INTRODUCTION -- Robert K. Berg

Our 38th Annual Progress Report highlights many of the research and demonstration projects conducted at Southeast Research Farm during 1998. It reflects the cooperation and dedication of our entire staff; faculty, support personnel, and administrators on campus; area Extension agents; and our advisory board as well as various commodity and agribusiness groups working together to serve the needs of our clientele. Two of our staff members received public recognition on campus last winter and at our Summer Tour on July 1, 1998. Career Service Awards were earned by Dale DuBois, from Lennox for 30 years and Bruce Jurgensen, from Alcester for 20 years of service at Southeast Research Farm. Their expertise and dedication greatly contribute to our success and we truly appreciate all they do for the SD Agricultural Experiment Station.

During the past year there was various administrative changes at SDSU. We welcome Dr. Peggy Elliott as the new President of our university after Dr. Robert Wagner retired. Specifically within our College of Agricultural and Biological Sciences Dr. Fred Cholick is now Dean, replacing Dr. David Bryant and Dr. Kevin Kephart is serving as Acting Director of the SD Agricultural Experiment Station. Larry Tidemann is Interim Director of the Cooperative Extension Service, replacing Dr. Mylo Hellickson and Dr. Kim Cassel serves as their Interim Program Coordinator. Dr. Don Boggs is the new Department Head for Animal and Range Sciences replacing Dr. James Males. We appreciate the many years of service provided by our former university administrators and wish everyone much success in their new positions. This was also a milestone in my own career as I was promoted to Associate Professor this summer. I would like to take this opportunity to express my sincere appreciation to my family, our entire staff, and all past and present Board of Directors as well as my fellow colleagues, administrators, and the clientele that we all serve throughout South Dakota.

Temperatures and precipitation for 1998 are presented on page 1. Our annual precipitation was 30.4 inches this year (5.25 inches above normal). Of this, 18.9 inches (0.2 inches above normal) arrived during the growing season (April - September) after which we received 80% of the year's above normal precipitation. We measured a total of 33 inches of snow in 1998 with 23 inches falling from January through June and 10 inches between July and December.

We accumulated a total of 3247 growing degree units (101% of normal) from April through October. The coldest day this year was -18°F on January 13 and the hottest temperature recorded was 95°F on July 21 and September 13. The last freezes this spring occurred on April 17 (27°F) and April 18 (32°F) then resumed again this fall on October 1 (28°F) providing 166 and 167 frost free days on a 32°F and 28°F basis, respectively. Only a few spring and summer months had air temperatures that were below normal by 2°F or more, however, half to three fourths of the months had above normal air temperatures. Average maximum monthly air temperatures ranged from 7°F below normal to 10°F above normal and average minimum temperatures ranged from 2°F below normal to 13°F above normal.

Our climate was relatively mild during much of the year and we received normal amounts of growing season precipitation. We started out the year finishing a very mild winter. Early spring field work went relatively well. Planting spring grains and corn in April was reasonably successful, even though March and April precipitation was 5 inches above normal. May was fairly dry which aided the establishment of corn and soybean. We were cooler than normal from June through August. Air temperatures in early June were in the upper 30 and 40°F range for nearly a week. Fall temperatures were warm which allowed corn to dry down well in the field. Early soybean harvest was hampered in many cases by green stems. A major blizzard in mid November delayed corn harvest in some areas. Extremely mild weather returned until just before the end of the year, which allowed harvest and fall field work to be completed.

Most crops in our area got off to an excellent start. With mild temperatures and abundant precipitation the potential for bumper yields of most crops looked strong. Our immediate area was quite dry from late July through September (2.6 inches below normal) which reduced yield potential for row crops to some extent. Small grain production was good for oat but fair to poor for spring wheat, some of which was affected by scab disease this year. Soybean yields ranged from a little below to somewhat above average this year. Corn yields were quite variable and tended to be average or a little above in most instances. Forage production was high. Harvesting good quality hay was extremely challenging during June and July but most late summer and fall cuttings were excellent. The prolonged rainy spell in June also made it difficult to finish sidedressing corn.

Soil moisture levels were good going into the growing season. Normal amounts of precipitation were received during the growing season, especially in the first half. The last half was drier but soil moisture was replenished this fall with precipitation amounts that were four inches above normal. First-generation European corn borer pressures were extremely heavy in May, nearly a month earlier than usual. Cool wet weather in early June really set them back but moderate levels of second-generation borers affected unprotected corn in some fields. There were still plenty of grasshoppers in our area but populations were generally less than in the past couple of years. Crop and livestock prices were both considerably lower than in recent years.

This year's beef cattle report evaluates the use of high oil corn in high concentrate finishing rations for yearling steers. In addition, we are feeding steer calves raised at the Cottonwood Experiment Station near Philip, SD. They are in the second of a five year study evaluating spring and summer calving seasons and early versus conventional weaning dates. Performance and carcass data are being collected on the steers fed here at Beresford. Swine research also tested the feasibility of using high oil corn for grow/finish rations. Funding was obtained from the South Dakota Corn Utilization Council to support a portion of our high oil corn research. They also contributed partial funding along with the Southeast Research Farm Corporation; Sioux Steel, Inc.; and the Department of Animal and Range Sciences for the purchase and installation of a hoop barn that is being used to evaluate alternative ways to raise swine.

We compared the field performance of high-oil and regular dent corn here for the second year, this time using the Top-cross system. The effectiveness of Bt corn hybrids and other types of new crop genetic and weed control strategies were again examined. Soybean cyst nematode continues to be found throughout eastern South Dakota and an update on its impact in the state is highlighted. Soil fertility research was continued to evaluate nitrogen, phosphorus, and micronutrient management for row crops. Additional experiments designed to investigate plant populations, planting dates, row spacing, evaluate crop performance, diseases, soybean inoculants, and crop rotation and tillage systems are also discussed.

Crop research continues efforts to include economics and crop quality information in many of our reports. Multidisciplinary research associated with our crop rotation and tillage project was expanded this year. An alternative economic approach that emphasizes different sizes of machinery and land acreage is discussed in a separate report. Our site was also used to carefully evaluate pest pressures associated with wheat scab and various wheat aphids.

Crop samples were collected for many of our fields in order to monitor crop quality at various levels. Two reports document the effects of planting date on oil and protein production for soybean. One of our goals is to prepare GPS field maps that show oil, protein, and other feed related responses for high oil and regular corn in addition to soybean. This year's soybean quality information is summarized in these reports for several of our smaller research trials, but the larger fields and our corn quality information are still being processed.

Grain yield and moisture maps were prepared for the fourth year in 1998 as part of our continuing efforts with precision farming technology. We cooperated with Pioneer HiBred International, Inc. in a trial that uses a modified split-planter method to compare the performance of two soybean varieties. Aerial photographs were also taken for several of our GPS fields at different stages of the growing season. Several of these had grid soil samples collected for use in regional or national site specific farming projects. Field work was done for a detailed soil survey map on our northwest quarter. Our directors also leased additional land to use for site specific research this year.

Our Annual Reports are available on the Internet through the SDSU/Agriculture and Biological Sciences/Plant Science Department web page beginning with our 1995 report (www.abs.sdstate.edu). If you would prefer to routinely access our annual report electronically through the Internet rather than receiving a printed copy let us know so we can adjust our mailing list. Please feel free to stop by and visit whenever you can. Let us know if you need additional printed copies of this material 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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TILLAGE & CROP ROTATIONS FOR SOUTHEAST SOUTH DAKOTA

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Southeast Farm 9801

INTRODUCTION

This project evaluates the feasibility of seven cropping systems in southeastern South Dakota during 1998. Our primary goals are to compare the production and economics of no-till and conventional tillage systems using multiple crop rotations (Table 1). Ridge-till is also examined in a two-crop rotation. This information can help producers select or modify cropping strategies based on long term systems-based research.

Table 1. Tillage and crop rotation systems. Southeast Research Farm; Beresford, SD; 1998.

System	Tillage	Crop Rotation
1	No-Till (NT)	Corn-Soybean (C-S)
7	Ridge-Till (RT)	Corn Soybean (C-S)
2	Conventional (CT)	Corn-Soybean (C-S)
3	No-Till (NT)	Corn-Soybean-Wheat (C-S-W)
4	Conventional (CT)	Corn-Soybean-Wheat (C-S-W)
5	No-Till (NT)	Corn-Soybean-Wheat-Alf (C-S-W+A)
6	Conventional (CT)	Corn-Soybean-Wheat-Alf (C-S-W+A)

Each system was established in 1990 and has been reported annually since 1991. During the project's first phase (1991-1995) alfalfa was grown as an annual and later as a biennial crop. Fertilizers and herbicides were also restricted in the conventionally tilled four-crop rotation to evaluate a system managed with reduced inputs. This project was modified at the beginning of the second phase (1996-2000). Fertilizers and herbicides are now used in System 6 and we intend to keep alfalfa stands established longer. These modifications allow a more thorough investigation of the interaction between tillage methods and crop rotations plus monitor the recovery of the former low input system. The project has also become more multidisciplinary in scope.

These results from 1998 mark the third year in the second phase of this project. Both Roundup Ready corn and soybean were used this season to help control weeds, including perennial patches of pigeon grass and Canada thistle. Our economic summaries are condensed in this report compared to previous years. If you need specific variable input costs for seed, fertilizer, herbicide, etc. contact our office and we will be glad to provide it.

Marty Draper, Extension Plant Pathologist at SDSU, and Louis Hesler, USDA/ARS Entomologist at Brookings, closely measured pests within the small grain components of these systems. Marty monitored the extent of wheat scab pressure and Louis measured the dynamics of aphid and other insects populations associated with several of our spring wheat systems. Wheat scab is discussed in this report. The insect research is presented in separate report (Plant Science XXXX pg 21).

Doug Franklin, SDSU Agricultural Economist, is using data collected from this project to summarize the long-term economic trends of these systems more extensively. We also cooperated with Jason Miller, USDA/NCRS, and Dwayne Beck, SDAES, at the Dakota Lakes Research Station, to update machinery costs to current prices and estimate acreage that could be effectively farmed with equipment inventories similar to those described for this project based on our 1996 and 1997 results. This information is also highlighted in a separate research report (Plant Science 9802, pg 20). Results from previous years are summarized in our 31st to 37th Annual Research Progress Reports (1991-1997, except 1993).

METHODS

No-till (NT) systems are raised without tillage or cultivation. Primary tillage for the conventional (CT) systems consists of chiseling corn stalks and small grain stubble after fall harvest and either field cultivating or disking soybean and wheat residue in the spring as needed to incorporate fertilizer and herbicide during seedbed preparation. Row crops are planted on ridges in the ridge-till (RT) system using row cleaners when possible to displace crop residue, herbicide is typically banded over the row at planting, and weeds between rows are controlled by cultivation. The two-crop systems (C-S) are a corn-soybean rotation. Three-crop systems (C-S-W) have corn then soybean followed by spring wheat. Four-crop systems (C-S-W+A) consist of the three-crop rotation plus alfalfa managed as a long-term forage crop.

Field operations were performed as outlined in Table 2. Spring wheat was drilled in 7.5-inch row widths with corn and all soybean established in 30-inch row widths. ‘Forge’ spring wheat was drilled at approximately 90 lb/ac. DeKalb 566RR corn was planted at 26,900 seeds/ac. ‘Prairie Brand 1920RR’ soybean was planted at 198,400 seeds/ac in all systems. DeKalb 127 alfalfa was drilled with oat as a nurse crop in 1996.

Table 2. Field operations for tillage and crop rotation systems. Southeast Research Farm; Beresford, SD; 1998.

Tillage System	1998 Crop Rotation	Growing Season[2] Before	During	After
NT	Corn	rotary hoe	spray	mow stalks
	Soybean		spray (2X)	
RT	Corn	rotary hoe	spray	mow stalks
	Soybean		spray, cultivate	
CT	Corn	rotary hoe, field cultivate	spray, cultivate	mow stalks, fall chisel
	Soybean	disk	spray, cultivate	
NT	Corn	rotary hoe, spray	spray	mow stalks
	Soybean		spray (2X)	
	Wheat	spray	spray	spray
CT	Corn	field cultivate	spray, cultivate	mow stalks, fall chisel
	Soybean	disk	spray, cultivate	
	Wheat	disk	spray	spray, fall chisel
NT	Corn	rotary hoe, spray	spray	mow stalks
	Soybean		spray (2X)	
	Wheat	spray	spray	spray
	Alfalfa		harvest (3x)	
CT	Corn	field cultivate	spray, cultivate	mow stalks, fall chisel
	Soybean	disk	spray, cultivate	
	Wheat	disk	spray	spray, fall chisel
	Alfalfa		harvest (3x)	

[1]All plots were fertilized, planted (see Table 3 except alfalfa), and harvested. Corn was sidedressed (June 12). Wheat and soybean stubble were soil sampled (November 5).

[2]Before = Jan 1 to planting/ emergence; During = from planting or alfalfa emergence to harvest or fall dormancy (includes banding herbicide and/or starter fertilizer at planting). After = from harvest or fall dormancy to Dec. 31.

Table 3. Herbicide and fertilizer rates for tillage & rotation system study. Southeast Research Farm; Beresford, SD; 1998.

ROTATION	TILLAGE	CROP	PLANTING DATE	FERTILIZER $N-P_2O_5-K_2O$[1]	HERBICIDE[2]
C-S	NT	C	May 8	187-45-0	Roundup, Post
		S	May 14	6-20-0	Roundup, Post (2X)
	RT	C	May 8	187-45-0	Roundup, Post
		S	May 14	6-20-0	Roundup, Post
	CT	C	May 8	162-45-0	Roundup, Post
		S	May 14	6-20-0	Roundup, Post
C-S-W	NT	C	May 8	182-25-0	Roundup, EPP; Roundup, Post
		S	May 14	6-20-0	Roundup, Post (2X)
		W	April 24	68-30-0	Roundup, PRE; Bronate, Post; Roundup, AH
	CT	C	May 8	157-25-0	Roundup, Post
		S	May 14	6-20-0	Roundup, Post
		W	April 24	68-30-0	Bronate, Post; Roundup, AH
C-S-W+A	NT	C	May 8	182-25-0	Roundup, EPP; Roundup, Post
		S	May 14	6-20-0	Roundup, Post (2X)
		W	April 24	68-30-0	Roundup, PRE; Bronate, Post; Roundup, AH
		A	April 19, 1996	12-45-0	None
	CT	C	May 8	157-25-0	Roundup, Post
		S	May 14	11-40-0	Roundup, Post
		W	April 24	68-30-0	Bronate, Post; Roundup, AH
		A	April 19, 1996	12-45-0	None

[1]Liquid fertilizer applied as 10-34-0 and 28-0-0.
[2] EPP =Early Preplant, PRE = Pre-emergence, Post = Post emergence, AH = After Harvest

Table 3 summarizes planting dates as well as fertilizer and herbicide applications for 1998. Liquid fertilizer was broadcast before planting as 10-34-0 and/or 28-0-0 for yield goals of 180 bu/ac corn, 50 bu/ac soybean and wheat, and 5 ton/ac alfalfa based on previous soil test results. Corn was sidedressed by injecting 25 gal/ac of 28-0-0 between alternate rows in June. Fall soil samples were collected from soybean and wheat plots in 1997 and 1998 to monitor soil fertility status and determine next year's corn and wheat N fertilizer requirements (SDSU Soil Testing Laboratory; Brookings, SD).

Wheat scab ratings were determined on July 20 and 21, 1998. Stand counts were measured at harvest for each annual crop as well as mature plant height for wheat and soybean. Grain was harvested from the middle of a plot so border effects would not confound crop yield results. All grain was measured in a weigh wagon with moisture and test weight recorded in the field and submitted for laboratory protein/oil analysis. Alfalfa was harvested as a three-cut system with sun-cured forage from entire individual plots measured at each cutting as large round bales. Relative feed values for alfalfa reflect random forage samples tested from various hay fields we manage that were harvested at the same times (instead of specific plots associated with this study). Lodging, weed, insect, and disease observations were noted throughout the season.

Corn and soybean yields and moistures were determined simultaneously using an IH/AFS combine yield monitor with a differential global positioning system (DGPS) for both the middle of the plot (corresponds with the weigh wagon weights) and entire plots as separate data files. Areas harvested for grain yield in this report were: wheat (grain only), 20% of plot (0.09 ac); soybean, 33% of plot (8 rows, 0.14 ac); and corn, 50% of plot (12 rows, 0.21 ac).

Crop rotations and tillage systems are grown on the same 45-acre plot location each year with crops rotated within each system as needed. Tillage and crop rotation combinations involve twenty treatments and each is replicated four times. Plot size is 0.4 ac (60 ft x 300 ft). Statistical comparisons among systems for measured agronomic responses are based on treatment means by crop obtained from Analysis of Variance as a randomized block design using Least Significant Differences (LSD) at the 90% probability level. Main effects of tillage and crop rotation as well as a tillage x rotation interaction are tested. Ridge-till observations are deleted for two-crop rotations after a preliminary analysis for treatment effects.

Economic analyses are based on 1998 costs and receipts using the actual rates of inputs, local commodity prices at harvest, and crop yields associated with each system. Market prices in 1998 were \$1.60/bu for corn, \$5.00/bu for soybean, \$2.93/bu for wheat, and \$60/ton for alfalfa hay. Variable and fixed costs are compared for each system by crop on a per-acre, per-bushel (or ton), and on a whole farm basis using Maximum Economic Yield Analysis Software (Potash and Phosphate Institute; Atlanta, GA; Version 3.0). Equipment inventory and 1991 costs for each of the three tillage systems suitable for a 640-ac cash grain farm are shown in Table 4. Fixed costs include cash rent for land ($70/ac), seasonal labor ($10/hr), interest on machinery debt, and depreciation for equipment purchased in 1991. Variable costs are calculated for field operations, seed, fertilizer, herbicide, insecticide, crop scouting, hauling and drying grain, crop insurance, soil testing, and a 7-month operating loan.

The economic summaries (Tables 10-13) are reorganized and condensed compared to previous years. This year's tables list information for all systems on a whole farm basis toward the top then by crop below. Table 10 shows totals for receipts, expenses, and net income. Table 11 has variable and fixed costs (including depreciation), net cash income, and net income (loss). Table 12 presents economic information on a per-acre basis and Table 13 itemizes costs per unit of production and seasonal labor for each system.

Table 4. Tillage and crop rotation system, 1991 equipment inventories. Southeast Research Farm; Beresford, SD; 1998.

	Tillage System		
Equipment	No-Till	Ridge-Till	Conventional
120-HP Tractor	45.000	45.000	45.000
70-HP Tractor	17,000	17,000	17,000
No-Till Drill 15 ft	20,000		
30" Planter 6-Row	10,000		10,000
Sprayer 45 ft	2,500	2,500	2,500
Fertilizer Applicator 6-row	2,500		
Ridge-Till Planter 6-row		14,000	
Ridge-Till Cultivator 6-row		12,000	
Chisel 13 ft			2,000
Tandem Disk 18 ft			9,000
Field Cultivator 19 ft			8,500
Drill 15 ft			6,000
Cultivator 6-row			4,500
Total Equipment Cost	$97.000	$90.500	$104.500

RESULTS & DISCUSSION

Crop Production

Conditions were relatively favorable for early spring fertilizing, tillage, and planting operations following the mild, open winter of 1997/1998. Spring fertilizer and planting was done in late April. Corn was planted in early May and soybean by mid May. Abundant soil moisture and precipitation coupled with warm temperatures promoted good emergence and early growth of all crops.

The first cutting of alfalfa could have been harvested by late May, but we were not intentionally managing for dairy quality hay. By the time it finally quit raining in mid to late June the crop was in the very late bloom stage and heavily lodged. The second cutting was swathed in late July but quality suffered because it received 2 inches of rain in the windrow. The third cutting in early September was excellent quality hay.

Weeds in corn and soybean were effectively controlled in nearly all systems with Roundup including burn down applications for several no-till systems. Bronate did a nice job controlling broadleaf weeds in wheat but annual became a problem in all wheat systems. This along with disease pressure from wheat scab resulted in poor performance for wheat this season.

Growing season precipitation was normal rather than excessive as in other nearby areas. First generation corn borers had little or no impact on corn in this study. Grasshopper pressure was low to moderate at times but less than in previous years and we did not treat with insecticides in this study. Crop production was generally very good for alfalfa, relatively good for corn and soybean, but poor for spring wheat. The percentage of the yield goal that each crop actually achieved was approximately 90% for corn and soybean, 54% for spring wheat, and 102% for alfalfa.

Corn Corn yielded well, dried down nicely, and had heavy test weight this year (Table 5). Plant populations, grain moisture, and test weight were not significantly influenced by tillage methods or crop rotations this season but rotations did impact grain yield. Two-crop rotations yielded 10 to 20 bu/ac less corn than with the three- and four-crop rotations. Reasons for this rotation effect are not obvious.

Fertilizer rates for corn were similar among the rotations for N but more P was actually applied to the two-crop systems (45 vs. 25 lb P_2O_5/ac) based on soil test levels. No-till corn produced around 5 bu/ac more grain than when conventionally tilled. This reflects more N applied as recommended without tillage. Even though it was cost effective the response was not large enough to be considered a significant ($p > 0.10$) tillage effect this year. Within two-crop rotations, ridge-till corn out yielded conventional tillage by about

12 bu/ac and the no-till system was intermediate. Corn production was not restricted this season for the reduced input system associated with the first phase of this project. Grain quality results from the laboratory are not available at this time.

Table 5. Effects of tillage and crop rotation systems on corn production.
Southeast Research Farm; Beresford, SD; 1998.

Rotation[1]	Tillage	Stand Count	Grain Yield[2]	Moisture Content	Test Weight
		plants/ac	bu/ac	%	lb/bu
C-S	NT	25,600	155	16.0	57.5
	RT	27,800	162	17.3	57.5
	CT	26,500	150	16.7	56.6
C-S-W	NT	25,500	173	17.7	56.4
	CT	25,100	166	16.8	56.9
C-S-W+A	NT	26,100	169	18.2	56.8
	CT	25,100	165	16.8	57.1
Avg		26,000	163	16.9	57.0
$LSD_{0.10}$		NS[3]	11	NS	NS
CV (%)		7.67	5.35	8.58	1.85

[1] 1997 Crop: C-S = soybean, C-S-W and C-S-W+A = wheat
[2] Grain yield at 15% moisture and 56 lb/bu test weight, harvested September 28, 1998
[3] NS = not significant

Soybean Soybean grain yields averaged 44 bu/ac with a test weight of 55.7 lb/bu and 12% moisture at harvest from plant populations of approximately 147,000 plants/ac (Table 6). The concentrations of protein and oil in grain were 42% protein and 21% oil on a 100% dry matter basis. This translates into 900 to 1200 lb protein/ac and 500 to 600 lb oil/ac. Grain production was highest in the four-crop CT system (48 bu/ac) and lowest in the two-crop RT rotation (37 bu/ac). The RT system produced 5 to 10 bu/ac less grain, about 200 lb/ac less protein, and 100 lb/ac less oil than most of the other systems.

Tillage methods and/or crop rotations significantly ($p < 0.10$) influenced plant height as well as grain, protein, and oil yields but not plant population, grain moisture, test weight, nor the concentration of protein or oil within the grain. Soybean plants were 3 to 5 inches taller when conventionally tilled which averaged about 2 bu/ac more grain yield, 60 lb/ac more protein, and 40 lb/ac more oil than the no-till systems. Soybean in the four-crop rotations were not much taller than in the two- or three-crop rotations but still produced 2 to 3 bu/ac more grain, 70 lb/ac more protein, and 30 lb/ac more oil. The good soybean performance associated with the four-crop conventional tillage system probably reflects the extra phosphorus that was applied according to soil test results. In any case it appears that the previous reduced input system has recovered in terms of soybean production this season.

Table 6. Effect of tillage and crop rotation systems on soybean production. Southeast Research Farm; Beresford, SD; 1998.

Rotation[1]	Tillage	Plant	Stand Count	Grain	Moisture	Test	- - - -Grain - - - -	
		inch	plants/ac	bu/ac	%	lb/ bu	lb/ac	lb/ac
C-S	NT	35	147,000	42	11.9	55.8	1072	541
	RT	34	154,000	37	12.0	54.6	938	473
	CT	38	152,000	44	12.0	55.8	1158	587
C-S-W	NT	35	141,000	44	11.9	55.0	1099	550
	CT	38	146,000	46	11.9	55.8	1151	577
C-S-W+A	NT	35	142,000	46	12.0	56.5	1164	573
	CT	40	150,000	48	12.1	56.3	1213	615
Avg		37	147,000	44	12.0	55.7	1114	559
$LSD_{0.10}$		3	NS[3]	3	NS	NS	73	31
CV (%)		7.20	6.55	4.94	0.3	1.77	5.35	4.59

[1] 1997 Crop = Corn
[2] Grain yield, protein, and oil at 13% moisture and 60 lb/bu test weight, harvested Oct 9, 1998
[3] NS = not significant

Wheat Spring wheat was planted in late April and good stands were established, however, disease and grass weed pressures resulted in poor grain yield and test weight for all wheat produced in 1998. Bronate effectively controlled broadleaf weeds but foxtail became abundant later in the growing season. Tillage method influenced plant height and grain yield as well as the concentration and yield of protein (Table 7), whereas the severity of wheat scab was affected by crop rotation in spring wheat (Figure 1). Conventionally tilled wheat was a few inches taller, yielded 5 bu/ac more grain, and had 0.6% higher concentration and 50 lb/ac more protein than the no-till systems. Fertilizer application rate was identical for these four systems, however, tilling the soil increased residual soil N by 25 lb/ac more in 1998 fall soil samples (75 vs. 50 lb NO_3 -N/ac) and probably accounts for most of these tillage responses.

Fusarium head scab was observed on 25 to 30% of the plants in mid to late July with a severity of 20% and a scab index rating of 6%. These disease responses were relatively consistent among these systems. There was evidence that scab severity was consistently 3 to 6% less ($p = 0.10$) in the four-crop systems than in the three-crop rotations.

Table 7. Effects of tillage and crop rotation systems on wheat production. Southeast Research Farm; Beresford, SD; 1998.

Rotation[1]	Tillage	Plant Height	Stand Count	Grain Yield[2]	Moisture Content	Test Weight	Grain Protein	Protein Yield
		inch	tillers/ft^2	bu/ac	%	lb/bu	%	lb/ac
C-S-W	NT	33	49	23	13.5	51.0	14.1	198
	CT	36	54	28	15.4	51.3	14.7	249
C-S-W+A	NT	35	43	25	13.4	51.1	14.2	216
	CT	36	50	30	13.4	51.4	14.9	269
Avg		35	49	27	13.4	51.2	14.4	233
$LSD_{0.10}$		2	NS[3]	6	NS	NS	0.5	57
CV (%)		4.48	22.77	18.52	0.95	2.19	2.80	18.87

[1] 1997 Crop = Soybean
[2] Grain yield at 13% moisture and 60 lb/bu test weight, harvested Aug 12, 1998;
[3] NS = not significant

Alfalfa Alfalfa production was successful again this season but forage quality was an issue (Table 8). Treatment differences between these two systems reflect tillage methods during Phase 1 of this project and were negligible for alfalfa in 1998. The first cutting produced an average of 2.9 ton/ac, the second produced 1.3 ton/ac, and the third produced nearly 0.9 ton/ac for a total of 5.1 ton/ac during the season. Wet weather in June delayed the first cutting until it was quite mature. The second cutting received more than 2 inches of rain while it was in the windrow. Weather cooperated nicely for the third cutting which was put up in excellent shape.

Table 8. Effects of tillage and crop rotation systems on third-year alfalfa hay production. Southeast Research Farm; Beresford, SD 1998.

Rotation[1]	Tillage	1st Cut	2nd Cut	3rd Cut	Total[2]
		- - - - - - - - - - - - -	ton/ac	- - - - - - - - - - - - -	
C-S-W+A	NT	3.04	1.24	0.84	5.12
	CT	2.84	1.36	0.86	5.06
Avg		2.94	1.30	0.85	5.09
Pr > F[4]		0.07	0.09	NS[3]	NS
CV %		3.5	5.19	4.14	3.20
RFV[5]		104	82	167	----

[1] 1997 Crop = Second-year Alfalfa
[2] Harvested: June 25, July 30, and September 04, 1998 (swathed)
July 01, August 12, and September 07, 1998 (baled)
[3] NS = not significant
[4] Pr > F = Probability of tillage treatments not being significantly different
[5] RFV = Relative Feed Value

Total Harvested Crop Production On a whole farm basis, the total production harvested from all crops ranged from 1,500 to 1,900 tons on 640 acres in these systems (2.3 to 3.0 tons/ac, Table 9). Four-crop rotations produced about 1,900 tons of total harvested crop with alfalfa providing the most production (42%), corn contributing about 39%, soybean 12%, and wheat 7%. Two-crop rotations produced slightly less crop (1,800 tons) than the four-crop rotations with corn accounting for 75% and soybean 25% of the total crop production. Three-crop rotations produced about 1,500 tons or less. These were almost 70% corn, 19% soybean, and 11% wheat grain.

Alfalfa and corn produced the greatest total harvested yields at 5 ton/ac, followed closely by corn at 4.9 ton/ac, then soybean at 1.3 ton/ac, and wheat at 0.8 ton/ac. Total crop produced was similar between tillage methods within each type of rotation (within 5 to 15 tons). Grain accounted for all of the total production in the two-crop rotations and three-crop rotations, and 57% of the total production in four-crop rotations. The tonnage of hay and grain in the four-crop rotations were 800 and 1,100 tons, respectively.

Economics

Income Total receipts for a 640-ac farm ranged from $120,000 to 150,000/system among the seven systems tested in 1998 (Table 10). Alfalfa generated the most income on a per-acre basis ($350/ac) followed by corn ($260/ac) then soybean ($185-240/ac) and spring wheat ($67-88/ac) (Table 11).

Table 9. Crop production summary for tillage and rotation study. Whole Farm Basis Southeast Research Farm. Beresford, SD. 1998.

	System	**1**	**7**	**2**	**3**	**4**	**5**	**6**
	Rotation	**CS**	**CS**	**CS**	**CSW**	**CSW**	**CSW+A**	**CSW+A**
	Tillage	**NT**	**RT**	**CT**	**NT**	**CT**	**NT**	**CT**
Total Crop	ton	1792	1807	1786	1462	1465	1917	1924
	ton/ac	2.8	2.8	2.8	2.3	2.3	3.0	3.0
	% THP[1]	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Grain	bu	63,040	63,680	62,720	51,201	51,199	38,400	38,880
	ton	1,792	1807	1786	1462	1465.2	1097.9	1113.6
	% THP	100.0	100.0	100.0	100.0	100.0	57.3	57.9
Hay	ton	0	0	0	0	0	819	810
	% THP	0	0	0	0	0	42.7	42.1
Corn	bu/ac	155	162	150	173	166	169	165
	bu	49,600	51,840	48,000	36,907	35,413	27,040	26,400
	ton/ac	4.65	4.86	4.5	5.19	4.98	5.07	4.95
	ton	1,388.8	1451.5	1344.0	1033.4	991.6	757.1	739.2
	% THP	77.5	81.4	75.3	72.1	67.7	39.5	38.4
Soybean	bu/ac	42	37	46	44	46	46	48
	bu	13,440	11,840	14,720	9,387	9,813	7,360	7,680
	ton/ac	1.26	1.11	1.38	1.32	1.38	1.38	1.44
	ton	403.2	355.2	441.6	281.6	294.4	220.8	230.4
	% THP	22.5	19.6	24.7	18.3	20.1	11.5	12.0
Wheat	bu/ac	0	0	0	23	28	25	30
	bu	0	0	0	4,907	5,973	4,000	4,800
	ton/ac	0	0	0	0.69	0.84	0.75	0.90
	ton	0	0	0	147.2	179.2	120.0	144.0
	% THP	0	0	0	9.6	12.2	6.3	7.5
Alfalfa	ton/ac	0	0	0	0	0	5.119	5.062
	ton	0	0	0	0	0	819	810
	% THP	0	0	0	0	0	42.7	42.1

[1] THP = Total harvested production

Expenses Total expenses ranged from $133,000 to 143,000/system (Table 10). They were approximately $260/ac for corn, $220/ac for alfalfa, and $190/ac for soybean and wheat (Table 11).

Net Income Five of the seven systems tested generated profit as measured by net income on a whole farm basis this year (Table 10). Net income ranged from $3,000 to $8,000 for two- and four-crop rotations but both three-crop systems lost more than $10,000. Alfalfa and soybean were consistently profitable in these cropping systems. Corn was successful in three- and four-crop rotations but it barely broke even with ridge-till management and lost money when grown with no-till or conventional tillage methods in the other two C-S rotations. Spring wheat lost an average of $25,000 which devastated both C-S-W rotations. Alfalfa was able to generate enough profit to compensate for this but having wheat in the four-crop rotations prevented them from excelling this year.

On a whole farm basis total variable costs ranged from $71,000 to $83,000, total fixed cash costs were $51,000, and depreciation came to nearly $9,000 per system (Table 11). Within a rotation variable costs were highest for corn; less, yet similar, for soybean and wheat; and intermediate for alfalfa. In the C-S rotations (w/o RT), no-till management had a positive net cash income but not enough to cover depreciation, whereas conventional tillage did not have a positive net cash income. Wheat not only failed to generate enough receipts to even pay for its own variable expenses in these three- and four-crop rotations, but it also kept both three-crop rotations from having a positive net cash income.

No-till systems were approximately half as profitable as conventional tillage systems in terms of whole farm net income on a per acre basis (Table 12). Conventionally tilled two- and four-crop rotations were the most efficient and generated a little more than $10/ac in profit. Net income was $5/ac for their no-till and ridge-till counterparts. Within these rotations alfalfa produced the most profit ($85/ac) followed by soybean ($20-50/ac, RT=$9/ac). Corn was less consistent in generating profit ($ 13/ac to - 25/ac). Net income for corn was $6 to 13/ac in the C-S-W and C-S-W+A rotations but in C-S systems it lost barely broke even with RT management and actually lost about $10 to 25/ac with the no-till and conventionally tilled systems in the shorter rotations. Wheat lost $100/ac or more.

Break-even Price Break-even crop prices on a whole farm basis ranged from $71 to 95/ton ($71 to 80/ton without the C-S-W rotations) (Table 13). Costs of production for corn ranged from $1.52 to 1.77/bu, were $3.77 to 4.76/bu for soybean, more than $6/bu for spring wheat, and about $43/ton for third-year alfalfa.

Table 10. Income and expense comparison for tillage and crop rotations
Southeast Research Farm. Beresford, SD; 1998.

	System	1	7	2	3	4	5	6
	Rotation	CS	CS	CS	CSW	CSW	CSW+A	CSW+A
	Tillage	NT	RT	CT	NT	CT	NT	CT
		- $ -						
Whole Farm	Income	146,560	142,144	150,400	120,392	123,267	140,658	143,578
	Expenses	143,104	139,004	143,305	138,363	133,026	138,155	135,712
	Net	3,456	3,140	7,095	(17,970)	(9,759)	2,502	7,866
Corn	Income	79,360	82,944	76,800	58,958	56,573	43,264	42,240
	Expenses	82,738	82,661	84,890	56,542	53,899	42,245	40,285
	Net	(3,378)	284	(8,090)	2,416	2,674	1,020	1,955
Soybean	Income	67,200	59,200	73,600	47,080	49,220	36,800	38,400
	Expenses	60,367	56,345	58,418	40,419	38,973	30,112	30,248
	Net	6,833	2,856	15,183	6,661	10,247	6,688	8,152
Wheat	Income	0	0	0	14,354	17,475	11,720	14,064
	Expenses	0	0	0	41,400	40,155	30,991	30,016
	Net	0	0	0	(27,047)	(22,680)	(19,271)	(15,952)
Alfalfa	Income	0	0	0	0	0	48,874	48,874
	Expenses	0	0	0	0	0	34,809	35,163
	Net	0	0	0	0	0	14,065	13,711

SUMMARY

Crop yields averaged across all systems in 1998 were 163 bu/ac for corn, 44 bu/ac for soybean, 27 bu/ac for spring wheat, and 5 ton/ac for alfalfa. Crop prices were lower at harvest this year compared to the past few years. Alfalfa and soybean were the most profitable crops produced in this study followed by corn, but money was lost raising spring wheat. The conventional two- and four-crop rotations generated the largest net income on a whole farm basis. No-till and conventional systems were profitable in two- and four-crop rotations, the RT two-crop rotation barely broke even, however, three-crop systems performed poorly. Selection of the best tillage method varied by crop. The third-year stand of alfalfa was profitable regardless of its previous tillage history. Soybean and usually corn production tended to be more profitable with conventional tillage, however, growing wheat was not generally cost effective with either tillage method. Using best management practices the past three years seems to have allowed recovery of System 6 from a previous history of withholding fertilizer and herbicide for five years (CTRI) during an earlier phase of this project.

Table 11. Operator summary for tillage and crop rotation systems. Southeast Research Farm; Beresford, SD; 1998.

Tillage / Rotation	NT C-S	RT C-S	CT C-S	NT C-S-W	CT C-S-W	NT C-S-W+A	CT C-S-W+A
System	1	7	2	3	4	5	6
WHOLE FARM (640 AC)	- $ -						
Total Receipts	146,560	142,144	150,400	120,392	123,267	140,658	143,578
Total Variable Expenses	83,393	80,054	81,713	78,642	71,734	79,004	75,144
Total Fixed Cash Expenses	50,981	50,805	52,187	50,991	51,887	50,421	51,163
Total Cash Income	12,186	11,285	16,500	(9,240)	(354)	11,232	17,271
Fixed Non-Cash Expenses	8,730	8,145	9,405	8,730	9,405	8,730	9,405
Net Income @ Yield	3,456	3,140	7,095	(17,970)	(9,759)	2,502	7,866
Acres/Crop	320	320	320	214	214	160	160
CORN							
Total Receipts	79,360	83,944	76,800	58,958	56,573	43,264	42,240
Total Variable Expenses	52,882	53,185	54,093	36,667	33,500	27,457	25,143
Total Fixed Cash Expenses	25,491	25,403	26,094	16,970	17,269	12,605	12,791
Total Cash Income	987	4,357	(3,386)	5,321	5,804	3,202	4,307
Fixed Non-Cash Expenses	4,365	4,073	4,703	2,905	3,130	2,183	2,351
Net Income @ Yield	(3,378)	284	(8,089)	2,416	2,674	1,020	1955
SOYBEAN							
Total Receipts	67,200	59,200	73,600	47,080	49,220	36,800	38,400
Total Variable Expenses	30,511	26,869	27,621	20,450	18,478	15,342	15,106
Total Fixed Cash Expenses	25,491	25,403	26,094	17,050	17,350	12,605	12,791
Total Cash Income	11,198	6,928	19,886	9,580	13,392	8,871	10,503
Fixed Non-Cash Expenses	4,365	4,073	4,703	2,919	3,145	2,183	2,351
Net Income @ Yield	6,833	2,856	15,183	6,661	10,247	6,688	8,152
WHEAT							
Total Receipts	0	0	0	14,354	17,475	11,720	14,064
Total Variable Expenses	0	0	0	21,525	19,756	16,203	14,874
Total Fixed Cash Expenses	0	0	0	16,970	17,269	12,605	12,791
Total Cash Income	0	0	0	(24,141)	(19,550)	(17,088)	(13,601)
Fixed Non-Cash Expenses	0	0	0	2,905	3,130	2,183	2,351
Net Income @ Yield	0	0	0	(27,047)	(22,680)	(19,271)	(15,952)
ALFALFA							
Total Receipts	0	0	0	0	0	48,874	48,874
Total Variable Expenses	0	0	0	0	0	20,021	20,021
Total Fixed Cash Expenses	0	0	0	0	0	12,605	12,791
Total Cash Income	0	0	0	0	0	16,248	16,062
Fixed Non-Cash Expenses	0	0	0	0	0	2,183	2,351
Net Income @ Yield	0	0	0	0	0	14,065	13,711

Table 12. Economic summary for tillage and crop rotation systems (per acre basis). Southeast Farm; Beresford, SD; 1998.

Tillage/Rotation	NT C-S	RT C-S	CT C-S	NT C-S-W	CT C-S-W	NT C-S-W+A	CT C-S-W+A
System	1	7	2	3	4	5	6
WHOLE FARM (640 AC)	- $/ac -						
Avg. Receipts	229	222	235	188	193	220	224
Total Variable Costs	130	125	128	123	112	123	117
Total Fixed Cash Exp	80	79	82	80	81	79	80
Net Cash Income	19	18	26	(14)	0	18	27
Fixed Non-Cash Exp	14	13	15	14	15	14	15
Net Income (Loss)	5	5	11	(28)	(15)	4	12
Acres/crop	320	320	320	213	213	160	160
CORN							
Receipts	248	259	240	277	266	270	264
Total Variable Costs	165	166	169	172	157	171	157
Total Fixed Cash Exp	80	79	82	80	81	79	80
Net Cash Income	3	14	(11)	25	27	20	27
Fixed Non-Cash Exp	14	13	15	14	15	14	15
Net Income (Loss)	(11)	1	(25)	11	13	6	12
SOYBEAN							
Receipts	210	185	230	220	230	230	240
Total Variable Costs	95	84	86	96	86	96	94
Total Fixed Cash Exp.	80	79	82	80	81	79	80
Net Cash Income	35	22	62	45	63	55	66
Fixed Non-Cash Exp	14	13	15	14	15	14	15
Net Income (Loss)	21	9	47	31	48	42	51
WHEAT							
Receipts	0	0	0	67	82	73	88
Total Variable Costs	0	0	0	101	93	101	93
Total Fixed Cash Exp	0	0	0	80	81	79	80
Net Cash Income	0	0	0	(113)	(92)	(107)	(85)
Fixed Non-Cash Exp	0	0	0	14	15	14	15
Net Income (Loss)	0	0	0	(127)	(106)	(120)	(100)
ALFALFA							
Receipts	0	0	0	0	0	305	305
Total Variable Costs	0	0	0	0	0	125	125
Total Fixed Cash Exp	0	0	0	0	0	79	80
Net Cash Income	0	0	0	0	0	102	100
Fixed Non-Cash Exp	0	0	0	0	0	14	15
Net Income (Loss)	0	0	0	0	0	88	86

Table 13. Economic summary for tillage and crop rotation systems (per unit of yield basis). Southeast Research Farm; Beresford, SD; 1998.

Tillage	NT	RT	CT	NT	CT	NT	CT
Crop Rotation	C-S	C-S	C-S	C-S-W	C-S-W	C-S-W+A	C-S-W+A
System	1	7	2	3	4	5	6
WHOLE FARM (640 AC)							
Variable Expenses, $/ton	46.54	44.31	45.76	53.78	48.96	41.63	39.26
Fixed Cash Expenses, $/ton	28.54	28.12	29.23	34.87	35.42	26.57	26.74
Fixed Non-Cash Exp, $/ton	4.87	4.51	5.27	5.97	6.47	4.60	4.92
Total Costs, $/ton	79.86	76.94	80.26	94.62	90.80	72.80	70.92
Seasonal labor, hours	259.2	256.6	352.0	260.2	322.0	203.2	249.6
CORN							
Variable Expenses, $/bu	1.07	1.03	1.13	1.00	0.95	1.02	0.95
Fixed Cash Expenses, $/bu	0.51	0.49	0.54	0.46	0.49	0.47	0.48
Fixed Non-Cash Exp, $/bu	0.09	0.08	0.10	0.08	0.09	0.08	0.09
Total Costs, $/bu	1.67	1.59	1.77	1.53	1.52	1.56	1.53
Seasonal Labor, hours	156.8	156.8	220.8	115.0	136.3	86.4	102.4
SOYBEAN							
Variable Expenses, $/bu	2.27	2.27	1.88	2.17	1.88	2.08	1.80
Fixed Cash Expenses, $/bu	1.90	2.15	1.77	1.81	1.76	1.71	1.67
Fixed Non-Cash Exp, $/bu	0.32	0.34	0.32	0.31	0.32	0.30	0.31
Total Costs, $/bu	4.49	4.76	3.97	4.29	3.96	4.09	3.77
Seasonal Labor, hours	102.4	108.8	131.2	68.5	87.7	51.2	65.6
WHEAT							
Variable Expenses, $/bu	0	0	0	4.39	3.31	4.05	3.10
Fixed Cash Expenses, $/bu	0	0	0	3.46	2.90	3.15	2.66
Fixed Non-Cash Exp, $/bu	0	0	0	0.59	0.52	0.55	0.49
Total Costs, $/bu	0	0	0	8.45	6.73	7.75	6.25
Seasonal Labor, hours	0	0	0	76.7	98.0	57.6	73.6
ALFALFA							
Variable Expenses, $/bu	0	0	0	0	0	24.58	24.58
Fixed Cash Expenses, $/bu	0	0	0	0	0	15.47	15.70
Fixed Non-Cash Exp, $/bu	0	0	0	0	0	2.68	2.89
Total Costs, $/bu	0	0	0	0	0	42.73	43.17
Seasonal Labor, hours	0	0	0	0	0	8.0	8.0

Introduction

No-till farming practices have been consistently identified as ways to effectively conserve soil moisture, reduce soil erosion, improve water quality, benefit wildlife, use labor efficiently, limit machinery investments, and sequester atmospheric carbon dioxide. Claims are less consistent when it comes to identifying the impact no-till has on making individual producers more profitable. In fact, research data can be found to support conclusions that no-till is less, more, or just as profitable as conventional tillage systems.

It appears that the "devil is in the detail". Factors such as trial location and duration, experimental methods (rotations, seeding equipment, fertilizer practices) and economic assumptions employed play a major role in determining the calculated relative profitability of the tillage practices tested. This inconsistency makes it difficult to predict with a high degree of certainty which tillage system is best for individual producers with differing management styles, locations, and economic circumstances.

The problem occurs because research that was designed to test a system component (tillage) is used to make judgments about the system as a whole (profitability). Comparisons often do not optimize cropping strategies for each tillage regime resulting in agronomic practices that inherently favor one system. This uncertainty and the unpredictability that results from this approach substantially slows adoption of no-till. It also leads to some early adopters abandoning no-till when unforeseen problems arise.

Methods

The economics of the crop rotation and tillage systems studied at the SE Research Farm were used to address this issue from a different angle for a No-Till Systems Technology Transfer Project team member workshop this year. Crop years 1996 and 1997 were analyzed using a computer program developed by USDA Natural Resources Conservation Service (NRCS) called Cost and Return Estimator (CARE). This software generates costs and returns for crop enterprises based on information entered in the program's databases.

The following assumptions were made to calculate the profitability of the cropping systems at the SE Research Farm:

1. The cost of 1997 crop inputs and drying costs were used in the calculations for both 1996 and 1997.

2. Only the 1997 machinery operations performed for each crop were used.

3. Crop yields and market prices for 1996 and 1997 were averaged to determine total revenue.

4. Land charge was $70.00 per acre.

5. The ridge-till system was omitted from this analysis. Rotations involving alfalfa were also excluded because this crop was

swathed and baled by custom operators. However, it should be noted that alfalfa can be used profitably to diversify a crop rotation and help break pest cycles.

6. Crop acreage for each rotation was based on the size of operation the no-till equipment could potentially farm assuming 600 acres per crop type. The size of most of the equipment used in these conventional tillage systems had to be increased to ensure that crops could be planted in a timely manner. See Table 1 for equipment size and cost based on tillage system.

Table 1. Tillage and crop rotation system equipment inventory with 1991 and 1997 prices. Southeast Research Farm; Beresford, SD.

	- - - - - - - - - - - - - -Tillage System- - - - - - - - - - - - - -			
Equipment	- - - - - No-Till - - - - -		- - - -Conventional - - - -	
	1991	1997	1991	1997
225 HP Tractor			$ 70,000	$ 88,246
120 HP Tractor	$ 45,000	$ 56,730		
140 HP Tractor			$ 50,000	$ 63,000
70 HP Tractor	$ 17,000	$21,431		
No-Till Drill - 15 ft	$ 20,000	$25,213		
Planter - 6 row 30”	$ 10,000	$12,607		
Planter - 12 row 30”			$ 17,000	$ 21,431
Sprayer - 75 ft	$ 7,000	$8,825	$ 7,000	$ 8,825
Chisel 24 ft			$ 4,000	$ 5,043
Tandem Disk - 34 ft			$ 12,000	$ 15,128
Field Cultivator - 36 ft			$ 9,000	$ 11,346
Drill - 30 ft			$ 8,000	$ 10,085
Cultivator - 12 row 30”			$ 6,000	$ 7,564
Combine	$ 55,556	$70,000	$ 55,556	$ 70,000
Corn Head - 6 row 30”	$ 8,071	$10,000	$ 8,071	$ 10,000
Soybean Flex Head - 25 ft	$ 6,457	$ 8,000	$ 6,457	$ 8,000
Total	$169,084	$212,806	$253,084	$318,668

Results and Discussion

Table 1 itemizes the sizes and prices of 1991 model equipment if purchased in 1997. The 1997 prices are used in CARE to accurately calculate ownership, operating costs, labor and to properly estimate maintenance and insurance costs. The Consumer Price Index (CPI) was used to update machinery costs to 1997 prices. The acreage that can theoretically be farmed with this equipment is shown in Table 2.

Table 2. The number of acres that can be farmed with equipment listed in Table 1.

Rotation	Tillage System No-Till	Conventional
	- - - - - - - - - - - - - - acres- - - - - - - - - - - - - - -	
Corn-Soybean	1,200	1,200
Wheat-Corn-Soybean	1,800	1,800

The far right column of Table 3 shows the net profit per acre for each crop in the rotation as well as the average profit per acre for the entire rotation. When viewing only net profit per acre for the rotation, the conventional corn-soybean system is the most profitable rotation and no-till corn-soybean is the second most profitable. However, a producer needs to consider the economic impacts of changing tillage systems on the entire farm's potential profit.

Whole farm profit is calculated by multiplying net return per acre for the rotation by total number of acres that can be farmed by the given tillage system. For example, the conventional corn-soybean rotation had a net profit per acre of $110.44 multiplied by the number acres this tillage system can potentially farm (1,200 acres) gives a whole farm profit of $132,522. Whole farm profit was maximized with the corn-soybean-wheat rotations in this analysis as summarized underneath Table 3. As expected, machinery costs decrease as crop diversity increases and is the lowest for a wheat-corn-soybean rotation. Fuel and labor costs are lower in a no-till system when compared to a conventional tillage system. However, material costs such as fertilizer, seed, herbicides are higher in no-till systems.

For producers to diversify crop rotations in eastern South Dakota, small grains and/or alfalfa need to be profitable. Crop diversity plays a crucial role in whole farm profit by decreasing pest pressures (weeds, diseases, and insects), fixed costs, and increasing crop yields compared to short rotations. To examine this a third scenario consisting of an additional no-till corn-soybean-wheat rotation was also considered in this analysis. The corn and soybean yields remained the same as the previous no-till corn-soybean-wheat rotation but, wheat yield was increased from 42 bu/ac to 70 bu/ac (minus the straw yield). This increased net profit by another $30/ac for wheat, by $10/ac for the rotation, and added $19,000 to whole farm profit.

In Table 4 crop selling prices were lowered to illustrate the affects of market prices on net return per acre and whole farm profit. As the crop prices are lowered to $2.00/bu for corn, $5.00/bu for soybean, and $3.20/bu for spring wheat, the overall trends regarding net profit were smaller in nature but similar and the economic differences among tillage systems decreased.

Research conducted across South Dakota has demonstrated the impacts of crop rotation on yields. These impacts on will vary depending on the length of the breaks between the same type of crops. For example, research at Dakota Lakes Research Farm near Pierre indicates winter wheat grown in a diverse rotation (with a 2 to 3 year break between wheat crops) yielded 3 to 10 bu/ac more than wheat grown every other year. Corn also grown in a diverse rotation (2 to 4 year break between corn crops) yielded approximately 12 to 20 bu/ac more than corn grown every year or every other year as in continuous corn or corn-soybean rotations. Soybean grown in a diverse rotation (2 to 4 year break between soybean crops) yielded approximately 5 bu/ac more than soybean grown every other year.

When considering a change in tillage systems a producer needs to understand how the agronomics of crop rotations impact the economic outcome. At the very minimum, crops grown in a no-till system need to yield equal to or better than a conventional tillage system; otherwise, a problem in the system exists and adoption of conservation tillage will diminish.

Problems such as extreme wetness, compaction, fertilizer placement, disease, insects, and weeds have reduced crop yields grown in improperly planned no-till systems. The inclusion of small grains and/or alfalfa and the use of cover crops and/or double crops have the potential to alleviate problems associated with no-till systems in the tall-grass prairie region of South Dakota.

One key economic factor that was not considered in this analysis was the cost per unit of production for a given crop. In other words, how much did it cost to produce a bushel of grain in each rotation. These numbers are extremely valuable, but can be difficult to predict in time to help market a crop. Actual cost per unit of production or long-term averages can be a valuable tool to help with marketing decisions.

These analyses agree with our previously reported observations that in recent years conventional tillage systems can be at least as profitable and sometimes more profitable than no-till systems in southeast South Dakota. They differ, however, because here producing spring wheat is not only profitable as a crop but also improves the profitability of the entire rotation on a whole farm basis.

Table 3. Economic analysis of the interaction among tillage systems and crop rotation using actual crop prices averaged for 1996 and 1997 ($2.42/bu corn, $6.29/bu soybean, and $4.02/bu spring wheat).

SE Research Farm 1996-1997 - Using CARE

Tillage Comparison

Tillage	1996-1997			Selling	Straw	Selling	Total	Machinery Cost		Materials Cost			Capital	Land		Net
Type	Crop	Acres	Yield(Grain)	Price	Yield	Price	Revenue	Ownership	Operating	Materials	Fuel	Labor	Costs	Charge	Total Cost	Profit
Conv-till	Beans	600	47	$ 6.29	(Ton/		$ 295.63	$ 29.70	$ 7.40	$ 69.76	$ 2.69	$ 5.99	$ 5.42	$ 70.00	$ 188.27	$ 107.36
Conv-till	Corn	600	154	$ 2.42	Acre)		$ 372.68	$ 23.20	$ 6.44	$ 145.47	$ 2.00	$ 5.28	$ 8.78	$ 70.00	$ 259.17	$ 113.51
System Average		1200					$ 334.16	$ 26.45	$ 6.92	$ 107.62	$ 2.35	$ 5.64	$ 7.10	$ 70.00	$ 223.72	$ 110.44
Conv-till	Beans	600	45	$ 6.29			$ 283.05	$ 19.92	$ 7.55	$ 76.60	$ 2.69	$ 5.99	$ 5.87	$ 70.00	$ 185.93	$ 97.12
Conv-till	Corn	600	153	$ 2.42			$ 370.26	$ 24.15	$ 8.14	$ 156.05	$ 2.82	$ 6.73	$ 9.56	$ 70.00	$ 274.63	$ 95.63
Conv-till	Wheat	600	38	$ 4.05	1.33	$ 50.00	$ 220.40	$ 13.82	$ 5.03	$ 65.68	$ 1.80	$ 4.33	$ 4.41	$ 70.00	$ 163.27	$ 57.13
System Average		1800					$ 291.24	$ 19.30	$ 6.91	$ 99.44	$ 2.44	$ 5.68	$ 6.61	$ 70.00	$ 207.94	$ 83.29
No-Till	Beans	600	46	$ 6.29			$ 289.34	$ 17.51	$ 4.08	$ 63.68	$ 1.18	$ 3.73	$ 4.49	$ 70.00	$ 163.49	$ 125.85
No-Till	Corn	600	143	$ 2.42			$ 346.06	$ 21.31	$ 4.81	$ 173.65	$ 1.43	$ 4.64	$ 10.12	$ 70.00	$ 284.53	$ 61.53
System Average		1200					$ 317.70	$ 19.41	$ 4.45	$ 118.67	$ 1.31	$ 4.19	$ 7.31	$ 70.00	$ 224.01	$ 93.69
No-Till	Beans	600	42	$ 6.29			$ 264.18	$ 12.71	$ 4.89	$ 72.36	$ 1.18	$ 3.73	$ 5.12	$ 70.00	$ 168.81	$ 95.37
No-Till	Corn	600	155	$ 2.42			$ 375.10	$ 17.10	$ 5.39	$ 178.29	$ 1.50	$ 4.99	$ 10.04	$ 70.00	$ 285.81	$ 89.29
No-Till	Wheat	600	39	$ 4.05	1.37	$ 50.00	$ 226.45	$ 10.85	$ 4.03	$ 77.08	$ 0.95	$ 3.16	$ 4.99	$ 70.00	$ 170.11	$ 56.34
System Average		1800					$ 288.58	$ 13.55	$ 4.77	$ 109.24	$ 1.21	$ 3.96	$ 6.72	$ 70.00	$ 208.24	$ 80.33
No-Till	Beans	600	42	$ 6.29			$ 264.18	$ 12.71	$ 4.89	$ 72.36	$ 1.18	$ 3.73	$ 5.12	$ 70.00	$ 168.81	$ 95.37
No-Till	Corn	600	155	$ 2.42			$ 375.10	$ 17.10	$ 5.39	$ 178.29	$ 1.50	$ 4.99	$ 10.04	$ 70.00	$ 285.81	$ 89.29
No-Till	Wheat	600	70	$ 4.05			$ 283.50	$ 15.00	$ 5.38	$ 94.43	$ 1.34	$ 4.54	$ 6.22	$ 70.00	$ 195.57	$ 87.93
System Average		1800					$ 307.59	$ 14.94	$ 5.22	$ 115.03	$ 1.34	$ 4.42	$ 7.13	$ 70.00	$ 216.73	$ 90.86

Whole Farm Profit

Rotation		
Corn-Soybean	CT	$ 132,522.00
Corn-SB-W	CT	$ 149,928.00
Corn-Soybean	NT	$ 112,428.00
Corn-SB-W	NT	$ 144,600.00
Corn-SB-W(70 bu)	NT	$ 163,554.00

Table 4. Economic analysis of the interaction among tillage systems and crop rotation using lower crop prices
($2.00/bushel corn, $5.00/bushel soybean, and $3.20/bushel spring wheat).

DATE OF PLANTING CORN

R. Berg, D. DuBois, B. Jurgensen,
R. Stevens, and G. Williamson

Southeast Farm 9803

SUMMARY:

The long-term effects of planting date and relative maturity have been compared for a corn-soybean rotation using two corn hybrids with little or no tillage in field trials here since 1986. This report summarizes results for the corn phase of this rotation during 1998.

Planting dates this year began on April 17 and ended on May 22. Optimum times to plant were early to mid May for the short season hybrid (167 bu/ac) and late April for the full season hybrid (184 bu/ac). The full season hybrid produced 20 to 30 bu/ac more grain than the short season hybrid when planted in April and the short season hybrid out yielded the full season hybrid by 30 bu/ac when planted in late May.

It was $30 to 60/ac more profitable to plant the full season hybrid in April but $40/ac more profitable to plant the short season hybrid in late May. Penalties for planting corn in late May instead of late April or early May were $40/ac for the short season hybrid and $110/ac for the full season hybrid in 1998. Waiting to plant in late instead of mid April was worth $25/ac for the full season hybrid and waiting until early May was worth $30/ac for the short season hybrid in 1998.

METHODS:

Our goal is to begin planting both a full and a short season corn hybrid in mid April and continue at approximately 10-day intervals through late May to evaluate crop production, quality, and economic considerations. Planting dates in 1998 were April 17, April 24, May 04, May 13, and May 22. Stand count, grain yield, moisture, test weight, and ear loss were measured at harvest. Grain samples were also submitted for laboratory analysis of oil, crude protein, and other characteristics. Economic return is based on corn marketed directly from the field at harvest for $1.60/bu after subtracting variable input costs for seed, fertilizer, herbicide, field operations, and moisture dockage ($0.05/bu for every point above 15% on a fresh weight basis). Table 1 outlines additional management factors related to this study for 1998.

Table 1. Management practices for date of planting corn study. Southeast Research Farm; Beresford, SD; 1998.

Previous Crop	Soybean
Tillage	No-Till
Planting rate	26,900 seeds/ac
Hybrids	DeKalb 512 (101 day RM)
	DeKalb 626 (112 day RM)
Fertilizer, lb/ac	175-46-0 (N-P_20_5-K_20)
Herbicide	Basagran+Aatrex, Post; 2,4-D, Post
Harvest	October 7

RESULTS AND DISCUSSION:

Corn production for this study is outlined in Table 2. Our earliest planting date began on schedule this year and planting intervals were relatively consistent and without major weather delays. Plant populations were slightly lower than usual (23,000 vs. 25,000 plants/ac) and were relatively consistent among planting dates. Grain yield averaged 155 bu/ac across all treatments and achieved 86% of our 180-bu/ac yield goal. Corn dried down well this year and had relatively good test weights except at the later planting dates. Economic return averaged $103/ac across all treatments. Almost no ear drop was observed (data not shown) and laboratory results are not available at this time.

The full season hybrid produced the most grain when planted in late April. Grain production increased nearly 2 bu/ac per day from mid to late April then lost 1 to 1.5 bu/ac per day when planted from late April to mid May and 5 bu/ac per day between mid and late May. The short season hybrid produced the most grain when planted in early to mid May. Yields were steady but less than the full season hybrids when planted in April. Production increased by 1.7 bu/ac per day for the planting interval between late April and early May, reached a plateau through mid May, then lost 3 bu/ac per day between the mid and late May planting interval.

Table 2. Effect of planting date and relative maturity on corn production; Southeast Research Farm; Beresford, SD; 1998.

Hybrid (RM)[1]	Planting Date	Stand Count	Grain Yield[2]	Moisture Content	Test Weight
		plant/ac	bu/ac	%	lb/bu
DK512	Apr 17	22,800	152	13.1	55.1
(101)	Apr 24	21,600	150	13.1	55.4
	May 04	22,400	167	14.5	55.3
	May 13	23,800	166	15.2	54.6
	May 22	23,400	135	18.9	51.1
DK626	Apr 17	22,300	169	15.5	55.6
(112)	Apr 24	23,600	184	15.8	55.4
	May 04	23,400	172	17.4	54.9
	May 13	24,400	154	17.7	53.6
	May 22	22,800	105	24.2	50.4
Avg		23,000	155	16.5	54.1
$LSD_{0.10}$		NS[3]	15	1.3	1.0
CV %		9.41	7.69	6.47	1.43

[1] RM = Relative maturity in days

[2] Grain yield at 15% moisture content and 56 lb/bu test weight.

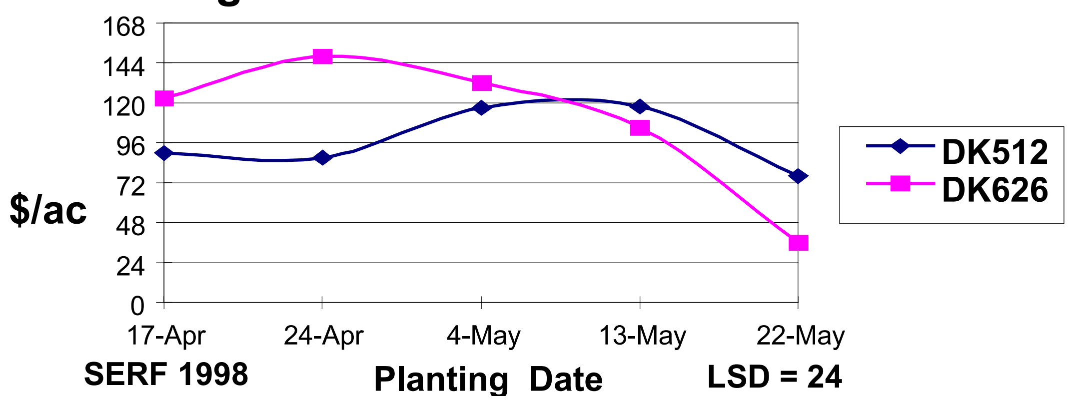
[3] NS = Not Significant

Both hybrids dried down well with the long, warm fall we had. The short season hybrid was quite dry when harvested and only the last planting date received a moisture dock (19% moisture). The full season hybrid had no moisture dockage when planted in April and was consistently 2 to 5% wetter than the short season hybrid at a given planting date. The range in grain moisture content between the first and last planting dates were 6 and 9% moisture for the short and full season hybrids, respectively.

Test weights were a little light but generally within 1.5 lb/bu of the standard until the mid May planting date for the short season hybrid then dropped to 51 lb/bu. Test weight was comparable for the full season hybrid but dropped off sooner beginning in early May and fell to 50 lb/bu for the last planting date.

Profitability varied depending on when these hybrids were planted, but declined steadily after their optimum planting dates (Figure 1). When planted in April, the full-season hybrid was $20 to 60/ac more profitable. Profit was similar between hybrids for plantings from early to mid May, then the short-season hybrid became $40/ac more profitable by the last planting date.

Figure 1. Economic Return



Yields in 1998 increased the long term yield values reported in Table 3 by 0 to 3 bu/ac. The various full season corn hybrids tested in this trial for more than a decade tend to produce well when planted in April or early May. After this they decline by 1.0 bu/ac per day for the planting interval between early and mid May and 2.5 bu/ac per day for the mid to late May interval. The short season corn hybrids tested have a 10 to 12 bu/ac lower yield potential through mid May, have the same yield potential when planted in mid May, then have a 10 bu/ac advantage at the late May planting date. They tend to do relatively well when planted from mid April through mid May then loose 15 bu/ac (1.5 bu/ac per day) in yield potential by the end of May.

Longer season hybrids obviously have more time to utilize available resources during the growing season and therefore have a much better profit potential within their adapted region. This holds true when: conditions are favorable to plant early in the spring, neither late spring nor early fall killing freezes occur during the growing season, and corn borers or other pests do not attack unprotected crop. On the other hand, short season hybrids are preferred when weather causes delays early in the planting season or producers want to avoid the risk of frost. This illustrates the importance of selecting a package of well-adapted corn hybrids with a range of maturity in order to provide greater potential profit as well as protect from various environmental risks.

Table 3. Twelve-year average (1986-1998)[1] grain yields for date of planting corn study. Southeast Research Farm; Beresford, SD; 1998.

Hybrid	- - - - - - - - - - - Avg. Planting Date - - - - - - - - - -				
Maturity	Apr 17	Apr 27	May 7	May 17	May 27
RM	- - - - - - - - - - - - - - bu/ac @ 15% -				
101-103 day	132	134	133	132	117
112-118 day	144	146	143	133	107

[1] No data for 1995

DATE OF PLANTING SOYBEAN

R. Berg, D. DuBois, B. Jurgensen,
R. Stevens, and G. Williamson

Southeast Farm 9804

SUMMARY:

This study reports how relative maturity and planting date influenced the production, quality, and profitability of soybean in 1998. Establishing early and mid season soybean varieties from early May through mid June has been evaluated here using little or no tillage since 1986. Soybean yields this season ranged from 43 to 62 bu/ac when planted from May 04 through June 22. Even though the mid Group II variety had a little better emergence it was out yielded by the late Group I variety by up to 10%. Grain protein yield ranged from 0.50 to 0.75 ton/ac and oil yield was 0.27 to 0.40 ton/ac. The most profitable planting dates were early to mid May. Economic return was approximately $15 to 30/ac less for each 10-day delay in planting through early June. If weather prevents establishing soybean until late June, profitability declined nearly $85/ac compared to the optimum planting dates.

METHODS:

Prairie Brand 197 and Prairie Brand 247 soybean varieties were planted in 30-inch rows on May 04, May 13, May 22, June 02, and June 22 during 1998. The factors of variety and planting date were established as a completely randomized block design with four replications of each treatment. Stand count, plant height, grain yield, moisture content, and test weight were measured. Grain samples were analyzed for protein and oil and are reported on a dry matter basis. Economic return was calculated using a market price of $5.00/bu at harvest less variable costs for seed, herbicide, and field operations. Table 1 reports additional management information relating to this study.

RESULTS AND DISCUSSION:

Actual planting dates were within 1 to 3 days of each intended target date through early June (9- to 11-day planting intervals). Prolonged rainy weather during June delayed our final planting date more than a week later than intended and resulted in a 20-day planting interval. Soybean performance for 1998 is summarized in Table 2 and Figures 1 through 5.

Table 1. Management practices for date of planting soybean study.
Southeast Research Farm, Beresford, SD; 1998.

Previous Crop	Corn
Tillage	Ridge-Till
Varieties	Prairie Brand 197, Prairie Brand 247
Seeding rate	192,000 seeds/ac
Weed Control	Roundup EPP; Broadstrike/Dual, EPP Cultivate 1X
Harvest Date	September 30

Table 2. Effect of planting date and relative maturity on soybean production.
Southeast Research Farm; Beresford, SD; 1998.

Variety	Planting Date	Stand Count	Plant Height	Grain Yield[1]	Moisture Content	Test Weight
		plants/ac	inch	bu/ac	%	lb/bu
PB197	May 04	129,000	33.7	60	10.7	52.8
(late I)	May 13	129,000	35.0	62	10.7	53.0
	May 22	138,000	35.4	56	10.9	52.6
	Jun 02	132,000	32.9	52	10.9	52.2
	Jun 22	144,000	31.6	43	11.8	53.1
PB247	May 04	148,000	33.1	57	10.9	53.1
(mid II)	May 13	140,000	33.6	56	10.8	52.8
	May 22	147,000	32.8	53	10.7	53.8
	Jun 02	146,000	37.2	50	11.0	53.5
	Jun 22	143,000	31.5	43	13.5	51.6
Avg		140,000	33.7	53	11.2	52.9
$LSD_{(0.10)}$		15,000	NS[2]	3	0.9	1.2
CV %		8.77	7.97	4.55	6.17	1.86

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

Relatively good stands of 129,000 to 148,000 plants/ac were established. Plant height for both varieties was similar (34 inches). Our yield goal of 50 bu/ac was achieved or exceeded at every planting date except when planted in late June. Grain moisture content when harvested in late September ranged from 10.7 to 13.5% and test weight was light at about 53 lb/bu. Protein and oil concentrations in the grain were 42 and 21%, respectively on a dry matter basis. This translates into comparable yields of 0.5 to 0.75 ton/ac for protein and 550 to 800 lb/ac of oil.

A common goal for soybean plant population is 150,000 plants/ac. Our stands were typically within 90% of this and about 75% of the seeds planted survived the entire growing season. Seeding rate and seed size were the same for these varieties but better stands were obtained with the mid Group II variety. Yields, however, tended to be greater with the late Group I variety. Better emergence (5 to 10%) associated with the full-season variety was not apparent during the growing season until the actual stand counts were measured.

Both variety and planting date significantly ($p < 0.001$) influenced soybean grain yield. The optimum planting dates were early to mid May for both varieties. The late Group I variety produced as much as 6 bu/ac more grain than its mid Group II counterpart. Grain moisture was just under 11% when harvested for the first four planting dates then increased by an additional 1 to 2.5% for the late June planting date. Test weights were generally 53 lb/bu but dropped by 1.5 to 2.0 lb/bu for the mid Group II variety when it was planted in late June.

Grain protein concentration gradually increased to a maximum of 43% when planted in late May to early June then steadily declined with later planting dates (Figure 1). This peak occurred when planted in early June for the late Group I variety, but was 10 days earlier and declined further for the mid Group II variety. Protein yield was greater when these varieties were planted in early to mid May (1,500 lb/ac) and fell to nearly 1000 lb/ac when planted in late June (Figure 2). The late Group I variety produced an average of almost 70 lb/ac more protein at most planting dates.

Oil content of the grain was about half of what the protein levels were. Oil levels ranged from 20.5 to 22.0%. They started out at 22%, declined as planting progressed through late May and early June, then increased for later planting dates (Figure 3). This trend inversely followed the pattern observed for protein, including bottoming out when planted in early June for the late Group I variety and in late May for the mid Group II variety. Oil yield started out at 750 to 800 lb/ac with the earlier planting dates and dropped to 550 lb/ac when planted in late June. The late Group I variety again tended to produce the most oil yield, especially when planted in mid to late May, but not at all planting dates.

Figure 1. Protein

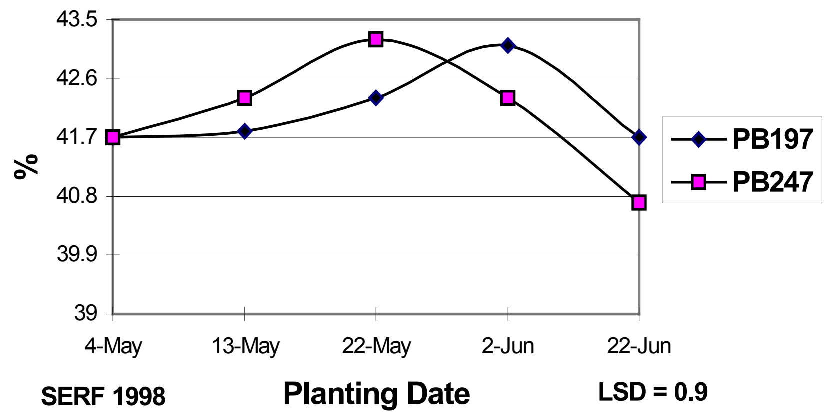


Figure 2. Protein Yield

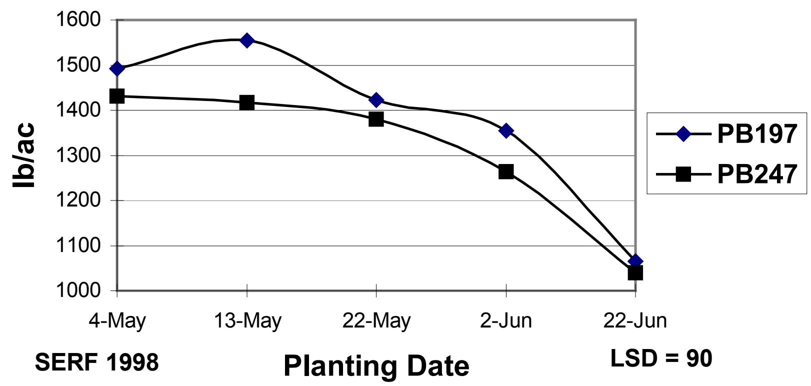


Figure 3. Oil

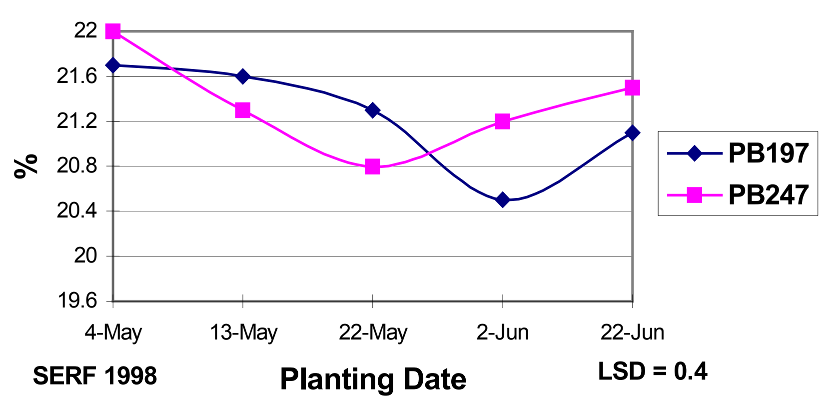
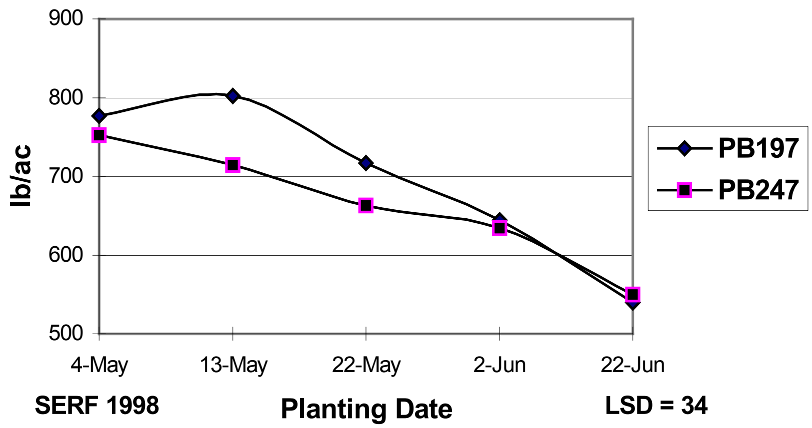
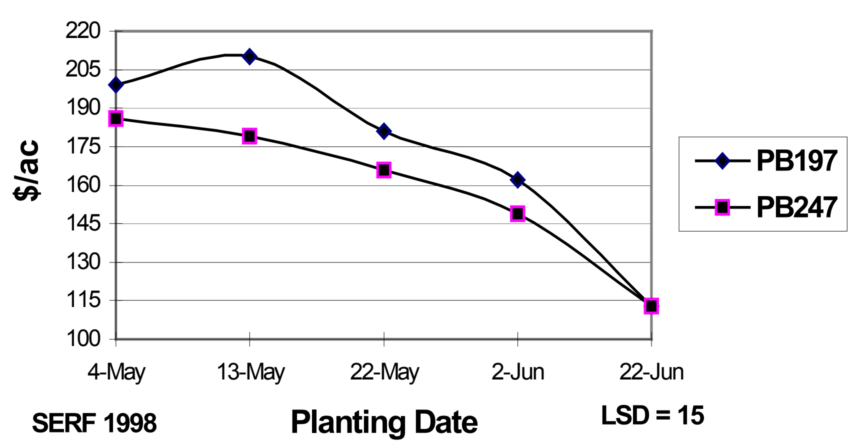


Figure 4. Oil Yield



Early to mid May plantings tended to optimize profit associated with marketing grain for both varieties (Figure 5). The late Group I variety generally provided $10 to 30/ac more profit when these varieties were planted in May or early June. Economic return decreased by nearly $15 to 30/ac by waiting to plant until late May, by almost another $15/ac if planted in early June, and by as much as another $35 to 50/ac for the late June planting date. Planting these soybean varieties in late June instead of early or mid May reduced net economic return by $70 to 95/ac. Group II soybean varieties are commonly grown in this area because they are reportedly better adapted to this region. In recent years we have observed in this and other studies that late Group I varieties yield as good as or frequently better than Group II varieties when planted in May at our location.

Figure 5. Economic Return



Grain production in 1998 increased the long term average grain yields by 0 to1 bu/ac (Table 3). Late Group I varieties generally yield 1 to 3 bu/ac more grain than the Group II varieties we have tested during these studies. The early varieties tend to yield well when planted through late May. It is usually better to establish mid Group II soybeans in early May. The yield of both groups tend to decline by 8 bu/ac when planted in mid June compared to early May.

Table 3. Thirteen-year average yields (1986-1998) for date of planting soybean study. Southeast Research Farm; Beresford, SD; 1998.

	- - - - - - - - - - Average Planting Date - - - - - - - - - -				
Variety	May 5	May 15	May 25	June 4	June 14
	---------------------bu/ac @ 13%--------------------				
Early (Group I & II)	45	44	44	42	37
Mid (Group II)	44	42	42	39	36

DOES THE ESTIMATED PROCESSED VALUE OF SOYBEAN DECLINE DUE TO DELAYED PLANTING AND MATURITY DIFFERENCES?

Roy Scott and Kevin Kephart

Plant Science 9805

In addition to market and crushing parameters, the estimated processed value of soybean depends on the relative levels of protein, oil, and yield obtained from the seed. These parameters must be evaluated for individual lines to develop soybeans that processors can use to respond to the growing demand for high quality soybean meal. The objective of this study was to evaluate the effects of planting dates and locations on the estimated processed value of soybeans in different maturity groups, and with different protein and oil concentrations.

Ten soybean cultivars with maturities ranging from group 00 to II were planted on four dates at four environments across South Dakota in a strip block design with four replicates. Four-row plots were used with 14-foot length and 30-inch row spacings. Planting date intervals ranged from 10 to 18 days. Protein and oil determinations were done on whole seeds using near infrared reflectance spectroscopy (Model 500, NIRSystems, Silver Springs, MD). Estimated processed value per acre (EPVA) was calculated using current meal and oil prices, and crushing parameters in the region. Default values in the computer program of Brumm and Hurburgh (1990) were used for additional processing criteria that were required.

There were significant differences among planting dates and cultivars for yield, protein, and oil at all locations. There were yield reductions with delayed planting after the second planting date. Yield, protein and oil at individual locations were not consistent across the planting dates. Combined across locations, there were significant planting date, variety, and location differences for yield, protein, and oil. Overall, protein increased and oil decreased with delayed planting. There were significant differences among planting dates and varieties for estimated processed value per acre (EPVA) at three locations. The EPVA of the varieties were not consistent across planting dates at any location. Three locations showed a decrease in EPVA with delayed planting. Low EPVA was observed with the high-protein variety, probably as a result of low yield and low oil; and with the 00 maturity group as a result of low yield. There were significant EPVA differences among dates, locations, and varieties. The EPVA did not start declining until after the second planting date. Mean EPVA of individual varieties at the different planting dates were consistent across locations, indicating that, at specific planting dates, EPVA did not change significantly because of the location where the variety was grown.

Summary and Conclusions

The increased protein of the high-protein variety did not compensate for the decreased yield and oil concentration. Moderately high protein varieties which were able to maintain relatively high oil concentration and high yields were the most desirable for EPVA. Varieties maintained their relative EPVA from location to location when planted at similar dates. The EPVA declined only when planting was done later than May. Maturity differences did not seem to affect EPVA, except for the 00 cultivar, which was low yielding.

CORN ROW SPACING & POPULATION STUDY

R. Berg, D. DuBois, B. Rops,
R. Stevens, and G. Williamson

Southeast Farm 9806

INTRODUCTION

Plant population and row width information are helpful in making seeding rate and equipment purchase decisions. Narrow row corn and high seeding rates continue to be popular topics for discussion. This study evaluates several stand densities planted at various row widths to see how these factors influence production, quality, and profitability of dryland corn in the western Cornbelt. A separate study was also conducted here this year to look at row spacing and corn hybrid performance **(page 45; Plant Science 9808).**

METHODS:

Corn was planted in 20-, 30-, and 36-inch row widths at rates of 20,000, 25,000 and 30,000plants/acpopulations in a conventionally tilled corn-soybean rotation. Nine treatments were established as a completely randomized block design with four replications of each combination. Each row was hand thinned to the proper population in 1998. Stand count, grain yield, moisture content, and test weight were measured. Relative yield was calculated as the ratio between grain yield and plant population. The economic return of these treatments is based on corn marketed at harvest at $1.60/bu after subtracting several variable costs including seed, fertilizer, herbicide, field operations, and moisture dockage ($0.05/point above 15% moisture, field moisture basis). Samples from each plot were also submitted for laboratory crude protein and oil analyses. This trial has been conducted annually from 1992 to 1998. Climate and other management factors relevant to this study are outlined in Table 1.

Table 1. Management practices for corn row spacing and population study. Southeast Research Farm; Beresford, SD; 1998.

Previous Crop	Soybean
Tillage	Conventional
Hybrid	Pioneer 3568 (RM = 104 day)
Fertilizer	135 lb N/ac as 28-0-0
Herbicide	Broadstrike/Dual, PPI
Planting Date	May 21
Harvest Date	October 9

RESULTS AND DISCUSSION:

This trial was established in late May. Temperatures were normal with average growing season precipitation. Soil moisture was adequate in the spring and early summer but dry during late summer. When averaged across all treatments, this field had a population of 24,700 plants/ac that yielded 144 bu/ac with 18.5% moisture and 57-lb/bu test weight at harvest (Table 2). Net returns after paying several variable costs were $113/ac and nearly 6 bu of grain was harvested for every 1000 plants/ac (0.33 lb of shelled corn per ear assuming one ear per plant).

Plant populations after thinning ranged from 18,000 to 31,000 plants/ac. This was within ± 4% of our intended stands, except the lowest population in 20-inch rows was 10% less. Thirty- and 36-inch rows generally produced 10 to 15 bu/ac more grain than comparable populations established in 20-inch rows. The most grain was raised from 30,000 plants/ac in 30-inch rows and the least with 18,000 plants/ac in 20-inch rows. Yield range between these extremes was 25 bu/ac (156 vs. 131 bu/ac, respectively).

Table 2. Row spacing and seeding rate effects on corn production. Southeast Research Farm; Beresford, SD; 1998.

Row Spacing	Seeding Rate[1]	Stand Count	Grain Yield[2]	Grain Moisture	Test Weight	Relative Yield
Inch	PLS/ac	plant/ac	bu/ac	%	lb/bu	bu/1000 plants
20	20,000	17,800	131	19.0	57.8	7.4
	25,000	25,700	140	17.7	58.0	5.9
	30,000	30,700	141	17.5	57.7	4.6
30	20,000	19,600	147	19.2	56.2	7.5
	25,000	25,000	146	19.4	56.8	5.8
	30,000	30,100	156	17.2	56.0	5.2
36	20,000	20,000	145	19.8	56.3	7.2
	25,000	25,100	149	18.0	56.3	5.9
	30,000	28,700	145	18.6	57.0	5.1
Avg		24,700	144	18.5	56.9	5.8
$LSD_{(0.10)}$		700	9	1.3	1.2	0.3
CV%		1.89	4.31	4.77	1.43	3.68

[1] Pure live seed basis

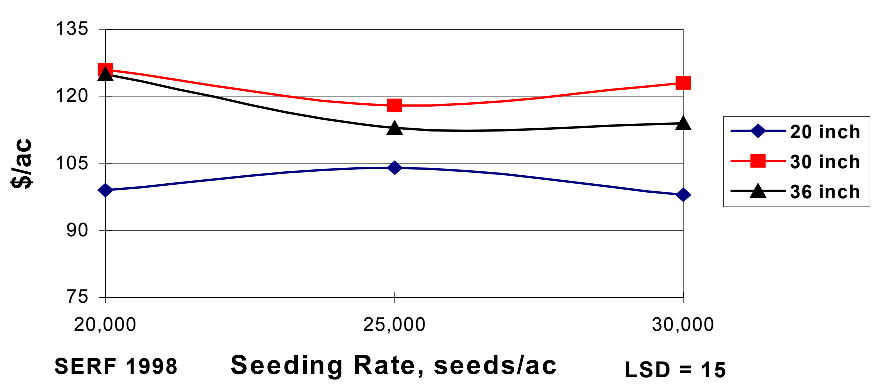
[2] Grain yield at 15% moisture and 56 lb/bu test weight.

Moisture content at harvest and relative grain yield were inversely related to plant population. Low plant density produced larger ears that dried more slowly and were 1 to 2% wetter at harvest than the smaller ears associated with high populations. Ear size as indicated by relative yield ranged from 0.26 to 0.42 lb/plant. Test weight was influenced more by row spacing than plant density. Narrow rows consistently produced grain that was 1.0 to 1.5 lb/bu heavier than comparable populations in either of the wider row spacings. Laboratory results for grain quality are still pending at this time.

Narrow rows were also less profitable than 30- or 36-inch row spacing this season (Figure 1). Both wider row spacings consistently generated $10 to 25/ac more economic return than corn produced in 20-inch rows. There was little or no evidence, other than improved test weight, that establishing the corn hybrid we tested in 20-inch rows would enhance crop production or be cost effective with the growing conditions we experienced this year. Row spacing had a greater impact than plant population on corn production and profitability associated with this study in 1998.

These results differ in some respects from the other corn row spacing study conducted here. It investigated a dozen hybrids with 70 to 104 day relative maturity in 15- and 30-inch rows. Yields here were greater for narrow-row corn by an average of 6 bu/ac in 1998 and showed a 2% advantage during the past two years. On the other hand, our findings agree with research presented at the annual meeting of the American Society of Agronomy this past fall in Baltimore, MD. There various industry and university scientists from across the USA reported that benefits associated with raising corn in narrow rows has been documented but is often inconsistent across time and location and may not be reliable enough to warrant major equipment changes

Figure 1. Economic Return



ROW SPACING EFFECTS ON HYBRID CORN (*Zea mays* L.) YIELD

Zeno Wicks III and Craig Converse

Plant Science 9807

Introduction:

There has been increasing interest in narrow row spacing (less than 30 inches) in South Dakota. Research done in other areas has shown that the more consistent yield responses have seemed to occur in the northern Corn Belt when planting corn in narrow rows. The objective of this experiment was to determine the effect of narrow spacing on hybrid corn yield in eastern South Dakota. Only the results from the Southeast Research Farm are in this report.

Methods:

Nine Pioneer brand hybrids, two Dekalb brand hybrids and one early maturing hybrid from Cornell University, which contains genes for high leaf number above the ear and dwarfism, were chosen to represent different genetic backgrounds. The two year study was set up in a split-plot, randomized design, replicated three times. Six 15 and 30-inch rows were planted in 27.5 foot rows and were thinned to a population of 27,878 plants/acre. A six-row John Deere flex planter was used to plant the 15-inch rows due to the ability of the planter units to be narrowed to 15 inches. The 30-inch rows were planted with a two-row John Deere Max Emerge planter equipped with planting cones. The experiment was planted May 6, thinned to the correct population on June 23 and harvested on October 21, 1998.

The center four rows were harvested in the 15-inch plots and the center two rows were harvested in the 30-inch plots to allow for a buffer between the two spacing and to represent the same acreage and the same number of harvested plants. The 30-inch plots were mechanically harvested with a Gleaner K combine that is equipped with an electronic weigh bucket and moisture tester. The 15-inch rows were hand harvested and ears were shelled and weighed using the Gleaner K combine.

Results and Discussion:

The 1998 results of this experiment (Table1) are displayed as %moisture at harvest time, %stalk lodging (stalks broken below the ear) and yield in bushels per acre adjusted to 15.5% moisture and a population of 27,878 plants per acre. Maturity is presented as overall relative maturity provided by the seed companies. The data was calculated as the average of three replications. The 15-inch row spacing (Table 2) averaged a significant ($p>0.05$) 5.8 bushel (3.8%) increase in yield for 1998. Harvested grain moisture from the 30-inch row spacing was a significant (p>.05) 0.6% dryer at harvest (Table 2).

The combined 1997 and 1998 results (Table 4) by hybrid is displayed as an average of the two environments. A significant (p>0.05) 2.3% increase in yield (Table 3) resulted from planting corn in a 15-inch row spacing. Narrow row corn resulted in a significant (p>0.05) 1.5% increase in stalk lodging (Table 3) and harvest moisture was a significant (p>0.05) 0.5% dryer with corn planted in 30-inch rows.

Generally, yield increases were small with corn planted in 15-inch narrow rows. However, it is important to note that these results are from only two years of data, one plant population, and a small genetic representation. Further testing is needed to determine which genotypes and what plant population is best suited for narrow row corn is this particular environment.

Table 1. 1998 hybrid by row spacing.

Hybrid	*Maturity (days)*	*Row Spacing*	*%Moisture*	*%Stalk Lodging*	*Yield (Bu/ac)*
CM174lfy	70	15	16.5	1.6	88.6
CM174lfy	70	30	15.1	0.8	80.6
P3941	82	15	16.0	2.3	138.2
P3941	82	30	15.2	2.0	134.3
P3970	77	15	16.4	5.4	125.2
P3970	77	30	15.7	4.7	118.8
DK345	84	15	15.7	0.8	136.4
DK345	84	30	15.3	0.8	132.3
DK417	91	15	16.1	2.7	162.5
DK417	91	30	15.6	2.7	150.2
P3861	93	15	16.3	1.5	164.3
P3861	93	30	15.6	1.2	162.5
P3893	90	15	16.2	4.2	159.3
P3893	90	30	15.6	3.9	147.9
P3914	86	15	16.2	1.6	149.9
P3914	86	30	15.6	0.0	140.0
P3559	104	15	17.1	1.1	177.3
P3559	104	30	16.5	0.8	176.0
P3563	103	15	17.8	2.0	174.9
P3563	103	30	17.3	1.9	170.8
P3730	99	15	16.7	0.8	173.3
P3730	99	30	16.0	0.0	171.6
P3751	97	15	16.3	0.4	173.9
P3751	97	30	15.6	0.0	169.6
Mean			**16.1**	**1.8**	**149.1**
C.V. %			**2.7**	**100.0**	**6.5**
$LSD_{(0.05)}$			**0.71**	**3.0**	**16.0**

Table 2. Average for 1998 by row spacing.

	%Moisture	*%Stalk Lodging*	*Yield (Bu/ac)*
15-inch rows	16.4	2.0	152.0
30-inch rows	15.8	1.6	146.2
Difference	**0.6**	**0.4**	**5.8**
$LSD_{(0.05)}$	**0.2**	**ns**	**4.6**

Table 3. 1997 and 1998 combined average by row spacing.

	%Moisture	*%Stalk Lodging*	*Yield (Bu/ac)*
15-inch rows	16.8	6.3	147.5
30-inch rows	16.3	4.8	144.1
Difference	**0.5**	**1.5**	**3.4**
$LSD_{(0.05)}$	**0.2**	**1.0**	**3.4**

Table 4. 1997 and 1998 combined hybrid by row spacing.

Hybrid	*Maturit*	*Row*	*%Moistur*	*%Stalk*	*Yield*
CM174lfy	70	15	16.2	2.5	87.2
CM174lfy	70	30	15.4	2.1	81.6
P3941	82	15	16.2	5.9	132.8
P3941	82	30	15.9	3.7	131.7
P3970	77	15	16.4	16.9	130.2
P3970	77	30	15.9	14.3	120.1
DK345	84	15	15.9	2.5	133.3
DK345	84	30	15.4	1.4	132.2
DK417	91	15	16.2	7.4	157.5
DK417	91	30	16.0	3.9	151.3
P3861	93	15	16.5	7.2	156.4
P3861	93	30	16.0	7.8	155.9
P3893	90	15	16.5	5.9	155.0
P3893	90	30	16.0	4.3	146.7
P3914	86	15	16.5	4.4	154.4
P3914	86	30	16.1	3.2	143.4
P3559	104	15	18.3	5.1	166.2
P3559	104	30	17.7	4.5	166.9
P3563	103	15	19.2	4.8	173.6
P3563	103	30	18.6	5.7	174.8
P3730	99	15	17.5	4.2	170.3
P3730	99	30	17.0	2.8	166.5
P3751	97	15	16.4	8.4	153.1
P3751	97	30	16.1	3.8	158.1
Mean			**16.6**	**5.5**	**145.8**
C.V. %			**2.9**	**51.8**	**7.1**
$LSD_{(0.05)}$			**0.6**	**3.3**	**11.9**

PERFORMANCE OF WHITE FOOD CORN HYBRIDS IN SOUTH DAKOTA

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Plant Science 9808

Commercial white food corn hybrids were grown at four locations in southern and eastern South Dakota in 1998. This was the second year of yield trials to determine the potential of white corn production in South Dakota. We plan on conducting trials again in 1999.

This year was exceptional for corn production, especially at the Southeast Research Farm. Corn of this maturity (110-115 DRM) will not perform this well in cooler seasons in this area. Part of our breeding program involves the development of earlier white corn hybrids (95-105 DRM) which are more suitable to southern South Dakota. 1999 will be the first year of yield trials involving experimental early maturing white corn hybrids.

Trials were grown in a Randomized Complete Block Design with three replications for each plot. Hybrids were planted in 2-row plots that were 27.5 ft long with 5 ft alley breaks between plots lengthwise through the field. Plots were overseeded and thinned to a population of 26,780 plants/acre when the plants were about 2 ft in height. Plots were harvested with a Gleaner K-series plot combine with an internal grain weight/moisture scale. Yields were adjusted to 15.5% grain moisture.

Table 1 lists the locations and inputs of each site. Tables 2 through 5 list grain yield and moisture at harvest for each trial. Entries in bold print are in the top yielding group and are not statistically different (LSD at a=0.05).

We are especially grateful to the following people: Kevin Kirby and Bob Hall of the SDSU Crop Performance Testing program, Bob Berg and the staff at the Southeast Research Farm, Dwayne Beck and the staff at the Dakota Lakes Research Farm, Todd Bortnem and the staff at the Brookings Agronomy Farm, Robert Clark of Armour, graduate student Craig Converse, and field assistant Kyle Kepner.

Table 1. Locations and inputs for 1998 white corn yield trials.

	Armour, SD	Beresford, SD	Pierre, SD	Brookings, SD
Planting date	6 May 1998	6 May 1998	30 April 1998	5 May 1998
Harvest date	21 October 1998	20 October 1998	18 October 1998	15 October 1998
Fertilizer	Unknown. Fertilized for 200 bu/ac.	39 gal/ac 28-0-0 (118 lbs act)	28-0-0 starter, 200 lbs act N through irrigation	150-50-50
Herbicide	Buctril + Accent at maximum labeled rate	Dual II + Bladex at maximum labeled rate	Atrazine + Banvel + Bladex at recommended rates	Dual II + Bladex at maximum labeled rate
Insecticide	Force at 4 lbs/ac, in-furrow	Force at 4 lbs/ac, in-furrow	Force at 4 lbs/ac, in-furrow	Force at 4 lbs/ac, in-furrow
Previous crop	Soybeans	Soybeans	Soybeans	Soybeans
Tillage	No-till	Conventional	No-till	Conventional
Irrigation	No	No	Yes	No
Heat Units* (GDD)	3222 (2890 norm)	3043 (2877 norm)	3198 (2850 norm)	2661 (2418 norm)

*Accumulated from 1 April through 30 September. October GDD are not available at this time.

Table 2. White corn grain moisture and yield for Armour, SD; 1998.

Hybrid	Moisture	Yield	DR M
	%	bu/ac	
IFSI 977	**21.3**	**200.9**	**111**
Wilson 1780W	**25.6**	**195.0**	**114**
Vineyard V453W	**26.0**	**194.9**	**116**
Novartis SG765W	**23.7**	**192.2**	**112**
Garst 8320W	**23.7**	**189.6**	**115**
IFSI 974	**24.7**	**189.5**	**111**
LG Seeds NB749W	**24.5**	**189.2**	**114**
Pioneer Brand 3394 (ylw chk)	**20.5**	**188.3**	**110**
IFSI 976	18.9	184.3	106
NC+ 5633W	22.4	182.5	114
IFSI 973	22.6	181.9	109
IFSI 972	19.6	181.3	109
Pioneer Brand 34P93	22.2	180.9	110
Wilson 1790W	24.9	180.5	113
Asgrow RX776W	24.7	179.2	114
Novartis SG730W	23.3	179.1	110
Diener DB114W	24.9	178.8	114
IFSI 975	23.5	177.7	110
Dekalb DK665W	24.2	175.6	116
Garst 8527W	19.5	174.4	108
IFSI 983	19.3	172.8	110
Garst 8419W	23.8	172.2	113
Novartis SG735W	20.7	169.8	110
Glen Seeds “White One”	22.0	168.8	105
LG Seeds 2558W	22.0	166.6	111
Vineyard V414W	22.5	165.2	110
Pioneer Brand 3559 (ylw chk)	18.2	163.0	104
LG Seeds 2596W	23.7	161.0	112
NC+ RE372W	20.4	160.3	108
LG Seeds NB742W	23.2	160.2	110
$LSD_{(.05)}$	1.2	16.1	
CV (%)	3.9	6.4	

Table 3. White corn grain moisture and yield for Dakota Lakes Research Farm, Pierre, SD; 1998.

Hybrid	Moisture	Yield	DR M
	%	bu/ac	
Pioneer Brand 34P93	**37.1**	**195.4**	**110**
LG Seeds 2596W	**33.9**	**191.2**	**112**
Asgrow RX776W	**37.3**	**190.7**	**114**
NC+ 5633W	**36.7**	**187.9**	**114**
LG Seeds NB749W	**37.8**	**187.8**	**114**
Wilson 1790W	**35.7**	**185.1**	**113**
IFSI 977	**36.7**	**181.9**	**111**
LG Seeds NB742W	**29.6**	**179.9**	**110**
Pioneer Brand 3394 (ylw chk)	**33.5**	**178.8**	**110**
Wilson 1780W	**32.2**	**178.4**	**114**
Novartis SG735W	**36.2**	**177.8**	**110**
LG Seeds 2558W	**34.1**	**177.5**	**111**
Novartis SG765W	**33.2**	**177.1**	**112**
Vineyard V453W	**35.0**	**175.0**	**116**
Garst 8320W	**32.2**	**174.3**	**115**
Pioneer Brand 3559 (ylw chk)	**29.3**	**167.8**	**104**
Novartis SG730W	**31.9**	**166.7**	**110**
Diener DB114W	**32.2**	**165.2**	**114**
Garst 8527W	28.9	162.3	108
IFSI 972	30.1	162.1	109
IFSI 983	29.5	161.8	110
Glen Seeds “White One”	31.1	161.4	105
IFSI 976	30.3	157.0	106
Garst 8419W	29.2	156.0	113
Dekalb DK665W	30.2	152.9	116
IFSI 974	29.3	152.4	111
IFSI 973	29.3	151.4	109
NC+ RE372W	25.3	137.5	108
IFSI 975	26.1	136.1	110
Vineyard V414W	24.9	132.0	110
LSD $_{(.05)}$	4.7	30.7	
CV (%)	7.1	8.9	

Table 4. White corn grain moisture and yield for Southeast Research Farm,

Beresford, SD; 1998

Hybrid	Moisture	Yield	DRM
	%	bu/ac	
Wilson 1780W	**24.5**	**210.3**	**114**
Garst 8320W	**22.4**	**207.3**	**115**
Novartis SG765W	**21.7**	**198.2**	**112**
B73 x Mo17 (ylw chk)	**22.1**	**198.0**	**115**
Wilson 1790W	**24.6**	**197.2**	**113**
Asgrow RX776W	**23.2**	**194.4**	**114**
Diener DB114W	**24.2**	**190.9**	**114**
LG Seeds NB749W	**23.4**	**190.7**	**114**
Vineyard V453W	**23.0**	**187.8**	**116**
NC+ 5633W	**22.1**	**186.9**	**114**
Pioneer Brand 34P93	**20.5**	**183.5**	**110**
LG Seeds 2596W	**22.5**	**182.6**	**112**
Novartis SG730W	**22.9**	**181.4**	**110**
IFSI 977	**21.1**	**181.1**	**111**
IFSI 976	**18.9**	**180.9**	**106**
IFSI 972	**19.5**	**180.8**	**109**
Pioneer Brand 3394 (ylw chk)	**20.1**	**180.2**	**110**
Garst 8419W	**22.3**	**179.6**	**113**
IFSI 983	20.0	179.1	110
IFSI 973	21.6	178.0	109
Novartis SG735W	19.7	177.3	110
Dekalb DK665W	23.3	177.0	116
LG Seeds NB742W	23.2	174.9	110
Garst 8527W	19.2	172.6	108
Pioneer Brand 3559 (ylw chk)	19.1	171.0	104
LG Seeds 2558W	21.1	166.8	111
Vineyard V414W	20.6	155.0	110
Glen Seeds “White One”	20.7	154.1	105
NC+ RE372W	20.0	149.0	108
IFSI 974	NP[a]	NP	111
IFSI 975	NP	NP	110
LSD $_{(.05)}$	0.8	30.7	
CV (%)	2.4	8.9	

[a] NP = Not Planted

Table 5. White corn grain moisture and yield for Brookings, SD; 1998.

Hybrid	Moisture	Yield	DRM
	%	bu/ac	
Pioneer Brand 3559 (ylw chk)	**21.9**	**163.6**	**104**
LG Seeds 2558W	**28.1**	**159.9**	**111**
Diener DB114W	**31.4**	**157.5**	**114**
Pioneer Brand 34P93	**27.2**	**147.6**	**110**
Pioneer Brand 3394 (ylw chk)	**25.6**	**144.6**	**110**
B73 x Mo17 (ylw chk)	**34.1**	**142.9**	**115**
IFSI 972	**27.6**	**140.6**	**109**
Wilson 1790W	30.7	140.4	113
Novartis SG730W	30.3	139.6	110
Dekalb DK665W	30.2	139.2	116
Garst 8527W	23.4	138.7	108
IFSI 983	29.9	136.8	110
Wilson 1780W	32.8	131.9	114
Asgrow RX776W	32.7	128.3	114
Garst 8320W	30.4	128.0	115
LG Seeds 2596W	30.2	128.0	112
IFSI 976	29.5	127.0	106
IFSI 977	27.1	126.9	111
Garst 8419W	30.3	125.5	113
Vineyard V453W	31.7	125.4	116
Novartis SG735W	29.0	124.8	110
NC+ RE372W	24.6	124.4	108
Vineyard V414W	29.2	122.8	110
NC+ 5633W	30.4	122.6	114
LG Seeds NB742W	29.2	121.8	110
Glen Seeds “White One”	26.3	119.7	105
IFSI 973	29.4	119.3	109
LG Seeds NB749W	33.3	115.4	114
Novartis SG765W	31.5	108.1	112
IFSI 974	NP[a]	NP	111
IFSI 975	NP	NP	110
$LSD_{(.05)}$	4.8	23.0	
CV (%)	8.1	8.5	

[a] NP = not planted

GRID SAMPLING IMPACT ON POTENTIAL PRECISION NUTRIENT MANAGEMENT PROFITABILITY IN TWO SOUTH DAKOTA FIELDS

Cheryl L. Reese, David E. Clay, Greg Carlson, Scott Christopherson, and Robert Berg

Plant Science 9809

Introduction

Grid and soil property-based sampling have been proposed as techniques to obtain information required for precision nutrient management. In grid sampling, soil samples are collected from grid points with a specified distance between adjacent samples (Crepis and Johnson, 1993). Following sample collection, they are chemically analyzed, nutrient contour maps constructed (Isaaks and Srivastave, 1989), and fertilizer application maps developed. Many studies have used grid sampling to evaluated natural systems (Ferguson et al., 1996, Franzen and Peck, 1995; Froment et al., 1996, Hergert et al., 1995; Mohamed et al., 1996; Mallarino, 1996). These studies show that if grid distances are short enough, then grid sampling provides excellent information about intrinsic and management induced variation (Chang et al., 1999). In spite of extensive research, farm managers are concerned that grid sampling is expensive, time consuming, and may be unprofitable. To reduce grid sampling costs Lowenberg-DeBoer and Swinton (1997) suggested that sampling and analysis costs be amortized over several years.

Soil property-based sampling uses remote sensed measured soil color, USDA-NRCS developed soil series maps, landscape position, and surveyed or digital elevation maps for characterizing soil management zones (Frazier et al., 1997; Franzen et al., 1998). Once management zones are identified, samples can be collected, chemically analyzed, and fertilizer application maps developed. Property-based sampling is perceived to balance sampling costs with information value. Franzen et al. (1998) suggests that soil-property based sampling is not recommended when: (i) field histories are unknown; (ii) fertility levels are high or high rates of fertilizer have been applied; (iii) manure was applied; (iv) the field contained a feedlot; (v) small fields were merged into a larger one; and (vi) nonmoble nutrients are important to map. The objective of this report is to determine the potential impact of adopting precision nutrient management techniques for fields where manure has been applied.

Materials and Methods

In the fall of 1997, fields located at Beresford and Flandreau were grid soil sampled. The Flandreau field was 125 acres in size and the Beresford field was 95 acres in size. Soil samples (0-6 in) were collected from a 200 by 200 ft grid. Composite samples contained 15 individual cores (Clay et al., 1997a).

Sample points were located using DGPS. Soil samples were air dried (35°C), ground, and analyzed for NO_3-N, NH_4-N, Olsen P, K, and pH by the Soil Testing Laboratory at South Dakota State University using standard methods (North Central Regional Publication, 1988). Conventional soil sample information was determined by averaging the laboratory test results from all sample points from within a field.

A modified procedure of Wollenhaupt et al. (1997) was used to estimate profitability. The assumptions used to calculated potential profitability were that: (i) corn yields were not increased when P fertilizer exceeded the recommendation; (ii) variable and fixed rate fertilizer application costs were $7.50/ac and $5.00/ac, respectively; (iii) 18-46-0 cost $259.50/ ton, 10-34-0 cost $235.50/ton and N fertilizer cost $0.25/lb; (iv) yield monitors or other precision farming tools were the same for precision and conventional treatments; and (v) fertilizer could increase the yield to 95% of the yield goal.

Grid and directed sampling approaches impact on fertilizer rates and profitability was calculated by subtracting the precision treatment from the control treatment. This approach assumed that N did not limit yields in either conventional or precision treatments. We assumed that corn had relative yields of 60, 73.5, 85, and 91% of the yield goal when grown in soil containing 1.5, 5.5, 9.5, and 13.5 μg P g $soil^{-1}$, respectively.

Amortization of sample collection and analysis costs were not conducted. Means, variances, and semivariograms of the whole field were calculated using Geo-eas 1.2.1 (Englund and Spark, 1991).

Results and Discussion

Precision management obviously infers higher expenses than conventional methods. The potential to recover the investment depends on the average soil test value and percentage of soil requiring more P than the fertilizer recommendation. Based on the soil test value, the Flandreau field required 17 lbs P_2O_5/ac, while the Beresford field required 0 lbs of P_2O_5/a. Approximately, 49 and 62 % of the acres in the Flandreau and Beresford fields required more fertilizer than the soil test recommendation (Table 1).

The total investment for precision management was similar for both fields (Table 2). These calculations assume that other precision farming tools (GPS and yield monitors) have not been purchased. The investment (not including K and N fertilizer) for the conventional treatment was much less than the precision treatment.

The yield increase due to precision management resulted from a 49 and 62% of the Flandreau and Beresford fields being P limited. The expected return from the P fertilizer was a function of value of the corn and the fertilizer cost (Table 3 and Fig. 1). As fertilizer costs decreased and corn value increased, precision farming profitability increased.

At Beresford, if the actual yield goal was 140 bu/ac, then the yield increase due to precision management was reduced from 11.76 bu/a to 10.24 bu/ac. Under these conditions if 10-34-0 was the fertilizer source then corn would have to sell for $1.81/bu to break even. If the Flandreau field yielded 140 bu/ac and 10-34-0 was the fertilizer source, then corn would have to sell for $2.94 to break even.

In summary, this project showed that precision farming techniques have the potential to increase agricultural profitability in South Dakota. However, the expected profitability was a function of corn value and fertilizer price. This report does not consider the impact of variable N application productivity, because the assumption was made that an adequate amount of N was applied to the field. This report points out the potential exists that yields can be increased by understanding P variability.

Table 1. Number of acres in each field contained in very low, low, medium, high, and very high soil test P categories.

Soil test Category	Flandreau	Beresford
	--------acres---------	
Very low	2.43	0.00
Low	16.53	15.70
Medium	42.15	31.40
High	23.97	11.57
Very high	40.50	36.36
Total acres	125.58	95.03
Field avg (ppm)	14	25

Table 2. Calculation demonstrating how precision fertilizer costs were calculated. These calculations assume that identical amounts of N are applied to all areas of the field and N does not limit yield.

Treat.	Yield goal	Ave lbs P_2O_5/ac	Cost 10-34-0 @0.35/lb	Cost 18-46-0 @0.28/lb	Sampling and fert. app. cost	N credit from 10-34-0 @0.25/lb	N credit from 18-46-0 @0.25/lb	Invest. 10-34	Invest 18-46
	bu/ac	-----------------	-----------------	-----------------	$/acre	-----------------	-----------------	-----------------	-----------------
Flandreau									
Precision	160	29.9	10.47	8.37	15.50	2.20	2.92	23.77	20.95
Conventional	160	17.0	5.95	4.76	5.00	1.22	1.66	9.73	8.10
Beresford									
Precision	160	29.0	10.15	8.12	15.50	2.13	2.84	23.52	20.78
Conventional	160	0.0	0.00	0.00	5.00	0.00	0.00	5.00	5.0

Table 3. Calculations demonstrating how profitability was calculated for the precision fertilizer treatment.

Treat.	P Potential source	Yield inc. due to prec. management	Net return corn $2.5/bu	Net invest. from Table 3	Profit
		bu/ac	--------------------------$/ac--------------------------------		
Flandreau					
Prec-con	10-34-0	5.39	13.48	14.04	- 0.56
Prec-con	18-46-0	5.39	13.48	12.85	+ 0.63
Beresford					
Prec-con	10-34-0	11.76	29.40	18.52	+10.88
Prec-con	18-46-0	11.76	29.40	15.78	+13.62

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LONG-TERM RESIDUAL PHOSPHORUS STUDY

Ron Gelderman and Jim Gerwing

Plant Science 9810

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 (Table 1) 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 as the split block were established. Two medium (M) soil test levels were established to compare placement (broadcast and 2 X 2) 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. Plot size is 15’ x 45’.

1994:
The annual broadcast rates (0, 20, 40, and 60 lb/ac P_20_5) were hand applied to one of the medium soil test blocks and chisel plow incorporated in the spring of 1994. The site was planted to DeKalb 554 at 25,600 seeds/ac on 10 May 1994. Identical annual P rates were applied to the other soil test blocks at planting with a fertilizer opener that placed the fertilizer 2 inches below and 2 inches to the side of the seed. The P fertilizer used for all treatments was 0-46-0. Five pounds of zinc/ac (as zinc sulfate) was applied with all annual treatments (including the zero rate). Ninety pounds of N (28-0-0) was knifed on all plots.

1995:
Soybeans (Marcus) were no-till planted in 30" rows at 180,000 seeds/ac on 19 May 1995. Annual band P rates for soybean were placed as for corn in 1994. Broadcast P rates were hand applied on the soil surface after planting. All P fertilizer was 0-46-0. No zinc was applied in 1995.

1996:
Corn (DK 512) was planted at 26,600 seeds/ac on 9 May 1996. Band and broadcast treatments were applied as in 1995. Nitrogen (28-0-0) was knifed on all plots at 120 lb N/ac on 19 June 1996. As in prior years, three of the center rows were harvested for grain with a plot combine on 24 October 1996.

1997:

Soybeans (DK 228) were planted with a 10' JD 750 no-till drill with 7.5" row spacing at 280,000 seeds/ac on 16 May 1997. Annual band P treatments were applied with the seed. Broadcast P rates were hand applied on the soil surface after planting. Phosphorus applied was 0-46-0. Plot size was 10' x 45'. The five foot fill area between plots was seeded with a no-till plot drill. Weed control consisted of Prowl and Pursuit as a preplant application. The entire 10' x 45' plot was harvested on Sept. 30,1997. As in prior years a grain sample was taken for P analysis.

1998:

Pioneer 34R06 corn was planted at 30,000 seeds/ac on May 1, 1998 with a plot planter. Band and broadcast treatments were applied as in 1995. Plot size is 10' X 45'.

Soil samples (1994-1998) were taken after harvest in 3-inch increments to a 9-inch depth from all zero rates in all soil test levels (Table 1) and all broadcast annual rate treatments (Table 2).

Results and Discussion

Phosphorus soil tests have stayed almost constant since the fall of 1994 on plot areas with lower soil test levels. However on the two high soil test levels, P tests have fallen since 1994 (Table 1).

Phosphorus soil tests appear to be increasing with annual broadcast applications above 20 lb/ac (Table 2). Increases in soil test even occur where P application is below the level of phosphorus removed by grain. For example at the 40 lb/ac rate, 160 lb P_2O_5 /ac (1994-1997) was added and 176 lb P_2O_5/ac removed. The reason for this is not clear although the plant may be translocating deeper soil P to the soil surface or more of the P may be in the form that is measured with the soil tests.

Annual rate of banded P increased corn yields similiarly at all soil test levels (Table 3 and Figure 1). Soil test level did not influence grain yields in 1998. However, there is a trend for increasing corn yields with soil test level at the zero annual P rate (8 bu/ac). The mean yields over all soil test levels would indicate the 40 lb/ac rate increased corn yields about 19 bu/ac over the check (Table 3, Figure 1).

Whether the phosphorus was row applied or broadcast applied did not influence corn yields (Figure 2). This result is surprising in that the broadcast P was applied to the soil surface after planting. This trend is also seen with the phosphate removed by grain as influenced by placement (Figure 4). Apparently plant roots under no-till are absorbing adequate P even with a broadcast surface placement.

Table 1. Phosphorus soil tests[1] and grain P removal during 1994-1997 from the long-term P study, SE Farm, Beresford SD. (Project no. 0698)

Soil Test level	--------- Olsen P -------------					--- P_2O_5 removal by grain -----				
	1994	1995	1996	1997	1998	1994	1995	1996	1997	Total
	-------------- ppm -----------					-------------- lb/ac-----------				
1	3	3	3	3	3	31	20	27	24	102
2	5	4	4	3	4	46	27	42	25	140
3	8	7	8	7	6	50	31	46	27	154
4	15	13	14	10	11	54	33	53	37	177

[1] Sampled in fall of each year from check plots (0-6") of each soil test level.

Table 2. Phosphorus soil tests[1] and grain P removal from broadcast rates of the long-term P study, SE Farm, Beresford SD. (Project no. 0698)

P_2O_5 rate	--------- Olsen P -------------					--- P_2O_5 removal by grain -----				
	1994	1995	1996	1997	1998	1994	1995	1996	1997	Total
lb/ac	-------------- ppm -----------					-------------- lb/ac -----------				
0	6	5	5	4	4	48	31	49	26	154
20	6	8	9	8	7	51	32	49	37	169
40	7	8	12	11	13	50	33	57	34	174
60	8	12	16	16	18	50	35	49	36	170

[1] Sampled in fall of each year from broadcast treatments (0-6") of each annual rate.

Table 3. Soybean yield as influenced by P soil test, annual P application rate and placement from the long-term P study during 1998 at SE Farm, Beresford SD. (Project no. 0698)

Soil test category[1]	---------------- annual P2O5 rates - lb/ac ------------------- 0	20	40	60	mean
	------------------------------ Yield, bu/ac ---------------------------------				
1 (band)	147	161	168	168	161
2 (band)	144	166	170	171	163
2 (bct.)	152	167	165	163	162
3 (band)	153	159	169	161	161
4 (band)	155	164	171	174	166
mean	150	163	169	167	

[1] 1,2,3,4,and 5 (Olsen P fall, of 1997) = 3 ppm (very low), 3 ppm (very low), 7 ppm (low) and 10 ppm (medium), respectively.

Pr >F: soil test level = 0.61 (NS); annual rate = 0.0076; soil test *rate = 0.47 (NS), Placement = 0.82 (NS). C.V.= 7.2%

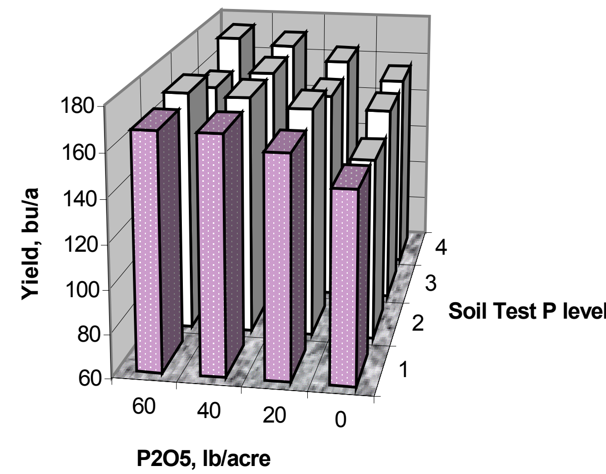

Figure 1. Influence of Soil P Test and fertilizer P on Corn Yield, SE Farm, 1998.

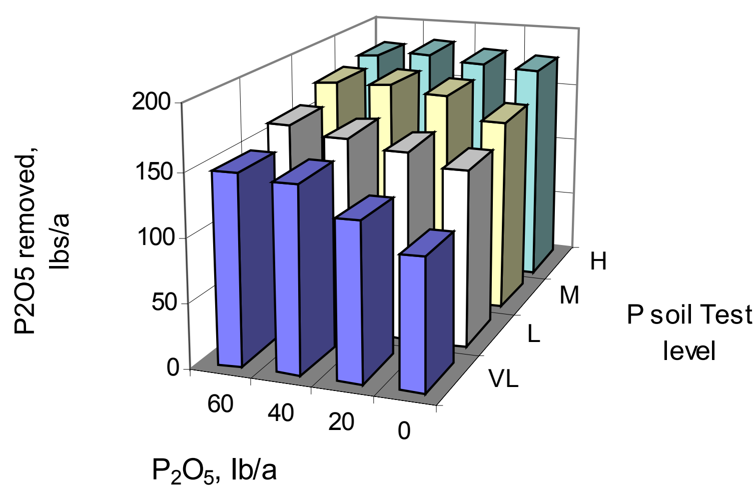

Figure 3. Influence of P soil test and rate of P on total grain P removal by crops for 1994-1998, SE Farm.

NITROGEN FOR CRP ACRES

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

Plant Science 9811

Introduction

By the year 2000 over 1.5 million acres of CRP could come back into crop production in South Dakota. Much of these acres are grass or grass/legume and typically are low in plant available nitrate-N. Tillage of these acres will result in the break down of organic residues into plant available nutrients. The objectives of this study are to evaluate the influence of tillage and added N on yields and soil nitrate levels after a grass sod.

Methods

The experiment site had been big bluestem (a warm season grass) for over 20 years. In later years the stand contained some cool season bluegrass. The grass was chiseled in the fall of 1995 then chiseled and disked in the spring of 1996 before planting.

1996:
The experiment was established with two tillage systems (tilled and no-till) and 6 rates of N (0, 30, 60, 90, 120, 150 lbs N/ac) in a split plot design. The tillage treatments were established in the fall of 1996. The treatments were replicated four times. Plot size was 15 feet by 40 feet. Pioneer hybrid 3556 was planted at 27,000 seeds/ac on May 7, 1996. Nitrogen was hand broadcast as ammonium nitrate just after corn emergence. Weed control consisted of Dual band applied with the planter and Buctril and Accent applied as a post emergence application. Considerable big bluestem plants emerged later in the season from the tilled sod; however, it was felt that yield reduction was minimal from this grass competition.

Two-foot soil samples were taken from the zero N plots at planting and 6-leaf growth stage. The zero and 150 lb N/ac rate plots were sampled at silk stage and all plots were sampled after harvest. Yields were taken by harvesting three of the center rows of the six-row plots on October 16, 1996. Phosphorus and K soil tests were considered very high. Organic matter was 3.5 to 4.0% and pH was 5.9. Yields and soil tests from 1996 are reported in the 1996 SE Farm Annual Report (36th Annual Progress Report 9609 p 43-44).

1997:
The tillage treatments were applied with a chisel and disk operation in the fall of 1996. A light disking was also done in the spring of 1997. Soybean variety Dekalb CX222RR (Roundup resistant) was planted with a 10' JD 750 no-till drill with 7.5" row spacing at 280,000 seeds/ac on May 14, 1997. Weed control consisted of Prowl and Pursuit as a preplant application and two post plant applications of Roundup to control the warm-season big bluestem grass. Grain yields were taken by harvesting 12 feet of the entire plot length with a plot combine. Yields and soil tests from 1997 are reported in the 1997 SE

Farm Annual Report (37th Annual Progress Report, 9709 p 48-49).

1998:

The tillage treatments were applied with a chisel in the fall of 1997 and a light discing in the spring of 1998. Nitrogen treatments were reapplied as in 1996. Corn (Dekalb 566RR) was planted on April 24, 1998 at 26,900 seeds/ac. One quart of Roundup was applied on May 28 for weed control. Grain yields were taken by harvesting three of the center rows of the six-row plots on September 23, 1998. Two-foot soil samples were taken after harvest from all treatments. Plant leaf samples were taken at initial silk.

Results & Discussion

Soil nitrate-N levels after harvest of soybeans in 1997 were 39, 39, 35 and 35 lb/ac for 2-foot depth for the no-till 0, no-till 150, till 0 and till 150 lb N/ac rate treatments, respectively. After harvest nitrate-N levels for 1998 were low (Table 1). A slight increase in residual N levels are seen with increasing N rate. Most of the applied N was probably taken up by the corn or immobilized by soil microbes.

Corn yields in 1998 were very good (Table 1 and Figure 1). There was a significant increase in yield to added nitrogen. Maximum yield was reached at about 60 lb/ac of nitrogen in the tilled plots whereas about 90 lb/ac N was required for the no-till plots. The “extra” 30 lbs of N for no-till has been noted in other research and is part of the SDSU Soil Testing Lab nitrogen recommendation for corn grown under very limited tillage. Apparently less net mineralization (more immobilization) is occuring with no-till. This makes sense in that we have less physical disturbance of the soil and less oxygen being incorporated for the breakdown of organic matter to occur.

However, total mineralization for both till and no-till treatments must have been quite large in 1998. There was 123 bu/ac of corn produced where no nitrogen was applied. Recommended N rates for 165 bu corn would have been about 125 lb/ac of N. It is assumed that this nitrogen is being supplied by the decomposition of the sod residue from the long-term grass grown on this area before 1996.

Although only 60 lb/ac of N was required in the tilled treatment, there was no large buildup of nitrate-N occuring for the larger N treatments (Table 1). Therefore, immobilization of any unused nitrogen must be occuring since leaching or other losses were probably minimal for 1998.

Conclusions:

Fertilizer nitrogen needs for the second corn crop after the third year out of grass were smaller than expected. Up to 60 lb/ac of N less than recommended may be needed for conventional tillage of former CRP areas under conventional tillage. For very reduced systems, 30 lb/ac N less than recommended levels may be needed.

Table 1. Soil nitrate-N and Corn yields as influenced by N rate and tillage, SE Farm, 1998 (project no. 25198).

Treatment	N rate					
	0	30	60	90	120	150
	nitrate-N lb/ac -2'					
Soil[1] - till	20	19	27	26	33	30
Soil[1] - no-till	17	18	27	22	33	40
	yield, bu/ac					
yield - till	123	154	168	168	163	171
yield - no-till	108	142	148	165	174	168

[1] Soil sampled after harvest in 1998.

Yield statistics, Pr>F: Rate 0.0001; tillage 0.096; rate x tillage 0.095. CV=6.7 %.

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

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

Plant Science 9812

Introduction

Some farmers in South Dakota are using phosphorus, potassium, sulfur, zinc and 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. The SDSU Soil Testing Lab, therefore, does not recommend nutrients be applied as fertilizer or lime unless soil test levels are lower. The studies reported on 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 SE Experiment 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. Corn was the 1998 crop.

The soil at the SE 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 elemental sulfur), 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) in 1997 and 1998. 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 once (the establishment year) at the SE Farm location and twice (1990 & 1992) at Brookings. All plots received nitrogen as urea for a 145 bu/ac yield goal using the 2 foot nitrate soil test and soybean credit. The nitrogen rate was 110 lb/a at Beresford and 95 lb/ac at Brookings. All fertilizer materials were broadcast and followed by either discing 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.

Adapted corn hybrids were planted the last week of April at both locations. Harvest was done with a field combine at Beresford and a small plot combine at Brookings.

Results and Discussion

Soil test results from soil samples taken in the fall of 1997 are presented in Table 2. Potassium soil tests were very high at both sites although just into the very high range (>160 ppm) at Brookings. Adding 50 lb of K_2O per year since 1988 at Beresford and 1990 at Brookings raised the K soil test by 55 and 20 ppm respectively.

The sulfur soil test in the check plots was low at both sites and sulfur would have been recommended on a trial basis. Adding 25 lb sulfur each year raised the soil test to 50 lb per acre at Beresford and 38 lb per acre at Brookings, a very high and high test respectively.

The zinc soil test in the check was high at Beresford (0.84 ppm) and very high (1.11) at Brookings. No zinc would have been recommended. Applying 5 lb zinc each year raised the soil test to 8.15 and 5.35 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 5.9 and limed pH 6.4. At Brookings the check pH was 6.3 and limed pH 7.1. The SDSU Soil Testing Lab would not have recommended lime at either site.

The phosphorus soil test level at the Brookings site was 16 ppm prior the phosphorus applications and no phosphorus would have been recommended. The 40 lb annual phosphorus application raised the Olson soil test level to 30 ppm. There was no phosphorus treatment at Beresford.

The 2 lb boron treatment started at Beresford in 1997 raised the boron soil test from 0.86 ppm to 1.42 ppm after one application. The check soil test was in the high range (>0.50 ppm) and no boron would have been recommended.

Corn grain yields and moisture content at harvest from Beresford are given in Table 3. Excellent growing season moisture and temperatures resulted in yields up to 187 bu per acre despite slow growth in May. Even though May growing conditions appeared normal, corn remained pale with some interveinal yellowing until the 7 or 8 leaf stage. The only exception was the sulfur treatment, which remained green and was taller during this period. This early season yellowing was apparently due to sulfur deficiency. However, the increased early growth and better color in the sulfur treatments did not result in a significant yield increase although grain moisture at harvest was lower (Table 3).

The potassium and zinc treatments did result in significant yield increases even though soil test levels were in the high range for zinc and very high for potassium. This was the first year since this study was started in 1988 that these treatments resulted in significant yield increases. These responses are consistent with past research which indicates responses are possible with high testing soil but the probability of them occurring is low.

Boron and lime at this location had no effect on yield.

Corn grain yields and moisture from the Brookings site are given in Table 4. Dry conditions during the growing season affected yield but it still averaged 110 bu/ac across all treatments. None of the treatments influenced yields significantly which is consistent with previous studies and current fertilizer recommendations made by SDSU.

Yield results and soil test levels from previous years for these two studies can be found in the SE Farm Progress Reports (1988-1997) and in the 1988-97 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, 1998.

	Fertilizer Rates	
Treatment	Beresford[1]	Brookings[2]
	- - - - - - - - lb/ac - - - - - - - -	
	0	0
	-----	40
	50	50
	25	25
	5	5
	2	-----
	-----[3]	-----[4]

[1] Applied each spring, 1988-1998 except boron applied only in 1997 and 1998.
[2] Applied each spring, 1990-1997.
[3] 4000 lb $CaCO_3$ equivalent applied spring 1988.
[4] 2500 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 Level			
	Beresford[1]		Brookings[2]	
Soil Test	Check	Treatment	Check	Treatment
Potassium, ppm	245	301	174	194
Sulfur, lb/ac, 0 - 6 in	6	20	4	8
lb/ac, 6 - 24 in	12	30	12	30
Zinc, ppm	0.84	8.15	1.11	5.35
pH	5.9	6.4	6.3	7.1
Olson Phosphorus, ppm	8	-----	14	30
Boron, ppm	0.86	1.42	-----	-----
NO_3-N, lb/ac 2 ft	35	-----	49	-----
Organic Matter, %	3.2	-----	3.1	-----
Salts, mmho/cm	0.3	-----	0.03	-----

[1] Sampled 10/30/97
[2] Sampled 10/28/97

Table 3. Fertilizer Effects on Corn Yield, Beresford, 1998.

Fertilizer Treatment	Yield	Moisture
	bu/ac	%
Check	163 a	17.7 a
Potassium	182 b	18.9 b
Sulfur	169 a c	15.8 c
Zinc	187 b	17.9 a
Boron	164 a	17.7 a
Lime	168 a	17.3 a
Prob of > F	0.001	0.0001
C.V. %	5.3	3.4
LSD $_{(0.05)}$	14	0.36

Table 4. Fertilizer Effects on Corn Yield, Brookings, 1998.

Fertilizer Treatment	Yield	Moisture
	bu/ac	%
Check	112 a	20.0 a b
Phosphorus	114 a	19.3 b
Potassium	106 a	20.6 a
Sulfur	106 a	19.7 a b
Zinc	109 a	19.9 a b
Lime	111 a	19.6 a b
Prob of > F	0.44	0.44
C.V. %	5.6	4.4
LSD $_{(0.05)}$	NS	0.77

NITROGEN MANAGEMENT IN A CORN SOYBEAN ROTATION

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

Plant Science 9813

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 than 10 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. 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, NO_3 - N 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 SE South Dakota Experiment 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 from 1988 to 1998 and soybean was planted in the odd numbered years, 1989 to 1997. The rates and timing of nitrogen fertilizer applied to the corn in 1998 are listed in Table 1. The treatments included a check (no N), the recommended rate applied in fall, spring or split between spring and 7-leaf stage and 200 and 400 lb/ac 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, however was adjusted according to the NO_3 - N soil test level and for credit given to the previous years' soybeans (1 lb N credit for 1 bushel beans). The recommended nitrogen rates were 123, 62, 90, 95, 95 and 110 lb/ac respectively for 1988, 1990, 1992, 1994, 1996, and 1998. Nitrogen was broadcast as urea and immediately incorporated by tillage except for the fall application which was not incorporated until the following spring.

Phosphorus, potassium and pH soil test levels at the site are 8 and 245 ppm and 5.9, respectively. A randomized complete block design was used on this experiment with four replications. Plot size was 15 feet by 65 feet.

Corn was planted on April 23, 1998. The site had been disked just prior to planting. Plots were harvested with a field combine. Soil samples were taken to a depth of 6 feet in 1-foot increments on Oct. 27, 1997. Four cores were taken per plot and replicates combined for nitrate analysis. Only the 0, spring recommended (110 lb), 200 and 400 lb/ac N treatments were soil sampled.

Results and Discussion

Nitrate soil test results from samples taken in the fall of 1997 and 1998 are given in Table 2. The recommended rate of nitrogen had 32 lb/ac nitrate in the top two feet after corn in 1998 and only 43 lb/ac total in the 4-foot profile. That was only 18 lb/ac more than the 0 N rate indicating no appreciable accumulations of N in soil with the recommended nitrogen rate. The 200 lb/ac rate, however, had residual nitrate of 119 lb/ac in the top two feet, indicating this rate was significantly higher than required by corn. The 400 lb/ac N rate residual 2 foot soil test was 308 lb/ac.

Soil tests from the 2 to 3 foot depths were 10 and 35 lb/ac foot for the 200 and 400 lb/ac rates, respectively. These relatively low levels compared to the 0 to 2 foot depths in these plots indicates little if any leaching below 2 feet occurred in the 1998 growing season. The year had a total rainfall of 25.3 inches (Table 3) which in combination with high corn yields did not supply enough water to move nitrate below 2 feet.
Favorable growing conditions resulted in corn yields of over 165 bu/ac or higher for the 110 lb N/ac spring, 110 lb N/ac split, and 200 and 400 spring applied N plots (Table 4). These four treatment yields were not significantly different indicating that the 110 lb/ac recommended rate was adequate to reach maximum yield. Although the split applied treatment had the highest yield of all treatments, it was not significantly higher than the spring applied N, giving further evidence along with the nitrate soil tests, that losses of N by leaching did not occur this year.

The fall applied urea N, which was not incorporated until spring, resulted in lower corn yield (154 bu/ac) than the split applied N (174 bu/ac). This reduction in yield may have been due to volatilization loss of some of the fall applied N since it was not incorporated and rainfall was minimal. The total precipitation for November, December, January and February was only 0.8 inches. The corn losses this year were likely small since the yield increase due to the fall N was still 53 bu/ac. Under cool conditions of late fall and winter, volatilization of N losses are usually minimal.

These plots will be rotated back to soybeans in 1999 and soil sampled in the fall to determine the amount and location of residual soil nitrate. Corn and soybean yields and soil tests from previous years of this study can be found in the SE Farm Progress Reports and in the Plant Science Department Soil/Water Science Research Annual Reports, 1988 to 1997.

Table 1. Nitrogen Fetilizer Treatments, Nitrogen Fertilizer Management Study, Beresford, SD, 1998.

Treatment	Time of Application		
	Spring[1]	Split[2]	Fall[3]
No.	- - - - - - - - - - lb N/ac - - - - - - - - - - -		
1	0	---	---
2	110	---	---
3	30	80	---
4	---	---	110
5	200	---	---
6	400	---	---

[1] April 23, 1998

[2] June 6, 1998

[3] November 5, 1997

Table 2. Fall Nitrate Soil Test Levels, Nitrogen Management Study, Beresford, SD.

	Fertilizer N Applied, lb/ac; (even years 1988 - 1998)							
	------ 0 -------		Recommended[1]		- - - - 200 - - - -		- -- - - 400 - - - -	
Depth	1997	1998	1997	1998	1997	1998	1997	1998
feet	- - - - - - - - - - - - - - - - - Soil NO_3 - N, lb/ac[2] - - - - - - - - - - - - - - - - -							
0-1	26	13	9	21	16	80	16	198
1-2	14	5	13	11	10	39	10	110
2-3	7	4	7	4	6	10	10	35
3-4	6	3	6	7	8	14	26	22
4-5	5	7	7	14	12	18	38	27
5-6	6	7	7	10	17	18	48	35

[1] Rates applied were 123, 62, 90, 95, 95 and 110 lb N/ac in spring of 1988, 1990, 1992, 1994, 1996 and 1998 respectively.
[2] Soil sampling dates: Oct. 30, 1997, Oct. 27, 1998

Table 3. Rainfall at the SE Experiment Farm, Beresford, Nov. 1, 1997 to Oct. 31, 1998.

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct
- -- inches -											
0.2	0.1	0.2	0.3	2.9	4.1	5.8	4.6	2.4	2.1	0.1	2.5

Table 4. Nitrogen Management Study Corn Yields, SE Experiment Farm, Beresford, 1998.

Treatment		
Time	N rate	Corn Yield
	lb/ac	bu/ac
Check	0	103 a
Fall[1]	110	154 b
Spring[2]	110	165 b c
Split[3]	110	174 c
Spring	200	173 c
Spring	400	167 b c
Pr > F		0.0001
CV%		6.6
LSD $_{(0.05)}$		15

[1] Fall = 11/8/97

[2] Spring = 5/1/98

[3] Split = 30 lb 5/1/98, 80 lb 6/9/98

PHOSPHORUS RATE AND PLACEMENT EFFECTS ON TILLED CORN AND SOYBEAN ROTATION

Ron Gelderman, Jim Gerwing, Bob Berg, and Anthony Bly

Plant Science 9814

Introduction

Phosphorus (P) fertilizer placement questions are still a concern. Is row placement of P more effective than broadcast for corn and soybean under a tilled environment? Will fertilizing only the corn in the rotation influence soil tests and influence yields? Because of these concerns, a long-term experiment was established south of the office building at the Southeast Experiment Farm. Objectives are to determine the long-term effect of P management practices on yield and soil test level in a tilled corn-soybean rotation.

Methods

Egan silty clay loam is the predominant soil of the study location. The study is separated into two parts by another experiment (210' apart). The west side has soybean in odd years and the east side has corn in odd years as a corn-soybean rotation. Treatments and locations are given in Table 1. The west side is smaller in area and only four treatments could be established compared to six on the east side. The treatment numbers 1,2,4 and 5 on the east side are identical to treatment numbers 7,8,9 and 10 on the west side.

The row placement treatments for corn are 10-34-0 placed directly with the seed. The 30 lb/ac P_2O_5 rate of this material will supply 9 lb/ac of N. Broadcast placements received 11-52-0 as a P source. Nitrogen was not balanced for these treatments. Any response is considered a starter response. Broadcast treatments were applied and disk incorporated prior to planting. Plot size for all plots was 15 x 50' with 30" row spacing.

For 30-inch row soybean, 7.6 gallons/ac of 10-34-0 (30 lb/ac P_2O_5) could harm germination. Therefore for the starter treatments on soybean, only 2 gallons/ac of 10-34-0 was applied in the row. The remainder of the P was broadcast applied after planting as 0-46-0. This was done to apply the total amount of P but yet apply enough in the row for a starter response.

The west side was planted to Pioneer 34R06 corn on April 24, 1998. The recommended N rate was surface sidedressed as ammonium nitrate on all corn plots. Weed control consisted of Clarity and Atrazine applied pre-plant. Corn grain yield was estimated by harvesting the center three of six rows with a field combine on September 24, 1998.

Pioneer 9172 soybeans were planted on the east side at 173,000 seeds/ac on May 19, 1998. Broadstrike/Dual was preplant applied and Poast was post applied to control weeds.

Results and Discussion

Soil P analysis from the broadcast treatment following corn in 1998 shows 5, 6 and 8 ppm Olsen P from the 0-3" depths in the check, 30 and 60 lb/ac broadcast rates, respectively. After one year of applying these rates, some soil test differences already exist.

There was a trend for P fertilizer, either row or broadcast to increase grain yield by 2 to 4 bushels per acre (Table 1). Corn was not significantly influenced by starter treatment for 1998 (Table 1). However, there was a 13 bushel increase from row application vs. the check and a 6-7 bushel increase from the starter over broadcast applications. Height measurements of corn showed significantly taller plants grown with 30 lb/ac P_2O_5 with the row or 60 lb/ac residual P_2O_5 as compared to the check.

Conclusion

Under tilled conditions, soybean responded to phosphorus in 1998, whereas, corn did not

Treatment	1998	Side of	P_2O_5	P	Crop	Plant	Grain
			lb/ac			inches	bu/ac
1	soybean	East	0	--	--	--	50 bc
2	soybean	East	30	Row	C	--	48 c
3	soybean	East	30	Row	C+S	--	54 a
4	soybean	East	30	Bct[2]	C	--	51 abc
5	soybean	East	60	Bct	C	--	53 ab
6	soybean	East	30	Bct	C+S	--	52 ab
7	Corn	West	0	--	--	70	166 a
8	Corn	West	30	Row	C	77	179 a
9	Corn	West	30	Bct	C	74	172 a
10	corn	West	60	bct	C	77	171 a

[1]C = corn, S= soybean
[2] Bct = broadcast
Yield Statistics Soybean: (Pr>F) all treatments = 0.04, CV = 4.4%
Corn: all treatments = 0.33 (NS), Row vs Bct = 0.23 (NS), CV = 5

INFLUENCE OF P SOIL TEST LEVEL, ROW SPACING, AND TILLAGE METHOD ON GROWTH AND GRAIN YIELD OF SOYBEAN VARIETIES

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Plant Science 9815

Introduction

Management of soybean production in South Dakota includes many different types of tillage systems, row spacing and variety/maturity group selections. Using different management practices might influence early soybean growth and grain yield. The objective of this experiment is to measure early plant growth and grain yield response of nine soybean varieties as influenced by P soil test level, row spacing, and tillage.

Materials and Methods

This field experiment has been conducted on the northeast quarter section of the Southeast Research Farm for four years. The soil type is predominately the Egan silty clay loam. In 1995 the tillage treatments (tilled and no-till), and crop rotation (corn/soybean), were established.

Fertilizer P applications to this site have totaled 175 lbs P_2O_5/ac. The first application (100 lbs P_2O_5/ac) was made in 1996 prior to planting soybean plots as spoke injected 10-34-0. The second application (75 lbs P_2O_5/ac) was band applied perpendicular to plot rows in 7 inch spacing prior to planting in 1998. No application of P was made in 1997 when corn was grown. Certain plots were tilled twice with a disk and field cultivated prior to planting. Soil sample cores (0-6 inch) were randomly selected and composited from each replication P treatment prior to this year's P fertilizer application and planting.

On May 29, three soybean varieties from each of three maturity groups (0, I, II) were planted at a rate of 200,000 pure live seeds/ac into tilled and un-tilled corn stalks with the same grain seeding drill. The varieties and maturity groups can be found in Table 3. Tillage treatments (no-till and disc/field cultivator), P application (0 and cumulative 175 lbs P_2O_5/ac), and row spacing (7,14, and 28 inch) were randomized as a strip/split block design within 4 replications. All variety plots measured 5' x 42.5'.

Weed control consisted of Roundup-Ultra for weed burndown on May 14 at 2 pts/ac, and 2.5 pts/ac Broadstrike/Dual applied immediately after planting. Volunteer corn was a problem in the conventional tillage treatment. However both tillage treatments were sprayed on June 25 with 7 oz/ac Select. Waterhemp weeds were also rouged out due to escape from herbicide application. Soil samples were also taken after harvest.

Early bloom plant samples were taken from a 2' x 5' section of each treatment plot on July 13 from maturity group 0 varieties and July 20 and 21 from maturity groups I and II. Samples were dried and weighed to determine dry matter weight. Grain from each plot was harvested with a small plot combine on Oct. 8 and 9. Treatments were compared using analysis of variance (ANOVA) and least significant difference (LSD) statistics by using SAS, a statistical analysis software computer program.

Results and Discussion

Soil sample results indicate differences in Olsen P levels between the check and P treated plots at both sampling dates (Table 1). Soil Test P from plots with applied P increased from spring to fall reflecting the P application made after spring sampling.

Two separate ANOVA were used to determine what sources of variation (SOV) had significant probabilities of a greater F value for early bloom (EB) dry weight and grain yield. The first ANOVA used variety as a SOV, in the second ANOVA maturity group was substituted for variety. All other SOV remained the same between the two separate ANOVA. ANOVA indicated that variety, row spacing, P treatment, and maturity group had significant F values for EB dry weight samples and grain yield (Table 2). Some interaction SOV were significant for EB dry weight samples and less for yield. Interaction SOV will not be discussed in this report.

The EB dry weight is highest with group II varieties, narrower row spacing, and P treated plots (Table 3). Grain yields are highest with maturity group II varieties, narrow row spacing and P treated plots (Table 3). The EB dry weight and grain yield responded similarly. A response to P application would be expected since check plot soil test P is considered to be in the low category.

Further work on measured variables are expected in the future, these include P uptake in the plant, grain protein, and oil.

Conclusions

- Residual P increased soil test levels of both sampling times.

- Variety, row spacing, P treatment and maturity group were significant sources of variation from ANOVA.

-Definite increased EB dry weight and grain yield trends were measured. These were higher with later maturity group varieties, narrower row spacing, and applied P.

Table 1. Soil sample analysis comparing the effect of fertilized P applications at the Southeast Research Farm near Beresford SD; 1998 (Project 17198).

	Time of Sampling			
	Spring[A]		Fall[B]	
Replication	Check	P applied	Check	P applied
	--------------------------Olsen P, (ppm)----------------------------			
1	10.8	19.8	9.4	28.8
2	6.8	15.3	5.8	16.2
3	9.5	18.8	7.6	31.3
4	6.4	10.6	6.6	13.9
Mean	8.4	16.1	7.4	22.6

[A] Sampled before fertilizer application in 1998, random composite cores (0-6 inch) from each replication P treatment and tilled block.

[B] Sampled after 1998 harvest, random composite cores (0-6 inch) from each replication P treatment and tilled block.

- 100 lbs P_2O_5/ac applied in May 1996 (spoke injected, 8.5" spacing)
- 75 lbs P_2O_5/ac applied in May 1998 (band applied, 7" spacings)
- Soybeans grown in 1996 and 1998, corn in 1997.

Table 2. ANOVA of main effects and interaction for either all nine varieties considered (ANOVA 1) or for varieties considered as maturity groups (ANOVA 2) as a source of variation (SOV) for early bloom (EB) dry matter weight and grain yield for the soybean study at the Southeast Research Farm near Beresford SD during 1998. (project no. 17198)

ANOVA 1		
	Dependant Variable	
	Early Bloom dry matter (g/10ft^2)	Grain Yield (bu/ac)
SOV	Pr > F	
Variety (V)	0.0001 **	0.0001 **
Tillage (T)	0.2412	0.0999
Row Spacing (S)	0.0002 **	0.0133 *
P treatment (P)	0.0128 *	0.0067 **
V x T	0.5103	0.0380 *
V x S	0.0016 **	0.2352
V x P	0.2885	0.7347
T x S	0.9340	0.3804
T x P	0.0082 **	0.6189
S x P	0.5609	0.8313
V x T x S	0.3593	0.0492 *
V x T x P	0.0164 *	0.0629
T x S x P	0.0377 *	0.3177
V x S x P	0.7618	0.1828
V x T x S x P	0.1254	0.0596
ANOVA 2		
Maturity Group (M)	0.0001 **	0.0944
Tillage (T)	0.2412	0.0999
Row Spacing (S)	0.0002 **	0.0133 **
P treatment (P)	0.0128 *	0.0067 *
M x T	0.4246	0.1562
M x S	0.0432 *	0.5521
M x P	0.9186	0.8810
T x S	0.9340	0.3804
T x P	0.0082 **	0.6189
S x P	0.5609	0.8313
M x T x S	0.2536	0.6921
M x T x P	0.0050 **	0.4383
T x S x P	0.0377 *	0.3177
M x S x P	0.5326	0.1685
M x T x S x P	0.6931	0.4896

** highly significant (Pr >F is less than 0.01)
* significant (Pr>F is less than 0.05)

Table 3. Treatment means of significant sources of variation (SOV) for early bloom (EB) dry matter and grain yield for a soybean study at the Southeast Reasearch Farm near Beresford SD during 1998 (project 17198).

SOV		Dependant Variable: Early Bloom dry matter[A]	Dependant Variable: Grain Yield
Variety (Maturity group)		$g/10\ ft^2$	bu/ac
Glacier	0	70.2a	40.6a
Dassel	0	97.4b	49.1bc
LOL L0727	0	93.4b	49.4bc
BSR 101	I	145.6c	47.1b
Granite	I	144.6c	47.5b
Hardin 91	I	169.7cd	49.1bc
Kenwood 94	II	170.5d	49.9bc
Marcus 95	II	162.7c	48.4b
IA 2021R	II	189.8e	51.6c
LSD $_{(.05)}$		7.3	3.2
Row Spacing (inches)			
7		153.6a	49.5a
14		144.7a	48.7a
28		116.3b	46.0b
LSD $_{(.05)}$		9.3	2.1
Maturity Group			
0		87.0a	46.4
I		153.3b	47.9
II		174.3c	50.0
LSD $_{(.05)}$		4.9	NS
P treatment			
No P applied		131.4	47.0
P applied (175 lbs P_2O_5/ac/4 years)		145.0	49.2
LSD $_{(.05)}$		8.1	1.1

[A] early bloom dry matter samples taken at beginning flowering stage from a 2' x 5' section of each plot.

- means within an SOV with similar lower-case letter are not significantly different.

SOYBEAN CYST NEMATODE STUDIES, 1998

James D. Smolik

Plant Science 9816

Objectives

Continue the survey for soybean cyst nematode (SCN) in eastern South Dakota.
Determine effect of SCN on yield of soybean.
Determine effect of crop rotation on SCN populations.

Results

Survey: Approximately 900 soil samples from eastern South Dakota were processed for SCN. The nematode was detected in an additional five counties in 1998 (Brown, Deuel, Minnehaha, Roberts and Yankton), bringing the total number of infested counties in South Dakota to fourteen. The current distribution of SCN in South Dakota and the year in which the infestation was detected are shown in Figure 1.

Figure 1. **Distribution of SCN in Eastern South Dakota**

Small Plot Tests: Several small plot experiments were established in a cooperator's field in Turner County. Soil in this field was a silty clay loam, and approximately 22 inches of rain was recorded from April through September. All of the row crops in these studies were planted in 30 inch rows. This field had a lengthy history of continuous soybean production and SCN populations were high. Test I was conducted in cooperation with Roy Scott (SDSU soybean breeder) and measured yield of various public, private and experimental soybean lines. Reproduction of SCN on the various lines was also determined.

Yield of the resistant (R) lines was 15 to 27% greater than the average yield of the susceptible (S) lines (Table 1). Also, populations of SCN were substantially reduced in plots planted to resistant varieties. The soybean lines included in this test were also planted at the SE Farm, where SCN has not been detected. It is noteworthy that three of the four top yielding lines in the Turner County test were among the top yielding varieties at the SE Farm (Table 1). This suggests that these SCN-resistant lines are likely to yield well in both SCN-infested and non-infested environments. A second small plot test was also conducted in the cooperator's field in Turner County. This test included only public and private lines. Yield of the resistant lines was 12 to 47% greater than the average yield of the susceptible lines (Table 2). Populations of SCN declined substantially on all of the resistant varieties. A third test in the Turner County field was designed to measure the effects of crop rotation on SCN populations. This study also included an interseeding component. At corn planting a set of treatments was established to measure the effect of interseeding corn with a resistant (P9234) or susceptible (P9245) soybean variety. The soybeans were planted between the corn rows immediately after corn was planted, and were removed 6 weeks after planting by cultivating. Previous studies have indicated that SCN populations decline more rapidly when a resistant soybean variety is planted than when a non-host (such as corn) is planted. These interseeding treatments were an attempt to enhance the decline in SCN populations in a non-host crop.

The yield of the resistant soybean variety was significantly higher than the susceptible variety (Table 3). There were no significant differences in corn yields. The greatest reduction (93%) in SCN populations occurred in plots planted to the resistant soybean variety (Table 3). Populations of SCN increased on the susceptible variety, and declined by approximately 40% to 60% in the remaining crops. There did not appear to be any substantial benefit to interseeding corn with soybean relative to reductions in SCN populations.

Field scale strip test: A replicated strip test was established in a producer's center-pivot irrigated field in Turner County. Soil in the study area was a sandy loam. This area of the field was planted to soybean in 1996 and corn in 1997. Individual plots in this test were six rows wide and approximately 400 yards long. There was no significant difference in yield between the resistant and susceptible varieties (Table 4). The population of SCN was only in the moderate range at planting, but increased to a very high level on the susceptible variety during the growing season. Populations of SCN declined substantially on the resistant varieties. The absence of yield differences between the resistant and susceptible varieties was likely due to several factors. As mentioned, the study was conducted in an irrigated field and an additional 22 + inches of rain was received throughout the growing season. Fertility in the test area was very good and weed control was excellent. Therefore, the plants were under very little stress, and soybean yields were not reduced by the moderate SCN population. It should be noted that it was not a mistake to plant this field with a resistant variety. If the field had been planted with a susceptible variety the SCN populations would have increased to very high levels (Table 4) and SCN populations at this level would cause severe damage to a subsequent susceptible soybean crop.

Yield map and SCN populations: The west half of the center pivot irrigated field was planted with a SCN susceptible variety. Corn had been planted in this half of the field for each of the previous three years. This field had not been extensively sampled for SCN, but limited sampling in 1996 indicated SCN was present in the northwest corner. Samples collected from the eastern edge of the field had very few or no SCN. About mid-August symptoms typical of SCN damage (stunted, yellow plants) began to appear in the field, especially in the southwest portion. A yield map of the field revealed several "pockets" of low to very low yielding areas. Soil samples were collected from these pockets as well as from higher yielding areas, and SCN populations were measured. In general, there was a good correlation between low yielding areas and high SCN populations (Figure 2). The lowest yields occurred in the extreme southwest corner of the field. This area was the only portion of the field that was not irrigated, and in spite of the above average rainfall SCN damage in this area of the field was severe. Note also the patchy distribution of SCN. This type of distribution has been quite typical of the well established SCN infestations we have encountered in our surveys. Although SCN damage was very obvious in this field for much of the growing season, yield maps such as these may be useful in the detection of earlier stages of an SCN infestation.

Acknowledgements I thank Joe Schumacher for his assistance in the preparation of the yield map. This research was supported in part by a grant from the South Dakota Soybean Research and Promotion Council.

Table 1. Soybean Yields and SCN Populations in Test I, Turner County and yields of tested lines at SE Farm, Beresford.

Entry	Response to SCN	Yield Bu/ac	#SCN eggs+J-2 per 100 cm^3 soil at harvest[\b]	Yield Bu/Ac SEFarm (Beresford)
Dekalb CX160C	R	54.4[\a]	667	62.7
IA 2036	R	50.1	600	53.4
SD94-495	R	49.7	933	60.8
SD93-522L	R	49.4	683	60.3
SDK96-349	MS	46.7	2566	53.8
SDK96-316	MS	46.7	2117	55.1
SDK96-332	MS	45.9	2633	55.2
SDK93-522E	R	45.6	1350	56.8
SDK96-340	MS	45.6	3183	56.2
Sturdy	S	44.2	9200	59.8
Parker	S	43.1	5550	63.8
Pioneer 9245	S	40.8	5150	50.8
Flsd $_{(0.05)}$		5.9		4.9

[a/] Average of 3 replications.
[b/] Population of SCN at planting was 4200 eggs+J-2 per 100cm^3 soil.

Table 2. Soybean yield and SCN populations in Test II, Turner County, SD; 1998.

Entry	Response to SCN	Yield Bu/ac	# SCN eggs+J-2 per 100 cm^3 soil at harvest[\b]
Pioneer 9234	R	53.0[\a]	150
Pioneer 92B91	R	52.8	17
DeKalb CX160c	R	48.6	117
DSR 296N	R	43.3	133
G.L. 2912	R	40.4	133
Terra	S	37.3	5617
Sturdy	S	36.8	3167
Pioneer 9245	S	34.3	3350
Flsd $_{(0.05)}$		6.2	

[a\] Average of 3 replications.
[b\] Population of SCN at planting was 3200 eggs+J-2/100cm^3 soil.

Table 3. Effect of crop rotation on SCN populations, Turner County, SD, 1998.

Crop	Yield Bu/ac	#SCN eggs+J-2 /100 cm^3 soil-post harvest[b]
Soybean - Pioneer 9234	46.4[a]	210
Soybean - Pioneer 9245	36.3	4110
Corn - I	170.8	1920
Corn - II	173.2	1900
Corn - interseeded with a susceptible soybean variety	168.6	1270
Corn - interseeded with a resistant soybean variety	169.8	1270
Alfalfa	--	1880
lsd $_{(0.05)}$		1920

[a/] Average of 3 replications.
[b/] Population of SCN at planting was 3130 eggs+J-2 per 100 cm^3 soil.

Table 4. Soybean yields and SCN populations in irrigated strip test, Turner County.

Entry[a]	Response to SCN	Yield Bu/ac	#SCN eggs+J-2 per 100 cm^3 soil at harvest[b]
Pioneer 9233	S	52.3[a]	7467
DeKalb CX235c	R	52.1	350
Pioneer 9234	R	49.7	233
Pioneer 92B91	R	48.5	150
Flsd $_{(0.05)}$		N.S.	

[a\] Average of 3 replications.
[b\] Population of SCN at planting was 862 eggs+J-2/100 cm^3 soil..

PERFORMANCE OF BT-CORN HYBRIDS EXPOSED TO BIVOLTINE CORN BORERS

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Plant Science 9817

INTRODUCTION

Bt-corn is a transgenic plant that contains a modified gene from the soil bacterium, *Bacillus thuringiensis*. This gene enables the corn plant to synthesize proteins that are toxic when fed upon by corn borer larvae. When a grower plants Bt-corn, it is assumed that corn borers will be present in the field in damaging numbers in the near future.

With Bt-corn, the decision to deploy a pest control tactic is made when the seed is purchased. However, until one actually scouts the field, corn borer economic threshold is hard to evaluate in advance. Economic advantage over conventional pest control practices is not guaranteed, and Bt-corn technology is not free. Seed companies charge technology fees which range from $5 to 15/acre. Ideally, growers must be able to recoup the technology fee every time they choose to plant Bt-corn hybrids.

In Beresford, 1998 was an ideal year for testing the economics of planting Bt-corn since corn borer infestations were very light compared to the previous years. Since 1996, our objective has been to test various Bt-corn hybrids for efficacy in preventing corn borer damage, and investigate their potential economic advantage over untreated conventional hybrids and conventional hybrids treated with an insecticide. We report in this article the performance of various Bt and conventional corn hybrids in Beresford, SD during the 1998 season.

Corn borer moth flight in Beresford (and surrounding areas) is of the two-generation or bivoltine type. Moths usually are abundant in June (first generation) and August (second generation). Very few moths are observed in July when most of the first generation corn borers are in their larval stages feeding inside corn stalks. From August to October, second generation larvae produce additional tunnels in the stalks and also injure the ear shanks, and corn ears. These larvae overwinter in corn stubble, then metamorphose into pupae then adult moths from May to June the following year.

Moth flight occurred early and in high numbers in 1998 (Figure 7). On the night of May 27th, 955 moths were captured in the light trap. Significant moth flight (about 150 moths/night) does not usually occur until mid-June. However, extremely cool temperatures during the first week of June may have disrupted moth flight and egg deposition (Figure 7). Moderate numbers of second brood moths were recorded from August to early September which means that a significant overwintering population may be in the field ready to infest corn in the spring of 1999.

MATERIALS AND METHODS

Seven hybrid groups (Dekalb 580Bt-Y, Garst 8600BLT, Golden Harvest EX8665, Mycogen 2787, Maximizer 454, Novartis 4640Bt, and Novartis 2555Bt) were evaluated for their performance against corn borers during the 1998 growing season. Experimental design was a split-plot with the main plots arranged as randomized complete blocks. Main plot treatments were the seven hybrid groups while subplot treatments were the methods of controlling corn borers namely: (1) Hybrid with the Bt gene; (2) Non-Bt isoline of the hybrid; and (3) Non-Bt isoline treated with Pounce 1.5G granular insecticide at the rate of 8 pounds of formulated material per acre. Granules were applied to whorl stage corn on July 11. Main plot treatments were replicated four times. Each subplot was six rows wide (15 feet) by 102 feet long.

Damage due to early and late season larvae were observed by splitting corn stalks and recording corn borer larvae feeding injuries in the stalks, ear shanks, and ears. Nocturnal moth flights of the corn borer moth were monitored using an ultraviolet light trap. Rows 2, 3 and 4 were left intact and harvested for yield, moisture content, and test weight data. Gross income was calculated as grain fresh weight × (market value - moisture dockage). Corn market value was at $1.60/bu, and moisture dockage was $0.05 per percentage point over 15% grain moisture.

RESULTS AND DISCUSSION

Figures 1 to 6 show relative performances of the corn hybrids tested during the 1998 season. Infestation due to first generation corn borer was minimal with percent stalks infested less than 15% in most of the hybrids (Figure 1). Infestation due to second generation corn borers was significant (Figure 2). The proportion of infested stalks in the untreated non-Bt hybrids ranged from 20 to 50%. Hybrid group by corn borer control treatment interaction was significant which means that the hybrid groups performed differently in response to second generation corn borer infestations. For example, Garst 8600BLT (with the StarLink Bt gene) had 22.5% less infestation compared to untreated Garst 8600IT which contains no Bt gene (Figure 2). The StarLink gene was designed to express in all cells of the corn plant and offer season-long protection against corn borer injuries. Garst 8600IT treated with Pounce 1.5G granular insecticide had 15% less infestation compared to its untreated equivalent. Mycogen 2787 (with the NatureGard gene), and Maximizer 454 and Novartis NX5297 (both with the KnockOut gene), are designed to express their genes only on the green tissues and pollen of the corn plant, thus, are expected to allow more corn borer infestation towards the end of the season (Figure 2).

Hybrids containing the YieldGard gene like Golden Harvest EX8665, Dekalb 580Bt-Y, and Novartis 4640Bt are expected to provide season-long protection since the gene is expressed in all plant cells. Pounce 1.5G granular insecticide (8 pounds/acre) which was applied early at whorl stage corn to work primarily against first generation corn borers, still provided protection against second generation corn borer similar to Bt corn in most of the hybrid groups (Figure 2).

Protection against second generation corn borer did not translate into significant yield gain in all of the hybrid groups (Figure 3). This may mean that the economic threshold was not reached at the critical time of plant development, and that the injuries did not result in significant stalk breakage, ear drop, and ear feeding. However, small yield advantages (compared to their respective untreated non-Bt isolines) of 1 to 6 bu/acre were still recorded for Garst 8600BLT, Golden Harvest EX8665, Mycogen 2787, and Maximizer 45, respectively. At harvest, the grain moisture content of the Bt hybrids were higher than the control in the Dekalb and Novartis hybrid groups but not in others (Figure 4). Figure 5 presents the test weights of the hybrids which were generally similar.

Ideally, growers must be able to recoup whatever technology fee they paid for choosing Bt corn over a similar non-Bt hybrid regardless of the severity of corn borer pressure during the growing season. That is, Bt corn must pay even at low corn borer pressures. Technology fees are not standardized and could cost from $5 to 15/acre depending on how many acres a grower plants per bag of seed (i.e., depending on plant population). For example, if the technology fee were less than $7.00/acre and were the same across Bt hybrids, then Garst 8600BLT, Golden Harvest EX8665, Mycogen 2787, and Maximizer 454 would have been a good choice over their non-Bt counterparts even at this year's (1998) light corn borer pressure in Beresford, SD (Figure 6). Growers must discuss with their seed dealers on how much exactly is the technology fee charged per bag of seed and estimate the fee on a per acre basis. Insecticide application with Pounce 1.5G would have paid for itself in non-Bt Garst, Mycogen, and Novartis N52-B2 if the cost of treatment (chemical plus application) were less than $5.00/acre with the margin most favorable in non-Bt Mycogen (Figure 6).

Finally, it must be remembered that we calculated gross income by considering yield, market value ($1.60/bu), and a penalty or dockage if the grain were wetter than 15% moisture ($0.05 per % above 15%). This scenario mimics selling immediately after harvest. Thus, any changes in this scenario will also change the economic outcome. For example, moisture dockage can be eliminated and price improved by storing the grain and selling when the market price improves. To reiterate, corn hybrids do not respond in the same manner to corn borer control tactics whether it is via Bt gene or a granular insecticide. We encourage the reader to see the 1998 SDSU Northeast Farm Progress Report for information on the damage caused by univoltine corn borers in northeastern South Dakota in 1998.

ACKNOWLEDGMENT

This research was supported in part by the South Dakota Corn Utilization Council and the South Dakota Crop Improvement Association.

CEREAL APHIDS IN CONVENTIONAL AND NO-TILL PLOTS OF SPRING WHEAT

Louis S. Hesler[1] and Robert K. Berg

Plant Science 9818

SUMMARY:

Cereal aphid infestation levels did not differ significantly between conventional tillage and no-tillage plots of spring wheat within 3- and 4-year rotations.

INTRODUCTION:

Cereal aphids such as the greenbug, bird cherry-oat aphid, and English grain aphid can infest small grain fields in South Dakota and cause direct yield loss. Little is known of how tillage practices affect levels of cereal aphids. The purpose of our research at the Southeast South Dakota Experiment Farm was to measure population levels of cereal aphids in small grain fields with conventional versus conservation tillage.

METHODS:

Cereal aphids were counted in conventionally tilled (CT) and conservation / no-till plots (NT) of spring wheat that were part of 3-year or 4-year crop rotations. Tillage treatment plots within each rotation were replicated four times. Twenty-five stems (tillers) were sampled per replication in the 3-year rotation every 3 to 4 days from May 7 through June 2. Twenty-five stems (tillers) were sampled per replication in the 4-year rotation on each Tuesday and Friday from May 7 through June 8. The mean number of cereal aphids per plot was calculated for each tillage treatment in each rotation study. The cumulative number of aphid days was tallied and compared by t-test between tillage treatments within a rotation.

RESULTS:

Counts of cereal aphids per plot (mean ± standard error) in the tillage treatments of the 3-year rotation are shown in Table 1. The number of cereal aphids counted per stem generally increased as sampling progressed through the season, but the numbers of cereal aphids in all plots of the 3-year rotation were far below the economic threshold. The mean cumulative aphid-days per plot in the NT treatment (45.3) and those of the CT plots (31.8) did not differ significantly ($P > 0.05$). When adjusted to a per-plant basis, the mean cumulative aphid-days were far below levels previously shown to cause yield loss in spring wheat.

[1] Research Entomologist, USDA-ARS, Northern Grain Insects Research Lab., Brookings, SD.

Counts of cereal aphids per plot (mean ± SE) in the tillage treatments of the 4-year rotation plots are shown in Table 2. The number of cereal aphids per stem generally increased as sampling progressed through the season. Numbers of cereal aphids in all plots of the 4-year rotation were far below the economic threshold. The mean cumulative aphid-days per plot in the NT treatment (444.5) and those of the CT plots (231.0) did not differ significantly ($P > 0.05$). When adjusted to a per-plant basis, the mean cumulative aphid-days for each tillage treatment were below levels previously shown to cause yield loss.

Table 1. Mean number of cereal aphids per spring wheat plot, 3-year rotation series, SE SD Experiment Farm, 1998.

	Mean no. aphids per 25 plants (x ± SE)	
Date	No tillage	Conventional tillage
May 11	0.0	0.3 ± 0.3
May 14	1.8 ± 1.0	2.5 ± 0.5
May 18	1.0 ± 0.6	2.0 ± 0.8
May 21	0.8 ± 0.5	0.3 ± 0.3
May 25	4.0 ± 2.0	0.5 ± 0.3
May 28	11.3 ± 3.6	3.0 ± 0.7
June 2	7.5 ± 2.7	6.8 ± 2.5

Table 2. Mean number of cereal aphids per spring wheat plot, 4-year rotation series, SE SD Experiment Farm, 1998.

	Mean no. aphids per 25 plants (x ± SE)	
Date	No tillage	Conventional tillage
May 7	0.0	0.0
May 11	1.0 ± 0.7	1.5 ± 0.7
May 14	3.5 ± 1.5	1.5 ± 0.3
May 18	1.5 ± 0.9	1.0 ± 0.7
May 21	1.5 ± 0.9	1.8 ± 0.9
May 25	7.5 ± 3.2	2.0 ± 1.7
May 28	11.5 ± 2.2	1.8 ± 0.9
June 1	11.3 ± 2.4	4.0 ± 0.9
June 4	19.3 ± 4.5	18.5 ± 2.2
June 8	10.0 ± 3.2	6.5 ± 2.3

1998 CEREAL LEAF BEETLE SURVEY: EASTERN SOUTH DAKOTA

Louis S. Hesler[1] and J. Bruce Helbig[2]

Plant Science 9819

SUMMARY:

Cereal leaf beetle (CLB), a serious pest of small grains, has not yet been detected in South Dakota. However, CLB populations occur on or near the eastern and western borders of South Dakota. Surveys for CLB were undertaken in May and June 1998 in South Dakota. Surveys consisted of taking 100 or more sweeps per field with a 15-inch diameter standard sweep net. Surveys in the eastern portion of the state included land on and around the Southeast South Dakota Experiment Farm near Beresford.

CLB was not detected in any field.

County	No. fields surveyed[a]
Brookings	5
Clay	4
Codington	3
Grant	1
Kingsbury	2
Total	14

[a] Fields consisted of winter wheat, spring wheat, barley, oats, or CRP-intermediate wheatgrass.

1998 SOYBEAN SEED TREATMENT TRIAL

Martin A. Draper, Roy Scott, Mary Thompson
and Greg Lammers
Plant Science 9820

Introduction

Soybeans can be damaged early in the season by a number of seedling diseases. As a result of these diseases, emergence may be delayed, early season plant population may be reduced, and root mass may be reduced which could affect late season plant populations. Diseases may be managed with seed treatments, especially if they are planted early in cold, wet soils, or if a severe rain event follows planting. Species of Pythium, Rhizoctonia, and Fusarium fungi can all cause early season pre-emergence and seedling diseases. Similarly, non-pathogenic fungi may cause emergence problems if the seed sits in a cool, wet seedbed for an extended period of time.

All fungicides do not address the same problems. Most products will suppress nonpathogenic fungi, but certain products may have a strength in suppressing certain seedling disease fungi. Seed treatment fungicides containing metalaxyl are active against oomycete fungi, which include Pythium and Phytophthora. Other products have little or no activity against these fungi. Products containing captan have general antifungal activity, while PCNB (pentachloronitrobenzene) has its best activity against Rhizoctonia and TBZ (thiabendazole) has its peak activity against Fusarium.

Materials & Methods

The variety 'Hardin 91' was selected for this study because it carries two specific resistance genes (Rps 1K and Rps 6) against races 3 & 4 of *Phytophthora sojae.* Resistance from two sources should remain durable, negating Phytophthora root and stem rot as a confounding factor as the season progressed. The experiment was planted as a RCBD with six replications of each treatment. In addition to the comparison of treated seed to non-treated seed, an aliquot of the same seed lot was subjected to high heat (40-45°C) under humidity (>90% R.H.) for 72 hours. This is known as accelerated aging, and it is typically used as a stress test for seed. In this case it was used accelerated aging to simulate a comparison of old and new crop seed.

The plot was planted, rated and harvested on the dates listed in Table 1. Plants were rated for early plant population (stand), disease index of Rhizoctonia root rot of five randomly selected plants and relative number of nodules. The disease index was assigned as a mean rating of percent of hypocotyl area symptomatic of Rhizoctonia root rot. The same five plants were rated on a 0 to 3 scale for relative number of nodules. A zero rating would indicate no nodules while a 3 rating would represent heavy nodulation.

Table 1: Dates and timing of planting, stand counts, disease evaluations and harvest at study locations in 1998.

Location	Activity	Date
SE Farm	Planting	5/19/98
	Early Stand Count	7/01/98
	Disease Rating (hypocotyl)	7/14/98
	Harvest	10/22/98
Northvill e	Planting	5/14/98
	Early Stand Count	6/30/98
	Disease Rating (hypocotyl)	7/10/98
	Harvest	Not harvested

Results and Discussion

At Beresford, there were no stand differences among treatments applied to new crop seed (Table 2). However, the stand of the aged seed was enhanced by seed treatments. A significant stand increase resulted from the Captan 400 and Rival + Allegiance treatments. There were no differences among the treatments for nodulation or the Rhizoctonia root rot rating, eight weeks after planting. While stand was increased by two of the treatments, those treatments did not produce significantly higher yields. However, Allegiance alone and the pre-blend of Rival/Allegiance did lead to significantly higher grain yields. No treatment led to higher 100 seed weights.

No differences were identified among treatments at Northville for stand, disease rating or nodulation (Table 3). Yield data was not available from Northville.

When numeric, as well as significant yield increasing treatments are considered, it appears that seed treatment fungicide products containing metalaxyl were most effective. These data indicate oomycete fungi, Pythium and Phytophthora, may have had a greater influence than expected. Phytophthora race specific resistance genes require ten to fourteen days to activate. Injury before that time may influence yield by affecting the structure of the root system.

Rival alone had no effect on yield in this study. This suggests that while Rhizoctonia root rot was very common in 1998, the losses from this disease were minimal, at least at this location.

Acknowledgement

This study was supported in part by a grant from the SD Soybean Research and Promotion Council.

Table 2: Stand, development of Rhizoctonia root rot and nodulation effects of various seed treatments at Beresford, SD, in 1998.

Treatment	Rate	Stand Counts (plants/m)		Rhizoctonia on Hypocotyl (scale of 0-5)		Root Nodulation (scale of 1-3)		Yield (bu/A)		G/100 seeds	
		New seed *	AA seed ♈	New seed *	AA seed ♈	New seed *	AA seed ♈	New seed *	AA seed ♈	New seed *	AA seed ♈
Untreated	n/a	21.5	17.8	1.7	1.2	1.5	1.7	60.1	65.9	15.8	15.6
Captan 400	1.5 fl oz/cwt	20.8	20.8	1.6	1.5	1.8	1.5	59.2	69.7	15.6	15.7
Rival	4 fl oz/cwt	20.0	20.1	1.5	1.3	2.0	1.7	59.5	64.3	16.1	15.8
Rival+ Allegiance	4 + 0.75 fl oz/cwt	22.8	21.8	1.7	1.4	1.5	1.7	63.2	68.0	15.8	15.8
Rival+Ridomil (banded)	4 fl oz + 1.5 pt/A	19.9	20.4	1.8	1.4	1.3	2.0	63.4	68.5	15.9	15.9
Allegiance	0.75 fl oz/cwt	23.3	20.3	1.4	1.5	1.5	1.3	68.8	70.1	161	15.9
Rival/Allegiance (pre-blend)	4.2 fl oz/cwt	23.7	20.0	1.5	1.4	1.5	1.5	68.1	64.0	16.1	15.9
Ridomil (banded)	1.5 pt/A	20.6	18.8	1.4	1.4	1.7	1.5	63.6	70.7	15.7	16.0
LSD $_{(0.05)}$		NS	2.7	NS	NS	NS	NS	5.6	NS	NS	NS

♈ New crop seed with age acceleration treatment

Table 3: Stand, development of Rhizoctonia root rot and nodulation effects of various seed treatments at Northville, SD.

Treatment	Rate	Stand Counts (plants/m)		Rhizoctonia on Hypocotyl (scale of 0-5)		Root Nodulation (scale of 1-3)	
		New seed*	AA seed♈	New seed*	AA seed♈	New seed*	AA seed♈
Untreated	n/a	21.3	19.3	2.5	2.5	1.5	1.8
Captan 400	1.5 fl oz/cwt	18.5	20.0	1.7	2.6	1.7	1.8
Rival	4 fl oz/cwt	21.1	18.8	2.4	2.3	1.7	1.5
Rival + Allegiance	4 + 0.75 fl oz/cwt	21.1	17.8	2.0	2.6	2.2	1.3
Rival + Ridomil (banded)	4 fl oz + 1.5 pt/A	17.3	20.6	2.6	2.1	1.8	1.8
Allegiance	0.75 fl oz/cwt	18.9	17.8	2.3	2.0	1.5	1.8
Rival/Allegiance (pre-blend)	4.2 fl oz/cwt	19.1	23.2	2.3	2.7	1.5	2.0
Ridomil (banded)	1.5 pt/A	18.0	18.3	2.5	2.4	2.0	1.3
LSD $_{(0.05)}$		NS	NS	NS	NS	NS	NS

* New crop seed without age acceleration treatment

♈ New crop seed with age acceleration treatment

A COMPARISON OF SOYBEAN SEED INOCULATION ACROSS FOUR EASTERN SOUTH DAKOTA LOCATIONS

R. G. Hall and K. K. Kirby

Plant Science 9821

Introduction

In 1997 crop performance testing conducted a soybean inoculation study at Armour on a field with no known soybean history. The zero inoculant check yielded 48, the liquid seed treatment 55, and the granular soil treatment 60 bu/ac. When comparing the average of the liquid and granular treatment against the zero check the 9.5 bushel advantage from the liquid and granular treatments was highly significant. When comparing the liquid versus the granules the 5 bushel advantage of the granular treatment was significant at the 0.11 level of probability. In summary, inoculation was beneficial as either a liquid or a granular compared to zero inoculation when seeding into soils with no soybean history.

In 1998, crop testing again repeated a similar study on a field with no prior soybean production at Armour. In addition, the study was expanded to three more locations on fields where soybeans had been produced for a number of years. The objective was to determine whether the more common liquid method of inoculation and the more convenient but costly granular method compared to a zero treatment check across several locations in eastern South Dakota.

Methods

The inoculation trial without a prior soybean history was established at Armour (Robert Clark farm). The sites where soybean had been produced for a number of years included Spink Co. (Steve Masat farm), the SE Research Farm (Beresford), and the NE Research Farm (Watertown). The cropping history at the Armour site included an extended period of alfalfa followed by no-till corn. The sites with a prior soybean cropping history generally included a soybean rotation with either corn or small grains. The treatments were as follows: (1) zero check, no inoculant, (2) granular soil inoculant, applied down the insecticide tube into the seed furrow, and (3) liquid seed inoculant, applied to prior to seeding.

The granular inoculant (Granular Soil Implant+ Nitragin Brand Inoculant for Soybeans) and the liquid inoculant (Cell-Tech 2000) used in this study were both manufactured by Lipha Tech, 3101 West Custer Ave, Milwaukee, WI 53209. The granular was applied at 6.5 lb/ac in 30” rows. This product was stored in a cold room prior to planting. A suggested retail price for this product is $50.50/40-lb container or $1.26/lb. This equals $8.19/ac.

The liquid inoculant was applied at 2.5 fl oz/bu seed or 2.5 fl oz on 60 lb/ac (165,000 seeds/ ac). The suggested retail price for this product is $42.00 /40 bu of seed or $1.05/bu treated. This treatment equates to about $1.05/ac.

Lipha Tech indicated the bacterial concentration in the liquid is higher than in the granules. However, they feel the efficacy of the products are similar in the field because once applied the granular bacteria in the soil appears to be in a better environment for inoculation than the liquid bacteria applied to the seed.

Plots consisted of four 30” rows 20’ long. The plots were seeded in a zero check, granular, liquid treatment sequence in order to prevent cross contamination of seed cones on the planter. The number of replications varied over locations and included Armour with 10, Spink Co. and Watertown with 12, and Beresford with 15 replications. The center two rows were harvested for yield. Each trial consisted of three treatments with each treatment seeded into strips with 10 to 15 replications. The variety Parker was used at all locations and weed control was excellent using recommended soybean herbicides.

Results and Discussion

The results of the study are indicated in Table 1, presented below. When analyzed over four locations the treatment, location, and treatment x location interaction effects were all significant ($P > F = 0.0001$). The yields at these locations indicate there was no treatment effects within a location except at Armour. At Armour all three treatments were significantly different from one another. In this case the zero check yielded 61, the liquid 66, and the granular 70 bu/ac. This is similar to last year’s data indicating the inoculant treatments out yielded the zero check. The Armour site with its lack of prior soybean history responded well to inoculation compared to the zero check. At the SE Farm, NE Farm, and Spink Co. the yields among the treatments did not differ significantly.

When Armour is deleted from consideration the response of the inoculation treatments to soils with a previous soybean history becomes more clear (3-location treatment mean column). When analyzed over 3 locations, there is no significant treatment ($P > F = 0.3450$) or treatment X location interaction ($P > F = 0.2338$) effects over the locations SE Farm, NE Farm, or Spink Co. The treatment means averaged 54 bu/ac across all locations. There is however, a significant location effect ($P > F = 0.0001$) over locations where yields averages ranged from a low of 50 at the NE Farm, 53 at Spink Co., to a high of 59 bu/ac at the SE Farm.

Table 1. Comparison of soybean seed inoculation across four eastern South Dakota locations.

Inoculantation Treatment	Location				Treatment Means	
	Armour	SE Farm	Spink Co.	NE Farm	4-Loc.	3-Loc.
				Bu/ac		
Zero check	61	60	53	49	55	54
Granular	70	59	54	50	58	54
Liquid	66	59	52	51	57	54
Location Mean	65	59	53	50		

In summary, these results again indicate inoculation is important when seeding into soils with no previous soybean history. They also indicate inoculation when seeding into soils with a prior soybean history does not always increase yields. Many growers feel inoculation is necessary but inconvenient while others consider inoculation as cheap insurance. If you consider inoculation important then the liquid treatment is likely the most attractive option for two reasons. First, the liquid is about 8 times cheaper than the granular on 30" rows. Second, the liquid option permits more flexibility in the type of seeding equipment or method used. It may be applied as a seed treatment or sprayed into the seed furrow. Presently, most granular is applied via insecticide boxes which in turn tends to limit it to rowed as opposed to drilled soybeans. This study will continue in 1999.

OAT FOLIAR FUNGICIDE TRIAL

M. Draper, D. Reeves, M. Thompson, and L. Hall

Plant Science 9822

Introduction:

Oats are subject to a variety of foliar diseases. Among the diseases commonly encountered on oats are Septoria leafspot (*S. avenae*) and leaf or crown rust (*Puccinia coronata*). Locally, severe outbreaks of stem rust (*Puccinia graminis* f. sp. *secalis*) were also observed in parts of SD in 1998. These diseases, being caused by fungi, often can be suppressed or managed through the application of fungicides. Other diseases such as red leaf, caused by barley yellow dwarf virus, are common but would not be expected to respond to fungicides. In some years, a significant yield increase has been documented following multiple fungicide applications in the presence of light disease pressure. The purpose of the following study was to determine the effects of various foliar fungicide treatments on yield, test weight and disease development of oats at the end of the season.

Materials and Methods:

In 1998 trials were conducted at the Southeast Experiment Station (SE Farm), Northeast Research Station (NE Farm), and the Brookings Agronomy Station (Brookings). The crown rust susceptible cultivar 'Don' was used in this study, as it has been for several years. Dates of planting rating and harvest are listed in Table 1. Three fungicides applied either early (5 leaf stage), to the flag leaf, at the boot stage, ten days after the boot stage, or at the boot stage and again ten days later. There were eight treatments plus an untreated check included in the trial (Table 2). The foliar fungicide treatments and number of plots were the same at all three locations. Treatments were replicated four times. At the NE Farm, plots were rated during the dough stage for overall disease and crown rust severity. The overall disease rating was a 0 to 5 scale, where a zero rating represented no disease and a five rating represented premature ripening. Crown rust was rated for percent diseased leaf area. Yield and test weight were measured at harvest.

Tilt (propaconizole) and Folicur (tebuconizole) are triazole fungicides with locally systemic activity. Neither product is currently registered for use on oats. They were tested as experimental products because of their effectiveness against leaf disease on other cereal crops. Dithane DF (mancozeb) was applied to the crop with Latron as a spreader-sticker, as recommended on the label.

Results and Discussion

In 1998, crown rust was moderate at the SE Farm, but appeared early. There was little crown rust pressure at the Brookings Agronomy Farm. Disease pressure, largely from crown rust, was great at the NE Farm, but appeared later in the season than at the SE Farm. As a result, the response to fungicide applications at the NE Farm were generally favorable.

Tilt, while an effective fungicide on wheat, did not reduce disease, increase yield or test weight at the SE Farm. Folicur significantly increased yield when applied at emergence of the flag leaf. Later applications of Folicur did not significantly increase yield. The only other fungicide application resulting in significant yield increase was mancozeb, applied during the boot stage and again ten days later. When disease development was delayed as at the NE Farm, yields were much higher and later fungicide applications were more effective. Under conditions where disease did not develop (Brookings), all treatments increased yield numerically, but not significantly. Under light disease or no disease, test weights were increased by the same treatments that increased yield under those conditions. When disease development was delayed as at the NE Farm, yields were much higher and later fungicide applications were more effective. Under conditions where disease did not develop (Brookings), all treatments increased yield numerically, but not significantly. Under light disease or no disease, test weights were increased by the same treatments that increased yield under those conditions.

Based on these results, a decision to use a fungicide on an oat crop can be delayed until the flag leaf is emerging. If no crown rust is present the decision can be delayed. If crown rust is building and the variety is susceptible to the disease, a fungicide application may be warranted and would be expected to produce a significant and profitable yield increase. However, under light disease or no disease pressure, fungicides may not be profitable in a given year.

Acknowledgements

This research was supported in part by a grant from the SD Crop Improvement Association.

Table 1: Dates of planting, fungicide applications, plot rating and harvest for the three locations.

Location	Activity	Product	Date
SE Farm	Planting	NA	4/14/98
	Fungicide application	Early	
		Flag	
		Boot	
		Boot +10 days	
	Rating		NA
	Harvest		7/23/98
Brookings Agronomy Farm	Planting		4/11/98
	Fungicide application	Early (5-leaf stage)	5/22/98
		Flag (Feeekes 8.5)	6/3/98
		Boot	6/9/98
		Boot +10 days	6/19/98
	Rating		NA
	Harvest		8/3/98
NE Farm	Planting		4/15/98
	Fungicide application	Early	5/21/98
		Flag	6/3/98
		Boot	6/9/98
		Boot +10 days	6/19/98
	Rating		7/22/98
	Harvest		7/27/98

NA = Not Applied or Not Applicable

Table 2: Disease ratings, yield and test weight for various fungicide treatments on Don oats.

Treatment Rate Crop Stage	Crown rust rating*	Foliar disease rating	Yield (bu/ac)			Test Weight (lb/bu)		
	NE Farm	NE Farm	SE Farm	Brook-ings	NE Farm	SE Farm	Brook-ings	NE Farm
Untreated (N/A)	32.1	4.5	78.5	84.7	96.0	27.2	35.3	33.2
Tilt 4 fl oz/A Flag	31.3	5.0	82.9	88.9	95.2	28.7	34.7	33.9
Folicur 4 fl oz/A Flag	9.0	3.6	93.8	87.9	123.0	29.8	34.8	35.8
Folicur 4 fl oz/A Boot	3.8	2.6	87.2	89.2	125.9	28.9	35.0	36.8
Mancozeb 1 #/A Early	19.0	3.6	83.5	86.6	108.1	28.5	34.3	34.9
Mancozeb 2 #/A Flag	15.0	3.8	83.2	86.8	115.4	28.5	35.2	35.3
Mancozeb 2 lb/A Boot	17.0	3.4	85.3	85.7	110.0	28.6	34.2	35.2
Mancozeb 2 lb/A Boot +10	8.6	2.8	70.1	89.7	118.6	26.3	34.8	35.4
Mancozeb 2 #/A Boot 2 #/A Boot +10	1.6	1.9	93.1	88.3	126.4	29.1	34.8	36.9
LSD $_{(0.05)}$	8.4	1.1	11.2	5.1	8.4	2.1	0.9	1.2

* on a scale of 0-100 (0 = no disease, 100 = 100% disease)

 on a scale of 0-5 (0 = no disease, 5 = 100% disease)

CROP PERFORMANCE TRIALS, CORN, SOYBEAN, AND OAT

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Plant Science 9823

Corn:

Early maturity trial results for 1998 and 1997-98 are indicated in Table 1. There were 25 entries tested over the two year 1997-98 time period with an average of 187 bu/ac. Entries also had to yield 187 bu/ac or higher to be in the top-yield group. There were 14 hybrids in the top-yield group for 1997-98. Yield differences between entries had to be 22 bu/ac or higher to be significant. There were 85 entries for 1998 with an average of 201 bu/ac. Top-yielding hybrids had to average 218 bu/ac or higher. There were 11 hybrids in the top-yield group for 1998. In 1998, hybrids had to differ by 13 bu/ac to be lb/bu, harvest population 27,878 plants/ac, and lodging 1%. Grain moisture had to differ by 1%, test weight by 2 lb/bu, and lodging by 2% for there to be a significant difference in these variables between any two hybrids in the trial.

Late maturity trial results for 1998 and 1997-98 are indicated in Table 2. There were 13 entries tested over the two year 1997-98 time period with an average of 189 bu/ac. The test trial was unable to detect significant hybrids yield differences over the two year time period. Therefore, even the lowest numerical yield of 176 bu/ac was in the top-yield group for 1997-98. Hence, there were 13 hybrids in the top-yield group for 1997-98. There were 25 entries for 1998 with an average of 207 bu/ac. Top-yielding hybrids also had to average 207 bu/ac or higher. There were 16 hybrids in the top-yield group for 1998. In 1998, hybrids had to differ by 16 bu/ac to be significantly different in yield. . In the late trial grain moisture averaged 20%, test weight 58 lb/bu, harvest population 27,878 plants/ac, and lodging 1%. Grain moisture had to differ by 1%, test weight by 1 lb/bu, and lodging by 2% for there to be a significant difference in these variables between any two hybrids in the trial. In both trials all populations averaged 27,878 plants/ac.

Soybean: Note – Protein and oil data in these results are for 1997.

Maturity group-I trial results for 1998, 1997-98, and 1996-98 are indicated in Table 3. There were 15 entries tested over the three year 1996-98 time period with an average of 60 bu/ac. Entries also had to yield 66 bu/ac or higher to be in the top-yield group. There were 5 varieties in the top-yield group for 1996-98. Yield differences between entries had to be 5 bu/ac or higher to be significant. There were 8 entries tested over the two year 1997-98 time period with an average of 58 bu/ac. Entries also had to yield 64 bu/ac or higher to be in the top-yield group. There were 6 varieties in the top-yield group for 1997-98. Yield differences between entries had to be 6 bu/ac or higher to be significant. There were 40 entries for 1998 with an average of 62 bu/ac. Top-yielding varieties had to average 67 bu/ac or higher. There were 11 varieties in the top-yield group for 1998. In 1998, varieties had to differ by 6 bu/ac to be significantly different in yield.

Maturity group-II trial results for 1998, 1997-98, and 1996-98 are indicated in Table 4. There were 28 entries tested over the three year 1996-98 time period with and average of 64 bu/ac. Entries also had to yield 68 bu/ac or higher to be in the top-yield group. There were 6 varieties in the top-yield group for 1996-98. Yield differences between entries had to be 4 bu/ac or higher to be significant. There were 25 entries tested over the two year 1997-98 time period with an average of 62 bu/ac. Entries also had to yield 63 bu/ac or higher to be in the top-yield group. There were 28 varieties in the top-yield group for 1997-98. Yield differences between entries had to be 5 bu/ac or higher to be significant. There were 133 entries for 1998 with an average of 65 bu/ac. Top-yielding varieties had to average 67 bu/ac or higher. There were 41 varieties in the top-yield group for 1998. In 1998, varieties had to differ by 5 bu/ac to be significantly different in yield.

Oat:

Results of the 1998 oat trial are indicated in Table 5. The top-yielding varieties for the period 1995, 1996,and 1998 were not detectable because the trial indicated there were no significant yield difference among the varieties over that time period. The top-yielding varieties for 1998 are Gem, Jerry, Jud, and the experimental lines SD93018, SD93311, SD94155, SD94160, and SD94173. Varieties or lines had to differ by 11 bu/ac or more to be significantly different in yield for 1998. SD95963, a hulless line, along with other lines and the varieties Hytest and Riser were the better test weight entries for 1998. During the longer three-year period Hytest, Riser and Jerry are the better test weight entries.

Table 1. 1998 Corn hybrid trial, early maturity - 110 days or less, thinned to 27,878 plants/acre.

BRAND & HYBRID	YIELDS AT 15.5% MOIST. 2-YR (Bu/A)	1998 (Bu/A)	1998 GRAIN MOIST. (%)	BU. WT. (lb)	PLANTS PER ACRE	STALKS LODGED (%)
	******* ENTRIES TESTED TWO YEARS *******					
LG SEEDS LG 2583	208	228	19	58	27878	1
KAYSTAR KX-777	204	231	17	57	27878	0
ASGROW RX730	201	214	20	58	27878	1
GARST P834	199	218	17	58	27878	1
KRUGER K-9513	199	200	19	58	27878	1
STAUFFER 2436	198	220	17	57	27878	0
NC+ 4880	197	221	20	58	27878	0
DEKALB DK586	197	217	18	58	27878	1
HOEGEMEYER 2612	196	204	18	56	27878	2
KRUGER K-9614A	196	220	19	60	27878	1
WILSON 1390	190	201	17	58	27878	1
TERRA TR 1087	190	213	19	58	27878	1
DAIRYLAND STEALTH-1406	188	215	18	58	27878	1
CARGILL 5677	187	214	17	59	27878	2
ASGROW RX601	185	194	18	58	27878	0
M-W GENETICS G 7610	184	191	19	57	27878	0
EPLEY EX2422	181	198	18	57	27878	1
SANDS SOI 9087	179	195	18	60	27878	0
SANDS SOI 9067	177	195	17	58	27878	0
FONTANELLE 4567	174	176	17	58	27878	0
FONTANELLE 4997	172	184	19	62	27878	0
MUSTANG DX720	172	192	18	58	27878	2
EPLEY EX1500	172	183	17	60	27878	1
CARGILL 6303	170	182	19	56	27878	0
HOEGEMEYER 2591	167	175	17	58	27878	1
	******* ENTRIES TESTED ONE YEAR *******					
DEKALB DK595BTX	.	224	19	58	27878	1
RENZE 6287	.	223	17	56	27878	1
GOLDEN HARVEST H-2515	.	220	18	58	27878	0
KRUGER K-9808	.	219	18	58	27878	1
RENZE 8158BT	.	218	18	60	27878	2
KALTENBERG 6901	.	217	19	56	27878	1
MUSTANG DX705	.	214	18	57	27878	1
TERRA TR 1097	.	214	20	56	27878	0
TERRA TR 1047	.	214	19	56	27878	1
JACOBSEN JS4685	.	214	18	57	27878	1
GOLDEN HARVEST H-2516	.	213	18	58	27878	1
DENBESTEN DB2608	.	211	18	56	27878	1
DAIRYLAND STEALTH-1410	.	211	18	58	27878	2
RENZE 8248BT	.	210	19	58	27878	1
GARST 8556IT	.	210	19	59	27878	0

Table 1. 1998 Corn hybrid trial, early maturity (Continued).

BRAND & HYBRID	YIELDS AT 15.5% MOIST. 2-YR (Bu/A)	YIELDS AT 15.5% MOIST. 1998 (Bu/A)	1998 GRAIN MOIST. (%)	1998 BU. WT. (lb)	1998 PLANTS PER ACRE	1998 STALKS LODGED (%)
KRUGER EX809	.	209	19	58	27878	5
KAYSTAR KX-780	.	209	18	57	27878	0
KRUGER K-9910	.	209	17	57	27878	2
RENZE 6327	.	209	20	57	27878	0
DEKALB DK545BTY	.	208	17	57	27878	1
ASGROW RX505BT	.	208	18	59	27878	1
DEKALB DK566BTX	.	208	16	57	27878	1
KRUGER EX807	.	207	20	57	27878	1
DEKALB DK580BTY	.	206	18	59	27878	0
KALTENBERG 6801	.	206	19	58	27878	0
JACOBSEN JS4500BT	.	205	19	58	27878	2
MYCOGEN 2598	.	204	16	56	27878	1
RENZE 6318	.	204	18	59	27878	0
WILSON E3034	.	204	17	58	27878	0
EPLEY E1510BT	.	204	18	59	27878	2
FONTANELLE 4988	.	203	17	57	27878	0
WILSON 1644	.	203	17	57	27878	2
TERRA E1058BT	.	203	19	57	27878	2
HOEGEMEYER 2641IMI	.	202	20	58	27878	1
CARGILL 5021BT	.	202	19	58	27878	0
GARST 8686	.	200	18	59	27878	0
TERRA E1089IT	.	199	19	57	27878	2
WILSON 1475PT	.	196	19	57	27878	0
DAIRYLAND STEALTH-1505	.	195	18	60	27878	2
MUSTANG DX661	.	194	18	59	27878	1
DENBESTEN DB2806	.	194	17	58	27878	1
GOLDEN HARVEST H-2398	.	193	17	58	27878	1
GARST 8585 GLS/IT	.	193	20	58	27878	1
EPLEY E2434	.	192	19	57	27878	1
DENBESTEN DB3608	.	192	19	61	27878	1
KRUGER K-9810	.	190	19	59	27878	2
KRUGER EX808	.	188	18	59	27878	2
DAIRYLAND STEALTH-1509	.	187	17	58	27878	2
DENBESTEN DB6750	.	187	18	57	27878	1
MYCOGEN 2620	.	184	18	59	27878	2
JACOBSEN JS4247	.	184	19	59	27878	0
CARGILL 5611	.	181	18	58	27878	0
TERRA TR 1107IT	.	179	22	58	27878	1
WILSON E6011	.	179	19	60	27878	1
DENBESTEN DB2702	.	179	17	58	27878	1

Table 1. 1998 Corn hybrid trial, early maturity (Continued).

BRAND & HYBRID	YIELDS AT 15.5% MOIST. 2-YR (Bu/A)	YIELDS AT 15.5% MOIST. 1998 (Bu/A)	1998 GRAIN MOIST. (%)	1998 BU. WT. (lb)	1998 PLANTS PER ACRE	1998 STALKS LODGED (%)
ASGROW RX587	.	176	17	61	27878	1
HOEGEMEYER 2618	.	175	19	61	27878	1
RENZE 6167	.	175	17	58	27878	1
HOEGEMEYER 592WX	.	174	19	58	27878	1
GOLDEN HARVEST H-2390	.	160	17	56	27878	0
AVERAGE:	187	201	18	58	27878	1
LSD (5%):	22	13	1	2	NS**	2
MIN. TOP YIELD VALUE*:	187	218				
COEF. OF VARIATION:	6	4				

*Top yield - yields within one LSD value of highest yield.
**Yield differences within a column are not significant (NS).

Table 2. 1998 Corn hybrid trial, late maturity - 111 days or more, thinned to 27,878 plants/acre.

BRAND & HYBRID	YIELDS AT 15.5% MOIST. 2-YR (Bu/A)	1998 (Bu/A)	1998 GRAIN MOIST. (%)	BU. WT. (lb)	PLANTS PER ACRE	STALKS LODGED (%)
	******* ENTRIES TESTED TWO YEARS *******					
CARGILL 7770	199	222	21	59	27878	1
KAYSTAR KX-808	197	208	19	56	27878	1
EPLEY EX3608	194	216	18	59	27878	3
STAUFFER 2207	194	213	21	58	27878	1
MYCOGEN 7250	193	209	21	57	27878	1
WILSON 1664	193	208	20	59	27878	0
M-W GENETICS G 7711	191	210	20	58	27878	4
CARGILL 6888	190	209	20	58	27878	1
MYCOGEN 2725	189	200	19	58	27878	1
SANDS SOI 9126	183	208	21	58	27878	1
EPLEY EX3242	181	199	18	57	27878	4
SANDS SOI 9115	179	189	19	58	27878	2
CARGILL 6997	176	191	21	57	27878	1
	******* ENTRIES TESTED ONE YEAR *******					
DEKALB DK626BTX	.	219	18	58	27878	1
KALTENBERG 7001	.	219	18	58	27878	0
MYCOGEN 2722	.	215	19	57	27878	1
LG SEEDS LG 2616	.	208	21	58	27878	2
DENBESTEN DB2611	.	208	21	59	27878	1
LG SEEDS LG 2587	.	207	20	60	27878	3
RENZE 6386	.	207	20	58	27878	1
HOEGEMEYER 2645	.	205	18	58	27878	1
DENBESTEN DB5112	.	204	19	59	27878	2
RENZE 6345	.	204	18	58	27878	1
EPLEY EX3620	.	203	20	58	27878	2
KALTENBERG 7101	.	195	21	58	27878	1
AVERAGE:	189	207	20	58	27878	1
LSD (5%):	NS**	16	1	1	NS	2
MIN. TOP YIELD VALUE*:	176	207				
COEF. OF VARIATION:	5	5				

*Top yield - yields within one LSD value of highest yield.
**Yield differences within a column are not significant (NS).

Table 3. 1998 Conventional soybean performance trial - maturity group-I,
seeded May 14, 1998.

--- BRAND / ENTRY ---	--- YIELD --- 3YR	2YR	'98	-- 1997 -- ** PROT.	** OIL	--- 1998 --- HT.	$$ LDG.	## REL. MAT.
	--- bu/a ---			-- % --		in.		
****** ENTRIES TESTED THREE YEARS ******								
PRAIRIE BRAND/PB-197	71	68	71	33.4	17.9	45	1	1.6
LATHAM/392	71	69	69	33.1	18.3	42	1	1.7
STINE/1970	70	69	71	33.3	18.2	43	1	1.9
LATHAM/250	67	64	68	33.9	18.3	40	1	1.7
TERRA/TS194	67	62	62	33.7	18.4	41	1	1.6
PUBLIC/STURDY,II-CK*	63	59	62	33.2	18.8	44	2	2.3
PUBLIC/IA1006	61	58	60	32.9	18.9	44	2	1.6
TOP FARM/TF6175	60	57	61	33.8	17.6	35	1	1.6
PUBLIC/PARKER,I-CK*	59	56	61	33.6	18.7	45	3	2.0
PUBLIC/BELL-SCN	57	54	57	35.7	18.5	39	1	1.7
PUBLIC/GRANITE	57	53	53	34.7	18.0	44	3	1.6
PUBLIC/FREEBORN-SCN	54	51	56	33.9	18.4	39	2	1.5
PUBLIC/MN 1301	53	50	56	35.1	17.8	41	2	1.4
PUBLIC/FAIRBAULT-SCN	48	46	46	32.4	18.9	38	2	1.6
PUBLIC/DAWSON,0-CK*	45	42	51	33.0	18.5	39	3	0.7
******* ENTRIES TESTED TWO YEARS *******								
KRUGER/K-2021	.	70	71	33.4	17.7	43	1	1.8
KRUGER/K-2021+	.	70	73	33.8	17.9	45	1	1.9
PRAIRIE BRAND/PB-194	.	63	66	33.8	18.5	40	1	1.7
DEKALB/CX205	.	62	64	32.6	18.6	46	2	1.7
JACOBSEN/J659	.	62	68	34.1	18.5	40	1	1.6
TOP FARM/TF6188	.	60	64	32.5	18.3	42	2	1.7
PUBLIC/MN 1401	.	51	56	34.6	18.3	44	1	1.3
PUBLIC/STRIDE	.	50	56	31.7	19.5	39	1	1.4
******* ENTRIES TESTED ONE YEAR *******								
SANDS/SOI 169	.	.	72	.	.	40	1	1.7
DYNA-GRO/3196	.	.	69	.	.	38	1	1.8
SANDS/EXP 2027	.	.	68	.	.	35	2	1.9
KRUGER/K-2125	.	.	68	.	.	38	1	1.8
KRUGER/K-1777	.	.	67	.	.	40	1	1.7
DENBESTEN/DB1997	.	.	66	.	.	43	2	1.7
KRUGER/K-1990	.	.	66	.	.	41	1	1.7
HYTEST/HTX1920	.	.	65	.	.	42	1	1.7
LATHAM/324STS	.	.	65	.	.	42	1	1.8
TOP FARM/TF6197	.	.	65	.	.	43	2	1.9
GARST/EX8156	.	.	64	.	.	41	1	1.5
DENBESTEN/DB1598	.	.	64	.	.	45	2	1.7
HYTEST/HTX1410	.	.	63	.	.	38	1	1.5
TERRA/E158	.	.	61	.	.	41	1	1.6
KAYSTAR/K1800	.	.	60	.	.	45	3	1.9

Table 3. Conventional soybeans (Continued) - Maturity group-I.

--- BRAND / ENTRY ---	--- YIELD --- 3YR	2YR	'98	-- 1997 -- ** PROT.	** OIL	--- 1998 --- HT.	$$ LDG.	## REL. MAT.
	--- bu/a ---			-- % --		in.		
GARST/D189	.	.	60	.	.	41	1	1.6
DENBESTEN/DB1797	.	.	56	.	.	37	1	1.6
TEST AVERAGE:	60	58	62	33.6	18.4	42	2	
LSD(5%) VALUES:	5	6	6					
MIN.TOP-YIELD VALUE($):	66	64	67					
COEF. OF VARIATION:	6	6	6					

* CK = maturity group check.
$Top yield - yields within one LSD value of highest yield.
$$ 1= Excellent, 5= Poor.
A scale difference of 0.1 is equal to 1.3 days in maturity.

Table 4. 1998 Conventional soybean performance trial - maturity group-II,
seeded May 14, 1998.

--- BRAND / ENTRY ---	--- YIELD --- 3YR	2YR	'98	-- 1997 -- ** PROT.	** OIL	--- 1998 --- HT.	$$ LDG.	## REL. MAT.
	--- bu/a ---			-- %	--	in.		
****** ENTRIES TESTED THREE YEARS ******								
HOEGEMEYER/202	71	68	71	33.5	18.1	40	1	2.5
LATHAM/480	69	66	68	33.4	18.6	41	2	2.2
PRAIRIE BRAND/PB-202	69	66	70	34.0	17.5	42	1	2.3
MUSTANG/M-2200	69	66	66	33.7	17.6	41	1	2.4
PRAIRIE BRAND/PB-276	68	65	65	32.8	18.5	39	1	2.6
JACOBSEN/J865	68	66	65	35.2	16.9	38	1	2.3
COYOTE/9525	67	63	67	31.4	18.8	46	1	2.4
DEKALB/CX229	66	62	66	32.7	18.1	42	2	2.4
PRAIRIE BRAND/PB-246	66	65	65	33.3	17.9	35	1	2.4
M-W GENETICS/G2440	66	62	66	34.1	17.9	37	1	2.5
MYCOGEN/J-251	66	62	67	33.6	17.8	37	1	2.5
KRUGER/K-2525	66	61	61	34.0	18.1	39	1	2.4
PRAIRIE BRAND/PB-2120	65	62	64	33.9	18.0	36	1	2.4
RENZE/R2297	65	61	65	34.6	18.3	41	1	2.2
HOEGEMEYER/225	65	61	66	34.1	17.9	39	1	2.5
KRUGER/K-2343+	65	63	66	33.5	18.1	43	1	2.3
MUSTANG/M-2262	64	61	63	33.1	18.2	42	1	2.6
TERRA/TS200	64	60	65	33.6	18.2	36	1	2.3
HY-VIGOR/2400	63	59	61	33.6	18.9	54	2	2.4
PRAIRIE BRAND/PB-236	63	59	64	33.2	17.8	39	1	2.3
HOEGEMEYER/232	62	60	63	32.4	19.3	45	2	2.2
COYOTE/9123	62	60	61	32.7	19.3	44	3	2.3
PUBLIC/IA2021	62	59	63	31.6	19.5	38	2	2.1
PUBLIC/IA2008R	59	54	57	32.7	18.3	48	2	2.5
PUBLIC/PARKER,I-CK*	59	56	59	33.9	18.5	49	3	2.0
PUBLIC/KENWOOD 94	58	54	56	33.9	18.3	43	2	2.6
PUBLIC/STURDY,II-CK*	58	53	57	33.8	18.5	42	2	2.3
PUBLIC/CORSOY 79	56	51	54	34.5	17.6	49	3	2.3
******* ENTRIES TESTED TWO YEARS *******								
PROFISEED/PS2898	.	68	68	33.6	18.1	38	1	2.6
STINE/2180	.	67	67	33.9	17.2	41	1	2.3
KRUGER/K-2725	.	66	67	34.7	17.2	40	1	2.5
GOLDEN HARVEST/H-1214	.	66	70	33.9	17.6	43	1	2.3
KRUGER/K-2818	.	66	67	33.8	18.1	40	1	2.6
KRUGER/K-2625+	.	66	67	35.1	17.4	37	1	2.5
GOLDEN HARVEST/H-1282	.	66	65	32.9	18.7	39	1	2.6
SANDS/EXP C301	.	65	66	33.1	17.7	44	1	2.6
KRUGER/K-3040	.	65	70	33.8	18.0	41	1	2.7
DYNA-GRO/3256	.	65	69	33.3	18.2	40	1	2.3

Table 4. Conventional soybeans (Continued) - Maturity group-II.

--- BRAND / ENTRY ---	--- YIELD --- 3YR	2YR	'98	-- 1997 -- ** PROT.	** OIL	--- 1998 --- HT.	$$ LDG.	## REL. MAT.
	--- bu/a	---		-- %	--	in.		
KRUGER/K-2535+	.	64	69	34.2	18.3	42	1	2.5
PRAIRIE BRAND/PB-235	.	64	67	34.7	18.2	41	1	2.5
JACOBSEN/J777	.	64	67	33.4	18.0	40	1	2.5
SANDS/SOI 278	.	63	65	33.2	18.3	39	1	2.5
LATHAM/640	.	63	66	35.4	17.7	39	1	2.5
TERRA/TS277	.	63	66	32.7	18.8	40	1	2.6
KAUP/2685	.	63	66	33.7	18.4	38	1	2.9
RENZE/R2798	.	63	64	32.7	18.5	40	1	2.5
STINE/2480	.	63	66	33.6	17.6	38	1	2.5
JACOBSEN/J971	.	62	62	33.2	17.8	46	1	2.7
JACOBSEN/J774	.	62	66	34.7	17.7	39	1	2.5
ASGROW/A2247	.	61	67	34.8	18.2	42	1	2.3
TOP FARM/TF6227	.	59	63	34.6	17.5	38	1	2.3
HY-VIGOR/2375	.	59	60	33.0	18.3	43	1	2.4
PUBLIC/JACK,III-CK*	.	53	53	33.4	18.4	51	4	2.8
	******* ENTRIES TESTED ONE YEAR *******							
MUSTANG/M-2238	.	.	72	.	.	44	1	2.3
KRUGER/K-2790	.	.	72	.	.	49	1	2.7
KAUP/2887	.	.	71	.	.	42	1	2.7
MYCOGEN/5261	.	.	71	.	.	44	1	2.6
M-W GENETICS/G2112	.	.	71	.	.	43	1	2.4
STINE/2490-1	.	.	71	.	.	38	1	2.4
KRUGER/K-2525+	.	.	71	.	.	38	1	2.4
MUSTANG/M-2218	.	.	70	.	.	41	1	2.3
HYTEST/HTX2210	.	.	70	.	.	42	1	2.3
STINE/2688	.	.	70	.	.	40	1	2.5
KRUGER/K-2242	.	.	70	.	.	46	1	2.3
MUSTANG/M-2278	.	.	69	.	.	40	1	2.5
KALTENBERG/KB268	.	.	69	.	.	38	1	2.6
KRUGER/K-2425	.	.	69	.	.	39	1	2.3
SANDS/EXP 2222	.	.	69	.	.	37	1	2.3
PROFISEED/PS2509	.	.	68	.	.	41	1	2.4
PRAIRIE BRAND/PB-237	.	.	68	.	.	39	1	2.5
LATHAM/830	.	.	68	.	.	41	1	2.6
DENBESTEN/DB2798	.	.	68	.	.	43	2	2.6
MUSTANG/E-209	.	.	68	.	.	34	1	2.3
LATHAM/EX-510	.	.	67	.	.	39	2	2.3
KRUGER/K-2303	.	.	67	.	.	37	1	2.3
GARST/EX8270	.	.	67	.	.	39	1	2.4
KRUGER/K-2022	.	.	67	.	.	36	1	2.3
MUSTANG/E-289	.	.	66	.	.	40	1	2.9

Table 4. Conventional soybeans (Continued) - Maturity group-II.

--- BRAND / ENTRY ---	--- YIELD --- 3YR	2YR	'98	-- 1997 -- ** PROT.	** OIL	--- 1998 --- HT.	$$ LDG.	## REL. MAT.
	--- bu/a		---	-- %	--	in.		
PROFISEED/PS2413	.	.	66	.	.	40	1	2.4
STINE/2788	.	.	66	.	.	37	1	2.6
KALTENBERG/KB208	.	.	66	.	.	43	1	2.3
GREAT LAKES/GL2334	.	.	66	.	.	41	1	2.3
TERRA/TS317	.	.	66	.	.	44	1	2.7
HOEGEMEYER/245	.	.	66	.	.	41	1	2.5
MUSTANG/M-2272	.	.	66	.	.	42	1	2.7
DENBESTEN/DB2098	.	.	66	.	.	43	2	2.3
DEKALB/CX295	.	.	66	.	.	42	1	2.8
GOLDEN HARVEST/X241	.	.	66	.	.	38	1	2.4
MUSTANG/E-244	.	.	66	.	.	38	1	2.4
TERRA/E248	.	.	65	.	.	41	1	2.3
GREAT LAKES/GL2451	.	.	65	.	.	40	1	2.5
RENZE/R2499	.	.	65	.	.	40	1	2.5
MYCOGEN/5287	.	.	65	.	.	39	1	2.5
SANDS/EXP 2716	.	.	65	.	.	41	1	2.6
PRAIRIE BRAND/PB-249X	.	.	65	.	.	36	1	2.4
DAIRYLAND/DST2124	.	.	65	.	.	45	1	2.3
DYNA-GRO/3252	.	.	65	.	.	39	1	2.6
KAYSTAR/K2700	.	.	65	.	.	43	1	2.6
LATHAM/710	.	.	65	.	.	38	1	2.7
LATHAM/EX-690	.	.	64	.	.	40	1	2.3
SANDS/EXP 9728	.	.	64	.	.	41	1	2.8
ASGROW/A2704	.	.	64	.	.	42	1	2.6
MYCOGEN/X58233	.	.	64	.	.	40	1	2.5
COYOTE/EX9006	.	.	64	.	.	43	1	2.5
SANDS/EXP 2435	.	.	64	.	.	39	1	2.3
LATHAM/950	.	.	64	.	.	46	2	2.7
KRUGER/K-2808+	.	.	64	.	.	39	1	2.6
MUSTANG/E-204	.	.	64	.	.	45	2	2.0
GARST/D265	.	.	64	.	.	37	1	2.9
DEKALB/CX255	.	.	64	.	.	43	1	2.5
DEKALB/CX289	.	.	64	.	.	48	2	2.6
RENZE/R2496	.	.	63	.	.	37	1	2.3
KRUGER/K-2727A	.	.	62	.	.	38	1	2.8
KALTENBERG/KB248	.	.	62	.	.	39	1	2.6
COYOTE/EX9008	.	.	62	.	.	41	1	2.4
DAIRYLAND/DST2329N	.	.	62	.	.	46	1	2.8
KALTENBERG/KB259	.	.	62	.	.	39	1	2.8
DAIRYLAND/DSR-246/STS	.	.	62	.	.	40	1	2.6

Table 4. Conventional soybeans (Continued) - Maturity group-II.

--- BRAND / ENTRY ---	--- YIELD --- 3YR	2YR	'98	-- 1997 -- ** PROT.	** OIL	--- 1998 --- HT.	$$ LDG.	## REL. MAT.
	--- bu/a ---			-- % --		in.		
CROPLAN/GENETICS L2779	.	.	62	.	.	40	1	2.6
DENBESTEN/DB2397	.	.	62	.	.	42	1	2.5
DAIRYLAND/DSR-220/STS	.	.	61	.	.	43	2	2.4
LATHAM/EX-764STS	.	.	61	.	.	44	1	2.6
MUSTANG/E-201	.	.	61	.	.	44	2	2.3
TERRA/TS247STS	.	.	61	.	.	43	2	2.4
MUSTANG/E-248	.	.	61	.	.	39	1	2.4
RENZE/R2098	.	.	61	.	.	42	1	2.2
TERRA/E298STS	.	.	61	.	.	43	1	2.8
DENBESTEN/DB2498	.	.	60	.	.	40	2	2.3
DAIRYLAND/DST2332STS	.	.	60	.	.	44	1	2.8
TERRA/TS227STS	.	.	60	.	.	42	2	2.2
DAIRYLAND/DST2333	.	.	60	.	.	38	3	2.6
KALTENBERG/KB221	.	.	59	.	.	45	2	2.4
MUSTANG/E-269	.	.	58	.	.	39	1	2.5
TEST AVERAGE:	64	62	65	33.6	18.2	41	1	
LSD(5%) VALUES($):	4	5	5					
MIN.TOP-YIELD VALUE($):	68	63	67					
COEF. OF VARIATION:	6	7	5					

* CK = maturity group check.
$Top yield - yields within one LSD value of highest yield.
$$ 1= Excellent, 5= Poor.
A scale difference of 0.1 is equal to 1.3 days in maturity.

Table 5. One- and three-year oat yield, test weight, and protein averages for 1995, 1996, and 1998.

VARIETY	'98	3-YR	'98	3-YR	'98	3-YR
	-- BU/A --		-- LBS/BU --		--- % ---	
DON	84	96+	28	32	13.3	.
GEM	113+	.	30	.	14.8	.
HYTEST	80	82+	35	38+	20.6	.
JERRY	112+	108+	33	35+	14.3	.
JIM	102	98+	30	34	13.8	.
JUD	112+	.	29	.	14.5	.
RISER	107	90+	34	36+	16.1	.
SETTLER	73	91+	28	32	14.9	.
TROY	63	83+	26	30	13.9	.
VALLEY	84	93+	27	31	13.2	.
SD93018	112+	.	34	.	14.1	.
SD93311	112+	.	33	.	14.6	.
SD94004	111	.	35	.	15.2	.
SD94152	110	.	33	.	15.1	.
SD94155	122+	.	35	.	15.2	.
SD94160	112+	.	32	.	14.9	.
SD94173	123+	.	32	.	15.1	.
SD95810HULL*	62	.	35	.	11.3	.
SD95963HULL	73	.	39+	.	17.6	.
TEST AVG.:	98	93	32	33	14.9	.
LSD (5%):	11	NS				
CV (%) :	8	7				

+ Indicates value was in the top-yield or top-test weight group within a yield or test weight column.
* Hull indicates experimental is a hulless type of oat.
# Indicates differences within a column are not significant(NS).

1998 BUMPER ALFALFA CROP
SOUTHEAST RESEARCH FARM

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Plant Science 9824

Several new alfalfa cultivars are released annually. This enables the producer to select from a wide choice of cultivars, but it also makes the decision process more difficult. The alfalfa cultivar yield trial is a tool to assist producers in identifying cultivars adapted to their specific locations and/or needs. It also allows seed companies and public breeders to test their product at various locations throughout the state.

The alfalfa cultivar yield trial was established at the Southeast Research Farm near Beresford, SD in April, 1997. Six replications of each entry were planted at 15 lbs pure live seed/acre. Fifty lbs/ac of super phosphate (P_2O_5) was applied preplant and another 30 lbs/ac were applied 9 July, 1998 according to recommendations from the South Dakota State Soil Testing Laboratory. Plots (51 ft^2) were harvested 4 times in 1998 with a sickle-type harvester to measure forage yield. Fresh herbage weights were obtained in the field immediately following plot removal. Random subsamples were taken from the fresh herbage to determine percent dry matter. Data were analyzed by analysis of variance and yield differences among cultivars were tested by the least significant difference (LSD) procedure at the 0.05 level of probability. Alfalfa cultivars were evaluated, prior to harvest, for stage of maturity using a mean-stage-by-count scheme (Table 1).

Table 1. Kalu and Fick[a] maturity index for phenological development of alfalfa.

Stage number	Stage name
0	Early vegetative
1	Mid-vegetative
2	Late vegetative
3	Early bud
4	Late bud
5	Early flower
6	Late flower
7	Early seed pod
8	Late seed pod
9	Ripe seed pod

[a]Kalu, B.A., and G. W. Fick. 1983. Quantifying morphological development of alfalfa for studies of herbage quality. Crop Sci. 21:267-271.

The 1998 growing season in Clay County produced excellent forage yields for our alfalfa cultivar yield trial. The average total alfalfa yield for the four harvests was 8.72 tons per acre and the highest yielding entry produced 9.5 tons per acre (Table 2). This trial will also be evaluated in 1999 and 2000 for forage production.

Table 2. Alfalfa forage production, Southeast Research Farm; Beresford, SD, 1998

Cultivar	8 June	9 July	17 Aug.	1 Oct.	Total
	------------ Tons Dry Matter/Acre ---------------				
Ciba 2888	3.92	2.35	2.00	1.23	9.50
Pioneer Brand 5312	3.57	2.34	2.05	1.23	9.19
Rhino	3.50	2.25	2.08	1.26	9.08
Excalibur II	3.44	2.27	2.02	1.33	9.06
Pioneer Brand 5347LH	3.61	2.26	1.98	1.15	9.00
WL 325 HQ	3.23	2.37	2.06	1.32	8.98
Rainier	3.43	2.36	1.95	1.18	8.91
Asset	3.50	2.29	1.98	1.13	8.89
Ciba 2444	3.45	2.32	2.02	1.10	8.89
DeKalb 140	3.50	2.28	1.92	1.12	8.82
Amerigraze 401 + Z	3.40	2.25	1.98	1.14	8.77
Depend + Ev	3.27	2.24	2.02	1.22	8.75
TMF Multiplier II	3.66	2.10	1.82	1.17	8.75
620	3.28	2.26	2.09	1.08	8.70
WL 324	3.34	2.25	1.89	1.22	8.70
Spartan	3.47	2.19	1.96	1.07	8.68
Avalanche +Z	3.40	2.30	1.86	1.09	8.65
631	3.33	2.23	1.92	1.08	8.56
DeKalb 127	3.44	2.15	1.88	1.08	8.56
Pioneer Brand 5454	3.38	2.22	1.84	1.07	8.52
Spur	3.56	2.16	1.67	1.14	8.52
Complete	3.10	2.27	1.96	1.14	8.46
Innovator +Z	3.23	2.25	1.86	1.02	8.36
DK 142	3.23	2.15	1.87	1.06	8.31
Vernal	3.18	2.10	1.89	0.96	8.12
Ace	2.96	2.11	1.87	1.10	8.04
Average	3.40	2.24	1.94	1.14	8.72
Maturity	4.5	4.5	3.8	3.1	
LSD (P=0.05)	0.25	0.16	0.21	NS	0.63

WEED CONTROL DEMONSTRATIONS AND EVALUATION TESTS FOR 1998

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Plant Science 9825

INTRODUCTION

Weed evaluation and extension demonstration plots provide weed control data for counties served by the Southeast Experiment Farm. The station is the major site for many corn and soybean weed control studies. The tests provide information on special local weed problems and management systems typical for producers in the area.

The tests provide data and are a source of training material for extension programs. The information is utilized in county extension meetings and for statewide programs.

1998 Evaluation/Demonstration Tests

Field tests are designed to provide comparative performance data for labeled herbicides and products that may be registered in the near future. Some tests are designed to evaluate control of specific weeds, such as cocklebur, velvetleaf, common waterhemp, and foxtail; others are designed to evaluate crop tolerance.

Plots are visually evaluated for weed control and crop response. Weed control ratings less than 70% are considered unsatisfactory; 85% control would be commercially acceptable in many situations; however at least 90-95% control is desired if seed production is to be minimized. Visual crop response ratings (VCRR) of 20% or less usually represent an acceptable level of stunting, discoloration or other effect. Ratings over 30% are considered excessive; 100% represents complete kill. Yields are harvested and reported for studies designed with replication.

Herbicide performance data in 1998 provided excellent information. Control in early planted tests was very good; rain was adequate for soil applied treatments. Conditions favored extended flush; reflected in differences between early and late evaluations. Common waterhemp emerged over a 4- to 6-week period; densities were high in many plot sites. Planting was delayed due to wet soil in some areas; weed pressure was less in these tests.

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 Resistant Corn
3. Velvetleaf Control in Corn
4. Sandbur Control in No-Till Corn
5. Cocklebur Corn Demonstration
6. Cocklebur Control in Corn
7. Postemergence Cocklebur Control in RR Corn
8. Velvetleaf Control in Corn
9. Velvetleaf Control with Aim
10. Weed Control with Balance
11. Preemergence Weed Control with Axiom in Corn
12. Weed Removal Timing in Corn
13. 1X & 3X Corn Rate - Pre
14. 1X & 3X Corn Rate - Post
15. Evaluation of Herbicide Drift on Corn
16. Effect of Day vs. Night Application
17. Soybean Herbicide Demonstration
18. Herbicide Resistant Soybean Demonstration
19. Waterhemp Control in Soybeans - Evaluation
20. Cocklebur Soybean Demonstration
21. Velvetleaf Control in Soybean Demonstration
22. Grass Product Antagonism in Soybeans
23. Pursuit vs. Roundup Timing on Soybeans
24. Postemergence Broadleaf Herbicides with Frontier - Soybeans
25. Weed Control with Sencor
26. Broadleaf Weed Control in Soybeans
27. Grass Control in Soybeans
28. Weed Removal Timing in Soybeans
29. 1X & 3X Soybean Rate - PPI/PRE
30. 1X & 3X Soybean Rate - Post

Other Herbicide Tests

Precise, small plot tests are established to evaluate experimental herbicides or to define rate comparisons. Treatments showing promise in these tests are moved forward into standard demonstration plots if industry continues development. Tests in 1998 include:

CORN

1. EPP & PRE No-Till Weed Control
2. No-Till Weed Control with Balance
3. No-Till Weed Control with Axiom
4. Velvetleaf Control with Dry Buctril
5. Weed Removal with Liberty
6. Waterhemp Control in Corn
7. Velvetleaf Control in IMI Corn
8. Velvetleaf Control with Action
9. Weed Control in Resistant Corn with Balance
10. PPI/PRE 1X & 3X Soybean Carryover to Corn
11. Post 1X & 3X Soybean Carryover to Corn
12. Weed Control with Sencor and Roundup
13. Additives with Roundup Ultra
14. Roundup Ultra Adjuvants

SOYBEANS

1. Waterhemp Control with Roundup
2. Waterhemp Control with Cobra
3. Waterhemp Control with Roundup and Cobra
4. Late Waterhemp Demonstration
5. Velvetleaf Control with Action
6. Grass Control in Soybeans
7. Weed Control in Resistant Soybeans
8. Volunteer Corn Control
9. Effect of Competition in Soybeans
10. Weed Removal Timing in Soybeans
11. Soybean Herbicide Safety
12. PPI/PRE 1X & 3X Corn Carryover to Soybeans
13. Post 1X & 3X Corn Carryover to Soybeans
14. Raptor Additives

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 agents 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. 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.***

Table 1. Corn Herbicide Demonstration

Demonstration
Variety: DeKalb 493
Planting Date: 5/9/98
PPI/PRE: 5/9/98 EPOST
EPOST: 5/28/98; Corn 2-2.5 lf; Grft 2-4 lf.
POST: 6/5/98; Corn 5 lf; Grft 3.5 lb, 2-4 in; Cowh .5-2 in.
POST1: 6/20/98; Corn 7-8 lf, 12 in; Cowh 1-4 in.
Soil: Silty clay loam; 3.2% OM; 5.9 pH

Precipitation:
PPI/PRE 1st week 0.94 inches
2nd week 0.48 inches
1st week 0.56 inches
2nd week 1.49 inches
POST 1st week 1.57 inches
2nd week 2.11 inches
POST1 1st week 0.32 inches
2nd week 0.20 inches

Grft=Green foxtail
Cowh=Common waterhemp

COMMENTS: Moderately heavy foxtail pressure; moderate common waterhemp density. Late season evaluations reflect late weed emergence. Data identify treatments that provide very good late season waterhemp control. Multi-year averages give indication of consistency.

Treatment	Rate/ac	% Grft 7/15/98	% Cowh 7/15/98	% Grft 8/21/98	% Cowh 8/21/98	2-Yr Avg. % Fxtl	2-Yr Avg. % Bdlf
Check	----	0	0	0	0	0	0
PREPLANT INCORPORATED							
Eradicane	4.75 pt	82	70	74	60	74	64
DoublePlay	5 pt	88	86	80	70	81	84
SHALLOW PREPLANT INCORPORATED							
Dual II Magnum	1.6 pt	87	78	78	58	---	---
Lasso	3 qt	84	90	76	79	72	80
Frontier	2 pt	89	89	75	68	75	76
Harness	2.3 pt	84	90	74	65	74	77
Surpass	2.5 pt	85	88	74	67	73	78
PREEMERGENCE							
Dual II Magnum	1.6 pt	91	86	78	60	78	70
Lasso	3 qt	94	90	80	76	77	80
Prowl	3.6 pt	76	79	58	60	63	68
Harness	2.3 pt	99	98	88	98	93	97
Surpass	2.5 pt	99	97	87	97	93	97
Frontier	2 pt	97	98	89	98	93	96
Axiom	22 oz	94	99	99	99	91	98
Balance	1.5 oz	96	99	86	99	80	98
Balance+Surpass	1.5 oz+1.25 pt	99	99	89	98	90	98
Python+Dual II Magnum	1 oz+1.6 pt	93	99	81	88	---	---
Axiom+atrazine	21 oz+1.1 lb	95	99	85	96	---	---
Acetochlor+atrazine	1.67 pt+1.1 lb	97	99	88	92	88	96
Lasso+atrazine	2 qt+1.1 lb	96	99	86	86	79	92
PREEMERGENCE							
Bicep Lite	4.8 pt	94	99	90	98	86	98
Optill	38 oz	97	99	96	99	---	---
BAS 656	21 oz	98	99	98	99	---	---

Table 1. Corn Herbicide Demonstration (Continued) . . .

Treatment	Rate/ac	% Grft 7/15/98	% Cowh 7/15/98	% Grft 8/21/98	% Cowh 8/21/98	2-Yr Avg. % Fxtl	2-Yr Avg. % Bdlf
PREEMERGENCE & POSTEMERGENCE(1)							
Ramrod&Clarity	4 qt&1 pt	86	99	80	98	---	---
Ramrod&Banvel	4 qt&.5 pt	82	98	74	95	62	97
Ramrod&2,4-D amine	4 qt&1 pt	80	96	70	76	63	81
Ramrod&Buctril	4 qt&1.5 pt	82	96	75	88	60	93
Ramrod&Buctril+atrazine	4 qt&1 pt+.56 lb	86	98	80	98	68	99
Ramrod&Sen/Lex+atrazine	4 qt&2 oz+.56 lb	88	99	82	96	63	98
Ramrod&Laddok S-12+ COC+28% N	4 qt&1.67 pt+ 1 qt+1 qt	86	97	80	95	---	---
Ramrod&Shotgun	4 qt&3 pt	84	98	79	96	68	97
Ramrod&Permit+X-77	4 qt&.67 oz+.5%	80	95	78	96	60	97
Ramrod&Beacon+ COC+28% N	4 qt&.76 oz+ 1 qt+4 qt	95	97	79	74	---	---
Ramrod&Hornet+ X-77+28% N	4 qt&2.4 oz+ .25%+2.5%	82	98	77	80	64	90
Ramrod&Resource+ atrazine+COC+28% N	4 qt&4 oz+ .56 oz+1 pt+2 qt	85	99	73	94	72	96
Ramrod&Aim+ atrazine+X-77	4 qt&.33 oz+ .56 lb+.25%	88	99	76	82	---	---
Ramrod&Distinct+ X-77+28% N	4 qt&6 oz+ .25%+1.25%	92	99	83	86	---	---
Dual II Magnum&Marksman	1.33 pt&2.5 pt	97	99	86	80	---	---
Surpass&Hornet+ X-77+28% N	2.5 pt&2.4 oz+ .25%+2 qt	98	99	91	99	---	---
Surpass&Hornet+Clarity+ X-77+28% N	2.5 pt&2.4 oz+4 oz+ .25%+2.5%	96	99	94	99	---	---
Dual II Magnum& Northstar+ X-77+28% N	1.67 pt& 4.75 oz+ .25%+2 qt	93	98	95	99	---	---
Dual II Magnum+atrazine& Northstar+X-77+ 28% N	1.67 pt+.75 lb& 4.75 oz+.25%+ 2 qt	94	99	93	99	---	---
Balance&Buctril/atrazine	1.5 oz&32 oz	90	99	80	97	---	---
Axiom&Sen/Lex+Clarity	21 oz&2 oz+.67 pt	94	98	81	99	---	---
PREEMERGENCE & POSTEMERGENCE							
Surpass&Accent+ COC+28% N	1.25 pt&.67 oz+ 1%+4 qt	98	97	84	94	93	97
Surpass&Accent+ COC+28% N	1.25 pt&.33 oz+ 1%+4 qt	97	98	83	92	---	---
Surpass&Basis Gold+ Clarity+COC+28% N	1 pt&14 oz+ 2 oz+1%+4 qt	99	99	90	99	---	---
Prowl&Accent+ Clarity+X-77+28% N	3 pt&.67 oz+ .5 pt+.25%+4 qt	98	99	85	98	87	97

Table 1. Corn Herbicide Demonstration (Continued) . . .

Treatment	Rate/ac	% Grft 7/15/98	% Cowh 7/15/98	% Grft 8/21/98	% Cowh 8/21/98	2-Yr Avg. % Fxtl	2-Yr Avg. % Bdlf
EARLY POSTEMERGENCE							
Prowl+Marksman	3.6 pt+2.5 pt	84	95	70	96	60	97
Basis+COC+28% N	.33 oz+1%+2 qt	91	96	75	85	66	92
Basis+Shotgun+ COC+28% N	.33 oz+3 pt+ 1%+2 qt	95	98	79	95	---	---
Basis Gold+COC+28% N	14 oz+1%+4 qt	94	99	83	98	---	---
Basis Gold+Harness+ Clarity+COC+28% N	14 oz+1 pt+ 2 oz+1%+4 qt	98	98	90	98	---	---
Prowl+Accent+Clarity+ X-77+28% N	3 pt+.33 oz+.5 pt+ .25%+4 qt	96	99	88	90	79	93
Frontier+Accent+Clarity+ X-77+28% N	1.25 pt+.3 oz+1 pt+ .25%+4 qt	97	98	83	87	78	92
POSTEMERGENCE							
Accent+COC+28% N	.67 oz+1%+4 qt	95	93	75	30	79	54
Accent+Northstar+ COC+28% N	.33 oz+3.5 oz+ 2 pt+2 qt	92	98	78	45	---	---
Accent+Buctril/atrazine+ X-77+28% N	.67 oz+2 pt+ .25%+2 qt	94	98	86	95	82	97
Accent+atrazine+ COC+28% N	.67 oz+.56 lb+ 1%+2 qt	91	99	79	50	82	74
Accent+Hornet+ atrazine+COC+ 28% N	.67 oz+2.4 oz+ .833 lb+.25%+ 2.5%	94	98	86	98	---	---
Accent+Beacon+ Clarity+X-77+28% N	.33 oz+.38 oz+ 2 oz+1 pt+4 qt	95	98	90	38	89	68
Accent Gold+COC+ 28% N	2.9 oz+1%+ 4 qt	98	99	93	58	---	---
Accent Gold+atrazine+ COC+28% N	2.9 oz+.56 lb+ 1%+4 qt	97	98	95	87	---	---
Tough+Accent+Beacon+ COC+28% N	1 pt+.33 oz+.38 oz+ 1%+4 qt	96	98	92	45	86	71
LSD (.05)		---	---	---	---	12	12

Table 2. Herbicide Resistant Corn

Demonstration
Variety: See comments
Planting Date: 5/9/98
PRE: 5/9/98
EPOST: 5/28/98; Corn 2-2.5 lf; Grft 2-4 lf.
POST: 6/5/98; Corn 5 lf; Grft 3.5 lf, 2-4 in; Cowh .5-2 in.
Soil: Silty clay loam; 3.2% OM; 5.9 pH

Precipitation:

PRE	1st week	0.94 inches
	2nd week	0.48 inches
EPOST	1st week	0.56 inches
	2nd week	1.49 inches
POST	1st week	1.57 inches
	2nd week	2.11 inches

Grft=Green foxtail
Cowh=Common waterhemp

COMMENTS: Varieties planted: DK493SR, DK493RR, Legend 7597T, and Legend 6889LL. Demonstration to compare weed control approaches with transgenic corn. Excellent early control; grass control diminished somewhat with some treatments; common waterhemp control reduced considerably due to late weed emergence if residual control was inadequate whole plot yield as indication of response to weed control.

Treatment	Rate/ac	% Grft 7/15/98	% Cowh 7/15/98	% Grft 8/21/98	% Cowh 8/21/98	Yield % of Max
	LIBERTY LINK CORN					
Check	----	0	0	0	0	2.7
EARLY POSTEMERGENCE						
Liberty+AMS	20 oz+3 lb	97	98	60	10	80.4
Atrazine+Liberty+AMS	1.5 pt+20 oz+3 lb	95	99	86	84	100.0
Liberty(3X)+AMS	84 oz+3 lb	98	99	79	35	95.3
POSTEMERGENCE						
Liberty+AMS	28 oz+3 lb	94	97	68	20	77.7
PREEMERGENCE & POSTEMERGENCE						
Atrazine&Liberty+AMS	1.5 pt&20 oz+3 lb	91	98	69	72	71.6
Surpass&Liberty+AMS	1.67 pt&20 oz+3 lb	97	98	92	90	91.9
EARLY POSTEMERGENCE & POSTEMERGENCE						
Liberty+AMS& Liberty+AMS	20 oz+3 lb& 20 oz+3 lb	97	98	80	68	95.3
	IMI CORN					
Check	----	0	0	0	0	52.8
PREEMERGENCE & POSTEMERGENCE						
Prowl&Resolve SG+ X-77+28% N	3.6 pt&5.3 oz+ .25%+2 qt	97	98	95	97	91.7
Surpass&Resolve SG+ X-77+28% N	1.5 pt&5.3 oz+ .25%+2 qt	98	99	92	98	97.9

Table 2. Herbicide Resistant Corn (Continued) . . .

Treatment	Rate/ac	% Grft 7/15/98	% Cowh 7/15/98	Yield % Grft 8/21/98	% Cowh 8/21/98	% of Max
	IMI CORN (Continued) . . .					
EARLY POSTEMERGENCE						
Lightning+Sun-It II+ 28% N	1.28 oz+1.5 pt+ 1 qt	94	96	91	20	97.9
Lightning+atrazine+ Sun-It II+28% N	1.28 oz+.56 lb+ 1.5 pt+1 qt	96	99	92	80	100.0
Lightning(3X)+atrazine+ Sun-It II+28% N	3.84 oz+.56 lb+ 1.5 pt+1 qt	98	99	99	92	95.1
POSTEMERGENCE						
Lightning+Sun-It II+ 28% N	1.28 oz+1.5 pt+ 1 qt	96	92	94	25	95.1
	SR CORN					
Check	----	0	0	0	0	67.4
PREEMERGENCE & POSTEMERGENCE						
Frontier&Poast Plus+ Laddok S-12+COC+28% N	20 oz&1.5 pt+ 1.67 pt+1 qt+2 qt	96	98	92	89	97.1
Frontier&Poast Plus+ Clarity+COC+28% N	20 oz&1.5 pt+ 1 pt+1 qt+2 qt	98	98	88	84	93.0
EARLY POSTEMERGENCE						
Frontier+Poast Plus+ Laddok S-12+COC+ 28% N	20 oz+1.5 pt+ 1.67 pt+1 qt+ 2 qt	94	95	84	77	92.4
Poast Plus+Laddok S-12+ COC+28% N	1.5 pt+1.67 pt+ 1 qt+2 qt	95	91	82	75	97.1
Poast Plus(3X)+ Laddok S-12+ COC+28% N	4.5 pt+ 1.67 pt+ 1 qt+2 qt	96	92	84	38	100.0
	ROUNDUP READY CORN					
Check	----	0	0	0	0	64.0
PREEMERGENCE & POSTEMERGENCE						
Harness&Roundup Ultra+ AMS	1 pt+1 qt+ 8.5 lb/100 gal	99	98	90	84	100.0
EARLY POSTEMERGENCE & POSTEMERGENCE						
Roundup Ultra+AMS& Roundup Ultra+AMS	1 pt+8.5 lb/100 gal& 1 pt+8.5 lb/100 gal	97	98	78	48	93.8
EARLY POSTEMERGENCE						
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal	91	91	70	40	94.4
POSTEMERGENCE						
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal	97	88	74	45	84.3
Roundup Ultra(3X)+AMS	3 qt+8.5 lb/100 gal	98	88	75	48	89.3

Table 3. Velvetleaf Control in Corn

RCB; 2 reps
Variety: Legend 7595T
Planting Date: 5/18/98
PPI/PRE: 5/18/98
POST: 6/26/98; Corn 6 lf; Vele 2-4 lf.
POST1: 7/9/98; Corn 30 in; Vele 6-8 lf.
Soil: Silty clay loam; 3.0% OM; 6.9 pH

Precipitation:

PPI/PRE	1st week	0.48 inches
	2nd week	0.24 inches
POST	1st week	0.20 inches
	2nd week	1.70 inches
POST1	1st week	0.16 inches
	2nd week	0.31 inches

Grft=Green foxtail
Vele=Velvetleaf

COMMENTS: Moderate velvetleaf density. Control was excellent for most treatments; 36 treatments provided at least 90% control in 1998.

Treatment	Rate/ac	% Grft 8/24/98	% Vele 8/24/98	3 Yr Avg. % Vele
Check	----	0	0	0
PREPLANT INCORPORATED				
Eradicane+atrazine	5 pt+1.1 lb	92	90	82
Contour	1.33 pt	95	97	96
Atrazine	2.2 lb	93	97	88
SHALLOW PREPLANT INCORPORATED				
Dual II Magnum+Python	1.67 pt+1 oz	97	99	---
PREEMERGENCE				
Pursuit DG+Scepter DG+Dual II	2.14 oz+.72 oz+2.5 pt	98	98	---
Dual II+atrazine	2 pt+2.2 lb	98	93	86
Dual II+atrazine	2 pt+1.1 lb	98	85	71
Balance	1.5 oz	99	99	---
PREEMERGENCE & POSTEMERGENCE				
Balance&Buctril+atrazine	1.5 oz&1 pt+.56 lb	99	99	---
PREEMERGENCE				
Axiom	21 oz	98	95	89
Axiom+atrazine	21 oz+1.1 lb	99	99	---
POSTEMERGENCE				
Accent+atrazine+Scoil+28% N	.67 oz+.56 lb+1%+4 qt	98	91	---
PREEMERGENCE & POSTEMERGENCE				
Ramrod&Resolve SG+X-77+28% N	5 qt&5.33 oz+.25%+1 qt	99	98	---
Ramrod&atrazine+COC	5 qt&1.1 lb+1 qt	99	92	79
Ramrod&Tough+atrazine+COC	5 qt&1 pt+1.1 lb+1 qt	99	88	---
Ramrod&atrazine+COC	5 qt&2.2 lb+1 qt	99	98	89
Ramrod&Distinct+X-77+28% N	5 qt&6 oz+.25%+2.5%	99	91	---

Table 3. Velvetleaf Control in Corn (Continued) . . .

Treatment	Rate/ac	% Grft 8/24/98	% Vele 8/24/98	3 Yr Avg. % Vele
PREEMERGENCE & POSTEMERGENCE				
Ramrod&Clarity	5 qt&1 pt	96	97	89
Ramrod&Marksman	5 qt&3 pt	96	96	89
Ramrod&Buctril/atrazine	5 qt&2 pt	94	96	84
Ramrod&Laddok S-12+28% N	5 qt&1.66 pt+4 qt	97	99	94
Ramrod&Shotgun	5 qt&3 pt	95	98	---
Ramrod&2,4-D amine	5 qt&1 pt	98	92	91
Ramrod&Buctril	5 qt&1.5 pt	95	92	86
Ramrod&Beacon+X-77+28% N	5 qt&.76 oz+1%+4%	98	86	66
Ramrod&Sen/Lex+2,4-D amine	5 qt&2 oz+.5 pt	92	86	84
PREEMERGENCE & POSTEMERGENCE & POSTEMERGENCE(1)				
Ramrod&Buctril/atrazine&Buctril	5 qt&2 pt&1 pt	92	97	96
PREEMERGENCE & POSTEMERGENCE				
Ramrod&Permit+X-77	5 qt&.67 oz+.25%	95	95	78
Ramrod&Resource+COC	5 qt&4 oz+1 qt	93	91	85
Ramrod&Sen/Lex+Buctril	5 qt&2 oz+1 pt	92	96	92
Ramrod&Hornet+X-77+28% N	5 qt&2.4 oz+.25%+2.5%	93	96	---
Ramrod&Lightning+atrazine+ Sun-It II+28% N	5 qt&1.28 oz+.56 lb+ 1.5 pt+1 qt	98	98	---
Ramrod&Hornet+atrazine+ COC+28% N	5 qt&2.4 oz+.56 lb+ 1%+2.5%	93	98	---
Ramrod&Action+COC	5 qt&1.5 oz+1 qt	94	98	98
Ramrod&Resource+atrazine+ COC+28% N	5 qt&4 oz+.56 lb+ 1 qt+2 qt	96	93	87
Ramrod&Aim+atrazine+X-77	5 qt&.32 oz+.56 lb+.25%	92	95	---
Ramrod&Northstar+X-77+28% N	5 qt&4.75 oz+.25%+4 qt	96	97	---
Ramrod&Accent Gold+ atrazine+COC+28% N	5 qt&2.9 oz+ .56 lb+1%+2 qt	99	98	---
PREEMERGENCE & POSTEMERGENCE(1)				
Ramrod&Aim+atrazine+X-77	5 qt&.32 oz+.56 lb+.25%	94	62	---
Ramrod&Banvel	5 qt&.5 pt	93	86	70
Ramrod&Resource+COC	5 qt&8 oz+1 qt	95	93	---
Ramrod&Action+COC	5 qt&1.5 oz+1 qt	95	98	97
Ramrod&Lightning+atrazine+ Sun-It II+28% N	5 qt&1.28 oz+.56 lb+ 1.5 pt+1 qt	95	84	---
LSD (.05)		5	11	10

Table 4. Sandbur Control in No-Till Corn

RCB; 3 reps
Variety: See comments
Planting Date: 5/22/98
PRE: 5/22/98
EPOST: 6/22/98; Corn 5 lf; Fisb 2-4 in.
POST: 7/1/98; Corn 8 lf; Fisb 2-5 in.
Soil: Clay; 3.0% OM; 7.8 pH

Precipitation:

PRE	1st week	0.28 inches
	2nd week	0.56 inches
EPOST	1st week	0.36 inches
	2nd week	1.86 inches
POST	1st week	1.86 inches
	2nd week	0.12 inches

Fisb=Field sandbur

COMMENTS: Varieties planted were DeKalb 493SR, 493GR, 493RR, and Legend 7595T. Study was established in no-till. Moderate sandbur density. Several split postemergence or preemergence followed by postemergence treatments provided excellent control. Limited precipitation the first week after preemergence application; heavy rain the second week.

Treatment	Rate/ac	% Fisb 8/25/98
Check	----	0
PREEMERGENCE		
Dual II Magnum	1.6 pt	40
Harness	2.3 pt	36
Frontier	2 pt	42
Balance	2 oz	42
Balance+Surpass	1.5 oz+1.25 pt	48
PREEMERGENCE & POSTEMERGENCE		
Surpass&Accent+COC+28% N	2.5 pt&.67 oz+1%+4 qt	93
EARLY POSTEMERGENCE & POSTEMERGENCE		
Prowl+Accent+COC+28% N& Accent+COC+28% N	3.6 pt+.67 oz+1%+4 qt& .33 oz+1%+4 qt	96
Accent+COC+28% N& Accent+COC+28% N	.33 oz+1%+4 qt& .67 oz+1%+4 qt	96
POSTEMERGENCE		
Accent Gold+COC+28% N	2.9 oz+1%+4 qt	70
	SR CORN	
PREEMERGENCE & POSTEMERGENCE		
Frontier&Poast Plus+Laddok S-12+ COC+28% N	20 oz&1.5 pt+1.67 pt+ 1 qt+2 qt	96
EARLY POSTEMERGENCE		
Frontier+Poast Plus+Laddok S-12+ COC+28% N	20 oz+1.5 pt+1.67 pt+ 1 qt+2 qt	66
PREEMERGENCE & EARLY POSTEMERGENCE & POSTEMERGENCE		
Frontier&Clarity&Poast Plus+ COC+28% N	20 oz&1 pt&1.5 pt+ 1 qt+2 qt	98

Table 4. Sandbur Control in No-Till Corn (Continued) . . .

Treatment	Rate/ac	% Fisb 8/25/98
POSTEMERGENCE		
Poast Plus+Laddok S-12+COC+28% N	1.5 pt+1.67 pt+1 qt+2 qt	90
EARLY POSTEMERGENCE & POSTEMERGENCE		
Poast Plus+Laddok S-12+COC+28% N&	1 pt+1.67 pt+1 qt+2 qt&	
Poast Plus+COC+28% N	1 pt+1 qt+2 qt	98
	LIBERTY LINK CORN	
PREEMERGENCE & POSTEMERGENCE		
Dual II Magnum&Liberty+AMS	1.6 pt&28 oz+3 lb	90
Surpass&Liberty+AMS	1.5 pt&28 oz+3 lb	81
POSTEMERGENCE		
Liberty+AMS	28 oz+3 lb	77
EARLY POSTEMERGENCE& POSTEMERGENCE		
Liberty+AMS&Liberty+AMS	16 oz+3 lb&16 oz+3 lb	71
	IMI CORN	
PREEMERGENCE & POSTEMERGENCE		
Prowl&Lightning+Banvel+Sun-It II+AMS	3 pt&1.28 oz+6 oz+1.5 pt+1 qt	96
EARLY POSTEMERGENCE		
Prowl+Lightning+Sun-It II+28% N	3 pt+1.28 oz+1.5 pt+1 qt	98
PREEMERGENCE & POSTEMERGENCE		
Surpass&Lightning+Sun-It II+28% N	1.5 pt&1.28 oz+1.5 pt+1 qt	99
EARLY POSTEMERGENCE		
Lightning+Sun-It II+28% N	1.28 oz+1.5 pt+1 qt	93
	ROUNDUP READY CORN	
PREEMERGENCE & POSTEMERGENCE		
Harness&Roundup Ultra+AMS	1.5 pt&1 qt+8.5 lb/100 gal	99
POSTEMERGENCE		
Harness+Roundup Ultra+AMS	2.3 pt+1 qt+8.5 lb/100 gal	99
EARLY POSTEMERGENCE & POSTEMERGENCE		
Roundup Ultra+AMS&	1 pt+8.5 lb/100 gal&	
Roundup Ultra+AMS	1 pt+8.5 lb/100 gal	99
POSTEMERGENCE		
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal	99
LSD (.05)		7

Table 5. Cocklebur Corn Demonstration

Demonstration
Variety: DeKalb 493RR
Planting Date: 5/9/98
PRE: 5/9/98
POST: 6/20/98; Corn 15 in; Cocb 6-10 in.
POST1: 7/2/98

Soil: Loam; 2.9% OM; 6.5 pH

Precipitation:		
PRE	1st week	0.94 inches
	2nd week	0.48 inches
POST	1st week	0.32 inches
	2nd week	0.20 inches
POST1	1st week	1.70 inches
	2nd week	0.16 inches

Cocb=Common cocklebur

COMMENTS: Heavy cocklebur density, RR corn. Seven treatments provided 95% or greater control in late season.

Treatment	Rate/ac	% Cocb 7/24/98	% Cocb 9/23/98	2 Yr Avg. % Cocb
Check	----	0	0	0
PREEMERGENCE				
Python+Ramrod	1 oz+4 qt	40	68	---
Harness Extra 5.6L	1.6 qt	40	58	---
Axiom+atrazine	23 oz+1.1 lb	50	70	---
Bicep Lite II Magnum+Sen/Lex	1.6 qt+2 oz	55	65	---
PREEMERGENCE & POSTEMERGENCE				
Harness&Roundup Ultra+AMS	1 pt&1 qt+8.5 lb/100 gal	93	79	---
Harness Xtra 5.6L+Roundup+AMS	1.6 qt&1 qt+8.5 lb/100 gal	88	86	---
PREEMERGENCE & POSTEMERGENCE & POSTEMERGENCE(1)				
Harness&Roundup Ultra+AMS& Roundup Ultra+AMS	1 pt&1 pt+8.5 lb/100 gal& 1 pt+8.5 lb/100 gal	98	99	---
POSTEMERGENCE				
Buctril	1 pt	65	77	74
Buctril/atrazine	2.25 pt	94	94	86
Sen/Lex+Buctril	2 oz+1 pt	78	78	---
Clarity	.5 pt	98	98	---
Marksman	2.75 pt	98	99	---
Shotgun	3 pt	97	98	98
Beacon+Peak+X-77+28% N	.576 oz+.25 oz+.25%+2.5%	93	96	---
Permit+X-77	1 oz+.5%	88	92	97
Beacon+COC+28% N	.76 oz+1 qt+4 qt	84	84	91
Hornet+X-77+28% N	2.4 oz+.25R+2.5%	95	99	99
2,4-D amine	1 pt	88	85	77
2,4-D ester	8 oz	78	76	---
Laddok S-12+COC+28% N	2.33 pt+1 qt+1 qt	80	70	76
Northstar+X-77+28% N	5 oz+.25%+4 qt	89	94	---
Distinct+X-77+28% N	6 oz+.25%+2.5%	97	95	---
LSD (.05)		---	---	12

Table 6. Cocklebur Control in Corn

RCB; 3 reps
Variety: DeKalb 493SR
Planting Date: 5/22/98
POST: 6/22/98; Corn 5 lf; Cocb 4-8 in; Pesw 2-3 in.
LPOST: 7/9/98; Corn 24-30 in; Cocb 10-12 in; Pesw 3-5 in.
Soil: Clay; 3.1% OM; 7.1 pH

Precipitation:

POST	1st week	0.36 inches
	2nd week	1.86 inches
LPOST	1st week	0.16 inches
	2nd week	0.31 inches

VCRR=Visual Crop Response Rating (0=no injury; 100=complete kill)
Cocb=Cocklebur
Pesw=Pennsylvania smartweed

COMMENTS: Heavy cocklebur density. Dual II Magnum applied to entire plot area. Excellent cocklebur control at both stages. Late season smartweed control was very good to excellent. Treatments with reduced late season smartweed ratings tended to have lower corn yield.

Treatment	Rate/ac	% VCRR 8/13/98	% Cocb 9/23/98	% Pesw 9/23/98	Yield bu/ac
Check	----	0	0	0	98
POSTEMERGENCE					
Marksman+28% N	3 pt+2.5%	8	97	97	110
Clarity+28% N	1 pt+2.5%	8	99	97	99
Distinct+X-77+28% N	6 oz+.25%+1.25%	3	99	99	111
Buctril/atrazine	1 qt	0	99	98	117
Beacon+Peak+X-77+28% N	.57 oz+.25 oz+.25%+2.5%	3	98	90	100
Northstar+X-77+28% N	5 oz+.25%+2.5%	3	99	95	111
Hornet+X-77+28% N	2.5 oz+.25%+2.5%	2	99	93	109
Laddok S-12+28% N	1.67 pt+2.5%	2	98	99	113
LATE POSTEMERGENCE					
Distinct+X-77+28% N	4 oz+.25%+1.25%	2	99	89	106
Hornet+X-77+28% N	2.5 oz+.25%+2.5%	0	98	92	96
Beacon+Peak+X-77+28% N	.57 oz+.25 oz+.25%+2.5%	3	96	93	110
Northstar+X-77+28% N	5 oz+.25%+2.5%	0	98	98	112
LSD (.05)		6	2	8	9

Table 7. Postemergence Cocklebur Control in RR Corn

RCB; 3 reps
Variety: DeKalb 493RR
Planting Date: 5/9/98
PRE: 5/9/98
POST: 6/20/98; Corn 12-15 in; Cocb 6-10 in.
Soil: Loam; 2.9% OM; 6.5 pH

Precipitation:

PRE	1st week	0.94 inches
	2nd week	0.48 inches
POST	1st week	0.32 inches
	2nd week	0.20 inches

Cocb=Common cocklebur

COMMENTS: Very heavy cocklebur density. Several treatments provided excellent control into late season. Atrazine in the preemerge treatment or Hornet with Roundup postemerge provided consistently high late season control.

Treatment	Rate/ac	% Cocb 7/6/98	% Cocb 7/24/98	% Cocb 9/23/98	Yield bu/ac
Check	----	0	0	0	90
PREEMERGENCE & POSTEMERGENCE					
Harness&Roundup Ultra+ X-77+AMS	1.33 pt&.5 pt+ .25%+1.5%	83	73	58	149
Harness&Roundup Ultra+ X-77+AMS	1.33 pt&.75 pt+ .25%+1.5%	93	75	65	151
Harness&Roundup Ultra+ X-77+AMS	1.33 pt&1 pt+ .25%+1.5%	93	81	66	145
Harness&Roundup Ultra+ X-77+AMS	1.33 pt&1.5 pt+ .25%+1.5%	94	81	69	157
Harness&Hornet+Roundup Ultra+ X-77+AMS	1.33 pt&1.6 oz+.5 pt+ .25%+1.5%	98	98	98	140
Harness&Hornet+Roundup Ultra+ X-77+AMS	1.33 pt&1.6 oz+.75 pt+ .25%+1.5%	98	96	97	148
Harness&Hornet+Roundup Ultra+ X-77+AMS	1.33 pt&1.6 oz+1 pt+ .25%+1.5%	97	96	97	145
Harness&Hornet+Roundup Ultra+ X-77+AMS	1.33 pt&1.6 oz+1.5 pt+ .25%+1.5%	97	98	98	148
Harness&Hornet+Roundup Ultra+ X-77+AMS	1.33 pt&2.4 oz+.5 pt+ .25%+1.5%	99	98	97	143
Harness&Hornet+Roundup Ultra+ X-77+AMS	1.33 pt&2.4 oz+.75 pt+ .25%+1.5%	99	98	99	149
Harness&Hornet+Roundup Ultra+ X-77+AMS	1.33 pt&2.4 oz+1 pt+ .25%+1.5%	99	98	97	147
Harness&Hornet+Roundup Ultra+ X-77+AMS	1.33 pt&2.4 oz+1.5 pt+ .25%+1.5%	97	96	97	144
Harness&Hornet+AMS	1.33 pt&1.5 pt+1.5%	94	82	71	150
Harness&Hornet+atrazine+ X-77+AMS	1.33 pt&2.4 oz+1.5 pt+ .25%+1.5%	99	98	99	150
PREEMERGENCE					
Harness Xtra 5.6L	1.33 qt	27	27	30	133

Table 7. Postemergence Cocklebur Control in RR Corn (Continued) . . .

Treatment	Rate/ac	% Cocb 7/6/98	% Cocb 7/24/98	% Cocb 9/23/98	Yield bu/ac
PREEMERGENCE & POSTEMERGENCE					
Harness Xtra&	1.33 qt&				
Roundup Ultra+AMS	1.5 pt+1.5%	98	91	89	147
Harness Xtra&Hornet+	1.33 qt&1.6 oz+				
Roundup Ultra+X-77+AMS	.75 pt+.25%+1.5%	98	98	98	153
Harness Xtra&Hornet+	1.33 qt&2.4 oz+				
Roundup Ultra+X-77+AMS	.75 pt+.25%+1.5%	98	98	98	146
Harness Xtra&Hornet+Banvel+	1.33 pt&2.4 oz+4 oz+				
X-77+AMS	.25%+1.5%	98	98	97	144
Harness&Beacon+Banvel+	1.33 pt&.38 oz+3 oz+				
X-77+AMS	.25%+1.5%	97	93	91	131
Harness&Hornet+	1.33 pt&4.8 oz+				
Roundup Ultra+X-77+AMS	3 pt+.5%+3%	99	98	99	141
Harness&Roundup Ultra	1.33 pt&3 pt	91	76	63	141
LSD (.05)		7	9	8	11

Table 8. Velvetleaf Control in Corn

RCB; 4 reps
Variety: DeKalb 493
Planting Date: 5/9/98
POST: 6/26/98; Corn 20 in; Vele 4-8 lf.
Soil: Silty clay loam; 3.4% OM; 6.3 pH

Precipitation: 1st week 0.20 inches
2nd week 1.70 inches

Grft=Green foxtail
Vele=Velvetleaf

COMMENTS: Dual II Magnum applied over plot area. Moderate velvetleaf; light foxtail density; Distinct and Hornet treatments tended to improve velvetleaf control when compared to Banvel alone. No differential crop response noted; yields were similar for all treatments.

Treatment	Rate/ac	% Grft 7/29/98	% Vele 7/29/98	Yield bu/ac
Check	----	86	0	135
POSTEMERGENCE				
Distinct+X-77+28% N	3 oz+.25%+1.25%	97	95	142
Distinct+X-77+28% N	6 oz+.25%+1.25%	94	92	132
Banvel+X-77+28% N	4 oz+.25%+1.25%	86	83	137
Banvel+X-77+28% N	8 oz+.25%+1.25%	93	85	135
Hornet+X-77+28% N	2.4 oz+.25%+2.5%	93	90	130
Hornet+Banvel+X-77+28% N	2.4 oz+4 oz+.25%+2.5%	92	87	132
Hornet+atrazine+COC+28% N	2.4 oz+.5 pt+1%+2.5%	94	89	125
LSD (.05)		7	8	15

Table 9. Velvetleaf Control with Aim

RCB; 3 reps
Variety: DeKalb 493
Planting Date: 5/9/98
PRE: 5/9/98
POST: 6/22/98; Corn 15 in; Grft 5-7 in;
Vele 4-6 lf.

Precipitation:

PRE	1st week	0.94 inches
	2nd week	0.48 inches
POST	1st week	0.36 inches
	2nd week	1.86 inches

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

Grft=Green foxtail
Vele=Velvetleaf

COMMENTS: Purpose to evaluate velvetleaf control with Aim. Broadleaf emergence delayed; grass exceeded optimum size for some post grass treatments. Velvetleaf control was very good to excellent with most treatments. No differential crop response was noted.

Treatment	Rate/ac	% VCRR 7/29/98	% Grft 7/29/98	% Vele 7/29/98
PREEMERGENCE				
Check+Ramrod	4 qt	0	0	0
PREEMERGENCE & POSTEMERGENCE				
Ramrod&Aim+X-77	4 qt&.33 oz+.25%	0	89	88
Ramrod&Aim+atrazine+X-77	4 qt&.33 oz+1 pt+.25%	0	91	87
Ramrod&Aim+Clarity+X-77	4 qt&.33 oz+4 oz+.25%	3	85	91
Ramrod&Aim+atrazine+ Clarity+X-77	4 qt&.33 oz+1 pt+ 3 oz+.25%	0	89	96
Ramrod&Aim+atrazine+X-77	4 qt&.33 oz+1 qt+.25%	0	93	90
POSTEMERGENCE				
Aim+Accent+X-77	.33 oz+.67 oz+.25%	0	25	95
Aim+Beacon+X-77	.33 oz+.4 oz+.25%	0	17	97
PREEMERGENCE & POSTEMERGENCE				
Ramrod&Aim+Marksman+X-77	4 qt&.33 oz+2 pt+.25%	0	92	98
Ramrod&Aim+Hornet+X-77	4 qt&.33 oz+3.2 oz+.25%	0	94	94
POSTEMERGENCE				
Aim+Basis Gold+X-77	.33 oz+14 oz+.25%	0	15	98
LSD (.05)		3	10	8

Table 10. Weed Control with Balance

RCB; 4 reps
Variety: DeKalb 493RR
Planting Date: 5/19/98
PRE: 5/19/98
Soil: Silty clay; 4.2% OM; 7.3 pH

Precipitation: 1st week 0.48 inches
2nd week 0.24 inches

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

COMMENTS: Light foxtail density; common waterhemp 13/ft^2. Grass and waterhemp control was excellent with all treatments; yields were similar.

Treatment	Rate/ac	% VCRR 7/24/98	% Yeft 7/24/98	% Cowh 7/24/98	Yield bu/ac
Check	----	0	0	0	124
PREEMERGENCE					
Balance	1.5 oz	4	97	98	148
Balance+atrazine	1.5 oz+24 oz	3	99	98	151
Balance+Bicep II	1.5 oz+24 oz	0	98	99	146
Balance+Harness Extra 5.6L	1.5 oz+26 oz	3	98	99	147
Balance+Fultime	1.5 oz+40 oz	3	98	99	143
Balance+Dual II Magnum	1.5 oz+.835 pt	0	97	99	148
Balance+Harness	1.5 oz+18 oz	0	98	99	147
Balance+TopNotch	1.5 oz+32 oz	0	97	99	146
Harness	37 oz	3	92	97	144
Balance	2 oz	3	98	99	143
LSD (.05)		4	2	1	13

Table 11. Preemergence Weed Control with Axiom in Corn

RCB; 4 reps
Variety: DeKalb 493
Planting Date: 5/19/98
PRE: 5/19/98
Soil: Silty clay loam; 3.7% OM; 6.8 pH

Precipitation: 1st week 0.48 inches
2nd week 0.24 inches

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

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

COMMENTS: Light grass, moderate common waterhemp density. Treatments provided excellent control; yield for treatments were similar.

Treatment	Rate/ac	% VCRR 7/22/98	% Grft 7/22/98	% Cowh 7/22/98	% Pesw 7/22/98	Yield bu/ac
Check	----	0	0	0	0	128
Axiom	21 oz	1	98	95	82	154
Axiom	23 oz	0	99	94	86	159
USA 1000	15 oz	0	99	99	96	155
Axiom+Balance	11.5 oz+2 oz	0	99	98	93	158
Axiom+atrazine	21 oz+1 lb	0	99	99	96	151
USA 1000+atrazine	11 oz+.83 lb	3	99	99	99	165
LSD (.05)		3	1	4	10	14

Table 12. Weed Removal Timing in Corn

RCB; 4 reps
Variety: DK493RR, Legend 296LL
Planting Date: 5/19/98
PRE: 5/19/98
2 WKS: 6/5/98; Corn 2 lf; Grft 2-3 lf; Cowh .5-1 in.
3 WKS: 6/20/98; Corn 5 lf, 8 in; Grft 2-4 in; Cowh 2-2.5 in.
4 WKS: 6/26/98; Corn 6 lf; Grft 6 in; Cowh 3-5 in.
5 WKS: 7/3/98; Corn 8 lf; Grft 7-10 in; Cowh 4-8 in.
Soil: Silty clay; 3.9% OM; 7.0 pH

Precipitation:

PRE	1st week	0.48 inches
	2nd week	0.24 inches
+2 WKS	1st week	1.57 inches
	2nd week	2.01 inches
+3 WKS	1st week	0.32 inches
	2nd week	0.20 inches
+4 WKS	1st week	0.20 inches
	2nd week	1.70 inches
+ 5 WKS	1st week	1.78 inches
	2nd week	0.16 inches

Grft=Green foxtail
Cowh=Common waterhemp

COMMENTS: Purpose to evaluate weed control and crop response to timing of herbicide application after planting. Moderate foxtail and common waterhemp pressure. Grass control was adequate with most treatments; late application to larger foxtail reduced control in Liberty treatments. Waterhemp control with application at 2 or 3 weeks was less due to later flush; however yield differences were not apparent. Yield expressed as % of the highest yield (100%) for each hybrid treatment group.

Treatment	Rate/ac	% Grft 10/14/98	% Cowh 10/14/98	Yield % Best
	ROUNDUP READY CORN			
PREEMERGENCE				
Harness+atrazine	2.25 pt+1 qt	86	98	100.0
PREEMERGENCE & POSTEMERGENCE				
Harness+atrazine&	2.25 pt+1 qt&			
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal	99	99	91.7
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal			
2 weeks		81	43	91.4
3 weeks		97	73	98.6
4 weeks		99	98	95.7
5 weeks		98	94	94.9
6 weeks		98	89	86.3
Roundup Ultra+AMS	1 pt+8.5 lb/100 gal			
2 weeks & 3 weeks		98	65	96.8
2 weeks & 4 weeks		97	91	92.4
2 weeks & 5 weeks		97	89	96.8
2 weeks & 6 weeks		98	92	96.8

Table 12. Weed Removal Timing in Corn (Continued) . . .

Treatment	Rate/ac	% Grft 10/14/98	% Cowh 10/14/98	Yield % Best
	LIBERTY LINK CORN			
PREEMERGENCE				
Harness+atrazine	2.25 pt+1 qt	92	98	100.0
PREEMERGENCE & POSTEMERGENCE				
Harness+atrazine&	2.25 pt+1 qt&			
Liberty+AMS	28 oz+3 lb	96	98	100.0
Liberty+AMS	28 oz+3 lb			
2 weeks		88	45	76.2
3 weeks		93	50	76.4
4 weeks		94	84	90.2
5 weeks		73	85	85.4
6 weeks		61	87	77.2
LSD (.05)		6	7	9

Table 13. 1X & 3X Corn Rate - Pre

RCB; 4 reps
Variety: Pioneer 3730
Planting Date: 5/18/98
PRE: 5/18/98
Soil: Silty clay; 3.7% OM; 6.4 pH

Precipitation: 1st week 0.48 inches
2nd week 0.24 inches

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

COMMENTS: Evaluation of response to X and 3X herbicide rates. Plots cultivated to control escaped weeds. Yield differences could not be measured for most treatments; yield tended to be similar for X and 3X rates of each herbicide. No significant visual crop responses were noted.

Treatment	Rate/ac	% VCRR	Yield bu/ac	2 Yr Avg Yield bu/ac
Check	----	0	96	122
PREEMERGENCE				
Atrazine	2.78 lb	0	115	139
Atrazine	5.55 lb	1	112	137
Lasso	3 qt	0	108	128
Lasso	9 qt	0	109	127
Dual II Magnum	1.67 pt	0	102	---
Dual II Magnum	5 pt	1	109	---
Surpass	3 pt	0	112	129
Surpass	9 pt	1	102	122
Frontier	2 pt	0	111	---
Frontier	6 pt	1	108	---
Python	1 oz	1	113	---
Python	3 oz	5	101	---
Balance	1.5 oz	0	119	---
Balance	4.5 oz	0	116	---
Axiom	23 oz	6	116	---
Axiom	69 oz	4	110	---
LSD (.05)		5	11	11

Table 14. 1X & 3X Corn Rate - Post

RCB; 4 reps
Variety: Pioneer 3730
Planting Date: 5/18/98
POST: 6/20/98; Corn 6 lf, 10-12 in; 4 collar
Soil: Silty clay; 3.7% OM; 6.4 pH

Precipitation: 1st week 0.32 inches
2nd week 0.20 inches

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

COMMENTS: Dual II applied over entire area. Represents one hybrid response. Evaluation of X and 3X herbicide rates. Yield differences could not be measured between X rates of all herbicides except for 2,4-D. Treatment of 2,4-D and Banvel at 3X resulted in some breakage due to wind; less response would have been expected from earlier application.

Treatment	Rate/ac	% VCRR	1998 Yield bu/ac	2 Yr Avg Yield bu/ac
Check	----	0	112	117
POSTEMERGENCE				
Accent+COC+28% N	.67 oz+1%+4 qt	0	120	127
Accent+COC+28% N	2 oz+1%+4 qt	1	113	119
Beacon+X-77	.76 oz+.25%	1	114	118
Beacon+X-77	2.3 oz+.25%	3	110	118
2,4-D amine	.5 qt	19	99	109
2,4-D amine	1.5 qt	43	55	87
Banvel	.5 qt	3	113	121
Banvel	1.5 qt	39	72	89
Buctril	1.5 pt	1	122	124
Buctril	4.5 pt	3	112	120
Permit+X-77	.67 oz+.25%	0	111	115
Permit+X-77	2 oz+.25%	4	107	121
Basis+X-77+28% N	.33 oz+.25%+2 qt	4	114	122
Basis+X-77+28% N	1 oz+.25%+2 qt	13	106	117
Accent Gold+COC+28% N	2.9 oz+1%+2 qt	1	113	----
Accent Gold+COC+28% N	8.7 oz+1%+2 qt	3	117	----
Hornet+X-77+28% N	4 oz+.25%+2.5%	0	116	----
Hornet+X-77+28% N	12 oz+.25%+2.5%	0	108	----
LSD (.05)		9	15	12

Table 15. Evaluation of Herbicide Drift on Corn

RCB; 4 reps
Variety: Legend 7595T
Planting Date: 5/22/98
POST: 7/13/98; Corn 12-18 in.
Soil: Silty clay loam; 3.1% OM; 7.1 pH

Precipitation: 1st week 0.16 inches
2nd week 0.35 inches

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

COMMENTS: This study was conducted to evaluate visual crop response symptoms and effect on corn yield from low rates of herbicide; simulating exposure from drift or equipment contamination. Dual II was broadcast over the plot area at planting. All treatments reduce corn yield except for Liberty at 1.4 to 2.8 oz/ac. Treatments that reduced yield more than 50% included Roundup at 1.6, 3.2, and 6.4 oz/ac; Touchdown at 2.4 oz/ac; and Gramoxone Extra at 6.4 oz/ac. Visual evaluation and yield response is helpful to assess field situations in early season and to improve decisions on replanting.

Treatment	Rate/ac	% VCRR 8/25/98	Yield bu/ac
Check	----	0	98
POSTEMERGENCE			
Roundup Ultra+AMS	1.6 oz+.85 lb/100 gal	50	42
Roundup Ultra+AMS	3.2 oz+1.7 lb/100 gal	81	8
Roundup Ultra+AMS	6.4 oz+3.4 lb/100 gal	95	0
Touchdown 5+X-77	1.2 oz+.025%	16	79
Touchdown 5+X-77	2.4 oz+.05%	54	46
Liberty+AMS	1.4 oz+.15 lb	8	90
Liberty+AMS	2.8 oz+.3 lb	8	89
Liberty+AMS	5.6 oz+.6 lb	30	57
Poast Plus+COC	3 oz+.25 pt	9	83
Poast Plus+COC	6 oz+.5 pt	29	53
Poast Plus+COC	12 oz+1 pt	88	2
Gramoxone Extra+X-77	3.2 oz+.063%	19	62
Gramoxone Extra+X-77	6.4 oz+.125%	34	42
LSD (.05)		8	10

Table 16. Effect of Day Vs. Night Application

RCB; 4 reps
Variety: DK 493RR, Legend 296LL
Planting Date: 5/22/98
NOON: 7/1/98; 10:15 a.m.
NIGHT: 7/1/98; 9:30 p.m.
Crop Stage: 6-7 lf
Weed Size: Yeft 3-6 in; Cowh 4-8 in.
Soil: Silty clay loam; 3.1% OM; 7.1 pH

Precipitation: 1st week 1.86 inches
2nd week 0.12 inches

Yeft=Yellow foxtail
Cowh=Common waterhemp

COMMENTS: Purpose to compare weed control with day vs. night applications. There were no differences in timing at any rate; however weed control increased with increasing rates.

Treatment	Timing	Rate/ac	% Yeft 7/29/98	% Cowh 7/29/98
Liberty+AMS	Noon	5 oz+3 lb	16	21
Liberty+AMS	Night	5 oz+3 lb	19	19
Liberty+AMS	Noon	10 oz+3 lb	20	33
Liberty+AMS	Night	10 oz+3 lb	21	24
Liberty+AMS	Noon	20 oz+3 lb	43	51
Liberty+AMS	Night	20 oz+3 lb	34	57
Roundup Ultra+AMS	Noon	4 oz+8.5 lb/100 gal	59	51
Roundup Ultra+AMS	Night	4 oz+8.5 lb/100 gal	49	52
Roundup Ultra+AMS	Noon	8 oz+8.5 lb/100 gal	84	84
Roundup Ultra+AMS	Night	8 oz+8.5 lb/100 gal	85	74
Roundup Ultra+AMS	Noon	16 oz+8.5 lb/100 gal	94	94
Roundup Ultra+AMS	Night	16 oz+8.5 lb/100 gal	94	92
LSD (.05)			12	10

Table 17. Soybean Herbicide Demonstration

Demonstration
Variety: Stine 01136F
Planting Date: 5/19/98
PPI/PRE: 5/19/98
EPOST: 6/20/98; Soybean 2-3 tri; Grft 1-3 in; Cowh 1-2 in
POST: 7/1/98; Soybean 3-4 tri; Grft 3-5 in; Cowh 4-7 in.
Soil: Silty clay; 3.4% OM; 6.2 pH

Precipitation:

PPI/PRE	1st week	0.48 inches
	2nd week	0.24 inches
EPOST	1st week	0.32 inches
	2nd week	0.20 inches
POST	1st week	1.86 inches
	2nd week	0.12 inches

Grft=Green foxtail
Cowh=Common waterhemp

COMMENTS: Foxtail pressure very light; not adequate to produce treatment differences. Common waterhemp treatment differences clearly apparent; less severe infestation than for other sites at the Southeast Experiment Farm.

Treatment	Rate/ac	% Grft 7/22/98	% Cowh 7/22/98	% Cowh 9/23/98%	3 Yr Avg Fxtl
Check	----	0	0	0	0
PREPLANT INCORPORATED					
Pursuit Plus	2.5 pt	97	85	82	---
Treflan	1.5 pt	98	89	96	95
Sonalan	2.67 pt	99	93	97	95
Prowl	3 pt	99	93	90	93
Treflan+Sen/Lex	1.5 pt+.5 lb	99	96	93	95
Treflan+Command	1.5 pt+1.5 pt	99	89	89	95
Command+Sen/Lex	1.5 pt+.33 lb	99	97	90	---
Python+Treflan	1 oz+1.5 pt	99	96	94	94
Prowl+Pursuit 2L	3 pt+2 oz	99	98	96	90
Steel	3 pt	99	96	90	92
Treflan+FirstRate	1.5 pt+.75 oz	99	99	99	93
Treflan+Authority	1.5 pt+4 oz	99	95	97	---
SHALLOW PREPLANT INCORPORATED					
Lasso+Treflan	2 qt+.5 pt	99	96	81	91
SHALLOW PREPLANT INCORPORATED & POSTEMERGENCE					
Command&Pursuit 2L+ Sun-It II+28% N	1.5 pt&2 oz+ 1 qt+1 qt	95	81	64	92
PREEMERGENCE & POSTEMERGENCE					
Command 3ME&Pursuit 2L+ Sun-It II+28% N	2 pt&2 oz+ 1 qt+1 qt	99	78	69	---
PREPLANT INCORPORATED & PREEMERGENCE					
Treflan+Sen/Lex&Sen/Lex	1.5 pt+.33 lb&.5 lb	99	96	99	97
Treflan&Sen/Lex	1.5 pt&.67 lb	99	98	98	98
Treflan&Authority	1.5 pt&4 oz	99	99	99	---

Table 17. Soybean Herbicide Demonstration (Continued) . . .

Treatment	Rate/ac	% Grft 7/22/98	% Cowh 7/22/98	% Cowh 9/23/98	3 Yr Avg % Fxtl
PREPLANT INCORPORATED & POSTEMERGENCE					
Prowl&Pursuit 2L+	2.5 pt&4 oz+				
Sun-It II+28% N	1 qt+1 qt	99	97	88	---
Prowl&Raptor+	2.5 pt&4 oz+				
Sun-It II+28% N	1 qt+1 qt	99	96	84	---
Treflan&FirstRate+X-77+28% N	1.5 pt&.3 oz+.25%+2 qt	99	97	93	---
Treflan&FirstRate+Flexstar HL+	1.5 pt&.3 oz+12 oz+				
Sun-It II+28% N	.25%+2 qt	99	99	99	---
PREEMERGENCE					
Dual II Magnum+Sen/Lex	1.33 pt+.67 lb	99	99	98	---
Lasso	3 qt	99	99	97	96
Dual II Magnum	1.67 pt	99	99	86	---
Frontier	2 pt	98	91	91	96
Pursuit 2L	4 oz	98	62	25	95
Authority+Command ME	4 oz+2 pt	99	97	93	---
Sen/Lex+Command ME	.5 lb+2 pt	99	98	97	---
Axiom	22 oz	99	98	96	97
PREEMERGENCE & POSTEMERGENCE					
Frontier&Poast+Galaxy+	20 oz&1.5 pt+2 pt+				
COC+28% N	.625%+1.25%	96	95	98	---
Sen/Lex&Raptor+	6 oz&4 oz+				
Sun-It II+28% N	1 qt+1 qt	99	94	86	---
Lasso&Pursuit 2L+	2 qt&4 oz+				
Sun-It II+28% N	1 qt+1 qt	97	84	76	96
Lasso&Scepter+X-77	2 qt&.33 pt+.5%	94	89	92	94
Lasso&Basagran+COC	2 qt&1 qt+1 qt	99	93	85	96
Lasso&Blazer+X-77	2 qt&1.5 pt+.5%	97	96	96	95
Lasso&Stellar+COC+28% N	2 qt&5 oz+.5%+2.5%	98	99	97	96
Lasso&Cobra+COC	2 qt&.8 pt+.5 qt	98	96	98	94
Lasso&Flexstar HL+	2 qt&12 oz+				
Sun-It II+28% N	1%+2.5%	99	96	97	---
Lasso&Galaxy+X-77+28% N	2 qt&2 pt+.5%+2.5%	99	99	98	96
Lasso&FirstRate+X-77+28% N	2 qt&.3 oz+.25%+2.5%	99	97	98	---
Lasso&Pinnacle+X-77	2 qt&.25 oz+.25%	99	98	95	95
Lasso&Classic+X-77	2 qt&.75 oz+.25%	99	91	94	92
Lasso&Reliance STS+	2 qt&.5 oz+				
X-77+28% N	.25%+1 qt	99	98	98	---
Lasso&Reliance STS+	2 qt&.5 oz+				
COC+28% N	1%+1 qt	99	98	93	---
Lasso&Basagran+	2 qt&1 pt+				
Pursuit 2L+COC	2 oz+1 qt	99	96	85	96
Lasso&Reliance STS+	2 qt&.5 oz+				
Pursuit 2L+X-77	3 oz+.25%	97	98	97	---

Table 17. Soybean Herbicide Demonstration (Continued) . . .

Treatment	Rate/ac	% Grft 7/22/98	% Cowh 7/22/98	% Cowh 9/23/98	3 Yr Avg % Fxtl
PREEMERGNECE & POSTEMERGENCE					
Lasso&Pursuit 2L+Cobra+	2 qt&4 oz+6 oz+				
Sun-It II+28% N	1 pt+1 qt	99	96	95	97
Lasso&Expert+X-77+28% N	2 qt&1.5 oz+.5%+2 qt	99	87	84	96
Lasso&Resource+Galaxy+	2 qt&2 oz+2 pt+				
X-77+28% N	.5%+2 qt	99	97	98	---
Lasso&Flexstar HL+Pursuit 2L+	2 qt&12 oz+2 oz+				
Sun-It II+28% N	1%+2 qt	99	99	97	---
Lasso&Flexstar HL+Pursuit 2L+	2 qt&12 oz+4 oz+				
Sun-It II+28% N	1%+2 qt	97	98	89	---
Lasso&Reliance STS+Basagran+	2 qt&.5 oz+1 pt+				
COC+28% N	1%+1 qt	99	92	68	---
EARLY POSTEMERGENCE					
Select+Flexstar HL+	7 oz+12 oz+				
Sun-It II+28% N	1%+2 qt	99	94	84	---
Fusion+Flexstar HL+	10 oz+12 oz+				
Sun-It II+28% N	1%+2 qt	96	92	83	---
Poast Plus+COC	1.5 pt+1 qt	99	0	0	97
Poast Plus	1.5 pt	99	0	0	97
Raptor+Sun-It II+28% N	5 oz+1 qt+1 qt	99	25	25	98
Pursuit 2L+Sun-It II+28% N	4 oz+1 qt+1 qt	99	35	20	97
Pursuit 2L	4 oz	97	25	15	92
Poast Plus+Galaxy+COC	2.25 pt+2 pt+1 qt	99	78	55	97
LSD (.05)		---	---	---	5

Table 18. Herbicide Resistant Soybean Demonstration

Demonstration
Variety: See comments
Planting Date: 5/19/98
PPI/PRE: 5/19/98
EPOST: 6/20/98; Soybean 2-3 tri; Grft 1-3 in; Cowh 1-2 in.
POST: 7/1/98; Soybean 3-4 tri; Grft 3-5 in; Cowh 4-8 in.
Soil: Silty clay; 3.4% OM; 6.2 pH

Precipitation:

PPI/PRE	1st week	0.48 inches
	2nd week	0.24 inches
EPOST	1st week	0.32 inches
	2nd week	0.20 inches
POST	1st week	1.86 inches
	2nd week	0.12 inches

Voco=Volunteer corn
Grft=Green foxtail
Cowh=Common waterhemp

COMMENTS: Varieties planted: Asgrow AG3601, 2704LL, CX196RR. Volunteer corn scattered, insufficient foxtail density to provide comparative evaluation. Moderate common waterhemp. Split preplant or preemergence followed by postemergence or split postemergence treatments provided excellent waterhemp control. No adverse crop response noted with 2X rates. Post treatments at 30 days were less effective than 40 days after planting.

Treatment	Rate/ac	% Voco 7/22/98	% Grft 7/22/98	% Cowh 7/22/98	% Cowh 9/23/98
Check	----	0	0	0	0
STS SOYBEANS					
EARLY POSTEMERGENCE					
Reliance STS+Assure II+ COC+28% N	.5 oz+7 oz+ 1%+2 qt	94	92	38	25
Reliance STS+Poast Plus+ COC+28% N	.5 oz+1.5 pt+ .625%+2 qt	96	95	45	30
PREPLANT INCORPORATED & POSTEMERGENCE					
Treflan&Reliance STS+ COC+28% N	1.5 pt&.5 oz+ 1%+2 qt	15	97	94	76
Treflan&Reliance STS+ COC+28% N	1.5 pt&1 oz+ 1%+2 qt	10	97	99	95
PREEMERGENCE & POSTEMERGENCE					
Authority&Reliance STS+ Assure II+COC+28% N	4 oz&.5 oz+ 7 oz+1%+2 qt	99	99	98	99
Frontier&Reliance STS+ Poast Plus+COC+28% N	20 oz&.5 oz+ 1.5 pt+.625%+2 qt	96	99	95	96
LIBERTY LINK SOYBEANS					
PREPLANT INCORPORATED & POSTEMERGENCE					
Treflan&Liberty+AMS	1.5 pt&20 oz+3 lb	98	99	91	94
EARLY POSTEMERGENCE					
Liberty+AMS	28 oz+3 lb	96	97	58	52
Frontier+Liberty+AMS	20 oz+20 oz+3 lb	82	92	54	48

Table 18. Herbicide Resistant Soybean Demonstration (Continued) . . .

Treatment	Rate/ac	% Voco 7/22/98	% Grft 7/22/98	% Cowh 7/22/98	% Cowh 9/23/98
LIBERTY LINK SOYBEANS (Continued) . . .					
EARLY POSTEMERGENCE & POSTEMERGENCE					
Liberty+AMS&Liberty+AMS	20 oz+3 lb&20 oz+3 lb	98	98	86	85
PREPLANT INCORPORATED & POSTEMERGENCE					
Treflan&Liberty(3X)+AMS	1.5 pt&56 oz+3 lb	99	99	99	98
PREEMERGENCE & POSTEMERGENCE					
Prowl&Liberty+AMS	2.2 pt&20 oz+3 lb	88	98	99	99
Frontier&Liberty+AMS	20 oz&20 oz+3 lb	84	97	98	99
ROUNDUP READY SOYBEANS					
EARLY POSTEMERGENCE					
Roundup Ultra+AMS	1 pt+8.5 lb/100 gal	95	93	45	54
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal	97	99	55	60
Roundup Ultra+AMS	2 qt+8.5 lb/100 gal	98	99	79	69
PREPLANT INCORPORATED & POSTEMERGENCE					
Treflan&Roundup Ultra+AMS	1.5 pt&1 pt+8.5 lb/100 gal	98	99	98	99
Pursuit Plus& Roundup Ultra+AMS	2.5 pt& 1 pt+8.5 lb/100 gal	99	99	95	95
Prowl&Roundup Ultra+ Pursuit 2L+AMS	2.5 pt&1 pt+ 4 oz+8.5 lb/100 gal	99	99	98	95
EARLY POSTEMERGENCE & POSTEMERGENCE					
Roundup Ultra+AMS& Roundup Ultra+AMS	1 pt+8.5 lb/100 gal& 1 pt+8.5 lb/100 gal	99	99	98	96
PREEMERGENCE & POSTEMERGENCE					
Frontier&Roundup Ultra+AMS	20 oz&1.5 pt+8.5 lb/100 gal	99	99	99	98
Sen/Lex&Roundup Ultra+AMS	6 oz&1.5 pt+8.5 lb/100 gal	99	99	94	98
Authority& Roundup Ultra+AMS	8 oz& 1.5 pt+8.5 lb/100 gal	99	99	99	99
Authority& Roundup Ultra+AMS	5.33 oz& 1.5 pt+8.5 lb/100 gal	99	99	99	99
Broadstrike+Dual& Roundup Ultra+AMS	2.5 pt& 1.5 pt+8.5 lb/100 gal	94	99	99	99
Dual II Magnum&Expert+ Roundup Ultra+AMS	1 pt&2 oz+ 1.5 pt+8.5 lb/100 gal	99	99	99	99
Dual II Magnum&Resource+ Roundup Ultra+AMS	1 pt&4 oz+ 1.5 pt+8.5 lb/100 gal	91	99	98	96
EARLY POSTEMERGENCE					
Frontier&Roundup Ultra+AMS	20 oz+1.5 pt+8.5 lb/100 gal	82	98	83	68

Table 19. Waterhemp Control in Soybeans - Evaluation

RCB; 4 reps
Variety: NK S14-M7
Planting Date: 5/19/98
PPI: 5/19/98
EPOST: 6/22/98; Soybean 5-8 in;
Cowh 4-6 in; Grft 1-3 in.
POST: 7/9/98; Soybean 10-12 in;
Cowh 10-14 in; Grft 3-4 in.
Soil: Silty clay; 3.5% OM; 6.6 pH

Precipitation:

PPI	1st week	0.48 inches
	2nd week	0.24 inches
EPOST	1st week	0.36 inches
	2nd week	1.86 inches
POST	1st week	0.16 inches
	2nd week	0.31 inches

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

COMMENTS: Generally dense waterhemp; some variability in growth in treatments. Several treatments provided greater than 90% common waterhemp control. Control tended to diminish for late season ratings due to extended weed emergence. Treatments utilizing split planting time and postemergence timings were most consistent. Foxtail density was light and control excellent for all treatments indicating foxtail was not a factor in crop performance. Crop vigor reduction was temporary for most treatments. Waterhemp control was a more significant factor affecting yield than crop response.

Treatment	Rate/ac	% VCRR 7/24/98	% Grft 7/24/98	% Cowh 7/24/98	% Cowh 9/23/98	Yield bu/ac
Check	----	0	0	0	0	13
PREPLANT INCORPORATED						
Treflan	1.5 pt	3	98	71	57	30
Treflan	2 pt	0	97	70	38	27
Prowl	3.6 pt	0	95	72	49	26
Sonalan	2.67 pt	0	97	76	57	33
Treflan+Sen/Lex	1.5 pt+.5 lb	1	96	87	87	39
Treflan+Python	1.5 pt+1 oz	4	95	93	88	40
Treflan+Authority	1.5 pt+8 oz	3	97	97	95	41
PREEMERGENCE						
Command 3ME+Authority	2 pt+8 oz	3	99	99	98	43
PREEMERGENCE & POSTEMERGENCE						
Authority&Poast Plus+COC	4 oz&1.5 pt+1 qt	8	97	89	87	33
Authority&Poast Plus+COC	8 oz&1.5 pt+1 qt	4	99	99	96	40
PREPLANT INCORPORATED & POSTEMERGENCE						
Python&Poast Plus+COC	1 oz&1.5 pt+1 qt	0	98	73	52	30
Treflan&Galaxy+COC	1.5 pt&2 pt+1 qt	11	95	98	97	37
Treflan&Blazer+X-77	1.5 pt&.75 pt+.5%	8	96	98	98	38
Treflan&Blazer+X-77	1.5 pt&1.5 pt+.5%	9	99	98	98	36

Table 19. Waterhemp Control in Soybeans - Evaluation (Continued) . . .

Treatment	Rate/ac	% VCRR 7/24/98	% Grft 7/24/98	% Cowh 7/24/98	% Cowh 9/23/98	Yield bu/ac
EARLY POSTEMERGENCE						
Blazer+Poast Plus+ COC	1.5 pt+1.5 pt+ 1 qt	8	99	95	91	39
Pursuit 2L+Status+ Sun-It II+28% N	4 oz+12 oz+ 1.5 pt+1 qt	1	88	88	70	34
PREPLANT INCORPORATED & POSTEMERGENCE						
Treflan&Cobra+COC	1.5 pt&.8 pt+1 pt	19	93	98	96	31
Treflan&Action+ X-77+28% N	1.5 pt&.5 oz+ .25%+2 qt	1	94	93	88	39
Treflan&Expert+COC	1.5 pt&1.5 oz+2 pt	6	98	87	78	38
Treflan&FirstRate+ X-77+28% N	1.5 pt&.3 oz+ .125%+2.5%	4	94	82	69	35
Treflan&Flexstar HL+ Sun-It II+28% N	1.5 pt&12 oz+ 1%+2.5%	5	97	98	97	39
EARLY POSTEMERGENCE						
Pursuit 2L+Sun-It II+28% N	4 oz+1 qt+1 qt	0	97	26	28	16
Raptor+Sun-It II+28% N	5 oz+1 qt+1 qt	0	79	50	35	23
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal	0	98	74	60	35
PREPLANT INCORPORATED & POSTEMERGENCE						
Treflan&Roundup Ultra+ AMS	1.5 pt&1 pt+ 8.5 lb/100 gal	9	99	96	97	38
EARLY POSTEMERGENCE & POSTEMERGENCE						
Roundup Ultra+AMS& Roundup Ultra+AMS	1 pt+8.5 lb/100 gal& 1 pt+8.5 lb/100 gal	0	98	43	29	22
LSD (.05)		5	11	9	14	7

Table 20. Cocklebur Soybean Demonstration

RCB; 2 reps
Variety: DeKalb CX196RR
Planting Date: 5/27/98
PPI/PRE: 5/27/98
POST: 7/1/98; Soybean 3 tri;
Cocb 2-4 lf; Cowh 1 in.
LPOST: Soybean 4-6 tri;
Cocb 6-8 lf; Cowh 1-3 in.

Precipitation:

PPI/PRE	1st week	0.28 inches
	2nd week	0.83 inches
POST	1st week	1.86 inches
	2nd week	0.12 inches
LPOST	1st week	0.16 inches
	2nd week	0.31 inches

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

COMMENTS: Very heavy cocklebur. The level of cocklebur control influenced waterhemp development. Yields were reduced by failure to control either weed. Five treatments provided greater than 90% cocklebur for the 3-year average.

Treatment	Rate/ac	% VCRR 7/20/98	% Cowh 8/14/98	% Cocb 8/14/98	Yield bu/ac	3 Yr Avg % Cocb
Check	----	0	0	0	8	0
PREPLANT INCORPORATED						
Steel	3 pt	0	77	78	39	---
Python	1 oz	0	83	42	27	---
PREPLANT INCORPORATED & PREEMERGENCE						
Sen/Lex&Sen/Lex	.5 lb&.33 lb	3	99	40	27	49
POSTEMERGENCE						
Basagran+COC	1 qt+1 qt	0	10	99	23	91
POSTEMERGENCE & LATE POSTEMERGENCE						
Basagran+COC& Basagran+COC	1 pt+1 qt& 1 pt+1 qt	0	30	99	22	98
POSTEMERGENCE						
Cobra+COC+28% N	.8 pt+.5 qt+4 qt	15	94	98	32	85
Blazer+X-77	1.5 pt+.5%	10	98	63	28	66
Classic+X-77	.75 oz+.125%	0	33	98	28	98
Pursuit+Sun-It II+28% N	4 oz+1 qt+1 qt	0	15	87	22	94
Reliance STS+X-77	.5 oz+.125%	0	75	90	39	85
Basagran+Pursuit 2L+ COC+28% N	1 pt+2 oz+ 1 qt+2 qt	0	43	99	42	94
Raptor+Sun-It II+28% N	5 oz+1.5 pt+1 qt	5	20	91	29	---
FirstRate+Sun-It II+28% N	.3 oz+.125%+2.5%	0	69	99	35	---
Expert+X-77+28% N	1.5 oz+.25%+4 pt	0	80	98	36	---
Stellar+COC	7 oz+1 pt	13	98	99	30	---
Flexstar HL+ Sun-It II+28% N	12 oz+ 1%+2.5%	5	97	92	38	---

Table 20. Cocklebur Soybean Demonstration (Continued) . . .

Treatment	Rate/ac	% VCRR 7/20/98	% Cowh 8/14/98	% Cocb 8/14/98	Yield bu/ac	3 Yr Avg % Cocb
POSTEMERGENCE & LATE POSTEMERGENCE						
Roundup Ultra+AMS&	1 pt+8.5 lb/100 gal&					
Roundup Ultra+AMS	1 pt+8.5 lb/100 gal	0	99	99	41	---
POSTEMERGENCE						
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal	0	95	96	37	---
Roundup Ultra+	1 pt+					
Pursuit 2L+AMS	4 oz+8.5 lb/100 gal	0	99	99	37	---
LSD (.05)		6	20	13	7	11

Table 21. Velvetleaf Control in Soybean Demonstration

RCB; 2 reps
Variety: Stine, NK S14-M7
Planting Date: 5/18/98
PPI/PRE: 5/18/98
POST: 7/9/98; Soybean 12-18 in; Vele 8-12 in.
POST1: 7/24/98; Soybean 18-24 in; Vele 12-24 in.
Soil: Silty clay loam; 3.0% OM; 6.9 pH

Precipitation:

PPI/PRE	1st week	inches
	2nd week	inches
POST	1st week	inches
	2nd week	inches
POST1	1st week	inches
	2nd week	inches

Grft=Green foxtail
Vele=Velvetleaf

COMMENTS: Moderate heavy velvetleaf density. Several treatments provided excellent control. Velvetleaf control was not improved with tank-mixes; some antagonistic trend.

Treatment	Rate/ac	% Grft 8/24/98	% Vele 8/24/98	2 Yr Avg % Vele
Check	----	0	0	0
PREPLANT INCORPORATED				
Treflan+Sen/Lex	1.5 pt+.5 lb	97	92	91
Command+Treflan	1.5 pt+1.5 pt	97	99	95
Command+Treflan	2 pt+1.5 pt	94	99	97
Prowl+Pursuit 2L	2.12 pt+4 oz	99	99	99
Treflan+Python	1.5 pt+1 oz	99	97	---
Treflan+Command+Sen/Lex+ Pursuit 2L+Scepter+Python	1.5 pt+.5 pt+.167 lb+ 1 oz+.167 pt+.167 oz	99	98	---
Steel	3 pt	99	99	97
PREPLANT INCORPORATED & POSTEMERGENCE(1)				
Treflan+Command&Pursuit 2L+ Sun-It II+28% N	1.5 pt+1 pt&2 oz+ 1 qt+1 qt	99	98	98
PREPLANT INCORPORATED & PREEMERGENCE				
Treflan&Sen/Lex	1.5 pt&.67 lb	99	99	92
Treflan&Sen/Lex+Sen/Lex	1.5 pt+.33 lb&.5 lb	99	97	98
Treflan&Lasso+Pursuit 2L	1.5 pt&2 qt+4 oz	99	99	---
SHALLOW PREPLANT INCORPORATED				
FirstRate+Treflan	.6 oz+1.5 pt	97	90	83
PREEMERGENCE				
Lasso+Lorox	2 qt+1 qt	98	56	57
Dual II+Sen/Lex	2 pt+.67 lb	99	99	94
Command 3ME	2.67 pt	99	99	---
PREPLANT INCORPORATED & POSTEMERGENCE				
Treflan&Blazer+28% N	1.5 pt&1.5 pt+4 qt	99	50	51
Treflan&Galaxy+28% N	1.5 pt&1 qt +4 qt	99	82	84
Treflan&Basagran+28% N	1.5 pt&1 qt+4 qt	99	90	82
PREPLANT INCORPORATED & POSTEMERGENCE(1)				
Treflan&Basagran+28% N	1.5 pt&1 qt+4 qt	98	88	75

Table 21. Velvetleaf Control in Soybeans (Continued) . . .

Treatment	Rate/ac	% Grft 8/24/98	% Vele 8/24/98	2 Yr Avg % Vele
PREPLANT INCORPORATED & POSTEMERGENCE & POSTEMERGENCE(1)				
Treflan&Basagran+28% N& Basagran+28% N	1.5 pt&1 pt+4 qt& 1 pt+4 qt	99	95	93
PREPLANT INCORPORATED & POSTEMERGENCE				
Treflan&Cobra+COC	1.5 pt&.8 pt+1 pt	96	44	50
Treflan&Reliance STS+X-77+28% N	1.5 pt&.5 oz+.25%+2 qt	97	62	---
Treflan&Pursuit 2L+Sun-It II+28% N	1.5 pt&4 oz+1 qt+4 qt	99	99	90
Treflan&Pursuit 2L+Sun-It II+28% N	1.5 pt&2 oz+1 qt+4 qt	94	57	51
Treflan&Basagran+Pursuit 2L+ COC+28% N	1.5 pt&1 pt+2 oz+ 1 qt+4 qt	99	90	82
Treflan&Flexstar HL+ Sun-It II+28% N	1.5 pt&12 oz+ 1%+2.5%	99	91	---
Treflan&Action+COC	1.5 pt&1.5 oz+1 qt	97	99	99
Treflan&Resource+COC	1.5 pt&4 oz+1 qt	90	83	63
Treflan&Stellar+COC	1.5 pt&5 oz+1 pt	99	81	77
Treflan&Expert+X-77+ 28% N	1.5 pt&1.5 oz+.25%+ 4 pt	99	82	74
Treflan&FirstRate+X-77+ 28% N	1.5 pt&.3 oz+.125%+ 2.5%	96	89	79
Treflan&Raptor+Sun-It II+28% N	1.5 pt&5 oz+1.5 pt+1 qt	99	99	94
PREPLANT INCORPORATED & POSTEMERGENCE(1)				
Treflan&Action+COC	1.5 pt&1.5 oz+1 qt	99	99	97
Treflan&Resource+COC	1.5 pt&8 oz+1 qt	98	80	84
PREPLANT INCORPORATED & POSTEMERGENCE				
Treflan&Roundup Ultra+AMS	1.5 pt&1 pt+8.5 lb/100 gal	97	94	81
Treflan&Roundup Ultra+AMS	1.5 pt&1 qt+8.5 lb/100 gal	99	87	83
PREPLANT INCORPORATED & POSTEMERGENCE(1)				
Treflan&Roundup Ultra+AMS	1.5 pt&1 pt+8.5 lb/100 gal	99	48	59
Treflan&Roundup Ultra+AMS	1.5 pt&1 qt+8.5 lb/100 gal	99	77	69
PREPLANT INCORPORATED & POSTEMERGENCE & POSTEMERGENCE(1)				
Treflan&Roundup Ultra+AMS& Roundup Ultra+AMS	1.5 pt&1.5 pt+8.5 lb/100 gal& 1 pt+8.5 lb/100 gal	99	98	98
PREPLANT INCORPORATED & POSTEMERGENCE				
Treflan&Classic+ Roundup Ultra+AMS	1.5 pt&.33 oz+ 1 pt+8.5 lb/100 gal	99	72	---
Treflan&Resource+ Roundup Ultra+AMS	1.5 pt&4 oz+ 1 pt+8.5 lb/100 gal	99	73	---
PREPLANT INCORPORATED & PREEMERGENCE & POSTEMERGENCE				
Treflan&Python& Roundup Ultra+AMS	1.5 pt&1 oz& 1 pt+8.5 lb/100 gal	99	64	---
LSD (.05)		5	16	14

Table 22. Grass Product Antagonism in Soybeans

RCB; 4 reps
Variety: Stine 01136F
Planting Date: 5/22/98
POST: 6/30/98; Soybean 4 tri; Voco 8-15+ in; Grft 3-6 in.
Soil: Clay; 3.1% OM; 7.1 pH

Precipitation: 1st week 1.86 inches
2nd week 0.00 inches

Grft=Green foxtail
Voco=Volunteer corn

COMMENTS: Purpose to evaluate antagonistic response for grass and volunteer corn control when broadleaf herbicides are tank-mixed with grass herbicides. Green foxtail rate used for each grass herbicide. Recommended additives (COC) used with each treatment. At those rates, Fusilade performed better on volunteer corn than for foxtail; Poast was more effective on foxtail. For late season ratings, five combinations with Cobra, 3 each with FirstRate, Reliance and Galaxy produced significant antagonism. For grass herbicides, seven antagonisms were significant with Assure II; six with Fusilade DX; one with Poast and none with Select.

				Fusilade DX (6 oz)		Poast (16 oz)		Assure II (5 oz)		Select (6 oz)	
Treatment	Rate/ac	% Gr	% Voco	% Gr	% Voco	% Gr	% Voco	% Gr	% Voco	% Gr	% Voco
Check	----	0	0	80	95	96	69	97	93	99	94
Cobra	8 oz	---	---	67*	81*	92	56*	80*	79*	95	91
First Rate	.3 oz	---	---	67*	94	95	76	80*	82*	98	98
Flexstar HL	12 oz	---	---	89	90	98	79	94	90	96	97
Galaxy	32 oz	---	---	67*	89	91	66	77*	84*	98	95
Raptor	5 oz	92	91	88	97	97	84	88	93	94	95
Reliance STS	.5 oz	---	---	70*	85*	97	77	86*	94	96	97
LSD (.05)		10	8	10	8	10	8	10	8	10	8

Table 23. Pursuit vs. Roundup Timing on Soybeans

RCB; 4 reps
Variety: NK S14-M7
Planting Date: 5/22/98
EPOST: 6/26/98; Soybean 3-4 tri; Grft 4-6 in; Cowh 8-12 in.
POST: 7/9/98; Soybean 12 in; Grft 6-10 in; Cowh 12-18 in.
POST1: 7/13/98; Soybean 18 in; Grft 8-10 in; Cowh 14-18 in.
Soil: Silty clay loam; 3.1% OM; 7.1 pH

Precipitation:

EPOST	1st week	0.20 inches
	2nd week	1.70 inches
POST	1st week	0.16 inches
	2nd week	0.31 inches
POST1	1st week	0.16 inches
	2nd week	0.35 inches

COMMENTS: Late planted due to wet plot site. Late ratings reflect delayed waterhemp emergence. Excellent early season control. There were no significant visual crop response differences that would be noted in a field basis. Early post control tended to produce greater yield than later postemergence treatments. Late post control reduced due to large waterhemp; late crop response represents crop growth reduction due to competition effect prior to control.

Treatment	Rate/ac	% VCRR 7/29/98	% Grft 7/29/98	% Cowh 7/29/98	% VCRR 8/13/98	% Grft 9/23/98	% Cowh 9/23/98	Yield bu/ac
Check	----	0	0	0	0	0	0	20
EARLY POSTEMERGENCE								
Pursuit DG+Roundup Ultra+	1.44 oz+1 pt+							
X-77+AMS	.25%+2.5 lb	0	98	93	0	99	90	45
Roundup Ultra+AMS	2 pt+2.5 lb	1	96	96	0	97	92	45
POSTEMERGENCE								
Pursuit DG+Roundup Ultra+	1.44 oz+1 pt+							
X-77+AMS	.25%+2.5 lb	5	99	95	6	98	93	40
Roundup Ultra+AMS	2 pt+2.5 lb	1	99	97	6	99	98	38
POSTEMERGENCE(1)								
Pursuit DG+Roundup Ultra+	1.44 oz+1 pt+							
X-77+AMS	.25%+2.5 lb	4	97	89	13	95	85	34
Roundup Ultra+AMS	2 pt+2.5 lb	1	98	96	13	96	93	36
LSD (.05)		4	3	5	4	2	6	6

Table 24. Postemergence Broadleaf Herbicides with Frontier-Soybeans

RCB; 4 reps
Variety: Stine 01136F
Planting Date: 5/19/98
PPI/PRE: 5/19/98
POST: 6/22/98; Soybean 3 tri; Cowh 2-5 in.
Soil: Silty clay; 3.5% OM; 6.6 pH

Precipitation:

PPI/PRE	1st week	0.48 inches
	2nd week	0.24 inches
POST	1st week	0.36 inches
	2nd week	1.86 inches

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

COMMENTS: Heavy waterhemp pressure. Uniform test area. Differential waterhemp control apparent for early season evaluations. Galaxy, Reliance, Flexstar, and Blazer in treatments provided very good control. No foxtail in test area.

Treatment	Rate/ac	% VCRR 7/24/98	% Cowh 7/24/98	Yield bu/ac
Check	----	0	0	8
PREEMERGENCE & POSTEMERGENCE				
Frontier&Galaxy+Poast+ COC+28% N	20 oz&2 pt+1.5 pt+ 1 pt+1 qt	6	81	43
Frontier&Basagran+Poast Plus+ COC+28% N	20 oz&2 pt+1.6 pt+ 1 pt+1 qt	0	72	41
Frontier&Galaxy+Poast+ Reliance STS+COC+28% N	20 oz&2 pt+1.5 pt+ .38 oz+1 pt+1 qt	6	94	47
Frontier&Basagran+Poast Plus+ Reliance STS+COC+28% N	20 oz&2 pt+1.6 pt+ .38 oz+1 pt+1 qt	0	93	51
Frontier&Galaxy+Poast+ Classic+COC+28% N	20 oz&2 pt+1.5 pt+ .33 oz+1 pt+1 qt	1	96	48
Frontier&Basagran+Poast Plus+ Classic+COC+28% N	20 oz&2 pt+1.6 pt+ .33 oz+1 pt+1 qt	0	80	42
Frontier&Galaxy+Poast+ FirstRate+COC+28% N	20 oz&2 pt+1.5 pt+ .33 oz+1 pt+1 qt	3	97	49
Frontier&Basagran+Poast Plus+ FirstRate+COC+28% N	20 oz&2 pt+1.6 pt+ .33 oz+1 pt+1 qt	0	77	44
Frontier&Basagran+Raptor+ Sun-It II+28% N	20 oz&1.5 pt+2 oz+ 1 qt+1 qt	1	89	46
Frontier&Basagran+Poast Plus+ Blazer+COC+28 %N	20 oz&2 pt+1.6 pt+ .5 pt+1 pt+1 qt	5	86	45
Frontier&Basagran+Poast Plus+ Flexstar HL+COC+28% N	20 oz&2 pt+1.6 pt+ 6 oz+1 pt+1 qt	0	92	52

Table 24. Postemergence Broadleaf Herbicides with Frontier - Soybeans (Continued) . . .

Treatment	Rate/ac	% VCRR 7/24/98	% Cowh 7/24/98	Yield bu/ac
PREPLANT INCORPORATED & POSTEMERGENCE				
Prowl&Pursuit 2L+	3.3 pt&4 oz+			
Sun-It II+28% N	1 qt+1 qt	0	68	40
Treflan&Flexstar HL+	1.5 pt&12 oz+			
Sun-It II+28% N	1%+2.5%	0	96	49
POSTEMERGENCE				
Flexstar HL+Fusion+	12 oz+6 oz+			
Sun-It II+28 %N	1%+2.5%	0	96	48
LSD (.05)		5	9	6

Table 25. Weed Control with Sencor

RCB; 4 reps
Variety: Stine 01136F
Planting Date: 5/19/98
PPI/PRE: 5/19/98
Soil: Silty clay loam; 3.7% OM; 6.8 pH

Precipitation: 1st week 0.48 inches
2nd week 0.24 inches

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

Roft=Robust foxtail
Cowh=Common waterhemp

COMMENTS: Heavy common waterhemp density. Yield response to waterhemp control. Good crop tolerance to all treatments.

Treatment	Rate/ac	% VCRR 7/24/98	% Roft 7/24/98	% Cowh 7/24/98	Yield bu/ac
Check	----	0	0	0	15
PREPLANT INCORPORATED					
Sencor+Treflan	6 oz+1.5 pt	0	83	56	33
Sencor+Command	6 oz+1.5 pt	0	92	64	38
Sencor+Pursuit Plus	6 oz+2.5 pt	0	97	84	44
PREEMERGENCE					
Sencor+Command 3ME	6 oz+2 pt	0	98	81	48
Sencor+Axiom+FirstRate	4 oz+11 oz+.75 oz	3	97	98	50
LSD (.05)		2	5	7	5

Table 26. Broadleaf Weed Control in Soybeans

RCB; 4 reps
Variety: NK S14-M7
Planting Date: 5/22/98
PRE: 5/22/98
EPOST: 7/2/98; Soybean 8 in; Grft 4-5 in; Cowh 3-5 in.
POST: 7/13/98; Soybean-bloom; Grft 10 in; Cowh 5-10 in.
Soil: Silty clay; 3.5% OM; 6.6 pH

Precipitation:		
PRE	1st week	0.28 inches
	2nd week	0.56 inches
EPOST	1st week	1.70 inches
	2nd week	0.16 inches
POST	1st week	0.16 inches
	2nd week	0.35 inches

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

COMMENTS: Roundup Ready variety. Some variability due to wet conditions during early season. Excellent grass control. Yields reflect common waterhemp control. Several split application programs provided satisfactory waterhemp control.

Treatment	Rate/ac	% VCRR 7/22/98	% Grft 7/22/98	% Cowh 7/22/98	% Cowh 10/14/98	Yield bu/ac
Check	----	0	0	0	0	14
PREEMERGENCE						
Broadstrike+Dual	2.25 pt	3	96	95	95	36
EARLY POSTEMERGENCE						
Expert+X-77	2 oz+.25%	3	94	38	6	14
PREEMERGENCE & EARLY POSTEMERGENCE						
Broadstrike+Dual& Expert+X-77	2.25 pt& 2 oz+.25%	0	97	94	92	32
Broadstrike+Dual& Expert+Action+X-77	2.25 pt& 2 oz+.5 oz+.25%	4	97	89	88	28
Broadstrike+Dual&Expert+ Cobra+COC+28% N	2.25 pt&2 oz+ 4 oz+1 pt+1 pt	9	96	97	93	30
Broadstrike+Dual&Expert+ Reflex+COC+28% N	2.25 pt&2 oz+ 8 oz+1 pt+1 pt	1	95	94	91	30
Broadstrike+Dual& Expert+Roundup Ultra+ AMS	2.25 pt& 2 oz+1.5 pt+ 8.5 lb/100 gal	0	99	96	88	38
Broadstrike+Dual& Roundup Ultra+ AMS	2.25 pt& 1.5 pt+ 8.5 lb/100 gal	0	99	98	93	37
EARLY POSTEMERGENCE						
Expert+Roundup Ultra+ AMS	2 oz+1.5 pt+ 8.5 lb/100 gal	8	99	87	82	28
Roundup Ultra+AMS	1.5 pt+8.5 lb/100 gal	4	99	78	72	26

Table 26. Broadleaf Weed Control in Soybeans (Continued) . . .

Treatment	Rate/ac	% VCRR 7/22/98	% Grft 7/22/98	% Cowh 7/22/98	% Cowh 10/14/98	Yield bu/ac
EARLY POSTEMERGENCE & POSTEMERGENCE						
Expert+Roundup Ultra+	1 oz+.75 pt+					
AMS&	8.5 lb/100 gal&					
Expert+Roundup Ultra+	1 oz+.75 pt+					
AMS	8.5 lb/100 gal	8	99	91	93	29
Roundup Ultra+AMS&	1 pt+8.5 lb/100 gal&					
Roundup Ultra+AMS	1 pt+8.5 lb/100 gal	4	98	93	94	29
LSD (.05)		8	4	8	9	9

Table 27. Grass Control in Soybeans

RCB; 4 reps
Variety: Stine 01136F
Planting Date: 5/22/98
POST: 7/1/98
Soil: Clay; 3.1% OM; 7.1 pH

Precipitation: 1st week 1.89 inches
2nd week 0.12 inches

Grft=Green foxtail
Voco=Volunteer corn

COMMENTS: Good foxtail pressure. Basagran & Blazer applied 7/6/98 at 1 pt plus 0.5 pt/ac for broadleaf weeds. Excellent grass and volunteer corn control with all treatments. Some late waterhemp flush. Yields similar for all treatments.

Treatment	Rate/ac	% Grft 7/22/98	% Voco 7/22/98	% Grft 8/25/98	% Voco 8/25/98	Yield bu/ac
Check	----	0	0	0	0	30
POSTEMERGENCE						
BAS 620+COC	9.6 oz+1.25%	99	98	99	98	51
Poast+COC	16 oz+1.25%	99	93	99	91	50
Poast Plus+COC	24 oz+1.25%	99	94	98	94	52
Assure II+COC	8 oz+1.25%	99	98	98	94	51
Fusilade DX+COC	12 oz+1.25%	89	91	92	92	52
Fusion+COC	10 oz+1.25%	99	97	96	97	52
Select+COC	8 oz+1.25%	98	95	99	98	51
LSD (.05)		4	7	4	5	6

Table 28. Weed Removal Timing Soybeans

RCB; 4 reps
Variety: NK S14 M7
Planting Date: 5/19/98
PPI: 5/19/98
1 WK: 6/5/98; Soybean unifoliate;
Grft 2-3 lf
3 WKS: 6/20/98; Soybean 3-4 tri, 6 in.;
Grft 2-4 in; Cowh 1 in.
4 WKS: 6/26/98; Soybean 8 in;
Grft 5 in; Cowh 2-3 in.
5 WKS: 7/3/98; Soybean 10 in;
Grft 7-9 in; Cowh 4-8 in.
6 WKS: 7/9/98; Soybean flowering;
Grft 10 in; Cowh 6-10 in.
7 WKS: 7/13/98; Soybean bloom;
Grft 12-15 in; Cowh 12-20 in.
Soil: Silty clay; 3.9% OM; 7.0 pH

Precipitation:

PPI	1st week	0.48 inches
	2nd week	0.24 inches
1 WK	1st week	1.57 inches
	2nd week	2.11 inches
3 WKS	1st week	0.32 inches
	2nd week	0.20 inches
4 WKS	1st week	0.20 inches
	2nd week	1.70 inches
5 WKS	1st week	1.78 inches
	2nd week	0.16 inches
6 WKS	1st week	0.16 inches
	2nd week	0.31 inches
7 WKS	1st week	0.16 inches
	2nd week	0.35 inches

Grft=Green foxtail
Cowh=Common waterhemp

COMMENTS: Timing based on weeks after emergence. Extreme common waterhemp density. Emerged waterhemp was controlled at application; reduced control primarily represents new emergence after application. Treflan + Roundup (5 weeks), Roundup at 4 weeks, Roundup at 3 and 5 weeks were in the top yield group. Emergence after 5 weeks did not reduce yield.

Treatment	Rate/ac	% Grft 10/14/98	% Cowh 10/14/98	Yield bu/ac
Check	----	0	0	1
PREPLANT INCORPORATED				
Treflan	1.5 pt	94	46	7
PREPLANT INCORPORATED & POSTEMERGENCE				
Treflan&	1.5 pt&1 qt+8.5 lb/100 gal			
Roundup Ultra+AMS (4 wks)		99	93	42
POSTEMERGENCE				
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal			
1 wk		83	40	4
3 wks		98	56	13
4 wks		99	89	35
5 wks		98	67	18
6 wks		99	74	13
7 wks		97	77	14
Roundup Ultra+AMS(1 wk)	1 qt+8.5 lb/100 gal	87	35	4

Table 28. Weed Removal Timing in Soybeans (Continued) . . .

Treatment	Rate/ac	% Grft 10/14/98	% Cowh 10/14/98	Yield bu/ac
POSTEMERGENCE				
Roundup Ultra+AMS	1 qt+8.5 lb/100 gal			
1&3 wks		96	36	4
3&5 wks		99	95	37
1&3&4 wks		96	59	23
1&3&4&5 wks		98	91	40
1&3&4&5&6 wks		99	98	42
1&3&4&5&6&7 wks		99	99	42

Table 29. 1X & 3X Soybean Rate - PPI/PRE

RCB; 4 reps
Planting Date: 5/19/98
PPI/PRE: 5/19/98
Soil: Silty clay; 3.5% OM; 6.5 pH

Precipitation: 1st week 0.48 inches
2nd week 0.24 inches

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

COMMENTS: Purpose to evaluate crop response to 1X and 3X herbicides. Very good crop tolerance under conditions of test.

Treatment	Rate/ac	% VCRR 9/23/98	Yield bu/ac	2 Yr Avg Yield %VCRR	
bu/ac					
Check	----	4	37	2	27
PREPLANT INCORPORATED					
Treflan	1 qt	3	44	6	38
Treflan	3 qt	10	48	11	39
Sonalan	2.67 pt	1	43	5	39
Sonalan	8 pt	4	43	10	37
Prowl	3 pt	5	47	3	38
Prowl	9 pt	13	47	9	41
Command 4L	1 qt	4	42	4	40
Command 4L	3 qt	4	52	4	44
Python	1 oz	1	43	---	---
Python	3 oz	5	44	---	---
Treflan+Scepter	1 pt+.67 pt	1	44	6	41
Treflan+Scepter	1 pt+2 pt	4	44	11	39
Treflan+Authority	1 pt+4 oz	6	47	---	---
Treflan+Authority	1 pt+12 oz	9	45	---	---
Frontier	2 pt	8	47	4	40
Frontier	6 pt	6	49	11	41
Sen/Lex	.67 lb	3	50	4	40
Sen/Lex	2 lb	5	44	14	39
LSD (.05)		8	8	7	6

Table 30. 1x & 3X Soybean Rate - Post

RCB; 4 reps
Planting Date: 5/19/98
POST: 6/26/98
Soil: Silty clay; 3.7% OM; 6.6 pH

Precipitation: 1st week 0.20 inches
2nd week 1.70 inches

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

COMMENTS: Visual crop response very slight. VCRR includes late season rating for delay in leaf drop. Crop safety differential at 1X and 3X not apparent in yield; crops under stress (lower yield potential) may respond differently.

Treatment	Rate/ac	% VCRR 9/23/98	Yield bu/ac	2 Yr Avg % VCRR	2 Yr Avg Yield bu/ac
Check	----	5	48	3	43
POSTEMERGENCE					
Classic+X-77	.75 oz+.25%	3	50	3	45
Classic+X-77	2.25 oz+.25%	4	52	3	45
Pinnacle+X-77	.25 oz+.25%	11	47	6	45
Pinnacle+X-77	.75 oz+.25%	9	51	8	44
Cobra+COC	.8 pt+.5 qt	0	50	4	45
Cobra+COC	2.4 pt+.5 qt	1	47	6	43
Blazer+X-77	1.5 pt+.5%	0	50	0	45
Blazer+X-77	4.5 pt+.5%	0	50	2	45
Basagran+COC	1 qt+1 qt	4	50	3	46
Basagran+COC	3 qt+1 qt	1	50	2	45
Resource+COC	.5 pt+1 qt	3	50	1	45
Resource+COC	1.5 pt+1 qt	8	48	6	44
FirstRate+X-77+28% N	.3 oz+.125%+2.5%	8	50	4	47
FirstRate+X-77+28% N	.9 oz+.125%+2.5%	4	51	3	47
Pursuit 2L+Sun-It II+28% N	4 oz+1.5 pt+1 qt	6	51	3	47
Pursuit 2L+Sun-It II+28% N	12 oz+1.5 pt+1 qt	5	48	6	44
Raptor+Sun-It II+28% N	5 oz+1.5 pt+1 qt	3	51	5	45
Raptor+Sun-It II+28% N	15 oz+1.5 pt+1 qt	10	47	14	43
Flexstar HL+Sun-It II+28% N	12 oz+1%+2.5%	0	50	---	---
Flexstar HL+Sun-It II+28% N	36 oz+1%+2.5%	1	51	---	---
LSD (.05)		6	4	5	3

USE OF HIGH OIL CORN HYBRIDS IN BEEF FEEDLOT DIETS

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Introduction

Markets for high oil corn (HOC) target both the human food industry as well livestock feed. Currently, one-third of current acreage of Optimum® HOC is grown on contract for export market. The other two-thirds is used as domestic livestock feed in the United States. The advantages of feeding high oil corn to swine and poultry are well documented. Originally, beef cattle were not considered a potential market because of the perception that ruminants are not capable of utilizing dietary lipid (fat + oil) as effectively as non-ruminants. In fact, problems usually arise when adding lipids to diets containing considerable forage. Oils high in unsaturated fatty acids are particularly detrimental to fiber digestion in the rumen. Conversely, the addition of lipid (e.g. tallow, soybean soapstock, etc.) to high concentrate finishing diets is common practice in southern feedlots. Generally, the total lipid content of the finishing ration does not exceed 8% of diet dry matter. Fiber content of finishing diets is low and poorly digested because of the lack of optimum rumen pH. As a result, the addition of lipid usually enhances feedlot performance due to the increased NE_g level of the finishing diets.

The inclusion of high oil corn in place of typical, bin-run corn in finishing diets would result in total diet lipid levels within the range of 5 to 8% , therefore not exceeding lipid levels already fed. Furthermore, the fact that the oil is located inside the kernel (rather than externally coated on feed particles) it may actually protect the rumen from exposure to part of the oil, increasing the amount that might be fed. Previous work at SDSU (Sharp and Birkelo, 1997) suggests that the presence of corn oil in the diet may also alleviate the occurrence of acidosis (grain overload) by slowing the rate, but not the extent of starch digestion. It seems reasonable to expect that comparable, or superior, performance can be observed by feeding high oil corn in cattle finishing diets. The objective of this study was to determine the effect of high oil corn fed whole or rolled on feedlot performance and carcass characteristics of steers.

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Materials and Methods

We utilized 154 head of crossbred yearling steers with an initial weight of 925 lb. These steers were randomly assigned to four treatments. The four treatments included a 1) 10% roughage diet containing unprocessed (whole) corn of normal oil content (regular), 2) 10% roughage diet containing rolled corn of normal oil content, 3) 10% roughage diet with unprocessed high oil corn (HOC), and 4) 10% roughage diet with rolled high oil corn.

The steers were processed on d 1 and placed on test. Processing on d 1 included vaccinations for IBR, BRSV, BVD, PI_3, 7-way, Ivomec pour on, and implanted with Ralgro. On d 42 the steers were re-implanted with Component TE-S (120 mg TBA and 24 mg E_2).

Pens of steers were allowed to consume feed ad libitum. Pens were fed once daily. A receiving diet was fed for one day followed by four step-up diets that were fed four days each. Finally, the finishing diet (Table 1) was fed for the duration of the feeding trial.

Weights were recorded every 42 days. Steers were taken off feed and water the afternoon before going on test, but only water was removed for the subsequent interim weights. Weekly samples of every ingredient of the diet were collected and frozen for lab analysis. Samples were ground and analyzed for bulk dry matter, Kjeldahl N (CP) and ether extract (oil). This trial began April 14, 1998 and a group of steers were on trial 112 and 128 days. Final weights were calculated from hot carcass weight and a standard 62% dressing percentage. Carcass data was collect two days after slaughter on a chilled carcass. The traits measured were HCW, REA, adjusted fat thickness, KPH fat, YG, marbling, and QG. Performance data, ADG, dry matter intakes, and F/G, along with the carcass data were analyzed using the General Linear Model procedure of SAS.

Results and Discussion

Feedlot Performance. Feedlot performance was not different between cattle fed HOC corn as compared to regular corn (Table 2). Cumulative ADG was not different (P >.05) between HOC and regular corn treatments [3.12 (HOC) vs. 3.05 (regular)]. Likewise, feed/gain (dry matter basis) values were similar (P >.05) between HOC and regular corn treatments [6.83 (HOC) vs. 6.97 (regular)].

We observed a significant corn type (HOC vs. reg.) by processing method (whole vs. rolled) interaction (Table 2) on dry matter intake for the entire feeding trial (P <.01) and the interim weigh periods: d 0 to 42, P = .06; d 43 to 84, P = .03; d 85 to 112, P = .08. We consistently observed that pens of steers receiving Reg/whole and HOC/rolled corn had higher dry matter intakes (20.93 lb/d, Reg/whole; 20.95 lb/d, HOC/rolled) as compared to pens of steers consuming Reg/rolled (20.21 lb/d) and HOC/whole (20.07 lb/d) corn. To our knowledge, this is the first trial to investigate HOC in the whole and rolled form. Based on those findings in this preliminary trial, we recommend rolling (cracking) HOC for optimal utilization in finishing diets. Theoretically, we may need to crack the kernel to maximize oil utilization in the ruminant digestive tract.

Carcass Characteristics. Carcass characteristic data is illustrated in Table 3. We observed a difference (P <.06) in KPH fat between carcasses from steers fed HOC (2.65%) vs. regular corn (2.50%). Furthermore, processing method resulted in significant difference in KPH fat. Carcasses from steers fed whole corn had greater (P <.05) KPH fat as compared to carcasses from steers fed rolled corn (2.66 vs. 248). These differences in KPH fat suggest potential differences in the site of nutrient utilization between HOC and regular corn as well as rolled vs. whole corn. No other significant differences in carcass characteristics were observed between HOC and regular corn.

An initial study (Andrae, et al, 1998) reported percent choice in carcasses from steers fed HOC was 31 percentage units higher as compared to carcasses from steers fed typical corn. (HOC = 78% choice; CTL = 47% choice). In this trial, we observed no difference in marbling (Table 3). The percentage choice was 38% for HOC and 44% for regular corn. More research is needed to sort out the marbling effects associated with feeding HOC to beef cattle.

Acknowledgment

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Table 1. Composition of Experimental Diets

Ingredient	Treatment	
	Regular	HOC
Corn, regular	79.50	-
Corn, HOC	-	79.50
Alfalfa Hay	10.00	10.00
Cane Molasses	3.00	3.00
Corn, ground	1.50	1.50
Dicalcium Phosphate	0.25	0.25
Limestone	0.90	0.90
Fat	0.14	0.14
Potassium Chloride	0.20	0.20
Soybean Meal	3.00	3.00
Urea	0.86	0.86
TM Salt	0.55	0.55
Monensin/Tylosin Pre-mix	0.10	0.10

Monensin 25g/Ton DMB; Tylosin 8g/Ton DMB

Table 2. The Effect of Corn Hybrid and Processing Method on Feedlot Performance of Yearling Steers[a]

Corn Processing	Regular Whole	Regular Rolled	HOC Whole	HOC Rolled	SE	Significance
No. Pens	5	4	4	5		
No. Steers	43	34	34	43		
Initial Wt., lb	927	926	922	925	7	
Final Wt., lb	1308	1312	1303	1321	9	
D 0 to 42						
ADG, lb	3.52	3.22	3.37	3.58	0.24	
DMI, lb	21.4	20.54	20.6	20.96	0.32	C * P; P = 0.06
F/G	6.13	6.50	6.40	5.88	0.46	
D 43 to 84						
ADG, lb	2.36	2.45	2.51	2.40	0.25	
DMI, lb	21.38	20.63	20.31	21.82	0.51	C * P; P = 0.03
F/G	9.30	8.53	8.63	9.25	0.77	
D 85 to 112						
ADG, lb	3.60	3.88	3.62	4.08	0.30	
DMI, lb	20.20	19.52	19.53	20.4	0.45	C * P; P = 0.08
F/G	5.68	5.19	5.53	5.04	0.42	
Cumulative						
ADG, lb	3.05	3.04	3.03	3.21	0.12	
DMI, lb	20.93	20.21	20.07	20.95	0.26	C * P; P = 0.001
F/G	7.09	6.86	6.89	6.76	0.25	

[a]Least Square Means

Table 3. Steer Carcass Data[a]

Item	Regular Whole	Regular Rolled	HOC Whole	HOC Rolled	SE	Significance
HCW, lb	803	801	798	813	5.7	NS
REA, in^2	12.98	13.06	13.29	13.12	0.15	NS
Adj. Backfat, in	0.53	0.48	0.51	0.47	0.02	NS
KPH Fat, %[b]	2.60	2.40	2.72	2.57	0.05	Proc P = .01 Oil P = .06
YG[c]	3.25	3.04	3.10	3.08	0.09	NS
Marbling Degree[d]	486	483	473	489	7.3	NS
Percent Choice	40	50	32	42		NS

[a]Least Square Means
[b]Estimated as percentage of HCW
[c]Calculated
[d]$Slight^0$ = 400; $Small^0$ = 500

A COMPARISON OF HIGH OIL CORN VS NORMAL CORN IN FINISHING SWINE DIETS

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Summary

One hundred pigs weighing 178 lbs were fed finishing diets whose grain source was either normal corn (corn) or high oil corn (HOC) in a 43-day trial. High oil corn was substituted for corn on an equal weight basis with all other ingredients being added at identical amounts. There were no differences in daily gains or carcass characteristics. However, pigs fed HOC diets consumed 4% less feed and were approximately 5% more efficient than pigs fed corn diets ($P<.05$). Based on this data, HOC improves finishing pig performance without affecting carcass characteristics. The decision of when to use HOC, therefore, needs to be based on corn cost and expected feed savings.

Introduction

The use of high oil corn (HOC) in livestock feeds is generating a great deal of interest by both producers and the feed industry. Traditionally, fat additions reduce feed intake and improve feed efficiency, but it is difficult to add in most on-farm situations. Therefore, many producers are unable to take advantage of fat additions. However, if HOC can be incorporated into swine diets without adversely affecting performance, producers will then be able to take advantage of the benefits of fat additions.

Procedures

One hundred high-lean gain barrows and gilts weighing 178 lbs were allotted to one of the two dietary treatments based on sex and weight. A randomized complete block design was used with 10 replicates per treatment. There were 5 pigs per pen, and feed and water was offered ad libitum. Diets were identical (Table 1) with corn type being substituted on an equal weight basis. Pig weights and feed consumption were measured on days 22, 37, and 43 of the trial. On day 43, all pigs were ultrasonically scanned for backfat thickness (BF) and longissimus muscle area (LMA) at the 10th rib. Percent lean was calculated using final weight, BF, and LMA. The HOC used in this trial was approximately 2% higher in oil/fat than the control corn.

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Table 1. Diet composition (lbs per ton of complete feed)

Ingredients	Normal Corn	High Oil Corn
Corn	1572.8	
High oil corn		1572.8
Soybean meal, 44%	380.8	380.8
Dicalcium phosphate	16.8	16.8
Limestone	17.6	17.6
Salt	5.0	5.0
Vitamin premix	3.0	3.0
Mineral premix	2.0	2.0
Tysolin (10 g/lb)	2.0	2.0
Calculated nutrient levels (%)		
Lysine	0.75	0.75
Calcium	0.60	0.60
Phosphorus	0.50	0.50

Results and Discussion

Growth and carcass data are presented in Table 2. Gain during the 3 growth periods and the overall 43 day period was unaffected by corn type (P>.05). However, feed intake was reduced and feed efficiency improved in all growth periods, and for the overall trial when HOC was the grain source. Percent lean, BF, and LMA were unaffected by corn source.

These data are very similar to other trials involving fat additions. Typically fat additions at this level have no impact on gain or carcass quality, as was observed in this study. Also, as a "rule-of-thumb", each 1% fat addition usually results in a 2% improvement in feed efficiency. The 4.7% improvement in feed efficiency observed in this trial from 2% added fat equates into a comparable 2.35% improvement in feed/gain for each 1% fat addition.

These data indicate that HOC will improve efficiency of gain in finishing pigs without adversely affecting gain or carcass quality. Therefore, HOC should be used in swine diets when the benefits of fat additions are greater than the extra cost of HOC.

Table 2. Growth performance and carcass characteristics.

	Day 0-22	Day 23-37	Day 38-43	Day 0-43
Daily gain, lbs				
Corn	2.10	2.37	1.46	2.11
HOC	2.18	2.34	1.40	2.13
Daily feed intake, lbs				
Corn[a]	7.32	8.00	6.73	7.47
HOC[b]	7.08	7.69	6.37	7.19
Feed/Gain				
Corn[a]	3.50	3.40	4.71	3.55
HOC[b]	3.24	3.29	4.55	3.38
Final pig weight, lbs				
Corn	224	260	268	
HOC	226	261	270	
Backfat thickness, in				
Corn				0.74
HOC				0.80
Longissimus muscle area, in^2				
Corn				7.43
HOC				7.40
Percent Lean				
Corn				54.80
HOC				54.29

[ab] Rows with unlike superscripts differ ($P < 0.05$)

DOLLAR AND LABOR COSTS ASSOCIATED WITH THE CONSTRUCTION OF A "HOOP-BARN"

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Introduction

The swine industry is undergoing dramatic changes. As swine operations get larger, the ever increasing costs of expensive facilities cause many independent producers to wonder if they should still raise pigs. Also, in order to be competitive, swine producers need to take advantage of technologies like all-in/all-out production, split-sex feeding, phase feeding, and high lean-gain genetics. In order for many producers to implement these technologies, they must either remodel or build new barns. The high costs of traditional "stick and concrete" buildings make it uneconomical for many traditional producers to adapt these technologies for small numbers of hogs. This situation, coupled with the uncertainty in the swine industry, is causing many independent producers to quit the business.

This loss not only affects the swine industry in South Dakota, but also substantially decreases the market for corn and soybean meal. Since a market hog consumes 10 bushels of corn and 150 lbs of soybean meal to get to market weight, and a sows eats 29 bushels of corn and 450 lbs of soybean meal in a year, even the loss of a few operations impacts the profitability of grain producers.

Other concerns with new confinement swine facilities include manure management, odor production, and the lack of other uses for the buildings. In the past two years, many producers have been denied the opportunity to build new hog barns and feed hogs, largely based on these concerns. Hoop barns utilize straw bedding, which cuts down on odor and use a manure management system most people are comfortable with. Also, hoop barns are about one-third the cost of confinement barns, and can also be used for grain storage, machine storage, hay storage, calving barns, and many other uses.

[1] The authors wish to thank the SD Corn Utilization Council and Sioux Steel Company for their support of this project.

Objective

The objective of this project is to link Extension and Research to provide producers with a model they can look at, walk in, and see unbiased information that is being collected at the Southeast Research Farm near Beresford. This will allow producers to realize that they can capture most of the available technologies in an inexpensive, multi-purpose facility that is environmentally friendly and produces little odor. By exposing them to an alternative to expensive confinement facilities, producers should be more positive about raising hogs. Again, anything we can do to keep producers raising hogs and encouraging new producers to start will increase the viability of family farms and strengthen our small, rural communities.

Since the basic parts and cost of the structure (hoops and canvas cover) differ from company to company, those costs will not be reported in this paper. Therefore, the purpose of this paper is to outline the costs, beyond the basic package, and labor hours associated with construction of a 30’ x 84’ hoop barn to help producers consider all the costs of building a hoop barn.

Procedures

Funding from the SD Corn Utilization Council, Sioux Steel Company, the Southeast Research Farm Corporation, and the SDSU Department of Animal and Range Sciences paid for the site preparation, the structure, equipment, and installing utilities, etc.

Brad Rops kept a detailed record of the hours spent in the project (Table 1). While an experienced crew would certainly take less hours to construct the barn, most producers putting up a barn themselves would be in the same “learning” situation as the Southeast Farm crew, so we feel these figures truly represent the time a producer would need in putting up a hoop barn for the first time.

Bob Berg tracked the financial costs associated with the project (Table 2). All expenditures over $300 required several bids so those costs should be very comparable to what a local producer would have to pay.

Table 1. Labor hours associated with construction of 30' x 84' "hoop-barn".
Southeast Farm, 1998.

ITEM	# WORKERS	HOURS	TOTAL
Stake out site	1.5	2	3.0
Drill post holes	2.5	11	27.5
Set posts	3.5	11	38.5
Attach brackets/ratchets	2	2	4.0
Assemble rafters & purloins	3	2	6.0
Pull cover over rafters	5	1	5.0
Lace cover	2	2	4.0
Construct pony wall	3	11	33.0
Set door posts & headers	3	2	6.0
Install quarter panels	1	4	4.0
Hang doors & hardware	1	3	3.0
Install plywood baffles	1	6	6.0
		TOTAL HOURS	**140.0**[1]

[1] Total hours equals 5.8 days for three workers.

Table 2. Construction costs[1] associated with "hoop-barn" project. Southeast Farm, 1998.

Description	Cost ($)
Site prep[2]	994.00
Water lines	369.10
Concrete work[3]	3,200.00
Building permit fee	20.00
Livestock special use permit	50.00
Saw rental	8.00
Equipment rental, level	78.00
Misc. hardware for waterer	43.60
Misc. supplies for hoop bldg.	236.65
Lumber for hoop project	82.75
Quarter panels, four	296.00
Treated lumber[4]	2,171.69
Waterer	417.00
Electrical work	650.00
Gates	562.00
Self-feeders, 2 large	1,150.00
Total	**$10,328.79**

[1] Excluding the covering and hoops
[2] Removal and burying of tree stumps, elevating and leveling the site
[3] 20' pad in the south end of the building for feeders and waterers, plus 10' pad in front of building
[4] Posts, tongue & groove sidewalls, and plywood

Summary

Construction costs excluding the covering and hoops ran $10,328.79 and took approximately 140 hours to construct. While these will vary from farm to farm, they still provide a basis for consideration of putting up a hoop barn.

The first study being conducted in the hoop barn is to run it continually for one year to collect all the requirements for labor, utilities, bedding, as well as monitoring temperature and pig performance.