PURDUE TILLAGE STUDIES--1979

Agronomy Farm--Main Experiment

Wet soils delayed spring operations until about May 1. Planting was begun on May 9 with Dr. Moldenhauer's JD "max-emerge" planter equipped with a 2" fluted coulter mounted on planter units ahead of disk openers. All past plot work in these studies had been done with an AC unit planter.

There was little precipitation during the first three weeks after corn planting, causing some delayed germination in no-till plots. Neither the AC nor JD planter does a completely adequate job of seed cover when no-till planting in wet soil. The no-till corn began to show drouth stress in some areas when 6" tall due to the dry weather, slow root development and drying in the coulter plot.

Rainfall from late May through the rest of the growing season was more than adequate, but caused no ponding water problems. Growing degree days were slightly behind normal until mid-season, but crops matured at average dates.

Ridged soybean plots were disked and replanted 18 days after original planting due to poor seed cover and the resulting irregular stands. Data from this treatment should not be compared with other tillage systems for 1979.

Cultural practices for the experiment were similar to previous years, with two exceptions. Corn seeding rate was increased by 2,000 plants per acre and N rate was increased by 80 lbs. per acre. Actual practices used were:

	Corn	Soybeans
Hybrid or variety	Becks 65X	Woodworth (Amsoy 71 in replanted ridges)
Seed rate	26,000/ac	48 lbs./ac
Seedbed prep.	Disk twice for plow and chisel; shape ridges with rolling cult.	Disk twice for plow and chisel; disk down ridges for replanting
Fertilizer	250 lbs/ac N as NH_3 100 lbs/ac 18-46-0 starter B'cast 222#/ac P_2O_5 + 444#/ac K_2O in fall	No N No starter B'cast same as corn
LIME Insecticide	3000 #/A LIQUID Furadan in row 13#/ac	SAME None
Weed control	Pre-emerg--1¼ qts Atrazine 4L + 1¼ qts Bladex 4L + 3 qts Lasso + 2 qts Roundup + surfactant. Post directed on no-till & ridges--2½# Lorox 50W + surfactant. Cultivated once--all except no-till c/c.	Pre-emerg.--3/4# Sencor + 3 qts Lasso + 2 qts Roundup + surfactant. Early post on 1 rep-- 1 qt Basagran for nutsedge. Post--1 qt Hoelon on all plots. Cultivated all plots once. Hand hoed milkweeds.

All activities and dates accomplished are listed in Appendix A.

control in plowed and chiseled corn plots was excellent, but ence herbicides did not adequately control foxtail in ridge and no plots. Lorox post-directed on these plots gave 80-90% control, b· as applied too late to achieve complete coverage of the grass.

Foxtail control in soybeans was better than in 1978, but still not adequate in no-till plots. As always, weed control was better in rotation than in continuous soybeans. Small areas of hedgebindweed in no-till plots remain uneffected by herbicides used. Milkweeds were hand hoed, but appear to be less competitive than in past years.

Cutworms, damaged a small percentage of the no-till corn following soybeans. Other insects did not appear to cause significant damage in 1979.

Stand, Growth and Yield

Corn--Stands were more uniform, both within plots and among treatments, than they have been in past years; probably due to more uniform seed placement with the JD planter. Only no-till corn after soybeans had reduced stands, with cutworm damage the apparent cause. Plant growth at 4 and 8 weeks showed plow and chisel corn to be equal after soybeans but chisel corn was slower in continuous cropping. Ridge and no-till corn growth was significantly reduced, but there was less difference after soybeans. No-till corn was 1 to 1½% wetter than other treatments at harvest.

Average corn yield for the experiment was about 40 bu/ac more than the previous 6-year average. This reflects the excellent July-August rainfall plus the increase in N rate and seeding rate for 1979. For the first time 200 + bu/ac yields were achieved with certain treatments. All yields were improved in rotation, with chisel and no-till showing the greatest increase. Plowing produced a better yield than all other systems in continuous corn, and was equal to chisel and better than others after soybeans. No-till was lowest in both continuous and alternate cropping.

Table 1. Corn Response to Tillage, Chalmers si.c.l. 1979

Prev. crop	Tillage	Stand, 4 wks. ppa	Ht., 4 wks. inches	Ht., 8 wks. inches	Harv., moist. %	Yield, @15½%M Bu/a
Corn	Plow	25,200	19.1	64.9	29.4	205.1
	Chisel	25,275	16.7	59.2	29.9	190.8
	Ridge	24,575	16.7	55.1	29.2	191.3
	No-Till	25,000	13.1	51.4	30.5	176.6
Beans	Plow	25,400	18.6	65.4	29.9	209.5
	Chisel	25,200	18.4	64.4	30.0	206.7
	Ridge	24,100	17.1	60.1	30.5	194.8
	No-Till	23,200	16.0	55.8	31.1	187.6

Beans--Conventional tillage had slightly better stands than other ...s, but all were within a range which was adequate for maximum yield. ...e 3 early planted systems, plant height data show no-till soybeans ...wing more slowly, but previous crop had little influence on growth. No ...ll and chisel soybeans were about 1% wetter at harvest after corn but ...chere was little difference in harvest moisture after soybeans.

Yields showed no difference between plowed and chiseled plots, with the replanted disk down ridges doing almost as well. No-till yields were slightly reduced, as in past years. How much of this reduction is due to foxtail competition cannot be determined. Rotation had little effect on soybean yields in 1979, contrary to the positive effect shown in previous years.

Table 2. Soybean Response to Tillage, Chalmers si.c.l., 1979

Prev. crop	Tillage	Stand, 6 wks. ppf	Ht., 8 wks. inches	Harv., moist. %	Yield @13%M Bu/a
Corn	Plow	7.75	21.4	13.0	48.6
	Chisel	6.68	19.1	13.7	49.5
	Ridge-disk[a/]	5.80	13.4	13.2	48.3
	No-till	6.09	16.9	14.2	43.5
Beans	Plow	7.22	19.7	13.4	47.9
	Chisel	6.88	19.7	13.5	49.2
	Ridge-disk[a/]	5.90	13.2	13.1	45.9
	No-till	5.77	16.9	13.5	45.0

a/ These plots were replanted to Amsoy 71 at 17 days after the original planting of Woodworth.

Analysis of variance for the 1979 data is summarized in Table 3. Tillage significantly affected most growth and yield factors for both corn and soybeans. Previous crop affected corn growth, but, surprisingly, previous crop influence on corn yield was significant only at the 20% level.

Table 3. ANOV Summary, Agronomy Farm Tillage Data, 1979

Variable	Corn					Soybeans			
	Stand 4 wks.	Ht. 4 wks.	Ht. 8 wks.	Harv. moist.	Bu /ac	Stand 6 wks.	Ht. 8 wks.	Harv. moist.	Bu /ac
	----------significance level----------								
Tillage	NS	.01	.01	.05	.01	NS	.01	NS	.01
Prev. crop	NS	NS	.05	.05	NS	NS	NS	NS	NS
Till. x prev. crop	NS	.05	NS	NS	NS	NS	NS	NS	NS

ıual yields for corn and soybeans since the project began are reported
ıles 4 and 5. Inclusion of 1979 corn yields increased average yields
all treatments, but average yield differences are still small. 1979
ybean yields show little difference from the previous 4-year average for
ıny of the tillage systems.

Table 4. Corn yield response to tillage & prev. crop, Chalmers si.c.l., 1975-79.

Prev. crop	Tillage	Bu/ac					
		1975	1976	1977	1978	1979	Avg.
Corn	Plow	176.1	140.4	137.8	146.8	205.1	161.2
	Chisel	165.0	147.4	135.5	144.7	190.8	156.7
	Ridge	141.4	154.7	137.2	135.5[a/]	191.3	152.0
	No-Till	165.4	153.7	136.3	146.1	176.6	155.6
Soybeans	Plow	167.4	145.1	146.1	145.4	209.5	162.7
	Chisel	177.1	140.8	149.5	140.2	206.7	162.9
	Ridge	149.5	154.7	147.8	142.1[a/]	194.8	157.8
	No-Till	175.2	143.4	144.4	142.8	187.6	158.7

[a/] Planted 1 week later in 1978.

Table 5. Soybean yield response to tillage & prev. crop, Chalmers si.c.l., 1975-79.

Prev. crop	Tillage	Bu/ac					
		1975	1976	1977	1978	1979	Avg.
Corn	Plow	56.4	54.4	55.4	39.3	48.6	50.8
	Chisel	57.6	50.7	54.1	45.0	49.5	51.4
	Ridge	49.9	50.9	50.4	39.4	48.3[a/]	
	No-Till	56.0	48.3	52.1	36.2	43.5	47.2
Soybeans	Plow	52.7	48.0	50.3	38.2	47.9	47.4
	Chisel	52.2	45.5	48.8	37.8	49.2	46.7
	Ridge	49.1	46.0	47.5	35.2	45.9[a/]	
	No-Till	47.8	41.4	44.6	34.1	45.0	42.6

[a/] Ridges were disked down and soybeans replanted in 1979.

Soil Temperatures

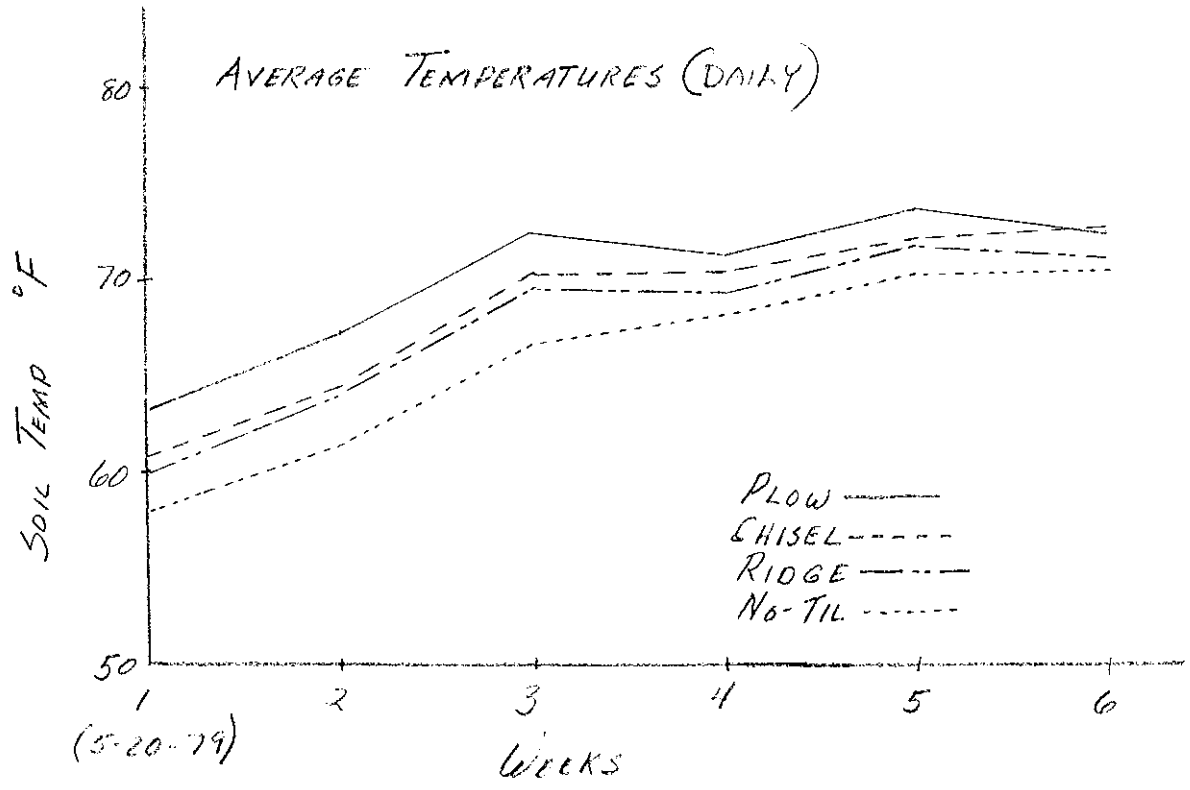
Four max-min soil temperature thermometers were installed at a 4" depth in the row in one rep. of the 4 tillage treatments in continuous corn. Weekly average soil temperatures for six weeks after planting (starting 5-20) are given in figures 1, 2 and 3.

Temperatures in plowed plots were warmest and no-till plot temperatures were coolest in all comparisons, with chisel and ridge temperatures intermediate. Dailey average temperatures showed a range of about 6°F during the first 3 weeks and about 3°F during the second 3 week period. Figures 2 and 3 show the temperature differences due to tillage to be much greater at daily maximum than at dailey minimum.

FIGURE 1

SOIL TEMPERATURES AT 4" C/C

AGRONOMY FARM 1979



SOIL TEMPERATURES AT 4" C/C
AGRONOMY FARM 1979

FIGURE II

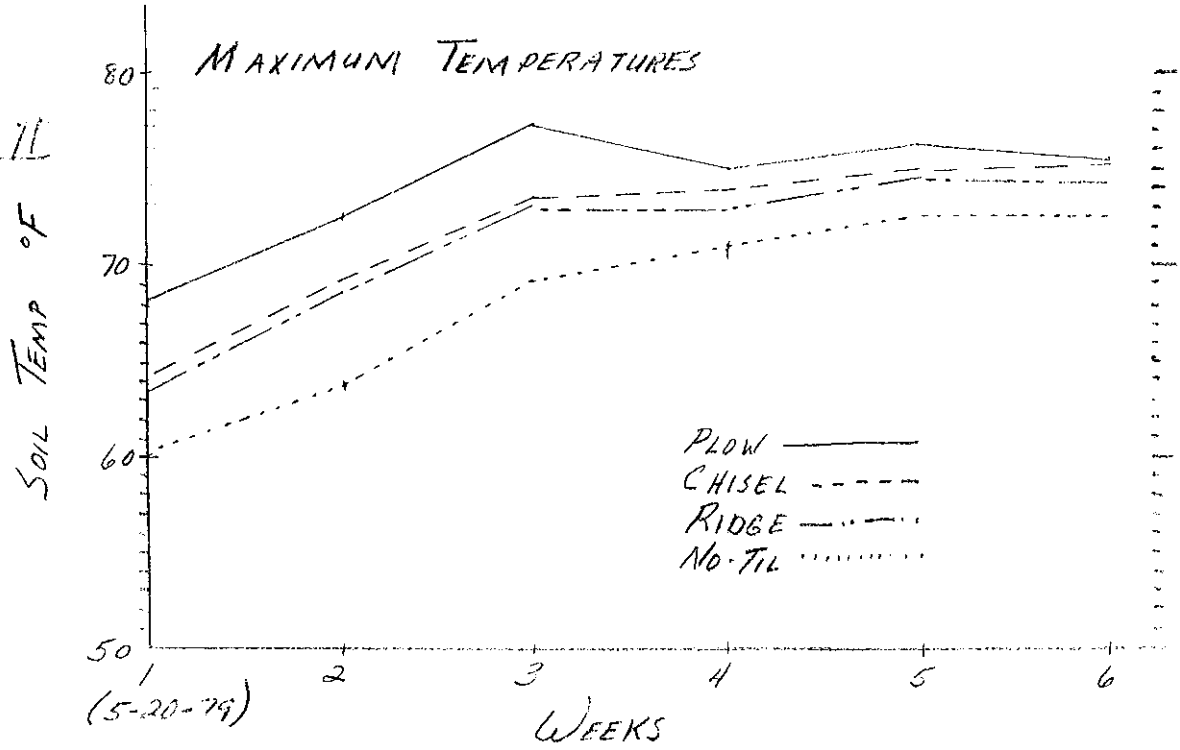
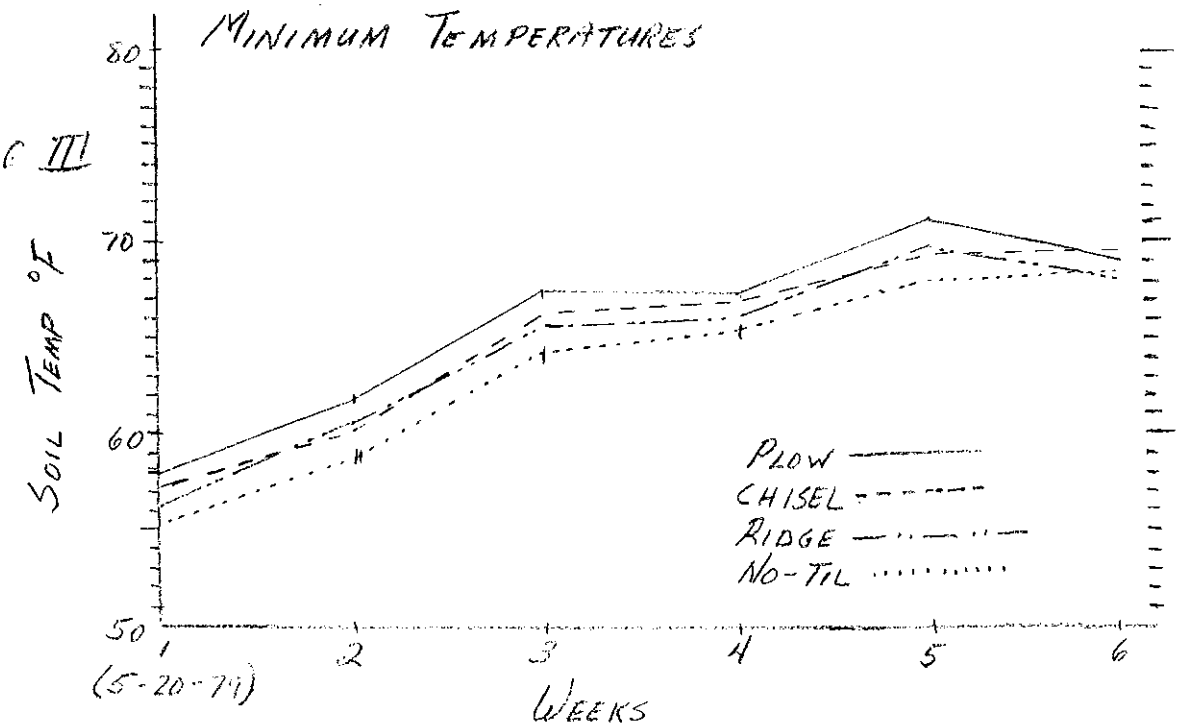


FIGURE III



SOIL TEMPERATURE AT 4-5 PM C/C VS. C/B
TILLAGE STUDY AGRONOMY FARM 1979

FIGURE IV

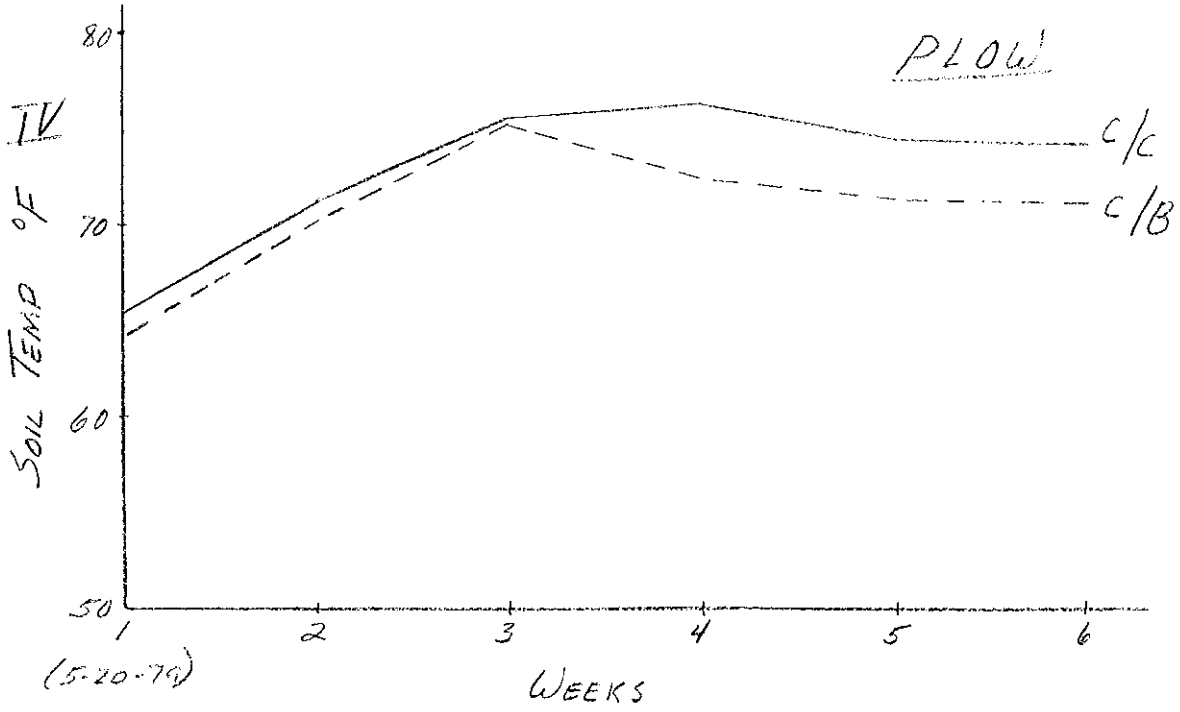
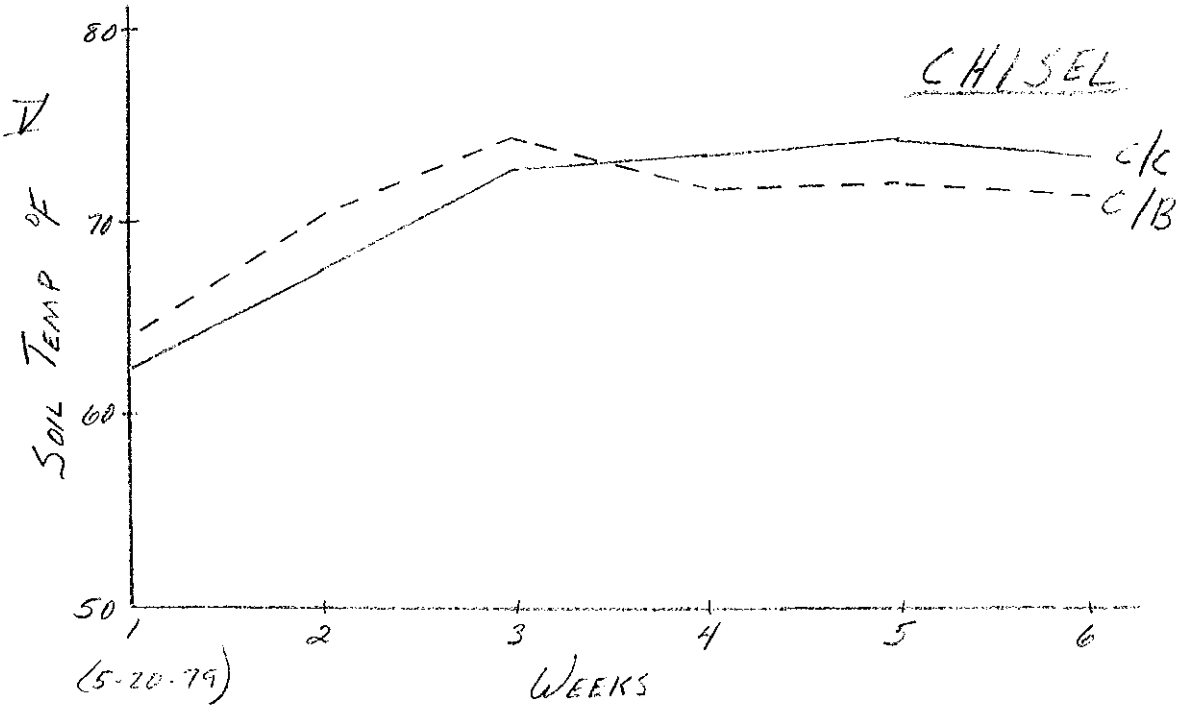


FIGURE V



SOIL TEMPERATURE AT 4-5 PM C/C VS. C/B
TILLAGE STUDY AGRONOMY FARM 1979

FIGURE VI

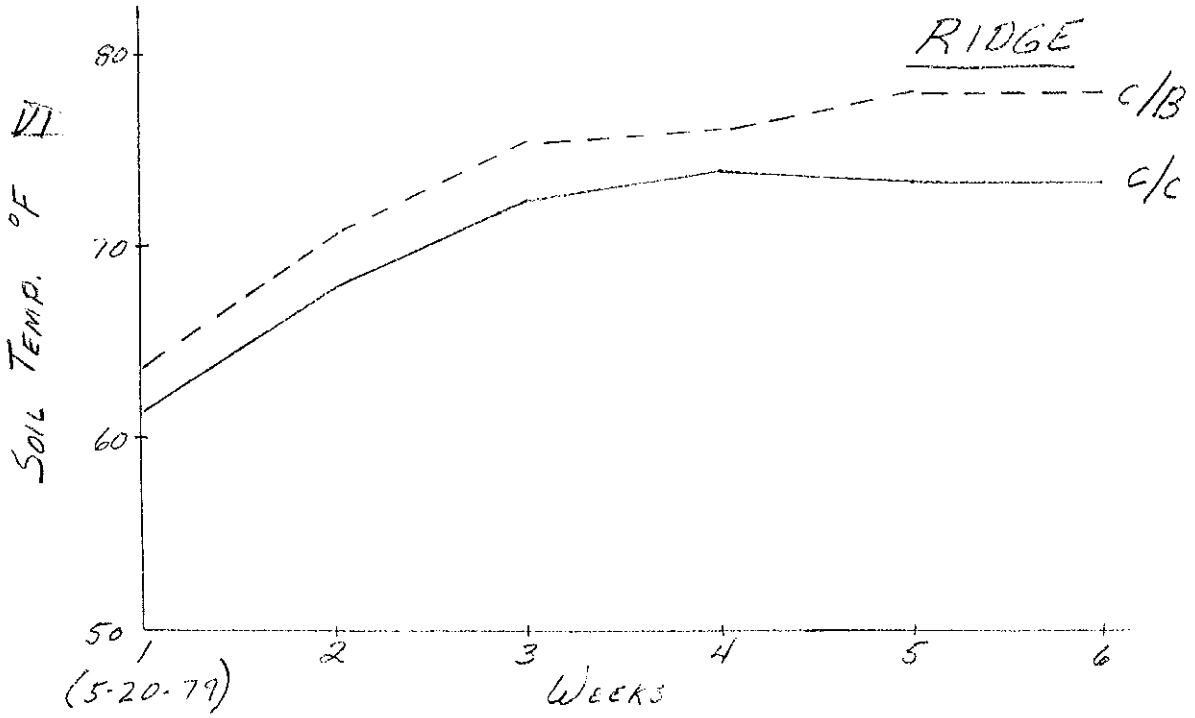
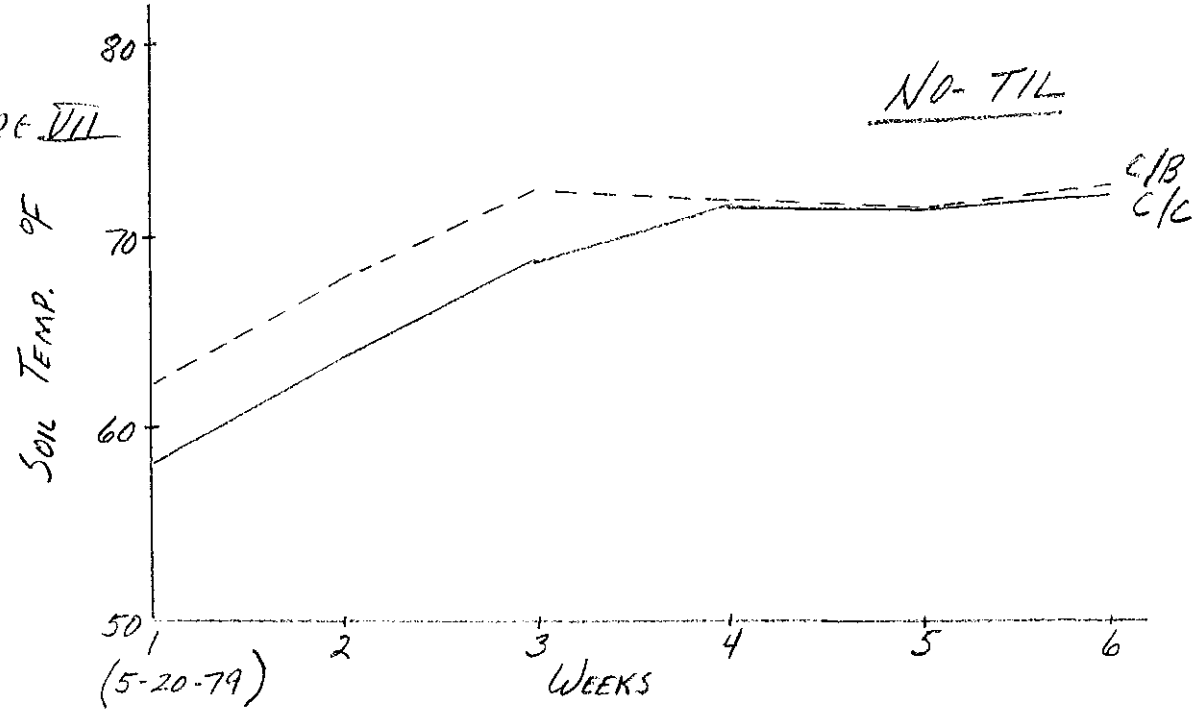


FIGURE VII



Soil temperatures for the four tillage systems for corn after soybeans were recorded between 4 and 5 p.m. (approximate daily maximums) using metal dial-type thermometers inserted to a depth of 4 inches. (Figure IV-VII). Some of the temperature comparisons seem reasonable, while others are questionable. All temperatures increased rapidly during the dry period after planting, then leveled off or declined as the rainy period (last 3 weeks) began. Warmer no-til temperatures after soybeans could be expected early in the season due to reduced residue. The relative increase in C/B temperature in ridges in weeks 4-6 and the relative decrease in C/B temperatures in plow and chisel plots in weeks 4-6 do not seem logical.

AGRONOMY FARM--SUBSOIL EXPERIMENT

A subsoil experiment was conducted in 1979 in 2 areas adjacent to the main experiment on variable Raub and Chalmers soils. Fifty-foot sections were subsoiled N-S across these blocks, then half of each block was plowed E-W. (See attached diagram) Both subsoiling and plowing were done in the fall. The four resulting treatments were:

1. Subsoil to 13", plow, disk 2, field cult., plant
2. Plow, disk, field cult., plant
3. Subsoil to 13", disk, plant
4. No-till plant

The hybrid, pest control and fertility practices used were the same as for similar treatments in the main experiment. Stands and yields are presented in Table 6, an average of 5 reps. on each soil type.

Table 6. Corn response to subsoiling, 1979.

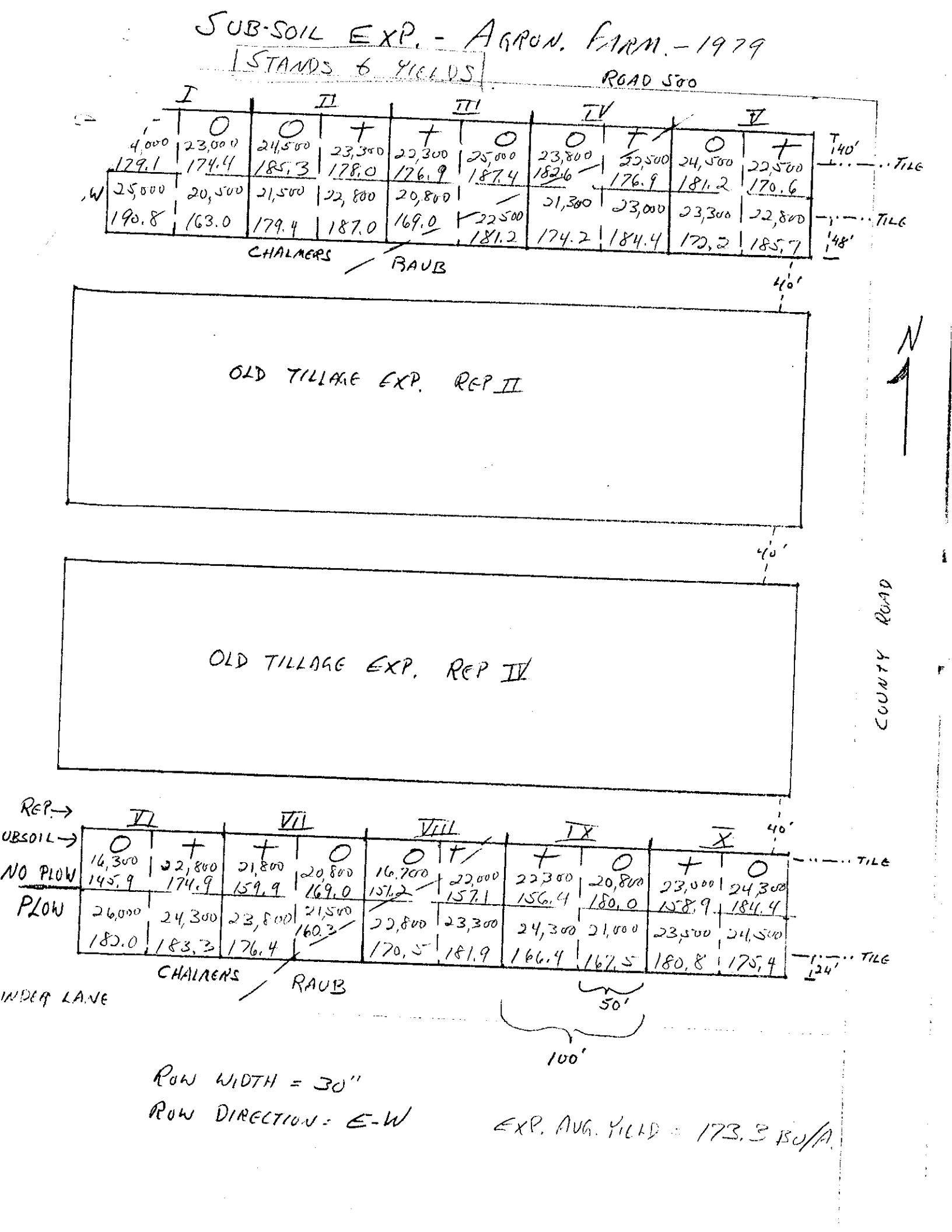
	Soil Type							
	Chalmers				Roub			
	Plow		No-plow		Plow		No-plow	
Subsoil	Stand	Bu/A	Stand	Bu/A	Stand	Bu/A	Stand	Bu/A
Yes	23,500	178.7	22,640	176.3	23,220	175.3	22,620	168.5
No	24,000	178.6	20,320	161.7	23,320	173.6	21,280	178.4

Low stands for no-till on Chalmers in 2 of the 5 reps. reduced yield. There was nothing to indicate a response to subsoiling on either soil.

Subsoiling to a 13" depth seems to be the maximum we can expect with equipment available at the Agronomy farm. Larger tractors were not available for short term rental locally in the fall of 1979. Because of this fact, and because Steinhardt-Mengel plan to start subsoiling research in the fall of 1980, this experiment will not be repeated.

SUB-SOIL EXP. - AGRON. FARM. - 1979

STANDS & YIELDS



SEPAC--Main Experiment

Cropping sequence and tillage practices for a long-term experiment were established at SEPAC in 1979. Tillage included fall chisel, spring chisel, spring plow, spring disk, and no-till. Cropping sequences will include C/C, C/B and B/C. In this establishment year, one rep. followed soybeans and 3 reps. followed corn. A plot diagram is attached. Corn was planted on 5-11 and soybeans on 5-14.

Cultural practices were used:

	Corn	Soybeans
Hybrid or variety	P-3184	Woodworth
Seed rate	26,000/A	48 lbs./A
Seedbed prep.	Disk twice for all but no-till	Same
Fertilizer	200 lbs./A N as NH_3 preplant	None
	100 lbs./A 7-22-5 starter	None
Lime	4 T/A	Same
Insecticide	Counter 15g-9#/A	None
Weed control	Pre-emerg.=1 qt Atrazine 4L + 1 qt Bladex 4L + 3 qts Lasso + 1 qt Paraquat + Surf. Cult. once	Pre-emerg.=1/2#Sencor +3 qts Lasso + 1 qt Paraquat + surf. Cult. once

Notes taken at planting indicate very irregular lime application on certain plots. This included skips, excessive turning on plots and spilling of lime. Plots affected were Rep I plot 1; Rep II plots 1, 15; Rep III plots 10, 12, 13, 14, 15 and Rep IV plot 1. These plots should be observed for variation in the future.

Significant problems encountered were:

A. Reduced germination in no-till C/C due to improper closing of the slot at planting, leaving some seed exposed. The problem was worse after corn than after beans due to extra soil moisture under the corn residue.

B. Cutworm damage on corn was more severe in no-till plots. All plots were sprayed with toxaphene for control.

C. Corn growth was quite variable from 3-6 weeks, after emergence, especially on no-till and disk plots. This was apparently due to variation in time necessary for corn roots to reach the NH_3 band. Later, growth appeared to even-out.

D. Late season grass control in soybeans was ineffective in no-till plots and less than adequate in other no-plow plots, especially for beans after beans. The following ratings were made at harvest for foxtail and fall panicum control (1=excellent, 10=very poor). Data are an average of 4 reps.

Table 7. Weed control ratings at harvest in soybeans

Tillage	Foxtail	Fall penicum
Sp. plow	1.00	1.00
Fall chisel	1.75	2.75
Sp. chisel	1.75	3.00
Disk	2.25	2.00
No-till	4.25	7.25

Stand, growth and yield data taken for corn and soybeans are presented in Table 8.

Table 8. SEPAC Tillage Trials, 1979

Tillage system	Stand	Ht, 4 wks.	Ht, 8 wks.	Harv. moist.	Bu /AC
	ppa	in.	in.	%	
Corn after corn [a]					
Spring plow	23,216	15.5	58.9	26.6	150.5
Fall chisel	22,300	16.0	59.3	25.9	148.6
Spring chisel	23,183	16.6	59.9	26.3	149.3
Spring disk	22,150	15.5	55.9	26.0	147.0
No-till	18,250	12.5	50.1	27.2	119.2
Corn after soybeans [b]					
Spring plow	21,950	16.8	63.2	25.9	164.5
Fall chisel	22,900	18.4	58.6	26.6	157.6
Spring chisel	21,300	18.1	64.4	25.6	162.7
Spring disk	20,200	17.5	61.1	26.5	161.5
No-till	22,550	18.5	61.5	26.0	153.4
Soybeans after corn [c]					
	ppf				
Spring plow	7.8		14.3	17.5	45.0
Fall chisel	7.9		13.8	17.2	43.7
Spring chisel	7.5		13.5	17.0	41.0
Spring disk	7.8		13.8	17.6	42.0
No-till	7.1		12.9	18.3	28.2
Soybeans after soybeans [d]					
Spring plow	8.2		13.0	18.0	43.2
Fall chisel	7.8		10.9	19.2	31.3
Spring chisel	8.1		10.9	18.6	31.0
Spring disk	7.0		12.8	19.8	36.9
No-till	5.6		14.7	19.9	16.2

[a] Average of 6 reps.

[b] Average of 2 reps.

[c] Average of 3 reps.

[d] One rep. only

Corn stand was reduced in no-till C/C due to poor seed cover and cutworm damage, but probably not enough to cause all of the 30 bu/ac yield reduction. No doubt, other factors were involved. No-till C/C grew more slowly and was slightly wetter at harvest than other tillage systems. For corn after soybeans, there was little difference among systems in stand and growth, but a 10 bu/ac reduction in no-till yield. All systems yielded significantly more in rotation than in corn after corn.

Soybean stands appeared adequate for all systems, although reduced slightly in no-till. Growth measurements showed little difference among systems. No-till bean yields were reduced for beans after corn and all no-plow system yields were reduced, compared to spring plow, for beans after beans. Poor grass control was the primary reason.

SEPAC Cover Crop Demonstration

A heavily eroded area was seeded to wheat following beans in the fall to provide winter cover. While rye would have provided better cover, the wheat did aid in erosion control. This spring prior to planting corn, the adjacent area was chiseled and disked, while the wheat was sprayed with Paraquat. The entire area was planted as one field with the JD max-emerg. no-till planter. No depth adjustment was made in going from tilled to no-till ground. In this year's demonstration, stand and corn yield were very similar in tilled and no-till areas.

Black Creek Tillage Trials

Only one of the five original replicated tillage trials in the Black Creek study was continued in 1979. This was on Morley-Blount silt loam soils and compared spring plow, fall chisel and no-till planting for continuous corn and corn after soybeans. Tillage comparisons for soybeans after corn were not harvested due to poor stands and poor weed control, both related to wet soils at planting. Only two of the four corn reps. were suitable for yield comparisons. Harvest checks were by hand and each figure in Table 9 represents 16 1/1000 ac. sub-plots.

Table 9. Black Creek tillage trials, Morley-Blount Soils, 1979.

Prev. crop	Tillage system	Harv. moisture %	Harv. pop. ppa	Yield Bu/ac
Corn	Sp. plow	23.7	20,562	114
	Fall chisel	25.0	20,812	112
	No-till	25.7	18.375	100
Soybeans	Sp. plow	24.0	21,812	134
	Fall chisel	23.8	22,062	136
	No-till	24.4	20,562	134

All of the corn after corn was severely lodged, apparently due to corn rootworm damage, even though Furadan insecticide was used at planting. This, no doubt, reduced yields. Population and yield of no-till corn after corn were reduced due to wet soils and poor seed cover at planting.

Yield checks were also taken from small watersheds planted by the S & WCD. Runoff from these watersheds was monitored to check the ANSWERS model in determining conservation tillage effect on water quality.

Table 10. Harvest data from monitored small watersheds, 1979

Farm	Tillage	Soils	Harv. moist. %	Harv. pop. ppa	Yield Bu/ac
Hebner	Soil-saver	Morley-Blount			
		0-3% slope	23.8	20,500	141
		4-6% slope	23.3	20,000	118
Amstutz	No-till	Morley-Blount	25.5	16,312	96[a/]
Bennett	No-till	Morley-Blount	24.4	19.750	128

[a/] Severe lodging due to corn rootworm damage lowered yield.

There will be no more replicated tillage trials in the Black Creek study, but the Allen County S & WCD will again plant the small watersheds using conservation tillage in 1980. The S & WCD is also making the soil-saver and no-till planter available to farmers for demonstrations.

Changes planned for 1980

Agronomy farm--Due to the increased interest in Till planting in Indiana, it was decided to substitute till planting for ridge-top planting in the Agronomy farm experiment starting in 1980. Previous ridges were disked down and reformed in the fall. A 4-row Buffalo planter is being leased from Fleischer Mfg. Current plans are to use a Buffalo disk hiller cultivator being leased by the Tippecanoe Co. S & WCD to make ridges at cultivating time in 1980.

Further studies of soil physical properties and plant rooting patterns will be done in 1980 by Jose Carlos Cruz, a graduate student, under the direction of Dr. Moldenhauer.

A directed sprayer will be used to apply Lorox or Evik postemergence to both corn and soybeans on tillage systems where preemergence chemicals do not give adequate control. Nozzles will be mounted on a cultivator frame, using the guage wheels to maintain uniform nozzle height. Cultivator shovels will be removed when spraying.

SEPAC--Based on some promising results on Clermont soil in Ohio, it was decided to include a 2-row bed system in our tillage experiment at SEPAC. It will replace the fall chisel system in the original plot design.

A bedder has been donated by John Deere. Double-disk "hippin" ridger units will be placed 60" apart so that 2-30" rows can go on each bed. Wheel tracks will be in bed-middles, not in furrows. Drainage outlets for the furrows must be maintained across the end of the plots. For 1980, the beds will be made in the spring. Subsoiler shanks to fit on the bedder just behind tractor wheels were also made available from John Deere.

Evando Mantovani, graduate student in Agr. Eng., will study the bed system relative to power requirements, timeliness, soil moisture and soil temperature.

Since early season nitrogen utilization was a problem in 1979, more N will be included in the starter fertilizer in 1980. Proper placing of the NH_3 bands in the bed system has not yet been determined.

N-Studies--form and placement of nitrogen with conventional and no-till planting will again be studied at the Agronomy farm by Darrel Nelson and at SEPAC by Dave Mengel.

Chronology of events, 1979 tillage studies

April 30 - Applied NH_3 at SEPAC

May 7 - Applied NH_3 at Agronomy farm
May 9 - Plant corn at Agronomy farm
May 11 - Plant corn at SEPAC
May 14 - Plant soybeans at SEPAC
May 17 - Plant soybeans at Agronomy farm
May 22/23 - Plant mini-watersheds, Black Creek
May 31 - Begin corn planting Morley exp., Black Creek

June 4 - Replanted soybean ridges at Agronomy farm
June 5 - Sprayed Basagran on beans at Agronomy farm, Rep. I
June 6 - Planted sod no-till demo. at Pinney PAC
June 11 - Cultivated corn at Agronomy farm except no-till C/C
June 22 - Direct sprayed all ridged & no-till corn at Agronomy farm with Lorox
June 22 - Sprayed all beans with Hoelon at Agronomy farm
June 23 - Cultivated all beans at Agronomy farm

October 4/5 - Harvested Agronomy farm beans
October 10 - Harvested SEPAC beans
October 11 - Harvested Agronomy farm corn
October 22 - Harvested SEPAC corn
October 30 - Harvested Black Creek corn

November 5 - Applied liquid lime at Agronomy farm, 3,000#/ac
November 8 - Chiseled at Agronomy farm
November 14 - Plowed at Agronomy farm
November 16 - Ridged for 1980 Buffalo at Agronomy farm