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AGRONOMY RESEARCH CENTER

Long Term Tillage Study

Introduction

Early evaluation of reduced tillage systems in the Midwest centered on well-drained and/or erosive soils. Due to reduced water erosion and savings in soil moisture, systems leaving 70% or more of the soil surface covered with residue often increased yield potential on these soils. These findings could not be generalized, however, to the dark silty clay loam soils of the Eastern Corn Belt where soil moisture and erosion were less severe problems.

Beginning in 1975, a range of tillage systems have been compared annually on Chalmers silty clay loam soil (4% OM) at the Purdue Agronomy Research Center in West-central Indiana. Our goal was to determine long-term yield potential of the different systems and to determine changes in soil characteristics and crop growth that could be associated with yield differences. Plow, chisel, ridge, and no-till systems were compared for continuous corn, corn following soybeans, soybeans following corn, and continuous soybeans. Plots were 12 rows wide and 150 feet long. Row width was 30 inches for both corn and soybeans from 1975 to 1994. Starting in 1995, soybeans were drilled in 7.5-inch rows for plow, chisel and no-till.

The following cultural practices have been used since the study began. Plowing and chiseling were done in the fall with one disking and one field cultivation for spring seedbed preparation. For the ridge system, ridges were made at cultivation in corn and after harvest in soybeans. All 30" row treatments except no-till were cultivated once.

Starter fertilizer was used for all corn plots, but not for soybeans. Placement was two inches to the side and 2 inches below the seed. Nitrogen source for corn was anhydrous ammonia, either pre-plant or side-dress. Phosphorus, potassium and lime were surface-applied as needed.

Several planting practices were changed in 1997. A flat disk was used to scrape ridges at planting from 1980 to 1996. Starting in 1997, planter mounted, double vertical disks were used to clear ridge tops of residue. For no-till planting, a one-inch fluted or bubble coulter was used ahead of disk openers from 1975 to 1996. Starting in 1997, no coulters were used ahead of disk openers as per planter manufacturer recommendation.

Herbicides were applied at planting from 1975 through 1996. In 1997, herbicides were applied pre-emergence after planting with a 3-point hitch sprayer. They included atrazine, Bladex, and Dual for all corn, plus either Roundup or Gramoxone Extra for burndown on ridge and no-till plots. Lorox L, Lorox Plus and Dual were used for all soybeans, with burndown the same as for corn. Where needed, plots were hand weeded to be sure that weed control did not limit yield. Counter 15G was band-applied at planting for corn rootworm control from 1975 through 1996. Starting in 1997, Force 1.5G was used. Chemical control for cutworms, stalk borers, bean leaf beetle, and spider mites was used as needed.

Four corn hybrids and eight soybean varieties have been used during the 24 years of this project.

Table 1. Planting dates for corn and soybean, Chalmers silty clay loam, ARC.

	Year	Corn	Soybean		Year	Corn	Soybean
1	1975	5/2	5/6	13	1987	5/5	5/7
2	1976	4/29	5/10	14	1988	4/26	5/12
3	1977	5/10	5/6	15	1989	4/25	5/12
4	1978	5/3	5/19	16	1990	4/26	5/21
5	1979	5/9	5/17	17	1991	5/10	5/3
6	1980	5/5	5/15	18	1992	5/5	5/7
7	1981	5/22	5/28	19	1993	5/11	5/12
8	1982	4/30	5/11	20	1994	4/26	5/17
9	1983	5/10	5/12	21	1995	5/22	6/1
10	1984	5/2	5/14	22	1996	5/31	6/21
11	1985	4/25	5/16	23	1997	4/29	5/16
12	1986	4/29	5/28	24	1998	5/14	5/18

1998

Equipment used:

Primary tillage included the use of an International Harvester 5-18 inch bottom semi-mounted moldboard plow on the plow treatments. A DMI 7-shank coulter-chisel plow equipped with 4 inch twisted chisel points on 15-inch centers and a 5-danish-tine sweep leveling bar was used for the chisel treatment. Secondary tillage for plow and chisel included the use of an International 15-foot pull type tandem disk and a Glenco 10 foot fully mounted field cultivator with rear mounted rolling baskets.

Nitrogen was applied preplant at a depth of 6 to 7 inches with a 5-knife 30-inch anhydrous ammonia applicator equipped with one coulter, one sealing wing, and two covering disks per knife. The covering disks were removed for no-till continuous corn due to residue plugging. The disks were also removed for all ridge plots to prevent "shaving" of the ridge shoulders. The outside knives (#1 and #5) were equipped to deliver 1/2 rate and after the first pass through the plots, an outside knife was placed back in the previous outside knife track to give a full rate. This method of knife placement gives us a marker for guiding the equipment for uniform application. We chose not to use a "splitter" in the anhydrous hoses to the outside knives. Instead, we equipped the outside half-rate knives with single tubes and hoses and the full rate knives with double tubes and hoses.

Corn was planted with a Case-IH model 955 4-row planter. Ripple coulters opened a slot for starter fertilizer placement. When planting the ridge treatment, row unit mounted double vertical disks scraped less than 1 inch of soil off the ridge tops and stabilized the planter on the ridge tops. We planted the no-till continuous corn 6 inches beside the old row rather than on the old row. We also used row unit mounted row cleaners to clear the row area of residue when no-till planting into corn and soybean residue.

Soybeans were planted with a 10-foot John Deere 750 no-till drill in the plow, chisel and no-till treatments. In the ridge treatment, the soybeans were planted with the Case-IH 4-row 30-inch planter.

All rowed plots, except no-till, were cultivated with a 4-row 30-inch Hiniker ridging cultivator to control weeds and aerate the soil. The ridging wings were raised (and inoperative for "level" cultivating) on the plow and chisel plots. Ridge-till soybean plots were re-ridged after harvest. All corn plots were harvested with a White model 7300 combine equipped with a 4-row 30-inch cornhead. All soybean plots were harvested with a John Deere model 3300 combine equipped with a 10-foot grain platform with pickup reel.

Summary of studies conducted on the tillage plots by researcher.

- Dr. James Wilcox, Agronomy.
  Conventional Tillage v. No-till Effects on Seed Composition, 1997-1998. "The objective of the study was to determine if tillage method affected seed protein of genotypes that varied widely in seed protein concentration. Average over two years, no-till plots averaged 4 days later in maturity, 2 inches shorter in mature plant height, 0.4 percentage points lower in seed protein and 0.2 percentage points higher in seed oil than conventional till plots. Tillage had no effect on seed yield or lodging resistance. The data indicate that even tillage extremes, conventional vs. no-till, do not have much effect on seed protein concentration. The lack of interaction of tillage method with genotype indicates that all genotypes were similarly affected by tillage method."
- Dr. Scott Abney, USDA-ARS, Botany and Plant Pathology.
  The overall objectives of the soybean pathology research in the Long-Term tillage plots are: 1) identify and describe incidence and severity of Phytophthora root rot in conventional vs. reduced-tillage soybean production systems; 2) characterize the role of selected fungicide and post-herbicide treatments associated with conventional and no-till systems on developmental progress of soybean diseases that will facilitate improved plant health; and, 3) continue identifying pathogenicity and virulence of *Phytophthora sojae* races and *Fusarium solani* strains isolated from soybeans with Phytophthora root rot and sudden death syndrome symptoms, respectively. This research is important to Indiana and the northcentral region agriculture and is an integral part of Abney's on-going soybean pathology research project which emphasizes maintaining improved plant health as a means of reducing yield losses caused by Phytophthora root rot, sudden death syndrome and late season diseases. During the 1990s, diseases caused by *P. sojae* and *F. solani* have increased throughout the northcentral region. Research data from field sites with a history of disease caused by these important soybean pathogens are critical to the success of the above objectives. Diseases caused by both pathogens occur in the Long-Term tillage plots and this test site is one of the best locations at the Purdue Agriculture Research Center to evaluate Phytophthora damage on soybeans. This study will continue in 1998.
- Dave Gehring and Dr. Gary Steinhardt.
  "Dave Gehring and Gary Steinhardt used the automated penetrometer and took readings to a depth of 40 cm for all plow and no-till plots. Readings were taken in the wheel track, row middle (non-tracked), and in the west

two rows for the corn plots. Data collected in soybeans was only wheel track and row middle (non-tracked). Initial results have not yet been determined, but more data will be needed to confirm whatever the results may be." Dave Gehring

"Dave Gehring used two Amoozemeter to measure the soil's saturated hydraulic conductivity for the C/C and C/B no-till and plow plots. He took measurements in four locations in the plot; wheel track, in the row, row middle (non-tracked) and the skip row (area between the plots). Initial results show the wheel track as having the lowest conductivity while the row middle as having the highest. Further data will be collected to confirm the initial results." Dave Gehring

- Cindy H. Nakatsu and Sylvie M. Brouder, Agronomy.
  Diversity of the Rhizosphere Bacterial Community of Corn and Soybean. "This was the second year of collecting corn and soybean plants from the long-term tillage plots. Collections were made of the disturbed (plowed) and undisturbed (no-till) soils, of corn and soybean crops, grown in monoculture or in a two crop annual rotation. This year we concentrated studies on the rhizosphere soils of corn and soybean to determine if distinct microbial communities could be observed if there are differences in root type, plant growth stage, and agronomic treatment. The rhizosphere is the soil region in contact with plant roots and exudates from the roots can promote microbial growth. However, very little is known about the diversity, composition and dynamics of this component of the terrestrial ecosystem. Both greenhouse and field experiments were conducted. Soil treatments resulted in distinct shoot and root growth patterns with significant differences observed in morphological and architectural aspects of the rooting systems. Root systems were partitioned into radicles, seminal roots and nodal roots, and root-specific rhizosphere soil was collected for analysis. Characteristic profiles of the communities were obtained by denaturing gradient gel electrophoresis (DGGE) of PCR amplified 16S rDNA from soil extracted DNA. Using this method PCR products with different sequences migrate different distances in the denaturing gel producing distinct "fingerprint" patterns. The method showed that the dominant rhizosphere bacterial populations, as indicated by band intensity, differ with root type and these populations change during plant growth and with soil treatment. There are two dominant populations common to the rhizosphere of corn grown in the field regardless of treatment. However, these populations were not observed in the rhizosphere of all corn treatments in the greenhouse experiments. Our results demonstrate that the technique can aid in identifying the specific dominant microbial populations in a community under different selective conditions. This approach provides a means to understand factors influencing the microbial ecology of the rhizosphere and conversely, the influence microbial ecology has on plant development." This study will continue in 1999. Cindy Nakatsu.
- Terry West and Dr. Gary Steinhardt, Agronomy.
  T. West and G. Steinhardt studied long-term affects of tillage and rotation by measuring plant population, growth, and yield of corn and soybeans.

CULTURAL PRACTICES USED 1998
Long Term Tillage Study, ARC, Purdue Univ.

Item	Corn		Soybean	
	Date	Application	Date	Application
Nitrogen fertilizer	4/20	NH_3 @ 200 LB/a. N in row middles, N-serve, double-disk sealers on all plow and chisel, also no-till corn after soybean.		None
Secondary tillage	4/28	Disk once on plow and chisel treatments.	5/15	Disk once on plow and chisel treatments.
	5/13	Field cultivate once on plow and chisel treatments.	5/16	Field cultivate once on plow and chisel treatments.
Hybrid/Variety planted	5/14	Beck's 5405 (110 Day) Row cleaners on c/b and c/c no-till. Shifted no-till c/c to east. (Shift to west in 1999).	5/18	Asgrow 3244 (3050 seeds/lb.).
Seeding rate		30000 seeds/a., Drum A, 24 pockets (variable rate controller).		Plow, chisel, no-till drilled: 210,000 seeds/a. Ridge 30" rows: 140,000 seeds/a. (variable rate controller).
Starter fertilizer/planter		34-0-0 @ 96 LB/a., 2 inches to the side and 2 inches below the seed (sprockets driver 36, driven 30).		None
Insecticide/planter		Force 1.5G, 10 oz/1000 row feet, banded over row. (Insecticide setting 2-0).		None
Weed control	5/15	<u>3 point hitch sprayer:</u> Pre-emergence: Bladex 4L 3 pt/a. Atrazine 4L 3 pt/a. Dual II 3 pt/a. Roundup 3 pt/a.: no-till and ridge. *All broadcast with flat fan 8006 nozzles at 30 psi and 40 gallons water/a., 4 mph.*	4/24 5/18	<u>3 point hitch sprayer:</u> Early pre-emergence: Gramoxone Extra 3 pt/a. 2,4-D (Weedone 64) 1 pt/a. Surfactant 1.5 pt/100 gallons water Pre-emergence: Dual II 2.5 pt/a. Lorox Plus 18 oz/a. Roundup 3 pt/a.: no-till and ridge *All broadcast with flat fan 8006 nozzles at 30 psi and 40 gallons water/a., 4 mph.*
Cultivation	6/23	Plow and chisel treatments.	6/23	Ridge treatment only.
	6/23	Ridge treatment (reridge).	10/20	Ridge treatment (reridge).
Harvest	9/22	Center 4 of 12 rows, 150 ft.	10/12	Center pass, 150 ft.
Lime	10/23	2 ton/ac. Bulk spread, one pass.	10/23	2 ton/ac. Bulk spread, one pass.
Phosphorous, Potassium	11/5	200 LB/ac 0-45-0 300 LB/ac 0-0-60 Bulk spread, 2 passes.	11/5	200 LB/ac 0-45-0 300 LB/ac 0-0-60 Bulk spread, 2 passes.
Primary tillage	11/6	Fall plow on plow treatment.	11/6	Fall plow on plow treatment.
	11/6	Fall chisel on chisel treatment.	11/6	Fall chisel on chisel treatment.

Stand, growth, and yield -- Corn.

In no-till continuous corn, establishing a uniform stand can be difficult. As hybrids become more stalk rot resistant, the residue can still be very tough come spring planting. We have found that these tough stalks do not decay enough to be easily broken and smashed down by the planter. This has lead to uneven seed depth as the planter units bounce over the old corn stubs. Often root balls "bulldoze over" leaving a rough soil surface, also resulting in uneven seed depth. The corn residue is thickest on the old row and we have noted seeds planted in contact with residue, not in contact with soil. Variable seed depth and inconsistent contact with the soil can result in non-uniform germination, reducing yield potential. We have shifted no-till corn after corn rows 6 inches (enough to clear the planter gauge wheels) to the side of last year's rows. By shifting the new rows, we wanted to gain more uniform seeding depth, improved seed to soil contact, and more uniform seedling emergence. This is the fourth year of shifting the new rows. In three of the four years, we achieved these goals.

Continuous corn. Stands were equal for all tillages when measured at 4 weeks after planting (Table 2). The secondary tillage passes in the plow and chisel plots left the soil cloddy. Many seeds were planted in dry and cloddy soil. It wasn't until 2 weeks after planting that sufficient rainfall occurred to germinate these seeds. Yield potential for these late plants was reduced when in competition with adjacent plants that emerged normally. The ridge and no-till treatments showed excellent emergence and growth through the season. Dry weather conditions in late July and through August resulted in incomplete pollination for all treatments. Many ears did not fill the last one-inch of the cob.

When corn followed soybeans, seed germination and plant stands were similar to continuous corn. Again soil conditions were dry and cloddy for the plow and chisel treatments. Ridge and no-till soil conditions at planting were ideal with adequate moisture. Chisel and plow corn yields were affected by the late germination.

With the late planting date (May 14), soil conditions for no-till were not as cold as we have experienced with earlier planting in most years of this study. The continuous corn yielded the 6th best out of the 24 years of this study. With more complete cob fill, this year could have been ranked much higher. This argues for later planting of no-till corn into heavy continuous corn residue cover when soil conditions are more favorable to uniform germination and early growth. It also suggests that when planting is delayed by wet soil conditions it could be more profitable to no-till plant the corn than take the time and expense to perform secondary tillage before planting. This would save on fuel, labor and machinery costs while planting the corn more timely. A date of planting/tillage study needs to be done to investigate this idea.

Table 2. Agronomic performance of corn as affected by tillage and rotation, Chalmers silty clay loam, Long Term Tillage Study, ARC, Purdue Univ., 1998. †

Previous Crop	Tillage	Residue cover after planting	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%
		%	ppa	in	in	%	Bu/a.
Corn	Plow	4d‡	29625	23.5	71.4	24.1	161.3
	Chisel	30c	29708	24.3	77.3	21.9	163.9
	Ridge	70b	30708	28.5	82.0	20.0	173.0
	No-till	87a	29875	25.7	84.3	20.6	166.6
Soybean	Plow	1d	28833	19.0b	73.0b	26.4	164.6ab
	Chisel	10c	28083	20.8ab	72.2b	25.6	159.1b
	Ridge	49b	30000	26.5a	76.5ab	21.8	182.9a
	No-till	70a	30041	26.5a	84.9a	22.1	178.7ab

†Average of 3 replications.
‡Within rotations, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P= .05).

Stand, growth, and yield -- Soybeans.

For the fourth year we drilled the plow, chisel, and no-till treatments at 7.5-inch row spacing, while the ridge treatment was planted at 30-inch row spacing. Seeding rates were set higher for the drilled treatments.

Rotation soybean/corn: The plow treatment had low plant populations compared to the other drilled treatments (Table 3). Rough and cloddy soil may have been the cause of the reduced stand, however there was sufficient population for good yields. Ridge plant populations were significantly lower due to the reduced seeding rate at planting for 30" rows. All treatments exhibited good plant growth through the year, with no-till being tallest at harvest (not recorded). There were no significant insect or disease problems noted. No-till yielded significantly highest at 70.8 bushels/acre. This is the highest soybean yield achieved in the history of this study. The 64.4 bushels/acre for plow was the highest plow yield, the 59.3 bushels/acre for chisel was tied for best chisel yield, and the 59.2 bushels/acre for ridge was the second best ridge yield in the history of this study. The 30" row ridge plots yielded 8.6% less than the 7.5" drilled treatments, but was not significantly different.

Continuous soybean: Plant emergence was very uniform in all treatments. Ridge plant populations were significantly lower due to the reduced seeding rate at planting for 30" rows. Plant height was shorter at the 8-week measurement than for soybeans in rotation. There were no significant yield differences among treatments. The ridge treatment continues to suffer from soybean cyst nematodes in some plots. The warmer and drier soil found in the ridges favors cyst nematode development. Without tillage or the use of a resistant soybean variety, it is likely that yields will continue to suffer, especially with periods of unusually dry weather. The 30" row ridge plots yielded 8.7% less than the 7.5" drilled treatments.

Table 3. Agronomic performance of soybean as affected by tillage and rotation, Chalmers silty clay loam, Long Term Tillage Study, ARC, Purdue Univ., 1998. †

Previous Crop	Tillage	Residue cover after planting	Stand‡ 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @13.0%
		%	ppa	in	in	%	Bu/a.
Corn	Plow	5a§	193341b	5.7	20.2	12.4	64.4b
	Chisel	45b	222247ab	5.7	19.8	12.2	59.3b
	Ridge	50b	134552c	6.5	20.6	12.5	59.2b
	No-till	95c	239780a	6.0	21.4	12.4	70.8a
Soybean	Plow	1a	226986a	5.4b	15.5	12.2	51.0
	Chisel	9b	222721a	5.6ab	15.5	12.1	47.4
	Ridge	31c	134552b	6.5a	17.0	11.9	45.1
	No-till	81d	218456a	5.8ab	17.4	12.1	49.8

†Average of 3 replications.
‡Plow, chisel, and no-till are 7.5" drilled, ridge is 30" rows.
§Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P= .05).

Table 4. Analysis of variance summary, tillage data, Long Term Tillage Study, ARC, Purdue Univ., 1998.

Variable	Residue cover after planting	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield Bu/a.
	------Significance Level------					
				Corn		
Tillage	.01	NS	.01	.01	.04	.04
Previous crop	.01	.05	.08	NS	NS	NS
Tillage x previous crop	.01	NS	NS	NS	NS	NS
				Soybean		
Tillage	.01	.01	.01	NS	NS	.01
Previous crop	.01	NS	NS	.01	.07	.01
Tillage x previous crop	.01	.03	NS	NS	NS	.04

Long Term Yields (Table 5.)

Average corn yields for chisel and ridge systems are reduced only 3% or less, compared to plowing, and in continuous corn and these systems are equal to plowing for corn after soybeans. No-till average yield is 18% less in continuous corn and 4% less for corn after soybeans, compared to plowing. In continuous corn, there is a tendency for greater reduction in no-till yields with time. Based on years 1975 to 1998, rotation corn yields were better than continuous corn yields by 5% with plowing, 8% with chisel, and by 16% with no-till. Based on years 1980 to 1998, rotation corn yields were better than continuous corn yields by 9% with the ridge system.

Soybean response to tillage shows long-term average yield with plowing about 5% better than yields with chisel, ridge, and no-till systems. There appears to be tendency for no-till soybean yields to be more competitive with time. Rotation soybean yields are better than continuous soybean yields by 8-11%.

The Journal of Production Agriculture article titled "Effect of Tillage and Rotation on Agronomic Performance of Corn and Soybean: Twenty-Year Study on Dark Silty Clay Loam Soil" gives a detailed report of this research project. This article can be found in Volume 9, no. 2, 1996 issue. A reprint can be obtained by contacting Terry D. West, Agronomy Department.

No-till Continuous Corn Row Position Study

Farmer experiences and long-term tillage plots have demonstrated the difficulty of planting no-till continuous corn in the previous crop row. Stand and yield have often been substantially reduced. Corn planted into soybean residue is less likely to have reduced stands and has smaller or no yield reductions. We have asked farmers who no-till continuous corn “Where do they plant the new crop row in relation to last year’s row?" Some say on the old row, some say beside the old row, some say in the middle, and some say they are not concerned with row placement (random). The residue thickness can vary greatly as you move across the row. Each row location needs careful attention to planter seed depth setting in order to achieve uniform seed depth with seed to soil contact. Random row placement, with one seed depth setting, is the most difficult to achieve correct seed depth due to varying thickness of the residue across the row.

The goal in no-till planting is to achieve consistent seed depth and seed to soil contact. Several factors are important in selecting a position for the new crop row. When planting into the heavy residues directly on the row, seed depth is variable as the planter gauge wheels roll over corn stalk stubs and mats of stalk and leaf residue. Moving off the old row enough to clear the gauge wheels eliminate the stubs, but still has considerable residue from leaves and upper stalks. Planting in the row middles involves compaction from wheel traffic.

Our objectives in this study include:

- Determine if row cleaners are effective in improving stand, growth and yield.
- Determine if location of new crop row has any impact on stand, growth and yield.
- How soil penetration is distributed.

Factors associated with reduced no-till corn yields:

- Heavy residue cover.
- Uneven soil surface.
- Soil compaction.
- Poorly drained soils.
- Slow plant emergence and growth.
- Variable soil types within a field.
- Cool soil temperatures in northern half of Corn Belt.

Factors associated with reduced stands in no-till continuous corn:

- Non-uniform seed depth.
- Non-uniform seed to soil contact.
- “Hairpinning” of residue.
- Alleopathy.
- Cool soil temperatures under heavy residues.

With no-till when planting in heavy corn residues:

- Should row cleaners be used for a residue free strip on each row?
- Should the new row be placed on, beside, or between previous rows?
- Will soil compaction limit yield potential when planting in tire tracks?

Treatments include positioning the new row on the old row, beside the old row, and in between the old rows (middles). These treatments are repeated with the addition of row cleaners on the planter. A chisel plow treatment represents full width tillage. For those plots that were planted beside the old row, a shift was made to the west on odd years and back to the east on even years.

Evaluation of Stand, Emergence and Yield: The following data were determined on each of the plots:

- Emergence both by day and total.
- Plant populations at 4 weeks after planting.

- Plant height at 4 and 8 weeks after planting.
- Grain moisture at harvest.
- Grain yield.

Evaluation of Soil Compaction:

A recording penetrometer was used to evaluate penetration resistance 3 weeks after planting in the second row from the east in each of the plots. Observations were also make in the east most row of the no-till plant 15 inches off the row. This row did not have a spring wheel track. Three observations were made in each plot and then combined to compare between replications.

Field equipment used:
- DMI 7 shank coulter chisel plow equipped with 4 inch twisted points on the chisel treatments.
- International Harvester 15 foot tandem disk.
- Glenco 10 foot mounted field cultivator with rolling baskets.
- Case-IH planter model 955 4 row, 30-inch planter equipped with detachable unit mounted row cleaners, no-till fertilizer coulters/openers, heavy duty down pressure springs on row units.
- Hiniker row crop cultivator.
- Century mounted sprayer, 32.5-foot boom.
- Case-IH model 5240 tractor.
- White model 3300 combine.

CULTURAL PRACTICES USED 1998
No-till Continuous Corn Row Position Study, ARC, Purdue Univ.

Item	Date	Application
Secondary tillage	4/28	Disk once on chisel treatment.
	5/13	Field cultivate once on chisel treatment.
Hybrid planted	5/14	Pioneer 3335 (113 day).
Seeding rate		29,215 seeds/a., drum A, 24 pocket, (variable rate controller).
Starter fertilizer/planter		34-0-0 @ 96 lb./a., 2 inches to the side and 2 inches below the seed (sprockets: driver 36, driven 30).
Insecticide/planter		Force 1.5G, 10 oz/1000 row feet, banded over row. (Insecticide setting 2-0).
Weed control	4/24	<u>3 point hitch sprayer, 4 mph, 30 psi, 40-gallon water/a., 8006 tips.</u>
		Gramoxone Extra at 3 pt/a.
		2,4-D (Weedone 64) 1 pt./a.
		Surfactant 1.5 pt/100 gallons of water.
	5/15	<u>3 point hitch sprayer, 4 mph, 30 psi, 40-gallon water/a., 8006 tips.</u>
		Atrazine 4L at 3 pt./a.
		Bladex 4L at 3 pt./a.
		Dual II at 3 pt./a.
		Roundup at 3 pt./a.
Nitrogen fertilizer	6/22	NH_3 @ 180 lb. N/a., sidedressed, no covering disks.
Cultivation	6/25	Chisel treatment, once.
Harvest	9/22	Center 4 of 12 rows.
Lime	10/23	2 ton/ac. Bulk spread, one pass.
Phosphorous, Potassium	11/5	200 LB/ac 0-45-0
		300 LB/ac 0-0-60
		Bulk spread, 2 passes.
Primary tillage	Not done	Fall chisel (4 inch twisted chisel points) with ridge leveling sweeps.

Results and discussion 1998.

Acceptable stands were achieved in all treatments (Table 6). When planting 15" off the old row we found limited areas of open slots in the soil from last year's anhydrous ammonia knife. Some seeds would fall too deep into this slot. We also noted that the planter closing wheel could not close this slot. These 2 factors likely caused the reduced stand found in the 2 treatments planted 15" off the old row. Plant emergence was quickest this year of the 3 years of this study. Planting on May 14 in warm soils was likely the reason for this. Plant growth through the year was good, however late season moisture stress caused the plants to mature early. This hybrid also suffered from gray leaf spot disease. Chisel plow yielded the highest on this poorly drained soil. No-till on the old row yielded the least but was not significantly different than the other no-till treatments.

Table 6. Agronomic performance of corn as affected by row cleaners, row location, and tillage, continuous corn, Chalmers silty clay loam, Row Position Study, ARC, Purdue Univ., 1998. †

Treatment	Days to 50% Emergence	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @ 15.5%
	days	ppa	in	in	%	Bu/a.
Chisel plow	5	29208a‡	25.3a	74.4	18.4c	162.7a
No-till on old row	8	28458ab	20.0c	72.8	20.9a	141.6b
No-till 6” off old row	7	27333ab	20.9c	73.5	20.3ab	146.9b
No-till 15” off old row	7	26542b	21.7bc	74.3	19.3abc	144.8b
No-till on old row/row cleaners	7	28500ab	21.4bc	74.0	19.7abc	145.9b
No-till 6” off old row/row cleaners	6	28500ab	23.6b	74.3	19.0bc	147.5b
No-till 15” off old row/row cleaners	7	26667b	22.1bc	73.1	19.8abc	145.5b
ANOV significance level		.01	.01	NS	.01	.01

†Average of 4 replications.
‡Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P = .05).

Results and discussion, 1996-1998.

Uneven stand establishment in corn can reduce yield potential. According to Bob Nielsen, rate of yield loss due to corn plant spacing variability is 2.5 bushels for each inch of standard deviation. The planter needs to be properly adjusted for uniform seed placement in tilled and no-till fields. Using Bob’s publication AGRY-91-01 “Stand Establishment Variability in Corn” as a guide, we measured plant spacing and calculated standard deviation for corn. A moderately variable stand of corn would be in the 3-5 inch range. The data presented in Table 7 documents that we did achieve uniform stands with standard deviations of 3.5 inches or less.

Table 7. Plant spacing variability, Row Position Study, ARC, Purdue Univ.

Treatment	**1996**	**1997**	**1998**	**Average**
Chisel	2.4	2.6	3.0	2.7
No-till on old row	2.9	3.3	3.3	3.2
No-till 6" off old row	2.9	2.8	2.9	2.9
No-till 15" off old row	3.1	3.3	3.2	3.2
No-till on old row with row cleaners	3.0	3.1	3.4	3.2
No-till 6" off old row with row cleaners	3.0	3.1	3.1	3.1
No-till 15" off old row with row cleaners	3.5	3.4	3.5	3.5

Plant emergence. The 3-year averages (Table 8) show strong differences in treatments for number of days to 50% plant emergence. The chisel plowed plots were fastest to emerge, the no-till plots on the old row were slowest and the various off row and row cleaned plots intermediate. Row cleaners appear beneficial when planting on the old row.

Year by year data are given in Figures 2, 3 and 4. Through 3 very different spring weather patterns, the above pattern held true.

Although there are significant differences for total plant stand measured at 4 weeks after planting, all stands were adequate for good yields (Table 8). Total stand measured at 4 weeks after planting showed chisel plots with greater stand than no-till on the old row with other treatments intermediate.

Yields reflect similar results to the emergence and stand studies. The chisel plow plots were the highest yielding and the no-till on the old rows the lowest. The plots planted off row and/or row cleaned were intermediate. Statistical analyses showed a statistical difference at the .01 level for each of these 3 conditions.

Table 8. Agronomic performance of corn as affected by row cleaners, row location, and tillage, continuous corn, Chalmers silty clay loam, Row Position Study, ARC, Purdue Univ., 1996-1998. †

Treatment	Days to 50% Emergence	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @ 15.5%
	days	ppa	in	in	%	Bu/a.
Chisel plow	11.3	29653a‡	15.7a	54.9a	21.2b	159.8a
No-till on old row	15.3	28264c	12.9c	51.0b	23.4a	137.1c
No-till 6" off old row	14.0	28708bc	13.5bc	52.9a	22.5ab	145.3b
No-till 15" off old row	14.3	28319c	13.9bc	54.1a	21.6b	143.8b
No-till on old row/row cleaners	14.0	28986b	14.0bc	54.0a	21.7b	144.5b
No-till 6" off old row/row cleaners	13.0	29222ab	14.5b	54.4a	21.5b	145.2b
No-till 15" off old row/row cleaners	14.0	28403c	14.3b	54.7a	21.5b	146.3b
ANOV significance level		.01	.01	.01	.01	.01

†Average of 4 replications.
‡Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P = .05).

Soil penetration resistance was quite variable across the range of conditions. Lowest penetration resistance was found for the non-tracked row, 15 inches from the old row. This has been influenced by the application of NH_3 with a knife applicator. Much higher penetration resistance was found in the wheel track at 15 inches from the old row. Directly on the old row the penetration resistance was higher than that with chisel plowing and secondary tillage. The penetration resistance at 6 inches from the old row was similar to the wheel track because on the row selected was included in the tire track of the previous season.

One interesting aspect of these results is the higher penetration resistance observed when row cleaners are used. There is no clear reason why this should occur. Moisture amounts are very similar and the cleaners were set to very lightly engage the soil surface. More work will be needed to resolve this issue.

Conclusions

1. In no-till continuous corn, stands can be improved by either planting off the row or using row cleaners.
2. In no-till continuous corn, yields can be improved by planting off the row or using row cleaners but yields are still less than those of full width tillage on this poorly drained soil.
3. Non-tracked rows had much less penetration resistance than tracked rows. Use of row cleaners in each of the 3 no-till row locations resulted in higher penetration resistance. The cause for this is not clear from the results.

Managing Soybean Cyst Nematode by Changing Soybean Variety on the Go

SCN is the most serious soybean pest in the US (Protect Your Soybean Profits: Manage Soybean Cyst Nematode, United Soybean Board, 1993). The use of resistant varieties can reduce yield loss to this pest. Some soybean variety tests show a decreased yield potential for resistant versus susceptible varieties when planted in non-infected soils. If this is true, then planting a resistant variety in the infested portions of a field, and a susceptible variety in non-infested portions should maximize yields

Project Goals

- Determine if planting of a resistant variety in SCN infected areas of a field and a susceptible variety in non-infected areas will maximize yields.
- Compare these 2 varieties in a non-infested field.
- Test variable variety drill.
- Determine how to map SCN infected areas.
- Develop GPS controls for changing variety.

Locations, West Lafayette, IN.

- Erwin Field: Continuous soybean with areas of severe SCN infection.
- Powell Field: Rotation corn/soybeans and no history of SCN.

Treatments

1. Resistant variety.
2. Susceptible variety.
3. Resistant in high SCN, susceptible in low SCN.
4. Resistant in low SCN, susceptible in high SCN.

Procedures

- The drill was loaded with resistant in front hopper and susceptible in rear hopper.
- Field flagged for each treatment with areas marked to plant susceptible and resistant. Areas determined by soil elevation with SCN sampling to be done during year.
- Hoppers switched manually on the go in tractor cab. (Plans are to GPS control this in future.)

CULTURAL PRACTICES USED 1998
Variable Variety/Soybean Cyst Nematode Study

Item	Erwin Field		Powell Field	
	Date		Date	
Previous crop		Soybeans	1995	Corn
		Soybeans	1996	Soybeans
		Soybeans	1997	Corn
Spring tillage	5/22	2 passes field cultivate		No-till
Variety planted	6/1	Pioneer 9352, susceptible to SCN	5/30	Pioneer 9352, susceptible to SCN
		Pioneer 9362, resistant to SCN		Pioneer 9362, resistant to SCN
Seeding rate		160,000 seeds/a.		160,000 seeds/a.
Planting speed		6.5 mph		6.5 mph
Weed control	5/22	Incorporate 2.5 pt/a. Broadstrike plus Dual		
Harvest	10/12	15'x1150'	10/16	15'x300'
Fertilizer	11/17	Potash 350 lb./a.		

Table 9. Soybean Cyst Nematode counts and soil fertility by soil topography, Erwin Field, 1998.

Soil Zone	Soil Topography	SCN per 250cc of Soil Before Planting.	SCN per 250cc of Soil After Harvest	Soil Fertility Potassium ppm
1	Low	17 cysts/845 eggs High	77 cysts/7,750 eggs Extremely high	105 Medium
2	High	6 cysts/225 eggs Low	25 cysts/2,500 eggs Very high	75 Low
3	Low	18 cysts/1200 eggs High	50 cysts/4,950 eggs Extremely high	91 Medium
4	High	9 cysts/650 eggs Medium	32 cysts/3,250 eggs Extremely high	63 Low

Table 10. Soybean Cyst Nematode counts by soil topography, Powell Field, 1998.

Soil Zone	Soil Topography	SCN per 250cc of Soil Before Planting.	SCN per 250cc of Soil After Harvest
1	Low	1 cysts/50 eggs Low	No samples taken
2	High	6 cysts/420 eggs Medium	No samples taken

Table 11. Agronomic performance of soybean as affected by SCN, Drummer si.c.l., Raub-Brenton complex, Throckmorton si.l., Chalmers si.c.l., continuous soybean, Erwin Field near Agronomy Research Center, 1998. †

				Weigh Buggy		Yield Monitor	
Treatment	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%	Harvest moisture	Yield @15.5%

	ppa	in	in	%	Bu/a.	%	Bu/a.
Resistant	142780	5.6	19.8	12.6a‡	42.1a	11.5	41.0
Susceptible	151008	5.5	20.7	12.2b	40.2b	11.1	39.2
Resistant-high ground/Susceptible-low ground	151008	5.6	19.8	12.4a	41.5ab	11.4	40.3
Resistant-low ground /Susceptible-high ground	153912	5.7	20.5	12.5a	40.7ab	11.2	39.5
ANOV sig. Level	NS	NS	NS	.01	.02	NS	NS

†Average of 4 replications.
‡Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P = .05).

Table 12. Agronomic performance of soybean as affected by SCN, Drummer si.c.l. and Rockfield si.l., rotation soybean/corn, Powell Field near Agronomy Research Center, 1998.†

				Weigh Buggy		Yield Monitor	
Treatment	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%	Harvest moisture	Yield @15.5%
	ppa	in	in	%	Bu/a.	%	Bu/a.
Resistant	164560	5.5a	21.6	11.5	48.1b‡	10.5	47.3b
Susceptible	151008	4.5b	20.8	11.4	56.0a	10.3	53.9a
Resistant-high ground/Susceptible -low ground	166012	5.1ab	21.3	11.5	50.9ab	10.4	49.1ab
Resistant-low ground /Susceptible-high ground	130196	5.1ab	21.6	11.4	53.9a	10.3	51.2ab
ANOV sig. Level	NS	.05	NS	NS	.02	NS	.04

†Average of 4 replications.
‡Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P = .05).

Conclusions after 1st year.

SCN:

- Predicting extent of infected areas is difficult without a known history of the field.
- Visual observation of plant symptoms is not adequate. Soil samples are needed for areas of suspected SCN.
- Low or medium SCN populations can increase significantly through the year.

Equipment we used:

- The Case-IH Progeny drill worked well with excellent seed placement and no problems with residue flow. After replacement of one hydraulic valve early in the season we had precise on/off switching of hoppers. A second valve appeared to have allowed "creeping" of second hopper's seed drive by season's end, thus contaminating one treatment with seed from second treatment. These unwanted soybean plants were removed by hand hoeing. This valve needs replaced for 1999.
- Manually switching of hoppers on the go is adequate for plots, but would be fatiguing in large field. This function needs to be GPS controlled.

Yields:

- Resistant variety in infected soils yielded best.
- Susceptible variety in non-infected soils yielded best.
- Data was inconclusive on mixed pass treatments due to extent of SCN infected soils.

Maximizing yields by changing varieties on the go depends on clearly defining and mapping SCN infected areas of a field. Planting resistant varieties in the "hot spots" appears beneficial but it is not clear that planting susceptible varieties in the rest of the field can maximize yield potential.

Weigh Buggy vs. Yield Monitor Comparison

We compared harvest data collection methods of using a stationary electronic weigh buggy versus a combine mounted yield monitor. The Erwin field plots were 15 feet wide and 1150 feet long. The Powell field plots were 15 feet wide and 300 feet long. Each plot was harvested with the combine and yield monitor data for total weight of grain harvested and grain moisture recorded before dumping into the weigh buggy. Other data recorded from the monitor included load number, plot length and grain yield. Weight of grain was recorded from the weigh buggy scale with moisture taken with a hand held Dickey-John moisture meter. Yields were corrected for grain moisture and are presented in Table 11 and 12. Figure shows experiment yield average for each field by data collection method. The percentage yield difference between the two methods was 2.7% for the longer Erwin field and 3.6% for the shorter Powell field.

PINNEY PURDUE AGRICULTURAL CENTER

Long Term Tillage Study

In this study we will be investigating crop residue/soil temperature/tillage relationships and their effects on crop growth and yield. In this northern Indiana location, cold soil temperatures limit no-till crop performance. Most farmers in this area use full width primary tillage with 2 secondary tillage passes to prepare a suitable seedbed. Our plans are to use a wide variety of tillage equipment to determine if there is a level of tillage that will preserve crop residues on the soil surface for erosion control, yet give satisfactory yields. The practices are designed to leave crop residue levels ranging from none to as much as possible with a number of levels in between. We are looking for the most effective mix to insure both soil protection and production. This has been a frequently expressed concern in northern Indiana and one in which farmers have real interest.

This study will be a good start toward addressing questions that area farmers have raised about reduced tillage. We feel this is finally going to provide the comparisons that farmers have been asking for on the soils that are most troublesome. This study was set up in the field in 1996 with proper row direction and cropping sequence. The study will continue for at least 4 years.

Crop Rotations	Tillage Treatments	Data to be Collected
Continuous corn	Fall chisel, spring disk and combo-mulch-finisher	Soil compaction
Corn/soybean	Fall chisel, spring combo-mulch-finisher	Residue cover
Soybean/corn	Fall aerator, spring aerator	Soil temperatures
	Fall disk, spring combo-mulch-finisher	Week 4 stand and height
	No-till	Week 8 height
		% grain moisture at harvest
		Yield

Not for publication.

CULTURAL PRACTICES USED 1998

Long Term Tillage Study, Fields B3 & C3, Pinney Purdue Agricultural Center

Item	Corn		Soybean	
	Date	Application	Date	Application
Spring tillage	4/24	2 passes with aerator: Case-IH 7220 tractor w/duals, 6 mph, and 2.5-degree angle on aerator gangs.	4/24	1 pass with aerator: Case-IH 7220 tractor w/duals, 6 mph, and 5-degree angle on aerator gangs.
Nitrogen fertilizer	4/25	NH_3 @ 150 LB/a. N, 5-knife applicator w/double rate on outside knives, 4.7 mph.		None.
Secondary tillage	5/12	Disk and/or field cultivate as required by treatment.	5/15	Disk and/or field cultivate as required by treatment.
Hybrid/Variety planted	5/12	Pioneer 3489 (108 day).	5/15	Pioneer 9306.
Seeding rate		27,700 seeds/a.		200,000 seeds/a.
Starter fertilizer/planter		19-17-0 @ 125 LB/a., 2 inches to the side and 2 inches below the seed.		None.
Insecticide/planter		Force 3G, 5 oz/1000 row feet.		None
Weed control	5/12	Pre-emergence with field cultivator: Atrazine 0.5 LB/a. Extrazine 1.5 LB/a. Dual 2 pt/a. Roundup 1.5 pt/a. *Broadcast with 8008 flat fan nozzles on 20" centers at 5.5 mph, 20 gallons water/a.*	5/7	Early pre-emergence: Roundup Ultra 24 ounces/a. 2,4-DLV 16 ounces/a. on Aerway and no-till plots.
			5/15	Pre-emergence with field cultivator: Prowl 2 pt/a. Roundup Ultra 1 pt/a. *Broadcast with XR 8008 flat fan nozzles on 20" centers at 5.5 mph, 20 gallons water/a.*
	6/10	Post-emergence with trailer sprayer: Accent 2/3 oz/a. Atrazine 4L 2pt/a. Ammonium sulfate 2 LB/a.	?/??	Post-emergence with trailer sprayer: Cobra 4 oz/a. Pursuit 4 oz/a. 28% 2 qt/a. Surfactant 1 qt/100 gallons water.
Cultivation	6/4	Once as required by treatment.		None
Harvest	10/5	All 6 rows, 130 ft.	9/28	Whole plot, 130 ft.
Fall tillage	10/19	Fall chisel with leveling bar. Fall disk, no harrow. Fall soil-aerator at 7 mph, 2.5-degree angle on gang, no weights, one pass.	10/19	Fall chisel with leveling bar. Fall disk, no harrow. Fall soil-aerator at 7 mph, 2.5-degree angle on gang, no weights, one pass.

Soil temperatures:

Soil temperatures were measured using maximum-minimum thermometers placed in the new row at 2 inches from soil surface. Temperatures were recorded daily and thermometers reset to capture the maximum-minimum temperatures for the period until next reading. No-till planting had the lowest average daily maximum soil temperature in monoculture and spring aerator the lowest in rotation (See Fig. 9). All levels of tillage increased the daily maximum soil temperature. Minimum soil temperatures for all treatments measured within a 3-degree range (See Fig. 10).

Stand, growth, and yield -- Corn.

Continuous corn. One of our goals for the tillage treatments is to achieve various levels of residue cover. Our one spring pass of the aerator at the least aggressive setting of the machine did not reduce residue cover as compared to no-till (Table 13). For the 1999 crop we made 1 pass with the aerator in the fall and will make another pass before planting in the spring. These 2 passes with the aerator should reduce residue cover compared to no-till. Our goal is that after 2 passes we will have approximately 50% residue cover. There were no significant differences for stand or plant height at 4 weeks after planting among treatments. By 8 weeks after planting, the aerator and no-till treatments were significantly shorter (.01 level). The aerator and no-till treatments yielded significantly less (.01 level) than the tilled treatments. It appeared that the aerator and no-till were slower developing through the year and this was reflected in the yields.

Rotation corn/soybeans. The aerator did reduce residue cover compared to no-till from 63% to 42%, respectively (Table 15). For the 1999 crop we made 1 pass with the aerator in the fall and will make another pass before planting in the spring. The aerator and no-till treatments yielded significantly less than chisel/disk/field cultivator and disk/field cultivator treatments. The chisel/field cultivator treatment was intermediate.

Table 13. Agronomic performance of corn as affected by tillage and rotation, Sebewa loam, Long Term Tillage Study, Pinney Purdue Agricultural Center, 1998.†

Previous crop	Tillage	Residue cover after planting	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%
		%	ppa	in	in	%	Bu/a.
Corn	Chisel/disk/field cultivator	15c‡	25458	19.2	77.0a	19.5c	188.4a
	Chisel/field cultivator	21c	24416	19.9	78.9a	19.4c	187.1a
	Aerator	74a	26500	15.7	68.3c	20.6ab	157.2b
	Disk/field cultivator	53b	24917	17.5	73.7b	20.0bc	180.4a
	No-till	82a	27250	15.6	68.6c	20.9a	156.0b
Soybean	Chisel/disk/field cultivator	3c	26458	22.0a	84.5a	18.8b	195.6a
	Chisel/field cultivator	6c	27541	19.1ab	82.3a	19.1b	186.6b
	Aerator	42b	25833	16.6b	71.6b	20.1a	170.7c
	Disk/field cultivator	10c	27583	19.3ab	81.1a	19.3b	196.1a
	No-till	63a	26958	17.4b	72.2b	20.0a	170.0c

†Average of 4 replications.
‡Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P = .05).

Table 14. Analysis of variance summary, tillage data, corn, Long Term Tillage Study, PPAC, 1998.

Variable	Residue cover after planting	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield Bu/a.
	------Significance Level------					
				Corn		
Tillage	.01	NS	.01	.01	.01	.01
Previous crop	.02	.05	.07	NS	.09	NS
Tillage x previous crop	.01	.01	NS	.07	NS	.02

Table 15. Agronomic performance of corn as affected by tillage and rotation, Sebewa loam, Long Term Tillage Study, Pinney Purdue Agricultural Center, 1997-98.†

Previous crop	Tillage	Residue cover after planting	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%
		%	ppa	in	in	%	Bu/a.
Corn	Chisel/disk/field cultivator	18d‡	25479	12.1a	51.0a	21.4b	187.8ab
	Chisel/field cultivator	30c	25125	12.3a	52.7a	21.3b	190.8a
	Aerator	73a	25229	9.6b	46.7bc	22.0a	169.3c
	Disk/field cultivator	62b	25167	10.9ab	48.5b	22.1a	182.3b
	No-till	76a	25729	9.4b	45.8c	22.5a	170.4c
Soybean	Chisel/disk/field cultivator	4c	26354	13.6a	57.9a	20.9	201.3a
	Chisel/field cultivator	7c	27188	12.2ab	57.1a	20.9	199.0a
	Aerator	36b	26063	10.7b	50.5c	21.1	189.2b
	Disk/field cultivator	10c	27020	12.1ab	54.4b	21.2	200.9a
	No-till	46a	26917	11.1b	50.4c	21.4	187.3b

†Average of 4 replications.
‡Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P = .05).

Table 16. Analysis of variance summary, tillage data, corn, Long Term Tillage Study, PPAC, 1997-98.

Variable	Residue cover after planting	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield Bu/a.
	----------Significance Level----------					
	Corn					
Tillage	.01	NS	.01	.01	.01	.01
Previous crop	.01	.01	.03	.02	.06	.01
Tillage x previous crop	.01	NS	NS	NS	NS	.05

Stand, growth, and yield -- Soybean.

The tillage treatments did result in the various levels of residue cover that we wanted (See Table 17). With the addition of a fall aerator pass in the aerator treatment, we should reduce residue cover compared to the no-till treatment. Stands were erratic in the tilled plots this year due to poor seed to soil contact and dry weather after planting. The aerator and no-till treatments had sufficient soil moisture to support the higher stands. Yields were equal for all treatments.

Table 17. Agronomic performance of soybean as affected by tillage, Sebewa loam, rotation soybean/corn, Long Term Tillage Study, Pinney Purdue Agr Center, 1998.†

Tillage	Residue cover after planting	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%
	%	ppa	in	in	%	Bu/a.
Chisel/disk/field cultivator	19d‡	112782b	3.7	15.8	12.3	48.6
Chisel/field cultivator	32c	96197b	3.6	15.4	12.1	48.3
Aerator	81a	153061a	3.9	13.7	11.8	49.9
Disk/field cultivator	52b	100935b	3.5	13.4	11.9	45.1
No-till	81a	152114a	4.2	15.3	12.1	51.0
ANOV sig. level	.01	.01	NS	NS	NS	NS

†Average of 4 replications.
‡Data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P= .05).

Table 18. Agronomic performance of soybean as affected by tillage, Sebewa loam, rotation soybean/corn, Long Term Tillage Study, Pinney Purdue Agr Center, 1997-98.†

Tillage	Residue cover after planting	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%
	%	ppa	in	in	%	Bu/a.
Chisel/disk/field cultivator	20d‡	146190b	3.0	13.1a	12.2	54.5
Chisel/field cultivator	29c	130078b	3.0	13.0a	12.1	55.0
Aerator	74a	172253a	3.2	11.6b	12.2	55.6
Disk/field cultivator	52b	136476b	2.9	11.5b	12.0	52.8
No-till	78a	161354a	3.3	12.1ab	12.2	55.9
ANOV sig. level	.01	.01	NS	.01	NS	NS

†Average of 4 replications.
‡Data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P= .05).

DAVIS PURDUE AGRICULTURAL CENTER

Variable Seeding Rate Study for Corn and Soybean

Jaime Bultemeier, Bob Nielsen, Gary Steinhardt, and Terry D. West

This study was setup to investigate corn and soybean plant growth and grain yield relationships when varying seeding rates across soil types. It also presented the opportunity to learn use Global Position Satellite (GPS) technology in a "hands on" fashion for Site Specific Farming (SSF). And did we ever learn!

Goals:

- Develop methods of mapping soils for on the go varying of seeding rate.
- Determine ideal sample size for crop and soil data.
- Develop methods of changing seeding rate on the go with planters.
- Learn to use GPS technology for mapping of crop development and problem areas.
- Document corn and soybean response to varying seeding rates.
- Document accuracy of yield data collection methods.
- ??

Some high lights and low lights:

- Soil mapping: When mapped by visual observation and flagged by walking, 20 acres is a lot of ground!
- When using GPS backpack equipment, take extra batteries. Batteries will fail half way through data collection.
- Manual switching of populations when planting would be too tiring for full size fields. This function must by automated.
- ??

Not for publication.

CULTURAL PRACTICES USED 1998

Variable Seeding Rate Study, Davis PAC

Item	Corn		Soybean	
	Date	Application	Date	Application
Primary tillage	Fall/97	Paratilled.	Fall/97	Paratilled.
Secondary tillage	5/20	Disk.	5/18	Field cultivate.
	5/21	Field cultivate.	5/21	Field cultivate.
Hybrid/Variety planted	5/21	Beck's 5405, 110 day, and Beck's 5909, 109 day, with a Case-IH 955 planter.	5/28	Beck's 388A. with a White splitter planter.
Seeding rate		34000 and 24000 seeds/a. (variable rate controller), 36 pocket drum, 6 mph, gear II-4 full throttle.		217,800 and 165,000 seeds/a
Row width		30 inches		15 inches
Starter fertilizer/planter		None		None
Insecticide/planter		Force 1.5G, 10 oz/1000 row feet, banded over row. (Insecticide setting 1-7)		None
Weed control	5/20	Pre-emergence: Atrazine 1.4 lbs./a.	5/20	Pre-emergence: Canopy 5 oz./a. Sulfate 1.7 lbs./a.
	6/25	Post-emergence: Basis Gold 14 oz./a. Crop oil 26 oz./a. Sulfate 2 lbs./a.	7/30	Post-emergence Fusion 10 oz./a. Crop oil concentrate 25 oz./a.
Nitrogen fertilizer	6/29	NH_3 @ 183 lbs./a. N in row middles, double-disk sealers.		None
Cultivation		None		None
Harvest	10/21	Center 6 of 8 rows, 1000 ft.	10/27	Center 15 ft. of 20 ft plot, 1000 ft
Primary tillage				

Stand, growth, and yield -- Corn.

Stand counts at 4 weeks after planting verified that we did achieve planting population goals. There were no significant treatment differences for plant height at 4 and 8 weeks after planting. There were also no significant differences for grain moisture at harvest by either hand held moisture meter or yield monitor moisture data collection. Yields were significantly different only when data was collected with the weigh buggy
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Table 19. Agronomic performance of corn as affected by ear type, plant population and soil, Blount silt loam and Pawamo silty clay loam, Field M2, Davis Purdue Agricultural Center, 1998.†

					Weigh Buggy		Yield Monitor	
Ear type	Population Treatment	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%	Harvest moisture	Yield @15.5%
		ppa	in	in	%	Bu/a.	%	Bu/a.
Flex	Low	25167c‡	12.9	38.8	20.5	139.2ab	19.3	135.4
Flex	High	34889a	12.2	40.3	20.7	138.8ab	18.5	137.0
Flex	Blount-low/Pewamo-high	29111b	12.4	41.4	20.9	131.8b	19.0	129.6
Flex	Blount-high/Pewamo-low	28056b	13.4	40.3	20.7	134.7ab	19.4	131.4
Fixed	Low	25000c	13.1	40.6	20.7	137.0ab	18.9	135.6
Fixed	High	34111a	13.6	41.2	21.0	138.5ab	18.8	137.0
Fixed	Blount-low/Pewamo-high	28500b	13.3	41.6	20.3	140.5ab	19.4	134.9
Fixed	Blount-high/Pewamo-low	30222b	12.6	41.9	20.1	146.8a	18.5	145.2
ANOV sig. level		.01	NS	NS	NS	.09	NS	NS

†Average of 3 replications.
‡Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P = .05).

Stand, growth, and yield -- Soybean.

Stand counts at 4 weeks after planting verified that we did achieve a high and low seeding rate. All populations were lower than expected due to wheel track seedlings being drowned following heavy rains. There were no significant differences in plant height and yields.

Table 20. Agronomic performance of soybean as affected by population and soil, Blount silt loam and Pawamo silty clay loam, Field M2, Davis Purdue Agricultural Center, 1998.†

				Weigh Buggy		Yield Monitor	
Population Treatment	Stand 4 weeks	Height 4 weeks	Height 8 weeks	Harvest moisture	Yield @15.5%	Harvest moisture	Yield @15.5%
	ppa	in	in	%	Bu/a.	%	Bu/a.
Low	125066b‡	4.9	24.1	12.2	48.9	10.5	49.8
High	172304a	4.9	25.6	12.4	50.7	10.6	51.2
Blount-low/Pewamo-high	157203a	5.0	24.4	12.4	50.7	10.6	50.9
Blount-high/Pewamo-low	154880a	4.8	23.1	12.2	48.9	10.6	49.6
ANOV sig. level	.01	NS	NS	NS	NS	NS	NS

†Average of 5 replications.
‡Within rotation, data followed by the same letter are not significantly different according to Student-Newman-Kuels Test (P = .05).

Weigh Buggy vs. Yield Monitor Comparison

Figures 12 and 13 show yield differences by data collection methods on a load by load basis. No explanation is given for these differences.

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