTION

With the rapid growth of the ethanol industry, there is an ever-increasing amount of the co-product Distillers Dried Grains with Solubles (DDGS) available as livestock feed. While research has shown that grow-finish pigs raised in confinement barns can be effectively fed diets containing 20% DDGS, no research has looked at feeding 20% DDGS to pigs housed in hoop barns. Hoop barns are an alternate housing type that uses canvas-covered structures and deep bedding, and there is no additional heat provided in this system. Therefore, this trial was designed to determine if 20% DDGS diets would support normal growth of pigs housed in a hoop barn during early winter.

## MATERIAL AND METHODS

The hoop barn located at the Southeast Research Farm (30 x 85 ft) was split in half lengthwise with cattle panels, and was bedded with a rotation of wheat straw and corn stalks. One hundred eighty barrows of Babcock genetics weighing approximately 41 lbs were divided into two groups based on body weight (BW), and 90 pigs were placed on each side of the hoop barn on October 16, 2002. Each side had its own waterer and self-feeder. The two dietary treatments were a corn-soybean meal (SBM) control (CON) diet and a 20% DDGS-corn-SBM diet (DDGS). A 3-phase feeding program was utilized containing the following total lysine levels: 1.00% from 41 to 88 lbs BW, 0.85% from 89 to 150 lbs BW, and 0.75% from 151 to 260 lbs BW. The diets were balanced on a total lysine basis and are shown in Table 1. Pigs were weighed at the initiation and termination of the trial. Phase changes were made at the desired weight breaks utilizing a standard feed budget. At an average final weight of 259 lbs on January 29, 2003, all pigs were sold to John Morrell & Co where carcass data was obtained via the *Fat-O-Meat'er*. Since there was only one observation/treatment, the data could not be statistically analyzed and the values presented are simply raw means.

## RESULTS AND DISCUSSION

Growth performance and carcass data are shown in Table 2.

[1] Extension Swine Specialist

[2] Livestock Manager, Southeast Research Farm

Daily gain was unaffected by dietary treatment (2.08 lb/d), but pigs fed the 20% DDGS diet consumed numerically less feed (6.51 vs 6.70 lb/d) and tended to be more efficient (3.13 vs 3.24) than the pigs fed the Control diet. Since DDGS contains approximately 10% fat, diets containing DDGS have slightly higher fat concentrations than corn-SBM diets. A similar reduction in feed intake and improvement in feed efficiency is observed when supplemental fat is added to diets, and it appears that the additional fat from DDGS is responsible for those effects in this trial as well.

Pigs fed diets containing 20% DDGS had higher dressing percents (75.89 vs 75.10%) than Con fed pigs. However, DDGS-fed pigs had similar $10^{th}$ rib backfat thickness (0.84 vs 0.81 in) and loin depth (2.46 vs 2.44 in), and a slightly lower % lean (52.8 vs 53.2%) than the control pigs. Based on the John Morrell & Company payment schedule on January 29, 2003, the total dollar value received for the average DDGS-fed pig was $94.85 and $93.95 for the average Con-fed pig.

## IMPLICATIONS

This demonstration trial shows that the ability of pigs to effectively utilize DDGS appears to be independent of housing system used. Producers utilizing alternate housing systems like hoop barns can feed grow-finish pigs diets containing 20% DDGS without adversely affecting performance, thereby making any potential benefit from DDGS available to all producers, regardless of size.

Table 1. Dietary Composition (%)

| | **Phase 1** | | **Phase 2** | | **Phase 3** | |
|---|---|---|---|---|---|---|
| **Ingredient** | **Control** | **DDGS** | **Control** | **DDGS** | **Control** | **DDGS** |
| **Corn** | 72.28 | 55.38 | 78.70 | 62.16 | 82.47 | 66.00 |
| **SBM, 46.5%** | 24.00 | 21.25 | 17.75 | 14.62 | 14.05 | 10.85 |
| **DDGS** | | 20.00 | | 20.00 | | 20.00 |
| **Dical Phosphate** | 1.47 | 0.80 | 1.40 | 0.74 | 1.38 | 0.71 |
| **Limestone** | 0.79 | 1.11 | 0.69 | 1.02 | 0.65 | 0.99 |
| **Salt** | 0.34 | 0.34 | 0.31 | 0.31 | 0.30 | 0.30 |
| **L-lysine HCl** | 0.12 | 0.12 | 0.15 | 0.15 | 0.15 | 0.15 |
| **Vit-Min Premix** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | | | | | | |
| **Calc Analysis** | | | | | | |
| **Lysine, %** | 1.00 | 1.00 | 0.85 | 0.85 | 0.75 | 0.75 |
| **Ca, %** | 0.70 | 0.70 | 0.63 | 0.63 | 0.60 | 0.60 |
| **P, %** | 0.61 | 0.61 | 0.57 | 0.57 | 0.55 | 0.55 |

Table 2. Growth performance and carcass characteristics

| Item | Control | 20% DDGS |
| --- | --- | --- |
| Initial weight, lbs | 41.0 | 41.0 |
| Final weight, lbs | 258 | 259 |
| Avg daily gain, lbs | 2.07 | 2.08 |
| Avg daily feed intake, lbs | 6.70 | 6.51 |
| Gain/Feed | 3.24 | 3.13 |
| | | |
| Dressing % | 75.10 | 75.89 |
| Backfat thickness, in | 0.81 | 0.84 |
| Loin depth, in | 2.44 | 2.46 |
| % Lean | 53.2 | 52.8 |
| Value/pig, $ on 1-29-03 | 93.95 | 94.85 |

# EFFICACY OF *SUPROL*® AS A GROWTH PROMOTANT IN GROW-FINISH PIGS

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Animal Science 0325

## INTRODUCTION

With the ban of the subtherapeutic use of antibiotics in the EU and similar legislation gaining strength in the US, it is imperative that alternative growth promotants are available to swine producers. Therefore, the objectives of this trial were two-fold. The first objective was to test the efficacy of SUPROL®, a "non-antibiotic" feed additive, in enhancing growth performance over a control diet. The second objective was to compare the effectiveness of SUPROL® against other commonly used, antibacterial growth promotants

SUPROL® is a microencapsulated mixture of organic acids (fumaric, citric, and malic acids) and essential oils (oregano, cinnamon, thyme, and capsicum) that is used as a natural alternative to antibiotics in swine diets. Previous research has demonstrated that SUPROL® significantly improves feed efficiency and tends to enhance daily gain in growing and finishing pigs. Possible modes of action include: increases beneficial gut micro-flora and limits harmful bacteria; enhances digestion and absorption; improves intestinal villi and mucosal membranes; and improves pancreatic enzyme secretions.

## MATERIALS AND METHODS

One hundred high-lean gain genotype, crossbred barrows weighing approximately 44 lbs were shipped to the Southeast Research Farm. Upon arrival, all pigs were individually weighed and ear-tagged, and then randomly allotted to one of the five dietary treatments based on initial weight. The five dietary treatments were:

A = Control
B = Suprol (2.0, 1.5, 1.0, and 0.5 lbs/ton for G1, G2, F1, & F2, respectively)
C = Suprol (Diet B levels) + BMD (30g/ton)
D = Tylan (40, 20, 20, 10g/ton for G1, G2, F1, & F2, respectively)
E = Mecadox (25, 25, 10, & 0 g/ton for G1, G2, F1, & F2, respectively)

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[1] Extension Swine Specialist
[2] Livestock Manager, Southeast Research Farm
[3] SODA Feed Ingredients

A 4-phase feeding program that met or exceeded all the animal's nutrient requirements (SD-NE Swine Nutrition Guide, 2000) was used: Grower 1 (44-80 lbs), Grower 2 (81-130 lbs), Finisher 1 (131-190 lbs), and Finisher 2 (191-251 lbs). Diet composition is shown in Table 1. Feed was in the meal form, and feed and water was offered ad libitum.

There were 5 pigs housed in each of the 20 pens in the mechanically ventilated confinement barn. Each pen contained a 2-hole, stainless steel feeder and 2 nipple waterers. The pen flooring was partially slatted, with two-third solid flooring and one-third slatted flooring. Temperature and humidity were maintained at levels generally accepted as normal by the industry.

During Grower 1, all animals were weighed and feed intake calculated weekly. Once the animals reach the Grower 2 phase (80 lbs), pigs were weighed and feed intake calculated every two weeks until the end of the trial. The trial was terminated at an average body weight of 251 lbs. Good husbandry practices were utilized throughout the trial, and the Unit Supervisor recorded any item that was not normal.

A Randomized complete Block (RCB) Design was used with initial weight as a blocking factor. There were four replicates per treatment. SAS was used for the statistical analysis, and the model included treatment and replicate. A means separation test was used to detect treatment differences.

## RESULTS AND DISCUSSION

The cumulative results from this trial are shown in Table 2. Average daily gain and average daily feed intake were unaffected by dietary treatment ($P>.05$). However, average daily gain from 44 to 251 lbs BW ranged from 2.02 lb/d to 2.13 lb/d for the Control and Tylan treated pigs, respectively, and daily fed intake ranged from 5.43 lb/d (SUPROL) to 5.90 lb/d (Tylan). However, feed efficiency was significantly affected ($P=.043$) by dietary treatment. Pigs fed the SUPROL diets were the most efficient group from 44-251 lb BW with a feed/gain ratio of 2.66, and pigs fed either the SUPROL+BMD or Tylan diets were the least efficient (2.79) for the overall growth period.

SUPROL's ability to significantly enhance pig performance observed in this study is similar to the results reported by other researchers. Perhaps by improving the intestinal integrity and gut environment, SUPROL was able to utilize more of the nutrient available. One reason for the lack of response in gain and feed intake may be attributed to the high health status of these pigs, which is reflected by the superior rate of daily gain expressed by all animals in this trial. The lack of response to growth promotants is often observed in university grow-finish trials where the pigs' environment is optimized and the confounding external stressors are minimized. It should be noted, though, that even with pigs in an excellent environment and performing at a high level, SUPROL additions were still able to improve feed efficiency. Perhaps in a commercial operation where the environment is less controlled and the disease load is higher, the responses in gain, feed intake, and feed efficiency would be even more pronounced.

Based on the results of this trial, SUPROL is an effective feed additive in improving feed efficiency and profitability in swine.

**Table 1. Diet composition and calculated analysis (as-fed basis)**
Formulated for High-Lean Gain Genotype Barrows

Five Dietary Treatments:

- A = Control
- B = Suprol
- C = Suprol + BMD
- D = Tylan
- E = Mecadox

**Grower 1 (44-80 lbs)**

| | |
|---|---|
| Corn | 1299.2 |
| SBM, 44% | 646.6 |
| Dical Phos | 22.8 |
| Limestone | 18.4 |
| Salt | 6 |
| Premix | 7 |
| Total | 2000 |

| | |
|---|---|
| Protein | 19.9% |
| Lysine | 1.10% |
| Calcium | 0.70% |
| Phosphorus | 0.58% |

**Grower 2 (81-130 lbs)**

| | |
|---|---|
| Corn | 1375.3 |
| SBM, 44% | 578.0 |
| Dical Phos | 16.6 |
| Limestone | 17.2 |
| Salt | 6 |
| Premix | 7 |
| Total | 2000 |

| | |
|---|---|
| Protein | 18.8% |
| Lysine | 1.01% |
| Calcium | 0.60% |
| Phosphorus | 0.51% |

**Finisher 1 (131-190 lbs)**

| | |
|---|---|
| Corn | 1484.0 |
| SBM, 44% | 472.1 |
| Dical Phos | 14.4 |
| Limestone | 16.5 |
| Salt | 6 |
| Premix | 7 |
| Total | 2000 |

| | |
|---|---|
| Protein | 16.9% |
| Lysine | 0.87% |
| Calcium | 0.55% |
| Phosphorus | 0.47% |

**Finisher 2 (191-251 lbs)**

| | |
|---|---|
| Corn | 1629.9 |
| SBM, 44% | 328.5 |
| Dical Phos | 13.1 |
| Limestone | 15.5 |
| Salt | 6 |
| Premix | 7 |
| Total | 2000 |

| | |
|---|---|
| Protein | 12.2% |
| Lysine | 0.55% |
| Calcium | 0.50% |
| Phosphorus | 0.43% |

**Table 2. Cumulative growth performance (44-251 lbs BW)**

| Parameter | Control | SUPROL | SUPROL + BMD | Tylan | Mecadox | P< |
|---|---|---|---|---|---|---|
| Daily gain, lb | 2.02 | 2.07 | 2.07 | 2.13 | 2.09 | 0.663 |
| Daily feed, lb | 5.50 | 5.43 | 5.80 | 5.90 | 5.80 | 0.251 |
| Feed/Gain | 2.71 | 2.66 | 2.79 | 2.79 | 2.78 | 0.043 |

SE FARM REPORT
SDSU

# EFFICACY OF A BIOFILTER IN REDUCING ODOR EMISSIONS FROM A MECHANICALLY VENTIALATED GROW-FINISH BARN

R. C. Thaler[1], S. H. Pohl[2], and B. D. Rops[3]

**Animal Science 0326**

## INTRODUCTION

Concern over odor from swine operations is one of the main factors limiting the approval of new swine facilities by local officials. While dietary modifications and other management techniques have proven effective in reducing odor production, the general public is still not satisfied with that level of odor control. Another method to reduce odor would be to treat the odor-carrying air leaving the barn. One simple, low cost method of accomplishing that would be to run the exhaust air through a biofilter. A biofilter is a bed of organic material 10-18” deep through which the exhaust air is passed through. The theory is that microbes in the organic material convert the odorous gases to carbon dioxide and water. Preliminary research in Minnesota has demonstrated that biofilters can reduce hydrogen sulfide and odor emissions by 95%, and ammonia emissions by 85% in nursery and sow barns. However, little work has been done in grow-finish barns, and there are no such systems currently operating in South Dakota. Therefore, this study was conducted to determine the efficacy of a biofilter made from locally available material in reducing odor emissions from a grow-finish barn during a South Dakota winter.

[1] Extension Swine Specialist
[2] Extension Structure & Environment Specialist
[3] Livestock Manager, Southeast Research Farm

## METHODS

With grant dollars provided by the South Dakota Pork Producers Council, a biofilter was built and attached to the mechanically ventilated grow-finish barn at the Southeast Research Farm the summer of 2002. A diagram of a biofilter very similar to the one used at the Southeast Farm is shown in Figure 1.

The biofilter was constructed in accordance with recommendations from the University of Minnesota (Nicolai et al., 2002). In general, the bed of the biofilter was made of wooden pallets and was 7.3 m long x 6.1 m wide. For the first 3.7 m, the pallets were raised 30 cm off the ground, and the last 3.6 m of the bed were raised 15 cm off the ground. The entire top surface of the wooden pallets was covered with a black plastic netting with 2 cm square holes, which prevented the compost-wood chip mixture from falling through the pallets. Compost and wood chips from the local landfill were mixed in a feeder wagon at a ratio of 40% compost and 60% wood chips. Key factors influencing biofilter performance are the amount of time the odorous air spends in the biofilter (contact time) and the moisture content of the filter material. Therefore, this ratio of compost:wood chips is critical in establishing a successful biofilter since the wood chips provide porosity and structure while the compost provides microorganisms, nutrients, and moisture holding capacity. This compost-wood chip mixture was applied over the entire bed at a uniform thickness of 36 cm, including all 4 ends which completely sealed the biofilter. A plenum was made out of treated plywood that directed the air from the exhaust fans to the open area underneath the pallets. The pressure from the fans then pushed the exhaust air up through the biofilter bed where the media would work on the odorous compounds.

Air samples were obtained on 4 different sampling dates during the mid December-March period. On each sampling date, 3 air samples were obtained from the plenum (pre-biofilter) and three samples were obtained off the surface of the biofilter (post-biofilter) at different locations. An electronic pump running at 3 liters/minute was used to fill each 10 liter Tedlar sample bag. Immediately after sampling, the Tedlar bags were shipped overnight to the University of Minnesota where a trained Odor panel evaluated the samples. A panel of 8 trained people evaluated every sample and the data reported for each sample was the average value of the 8 panelists. The exact odor analysis methodology is described in a proceeding by Nicolai et al., 1997.

## RESULTS AND DISCUSSION

The results from the Odor panel are presented in Table 1. The two parameters evaluated were Detection Threshold and Odor Persistence, and the values listed in the table are the average values from the 3 samples taken on each date.

Detection threshold is a measure of odor intensity and is reported in Odor Units (OU). The value refers to the dilution rate needed to make the odor just detectable. For example, the Detection Threshold for the "Before" sample on December 10th was 533.5. That means that 1 part of that particular odor sample had to be diluted with 533.5 parts of fresh air to be at the just detectable level. In contrast, the "After" sample on the same day only needed to be diluted in a 1:25.5 ratio, indicating a much weaker odor. The "% Reduction" value was calculated as follows:

$$\% \text{ Reduction} = \frac{(\text{Before OU} - \text{After OU}) \times 100}{\text{Before OU}}$$

Again, using data from the December 10th observation, Detection Threshold was reduced by 95.2% by the biofilter.

$$\% \text{ Reduction} = \frac{(533.5 \text{ OU} - 25.5 \text{ OU}) \times 100}{533.5 \text{ OU}}$$
$$= 95.2\% \text{ odor reduction}$$

Looking at all 4 sampling dates, the biofilter was effective in reducing the Detection Threshold in a range from 89.54% to 97.4%. Averaging the values from the 4 collection points, the overall reduction in Detection Threshold was 93.3% by the biofilter. Therefore, the biofilter was extremely effective in reducing most of the odor emitted from the grow-finish barn.

Odor Persistence is a term used in conjunction with intensity. The perceived intensity of an odor will change in relation to its concentration. However, the rate of change in intensity verses concentration is not the same for all odors. The slope of the line of intensity vs dilution is termed the persistency of the odor, and is basically a measure of how long an odor is detectable. Odors with a low persistence may be initially detected, but then are quickly gone while odors with a high persistence can be detected a long time after the initial exposure. Looking at the data from this trial, it can be seen that the biofilter reduced odor persistence in a range of 77.3% to 91.7%. When pooling all 4 data points, the overall reduction in persistence from the biofilter was 85.0%. This large change in odor persistence is a reflection that the biofilter actually changed the character of the odor. The air entering the biofilter had a “pig-type” odor while the air exiting the biofilter was changed to a “compost-type” odor. Therefore, not only was the biofilter able to reduce over 90% of the odor from the swine barn, but it also changed it to a more acceptable odor with less persistence.

## IMPLICATIONS

This and other studies demonstrate that biofilters can effectively reduce odor from mechanically ventilated swine barns. Biofilters are inexpensive to construct and maintain, making them attractive to pork producers. Also, since they are so effective and use an environmentally-friendly system, biofilters should be accepted by the public as an excellent way to reduce odors. By incorporating biofilters into their odor control plans, producers should meet more acceptance when trying to get new barns permitted.


## ACKNOWLEDGEMENTS

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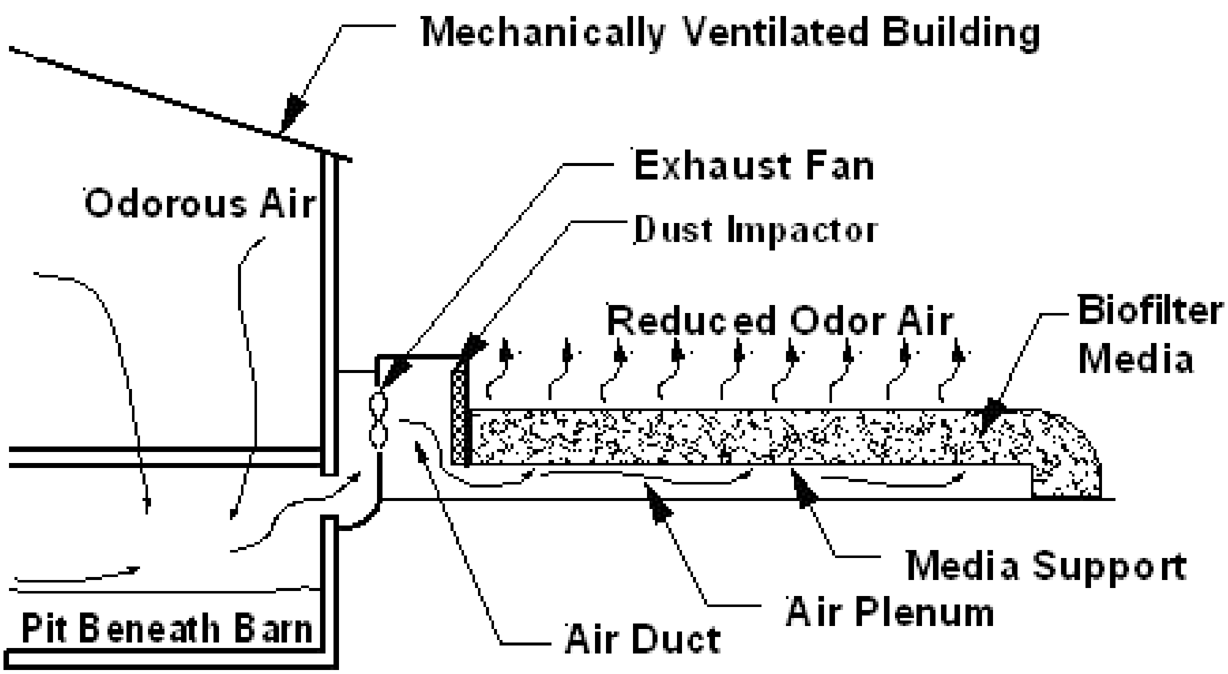


Figure 1. Schematic of a typical open-faced biofilter

**Table 1.** Biofilter effects on odor detection threshold and persistence*.

| Item | Detection Threshold (OU) | | Persistence |
|---|---|---|---|
| 12-10-02 | | | |
| Before | 533.5 | | 58.5 |
| After | 25.5 | | 6.5 |
| % Reduction | 95.2 | | 88.9 |
| | | | |
| 1-14-03 | | | |
| Before | 1110 | | 31.7 |
| After | 29 | | 5.7 |
| % Reduction | 97.4 | | 82.0 |
| | | | |
| 1-28-03 | | | |
| Before | 532.7 | | 38.3 |
| After | 52.7 | | 8.7 |
| % Reduction | 90.1 | | 77.3 |
| | | | |
| 2-11-03 | | | |
| Before | 1058 | | 24 |
| After | 111.3 | | 2.0 |
| % Reduction | 89.5 | | 91.7 |
| | | | |
| Avg of 4 periods | | | |
| Before | 808.6 | | 38.1 |
| After | 54.6 | | 5.7 |
| % Reduction | 93.3 | | 85.0 |
| | | | |

* Before and after values are the means of the 3 observations on that day.

# Effect of Dietary Inclusion of Distiller's Dried Grains with Solubles, Soy Hulls, or Antibiotic Regimen on Gastrointestinal Health and Ability to Resist Ileitis Challenge in Growing Pigs[1]

SE FARM REPORT
SDSU

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**Animal Science 0327**

## INTRODUCTION

Ileitis is a major enteric disease in the US swine industry costing producers millions of dollars annually. Field reports indicate that Distiller's Dried Grains with Solubles (DDGS), a co-product of the ethanol industry, alleviates this condition. However, only limited controlled research has been conducted to verify if, in fact, DDGS does control ileitis. Therefore, the objective of this study was to determine if dietary additions of DDGS alleviated the negative effects associated with ileitis. Also tested were dietary additions of soy hulls and tylosin (an antimicrobial agent approved for use against ileitis). If DDGS were to prove effective, it would provide swine producers a "natural" method to combat ileitis, increase its usage in swine feeds, and create a large, new market for DDGS (100+ million hogs raised annually in the US).

## METHODS

Ninety-five gilts, approximately 17 days of age, were weighed and randomly allotted by weight and ancestry to one of five treatment groups (15 pigs for treatment 1, 20 pigs for all other treatment groups) to assess the effect of two different dietary ingredients and antibiotic supplementation on the ability of pigs to resist a *Lawsonia intracellularis* (the agent that causes ileitis) challenge. Pigs originated from a herd that had no history or recorded cases of ileitis, and was serologically negative for *Lawsonia intracellularis*, porcine respiratory and reproductive syndrome (PRRS), and *Actinobacillus pleuropneumonia*. Treatment groups included: (1) negative control group (NC) – no exposure to *Lawsonia intracellularis* and fed a control corn-soybean meal diet, (2) positive control group (PC) - *Lawsonia intracellularis* challenged and fed a control corn-soybean meal diet, (3) DDGS group (DG) - *Lawsonia intracellularis* challenged and fed a 20% DDGS diet, (4) soy hulls group (SH) - *Lawsonia intracellularis* challenged and fed a corn-soybean meal diet with 5% soybean hulls inclusion, and (5) antibiotic regimen group (AR) - *Lawsonia intracellularis* challenged and fed a corn-soybean meal diet with antibiotic Tylan supplemented at 100 g/ton. The supplementation level of 20% of DDGS in the diet was chosen based on results from previous nursery performance studies conducted at the University of Minnesota indicating that up to 25% "New Generation" DDGS can effectively be added to the diet (when formulated on an apparent ileal digestible

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mulated on an apparent ileal digestible amino acid basis) without detrimental effects on growth performance for pigs weighing more than 15 lbs in body weight.

Diets were fed in a phase feeding sequence, with 7 phases of experimental diets being fed (Nursery Phase 2, Nursery Phase 3, Grower Phase 1, Grower Phase 2, Finisher Phase 1, Finisher Phase 2, Finisher Phase 3) after initial 4 day acclimation period using a commercial Phase 1 experimental diets. All pigs were weighed upon arrival, upon initiation of experimental treatments, at time of oral Lawsonia challenge, and every 2 weeks thereafter, until animals reached market weight. Feed disappearance was monitored and recorded between each weigh period. In addition, biosecurity procedures were developed to ensure that negative control pigs (treatment 1) were maintained without *Lawsonia intracellularis* exposure. These included filling the first 3 pens of the barn with negative control pigs, and leaving the fourth pen empty as a "buffer" pen between the challenged and non-challenged pigs. Also, solid pen partitions were placed between the third and fourth pens and the fourth and fifth pens to reduce any potential airborne transmissions. Negative control pigs were fed first, and separate, clean coveralls and boots were worn any time the "unchallenged" pens were entered. Personnel flow only occurred from the negative control side to the other "dirty" side, and not vice versa. Separate scales were used to weigh the "clean" and challenged pigs.

Approximately four weeks after initiation of dietary treatments (7 weeks of age), animals in PC, DG, SH, and AR groups were inoculated (challenged) with an oral dose (via stomach tube) of intestinal homogenate obtained from infected porcine intestines containing *Lawsonia intracellularis* at a rate of approximately $10^8$ (approximately 10% dilution). The inoculum was prepared from porcine intestines affected by histologically confirmed proliferative enteritis. Pigs were maintained in each pen until pelleted nursery diet. Composition and calculated nutrient analyses of experimental diets are shown in Tables 1 and 2.

Blood samples were randomly collected from 20 pigs upon arrival at the SDSU SE Farm Research Station, and serology was conducted to ensure animals were free of *Lawsonia intracellularis*. Animals were housed in a 20-pen, partially slatted grow-finish barn with 5 pigs per pen. After the initial 4-day period, pigs were fed average pen weight reached 250 lbs, with animals being removed from test on a weekly basis.

Fecal samples from all pigs were obtained immediately after arrival, one to two days before challenge, and on days 14, 21, and 28 post-challenge, and *Lawsonia intracellularis* DNA was analyzed via PCR techniques (University of Minnesota Veterinary Diagnostic Laboratory) to determine rate of fecal shedding of the organism from animals (days 14, 21 and 28 along with pre-challenge samples). Clinical scores were determined and recorded for each individual pig at the time of experimental diet initiation and once per week prior to disease challenge. After disease challenge, clinical scoring was conducted 3 times/week until day 28 post-challenge, and weekly thereafter until the end of the experiment. Clinical scores included fecal, abdominal, and attitude.

Fecal scores (1 – 5) were based on the following characteristics of feces:

1 = no diarrhea,
2 = semi-solid feces with no blood,
3 = watery feces without dark or bloody feces,
4 = blood-tinged feces that are loose or formed, and
5 = profuse diarrhea with frank blood or dark tarry feces.

Abdominal scores (1 – 3) were based on the following body condition characteristics:

1 = normal,

2 = slightly to moderately gaunt, and

3 = severely gaunt.

Attitude scores (1 - 3) were based on the following animal behavior characteristics:

1 = normal,

2 = slightly depressed, listless, and still standing, and

3 = severely depressed or recumbent.

**RESULTS & DISCUSSIONS**

The trial was initiated on September 3, 2002 and was terminated on February 3, 2003 when the last pens of pigs reached 250 lbs.

The trial ran according to the protocol with the exception that at 10 days after the challenge, all pigs exhibited a severe case of roundworms. An anthelmentic was immediately provided via the water and the roundworms were eliminated. When analyzing the data, it appeared that all treatment groups were affected similarly.

Figures 1 and 2 show the effectiveness of the ileitis challenge. As expected, no *Lawsonia intracellularis* was detected from any pig on Day 0 (Figure 1). However, 85% of the challenged pigs shed *Lawsonia intracellularis* on days 14 and 21 post-challenge, and 60% were shedding on day 28. This is in contrast to the non-challenged pigs where only 21% (3 pigs out of 15), 0%, and 7% (1 pig out of 15) of them shed *Lawsonia* on days 14, 21, and 28 post-challenge, respectively. Since no *Lawsonia intracellularis* was detected from the non-challenged pigs on Day 14, and only 3 pigs on Day 14, and 1 on Day 28 tested positive, it would be logical to assume that the non-challenged pigs were never actually exposed to *Lawsonia intracellularis*, and that these were false positives. The *Lawsonia intracellularis* detected in the non-challenged pigs could have come from sample contamination during sample collection, shipment, and/or thawing. Therefore, it appears that the positive control pigs did receive an adequate challenge of *Lawsonia intracellularis* and the negative control pigs were able to stay naïve the first 28 days post-challenge. This is supported by the differences in average daily gain between the challenged and non-challenged pigs shown in Figure 2. Also, on the day that the non-challenged pigs reached 250 lbs, the average weight of all the challenged pigs was 233.4 lbs

Growth data from the four *Lawsonia intracellularis* challenged treatments are shown in Table 3. As expected, dietary treatment did not affect pig performance prior to the ileitis challenge (P>.10). However, for the first 21 and 35 days post-challenge, only the pigs fed tylosin gained significantly more weight(P<.05) and were more efficient (P<.05) than the PC pigs. This difference in pig performance is supported by the fact that the AR pigs shed significantly less *Lawsonia intracellularis* (P<.05) than pigs from the other treatments throughout the observation period. Pigs fed diets containing tylosin had fecal (Figure 3) and abdominal scores (Figure 4) similar to the non-challenged pigs while the DDGS-fed pigs had higher values that were similar to those of the PC group, with the SH pigs having intermediate scores.

Pigs fed the DDGS diets appeared to have a numerically higher growth rate during the later growth stages, since overall daily gain and days-to-market for DDGS-fed pigs were intermediate between the PC and AR pigs.

In this study, neither 20% DDGS nor 5% soy hull additions reduced the severity of an ileitis challenge in early grower pigs, but tylosin supplementation did. This lack of response to DDGS does not necessarily mean DDGS is not effective against a *Lawsonia intracellularis* challenge. It may indicate that it's just not a consistent response. In personal communications with veterinarians and other nutritionists, they report that a lack of DDGS response to ileitis is not totally unexpected. They indicate that DDGS appears effective in approximately 50% of the herds where it is fed, but the reason for this inconsistent response is not known. However, one explanation may be that in herds where DDGS is effective, there may be other infectious agents in addition to *Lawsonia* that DDGS is working against. Therefore, while DDGS is a good feedstuff for swine, an economic value cannot be placed on its health benefits since that response appears not to be consistent.

**ACKNOWLEDGEMENT**

This research supported by funds from the South Dakota Corn Utilization Council.

Table 1. Composition and Calculated Nutrient Analyses of Nursery Diets 2 and 3

Nursery Phase 2 Diets
Fed from 21 to 35 days of age

| ***Ingredients*** | **Con** | **DDGS** | **Hulls** |
|---|---|---|---|
| Corn | 50.56 | 32.62 | 44.17 |
| SBM, 47% | 23.43 | 21.75 | 22.95 |
| DDGS | 0.00 | 20.00 | 0.00 |
| Soy hulls | 0.00 | 0.00 | 5.00 |
| Whey, dried | 15.00 | 15.00 | 15.00 |
| Fish meal, select menhaden | 6.00 | 6.00 | 6.00 |
| Choice white grease | 2.20 | 2.05 | 4.07 |
| Dicalcium phosphate | 1.18 | 0.59 | 1.25 |
| Limestone | 0.35 | 0.76 | 0.25 |
| Vit/TM Premix | 0.45 | 0.45 | 0.45 |
| Zinc oxide | 0.28 | 0.28 | 0.28 |
| Salt | 0.30 | 0.30 | 0.30 |
| L-lysine | 0.15 | 0.15 | 0.15 |
| DL-methionine | 0.10 | 0.07 | 0.12 |
| Tylosin trt inclusion rate | 100 g/ton | | |
| ***Calculated analysis*** | | | |
| Crude protein, % | 22.37 | 25.60 | 22.17 |
| App Dig Lysine, % | 1.35 | 1.35 | 1.35 |
| App Dig Meth & Cys, % | 0.80 | 0.80 | 0.80 |
| App Dig Threonine, % | 0.79 | 0.83 | 0.78 |
| App Dig Tryptophan, % | 0.24 | 0.25 | 0.24 |
| ME, kcal/kg | 3330 | 3330 | 3330 |
| Ca, % | 0.95 | 0.95 | 0.95 |
| P, % | 0.80 | 0.80 | 0.80 |

Nursery Phase 3 Diets
Fed from 35 to 56 days of age

| ***Ingredients*** | **Con** | **DDGS** | **Hulls** |
|---|---|---|---|
| Corn | 61.81 | 43.85 | 55.40 |
| SBM, 47% | 32.62 | 30.93 | 32.14 |
| DDGS | 0.00 | 20.00 | 0.00 |
| Soy hulls | 0.00 | 0.00 | 5.00 |
| Choice white grease | 2.20 | 2.07 | 4.10 |
| Dicalcium phosphate | 1.67 | 1.07 | 1.74 |
| Limestone | 0.56 | 0.97 | 0.47 |
| Vit/TM Premix | 0.45 | 0.45 | 0.45 |
| Copper sulfate | 0.10 | 0.10 | 0.10 |
| Salt | 0.40 | 0.40 | 0.40 |
| L-lysine | 0.15 | 0.15 | 0.15 |
| DL-methionine | 0.04 | 0.01 | 0.06 |
| Tylosin trt inclusion rate | 100 g/ton | | |
| ***Calculated analysis*** | | | |
| Crude protein, % | 20.93 | 24.16 | 20.73 |
| App Dig Lysine, % | 1.15 | 1.15 | 1.15 |
| App Dig Meth & Cys, % | 0.65 | 0.65 | 0.65 |
| App Dig Threonine, % | 0.69 | 0.73 | 0.68 |
| App Dig Tryptophan, % | 0.24 | 0.24 | 0.23 |
| ME, kcal/kg | 3390 | 3390 | 3390 |
| Ca, % | 0.80 | 0.80 | 0.80 |
| P, % | 0.70 | 0.70 | 0.70 |

# Table 2. Composition and Calculated Nutrient Analyses of Grower and Finisher Diets

| | Gilt Grower Phase 1 Fed from d 57 to 90 lbs | | | Gilt Grower Phase 2 Diets Fed from 90 - 130 lbs | | | Gilt Finisher Phase 1 Diets Fed from 130 - 170 lbs | | | Gilt Finisher Phase 2 Diets Fed from 170 - 210 lbs t | | | Gilt Finisher Phase 3 Diets Fed from 210 - 250 lbs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Ingredients*** | **Con** | **DDGS** | **Hulls** | **Con** | **DDGS** | **Hulls** | **Con** | **DDGS** | **Hulls** | **Con** | **DDGS** | **Hulls** | **Con** | **DDGS** | **Hulls** |
| Corn | 60.53 | 49.00 | 60.57 | 69.29 | 51.37 | 62.93 | 73.76 | 55.81 | 67.38 | 76.59 | 58.64 | 70.23 | 80.66 | 62.71 | 74.29 |
| SBM, 47% | 33.80 | 27.12 | 28.33 | 25.18 | 23.48 | 24.68 | 21.41 | 19.71 | 20.92 | 17.73 | 16.04 | 17.24 | 13.99 | 12.29 | 13.50 |
| DDGS | 0.00 | 20.00 | 0.00 | 0.00 | 20.00 | 0.00 | 0.00 | 20.00 | 0.00 | 0.00 | 20.00 | 0.00 | 0.00 | 20.00 | 0.00 |
| Soy hulls | 0.00 | 0.00 | 5.00 | 0.00 | 0.00 | 5.00 | 0.00 | 0.00 | 5.00 | 0.00 | 0.00 | 5.00 | 0.00 | 0.00 | 5.00 |
| Choice white grease | 2.50 | 1.04 | 3.06 | 2.50 | 2.33 | 4.36 | 2.00 | 1.82 | 3.86 | 3.00 | 2.82 | 4.87 | 2.82 | 2.66 | 4.71 |
| Dicalcium phosphate | 1.25 | 0.65 | 1.30 | 1.29 | 0.69 | 1.35 | 1.08 | 0.49 | 1.15 | 0.90 | 0.31 | 0.97 | 0.71 | 0.11 | 0.77 |
| Limestone | 0.72 | 1.08 | 0.57 | 0.63 | 1.04 | 0.53 | 0.66 | 1.08 | 0.57 | 0.69 | 1.10 | 0.59 | 0.72 | 1.13 | 0.63 |
| Vit/TM Premix | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| L-lysine | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| DL-methionine | 0.11 | 0.02 | 0.07 | 0.03 | 0.00 | 0.05 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Tylosin trt inclusion rate | 100 g/ton | | | 40 g/ton | | | 40 g/ton | | | 20 g/ton | | | 20 g/ton | | |
| ***Calculated analysis*** | | | | | | | | | | | | | | | |
| Crude protein, % | 20.27 | 22.80 | 19.37 | 18.02 | 21.25 | 17.81 | 16.58 | 19.84 | 16.38 | 15.08 | 18.33 | 14.85 | 13.64 | 16.90 | 13.42 |
| App Dig Lysine, % | 1.05 | 1.05 | 1.05 | 0.95 | 0.95 | 0.95 | 0.85 | 0.85 | 0.85 | 0.75 | 0.75 | 0.75 | 0.65 | 0.65 | 0.65 |
| App Dig Meth & Cys, % | 0.63 | 0.63 | 0.63 | 0.57 | 0.58 | 0.57 | 0.51 | 0.54 | 0.51 | 0.47 | 0.51 | 0.45 | 0.44 | 0.47 | 0.42 |
| App Dig Threonine, % | 0.60 | 0.68 | 0.63 | 0.59 | 0.63 | 0.58 | 0.54 | 0.57 | 0.53 | 0.48 | 0.52 | 0.47 | 0.43 | 0.47 | 0.42 |
| App Dig Tryptophan, % | 0.21 | 0.22 | 0.21 | 0.19 | 0.20 | 0.19 | 0.17 | 0.18 | 0.17 | 0.15 | 0.16 | 0.15 | 0.13 | 0.14 | 0.13 |
| ME, kcal/kg | 3360 | 3360 | 3360 | 3415 | 3415 | 3415 | 3400 | 3400 | 3400 | 3450 | 3450 | 3450 | 3450 | 3450 | 3450 |
| Ca, % | 0.75 | 0.75 | 0.75 | 0.70 | 0.70 | 0.70 | 0.65 | 0.65 | 0.65 | 0.60 | 0.60 | 0.60 | 0.55 | 0.55 | 0.55 |
| P, % | 0.65 | 0.65 | 0.65 | 0.60 | 0.60 | 0.60 | 0.55 | 0.55 | 0.55 | 0.50 | 0.50 | 0.50 | 0.45 | 0.45 | 0.45 |

Figure 1. Effect of Challenge on Fecal Shedding via PCR Analysis

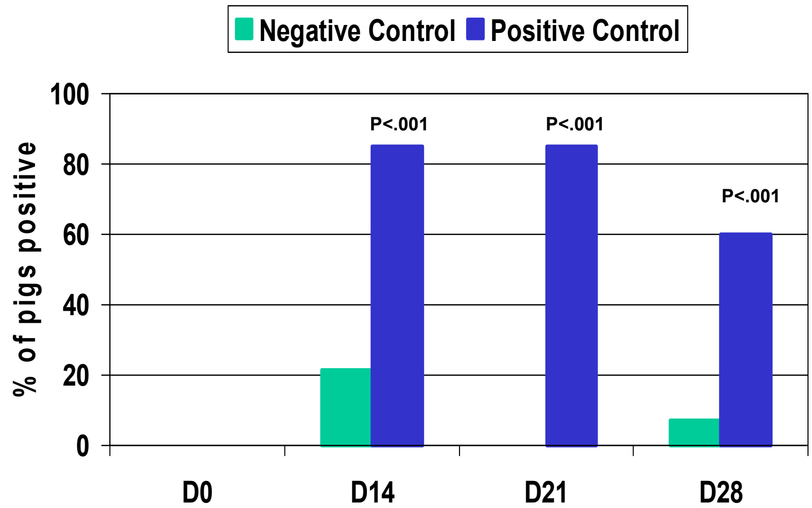


Figure 2. Effect of Challenge on Growth Rate

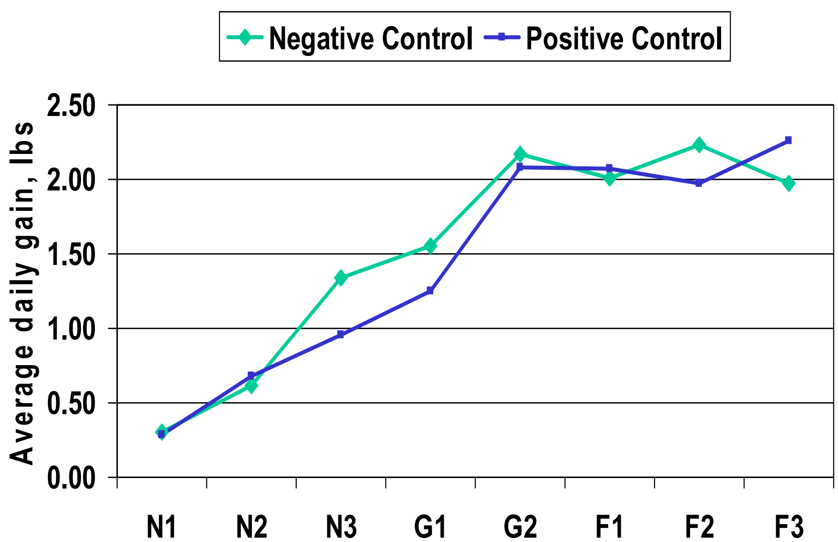

**Figure 3. Fecal Scores**

**(1=no diarrhea to 5=profuse diarrhea)**

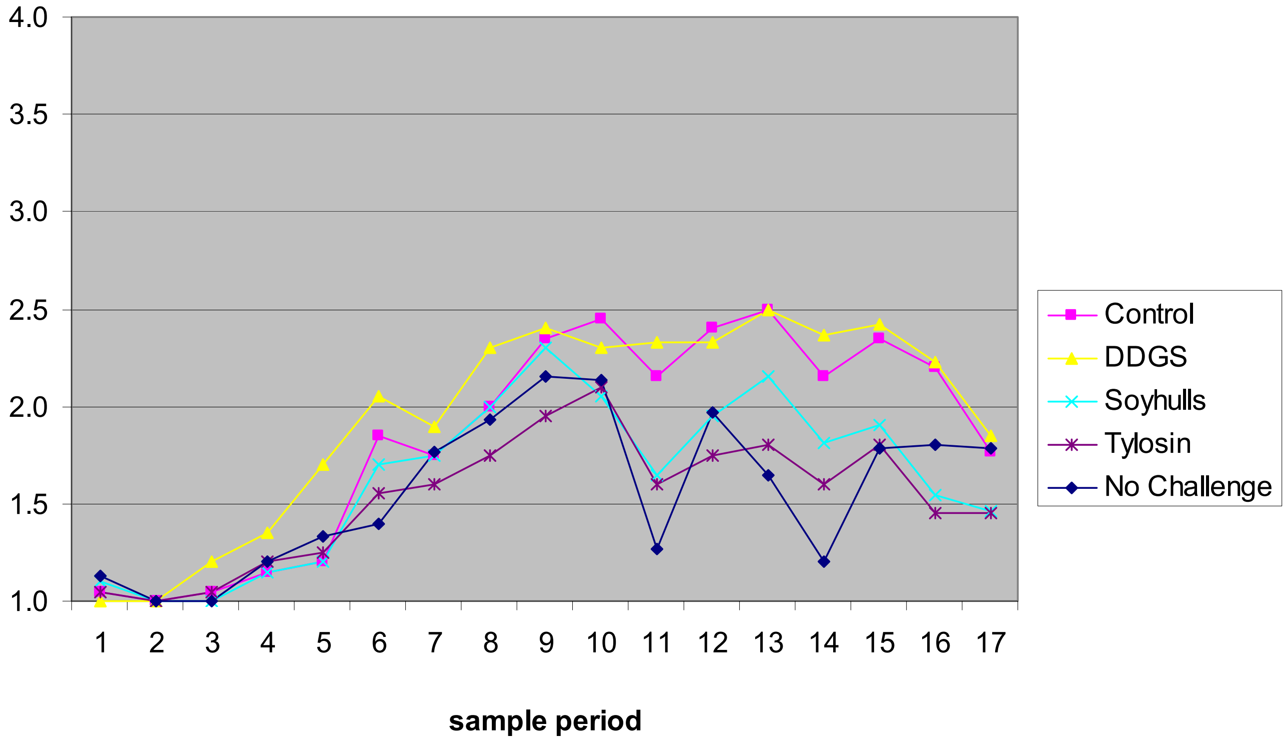


**Figure 4. Abdominal Scores**

**(1=normal to 3=severly gaunt)**

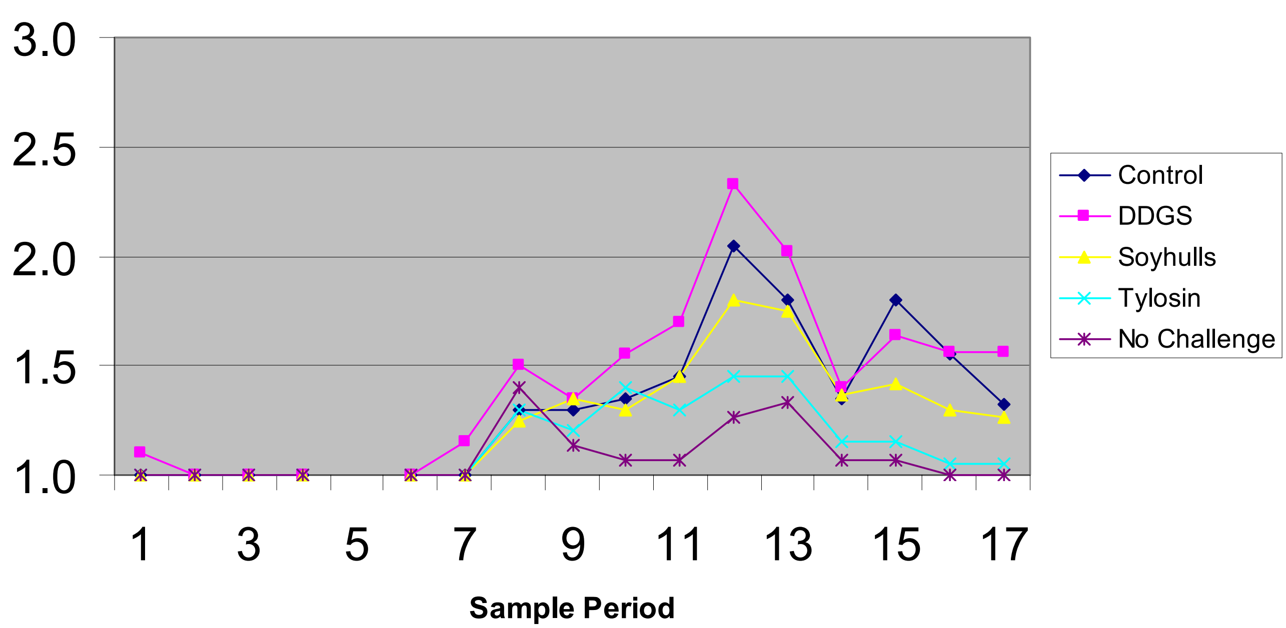

Table 3. Efficacy of DDGS, soy hulls, or tylosin in alleviating an ileitis challenge.

| Avg Daily Gain, lbs | Control | DDGS | Soy Hulls | Tylosin |
|---|---|---|---|---|
| Pre-challenge | .78 | .70 | .77 | .69 |
| 21-d post-challenge | $.46^{a}$ | $.39^{a}$ | $.43^{a}$ | $.68^{b}$ |
| 35-d post-challenge | $.88^{a}$ | $.94^{a}$ | $1.03^{a}$ | $1.30^{b}$ |
| Total post-challenge | $1.68^{a}$ | $1.75^{ab}$ | $1.78^{ab}$ | $1.86^{b}$ |
| | | | | |
| Daily Feed Intake, lbs | | | | |
| Pre-challenge | 1.18 | 1.08 | 1.22 | 1.04 |
| 21-d post-challenge | 1.15 | 1.08 | 1.23 | 1.26 |
| 35-d post-challenge | $2.09^{a}$ | $2.11^{a}$ | $2.23^{ab}$ | $2.56^{b}$ |
| Total post-challenge | $4.43^{ab}$ | $4.60^{ab}$ | $4.41^{a}$ | $4.80^{b}$ |
| | | | | |
| Feed Efficiency (G/F) | | | | |
| Pre-challenge | .67 | .65 | .63 | .66 |
| 21-d post-challenge | $.39^{a}$ | $.36^{a}$ | $.38^{a}$ | $.54^{b}$ |
| 35-d post-challenge | $.42^{a}$ | $.43^{a}$ | $.46^{ab}$ | $.50^{b}$ |
| Total post-challenge | .38 | .38 | .41 | .39 |
| | | | | |
| Total Days on Test | 151.3 | 149.5 | 149.5 | 146.0 |
| | | | | |
| % Pigs Shedding Ileitis | | | | |
| Day 0 (post-challenge) | 0 | 0 | 0 | 0 |
| Day 14 | $85^{ab}$ | $95^{a}$ | $85^{ab}$ | $40^{b}$ |
| Day 21 | $85^{a}$ | $85^{a}$ | $75^{a}$ | $35^{b}$ |
| Day 28 | $60^{ab}$ | $75^{a}$ | $70^{ab}$ | $42^{b}$ |

$^{a,b}$ Means within a row with unlike superscripts differ ($P<.05$)