3-1-1970

Till Planting of Corn in Eastern South Dakota: Irrigation - Dryland

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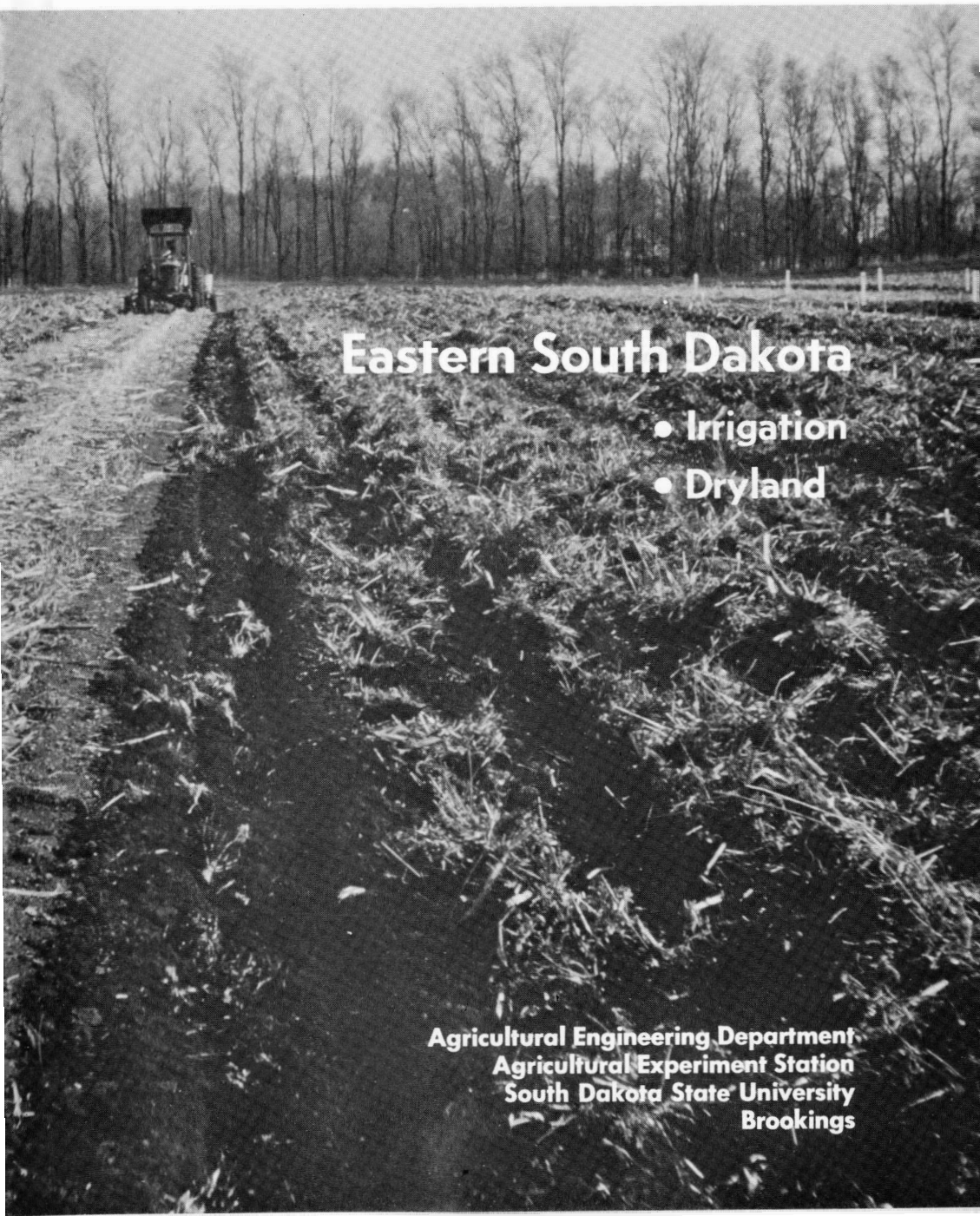
Bulletin 567
March 1970

Till Planting Corn



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Contents

Till Planting of Corn in Eastern South Dakota

Irrigation - Dryland

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INTRODUCTION

A growing interest is evident in minimum tillage, or combined tillage, operations for growing corn. In addition to conventional planters, machines are available commercially which will till-plant, wheel-track plant, hard-ground list, or strip-process plant. Modifications of these machines and machines for new planting systems that appear periodically on the market reflect the interest among today's farm operators in minimum tillage or reduced tillage.

Any discussion involving minimum tillage requires a definition or explanation of what is meant by the term. To some people it means reducing the number of trips made across the field by combining individual operations into a once-over operation. In this case the number of tillage operations are not reduced, just the number of trips over the field. To others it implies reducing the number of individual operations done in one or several passes over the field.

Minimum tillage, also called optimum tillage, involves the following points:

(1) Minimizing the energy requirements prior to placing the seeds in the soil.
(2) Minimizing or altering cultivation or other weed control measures to provide effective weed control.
(3) Maximizing efficient use of time.
(4) Maximizing profit.

To achieve point (1), it would appear desirable to consider elimination of the moldboard plow. Plowing requires the largest amount of energy. Wheel-track plant, plow plant and some other once-over or combined tillage operations, and of course conventional planting, all require plowing. Listing usually eliminates the need for plowing, but the energy requirement (hp.-hr./acre) is still relatively high, although not as high as for plowing. Till planting does require less energy than listing unless the till planter is operated as a lister.

Achieving point (2) depends on obtaining satisfactory weed control. Some combination of mechanical and chemical weed control brings best results. Points (3) and (4) are obtained if (1) and (2) are achieved.

TILL PLANTING

Till planting is a method of minimum tillage which is in effect a strip processing operation. It consists essentially of the following operations.

Cut stalks. A power-driven rotary stalk cutter is best for reducing stalks and weeds from the previous year to allow subsequent machine operation without plugging and trash interference.

Plant. In one operation, planting is done in the old ridge. The planter consists of a blade, 12 to 18 inches wide, running 1 to 3 inches deep in the old ridge. Trash guards move the cut soil and trash to the center between the old rows. Planting units with shoe type furrow openers are mounted behind the blade. The corn is planted in the same location as the previous rows. Application of insecticides, herbicides, and starter fertilizer may be done with the same unit in this once-over operation.

Cultivate. The last cultivation is done when the corn plants are about 10 to 16 inches tall. The use of disk hillers in combination with large sweeps should prevent plugging of the cultivator with trash.

Before Till Planting

Part I
Four Years Under Irrigation

PROCEDURE

A field experiment was designed to compare till-planting with conventional tillage and planting in continuous corn production. The experiment was a randomized block design with four replicates and six weed control methods including conventional corn production method as a control. The plots were at the Agricultural Engineering Research Farm, Brookings, S. Dak.

OBJECTIVES

The objectives of the study were to:

(1) Study feasibility of till-planting corn on a continuous corn basis in South Dakota under irrigated (4-years) farming conditions.

(2) Develop suitable weed control methods in conjunction with till planting.

Treatments

The six weed control methods and cultural practices were:

(1) Chop stalks, till plant into previous rows, one cultivation at corn plant height of 16 to 24 inches.

(2) Chop stalks, till plant into previous rows, two cultivations, one soon after emergence and the second one the same as in (1).

(3) Chop stalks, till plant into previous rows, post-emergence application of an atrazine-oil mixture band-

After Till Planting

sprayed at the rate of 1 pound per acre, one cultivation.

(4) Chop stalks, till plant into previous rows, pre-emergence application of atrazine bandsprayed at a rate of 1 pound per acre, one cultivation.

(5) Chop stalks, till plant into previous rows, pre-emergence application of atrazine sprayed over whole area at a rate of 3 pounds per acre.

(6) Chop stalks, plow with moldboard plow, disk with tandem disk, plant (with till planter), two cultivations as in treatment (2). The planting mechanisms are similar for both the till planter and a conventional planter, thus using the till-planter for planting the conventional plots would not affect the results.

Cultural Practices

Fertilizer. All plots received equal amounts of fertilizer. Each year a part of the fertilizer was applied prior to or at planting time. Rates varied some from year to year. Additional nitrogen was applied with irrigation water. Fertilizer rates applied in dry form and with irrigation water are shown in table 1.

Irrigation. The plots were sprinkler irrigated as needed during the growing season. The same amount of water was applied to all plots.

Cultivation. Where two cultivations were made, the first one was performed as soon as the corn was made when the corn plants were 6 to 8 inches high and it could be cultivated without covering the plants. The second cultivation was about 24 inches high. This cultivation was also a "hilling" or ridging operation. Ridging of the rows is a necessary operation when till planting is practiced because the till planter removes about 2 inches of soil from the row area and deposits it along with the trash midway between the rows. Thus, if no ridging is done, the soil profile in the row becomes 1 to 2 inches lower for each planting operation.

Treatment No. 5 included only chemical weed control. After 2 years of till planting in these plots, the

Table 1. Fertilizer application to plots during the experiment.

Year	Actual lbs. of nutrients applied N	P	K
1965			
Preplant	0	0	0
Planting	60	75	0
Irrigation July 10	32		
Irrigation July 20	32		
TOTAL	124	75	0
1966			
Preplant	0	0	70
Planting	33	46	0
Irrigation July 5	50		
Irrigation July 15	17		
TOTAL	100	46	70
1967			
Preplant	0	48	24
Planting	8	32	16
Irrigation July 18	64		
Irrigation July 28	43		
TOTAL	115	80	40
1968			
Preplant	0	70	40
Planting	8	32	16
Irrigation June 5	50		
Irrigation July 1	50		
TOTAL	108	102	56

original ridges had completely disappeared. In fact, a slight depression was obtained. Thus, in the second year these plots were ridged when the corn was about 20 inches high. Because these plots were practically weed free, it was felt that this operation did not affect the weed count significantly.

In cases of only one cultivation (treatments 1, 3, 4), it was done when corn plants were about 24 inches high and the rows were hilled or ridged by this cultivation.

Cultivation Equipment. A conventional sweep-type, rear mounted cultivator was used the first 2 years for all cultivations. This type of cultivator was not satisfactory because the trash on the soil surface caused frequent plugging of the sweeps. The last 2 years a special cultivator designed for till-planted corn was used. This cultivator has a large sweep in the center between each row. Disk hillers are used to remove weeds near the corn plants by moving soil away from the plants during the first cultivation. During the second cultivation the disks serve as ridgers. With this type of cultivator, satisfactory weed control was obtained and plugging due to trash was not a problem.

RESULTS

Corn Yield. Each plot consisted of four, 30-inch rows, 60 feet long. The inner two rows were harvested over a 40-foot long section for yield calculations. Two subsamples were taken, each subsample consisting of one 20-foot long section from each of the two rows. During the first 2 years, the ear samples were shelled and the sample weights of shelled corn converted to bushels per acre at 15.5% moisture content. For the other years, the ears collected were weighed and converted to bushels per acre shelled corn at 15.5% moisture content by using an appropriate conversion factor. Yield data are in table 2.

Plant Population. At harvest time plant population was determined for each plot. Population data are shown in table 3. Note that treatments 3, 4 and 5 had the highest plant population. These are also the treatments which had an application

Till planted corn on a July 12

of atrazine. Apparently, heavy weed growth in the row area caused some corn plants to die or fail to produce ears.

Weed Counts. The first 2 years of the experiment weed plants were counted in each plot at the end of July. Counts were taken at random at four locations in each plot using a 30x30-inch frame. The number of broadleaf plants and the number of stems (for grasses) were recorded. Weeds were not removed but left to grow to maturity as they would in other parts of the field.

It was difficult to obtain an estimate of the pound-dry-matter of weeds produced per acre with this method. Thus, for the last 2 years weeds were cut in the fall (after maturity), weighed and weights converted to pounds-dry-matter per acre. Four 30x30-inch areas were cut per plot. By postponing this operation until fall, it permitted the weeds to mature and produce seeds. Thus the next year's weed crop was not affected by cutting and removing the sample. Weed data for the last 2 years of the experiment are in table 4.

Table 2. Corn yields in bushels per acre for the various weed control practices.

Weed control method No. Description	Corn yield, bushels/acre 1965	1966	1967	1968	3-year average†
(1) Till-planted, one cultivation	88.4	85.7	69.4	18.8	58.0
(2) Till-planted, two cultivations	94.2	66.8	70.3	32.5	56.3
(3) Till-planted, one cultivation, post-emergence band application of Atrazine-oil mixture*		119.0	86.9	53.6	90.0
(4) Till-planted, one cultivation pre-emergence band application of Atrazine	102.6	114.3	85.1	56.1	85.1
(5) Till-planted, whole area sprayed with Atrazine	99.9	77.7	91.2	54.1	74.3
(6) Conventional planting	114.6	89.3	93.3	31.3	71.3

*This treatment was started in 1966, and it replaced a "till-planting, three cultivation" treatment that was not practical.
†Yields from first year were omitted because all plots had been plowed.

Table 3. Plant population for irrigated plots

Weed control method No. Description	Plants per acre for year 1965	1966	1967	1968	4-year average
(1) Till-planted, one cultivation	16,957	14,732	17,257	17,312	16,565
(2) Till-planted, two cultivations	18,696	13,790	17,910	17,375	16,943
(3) Till-planted, one cultivation, post-emergence band application of Atrazine-oil mixture	18,370	17,400	17,965	18,312	18,012
(4) Till-planted, one cultivation pre-emergence band application of Atrazine	18,696	16,312	18,237	17,562	17,702
(5) Till-planted, whole area sprayed with Atrazine	17,891	17,055	17,801	19,250	17,999
(6) Conventional planting	17,500	16,240	17,420	17,750	17,227
Average	18,018	15,922	17,765	17,927	17,408

DISCUSSION OF RESULTS

Corn Yield

Corn yield data for the 4-year experimental period are in table 3 and an analysis of variance is contained in table 5. In all 4 years, there were highly significant yield differences between treatments.

Yields declined from an average of 100.0 bushels per acre in 1965 to an average of 82.7 bushels per acre in 1967. In 1968 the average yield was only 41.4 bushels per acre. Reasons for the large yield drop from 1967 to 1968 were not investigated, but much of the decline may probably be accounted for by a general decline in fertility of the soil and by poor pollination weather in the sum-

Table 4. Weed growth for the 1967 and 1968 experiments

Weed control method No. Description	Weed yield in lbs. dry matter per acre for year 1967	1968
(1) Till-planted, one cultivation	737	1640
(2) Till-planted, two cultivations	282	1002
(3) Till-planted, one cultivation and post-emergence band application of Atrazine-oil mixture	375	286
(4) Till-planted, one cultivation and pre-emergence band application of Atrazine	687	58
(5) Till-planted, whole area sprayed with Atrazine	384	123
(6) Conventional planting	587	1255
Average for all treatments	509	727

Table 5. Analysis of variance for corn yield data.

Source	Dif.	SS	MS	F
	1965			
Plots	23	5,679	246.9	
Blocks	3	854	284.5	5.47†
Treatments	5	3,104	620.8	5.41†
Exp. Error (BxT)	15	1,721	114.7	2.18†
Sampling Error	24	1,259	52.5	
	1966			
Plots	23	21,178.60	920.81	
Blocks	3	243.94	81.31	.58
Treatment	5	16,910.84	3,382.17	11.77†
Exp. Error (BxT)	15	4,023.82	287.42	2.04
Sampling Error	24	3,382.51	140.94	
	1967			
Plots	23	5,119.45	222.58	
Blocks	3	105.34	35.11	.86
Treatment	5	4,307.63	861.53	18.29†
Exp. Error (BxT)	15	706.49	47.10	1.16
Sampling Error	24	977.63	40.73	
	1968			
Plots	23	23,005	100	
Blocks	3	146	61.7	1.26
Treatment	5	19,540	3,908	17.7†
Exp. Error (BxT)	15	3,319	221.2	4.51†
Sampling Error	24	1,176	49	

†Denotes significance at the 95% level.

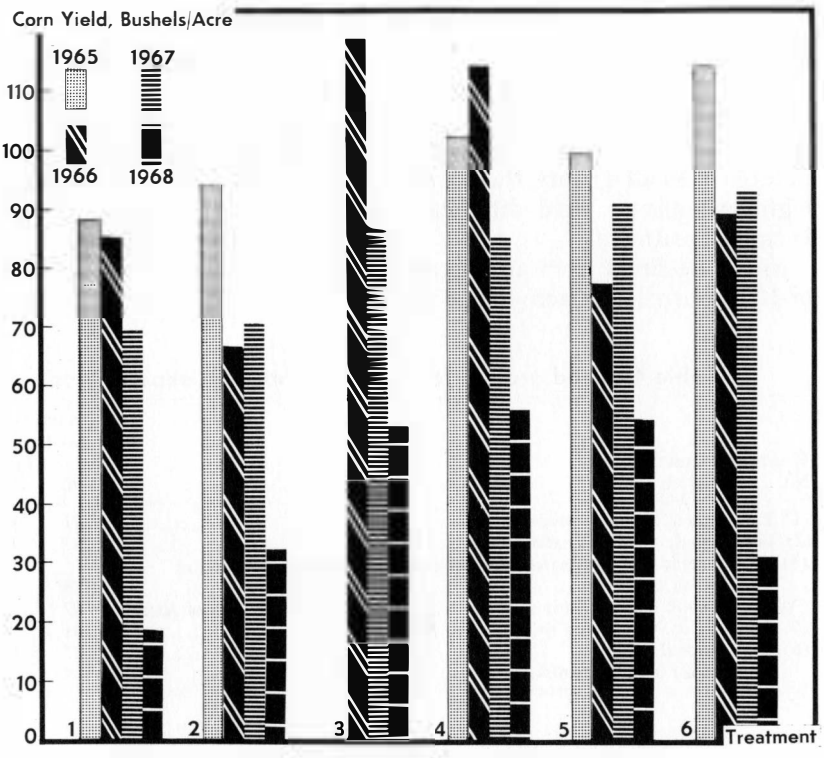


Figure 1. Corn yields for various weed control practices.

Six Weed Control Methods and Cultural Practices Use in Figures 1, 2 and 3.

(1) Chop stalks, till plant into previous rows, one cultivation at corn plant height of 16 to 24 inches.

(2) Chop stalks, till plant into previous rows, two cultivations, one soon after emergence and the second one the same as in (1).

(3) Chop stalks, till plant into previous rows, post-emergence application of an atrazine-oil mixture bandsprayed at the rate of 1 pound per acre, one cultivation.

(4) Chop stalks, till plant into previous rows, pre-emergence application of atrazine bandsprayed at a rate of 1 pound per acre, one cultivation.

(5) Chop stalks, till plant into previous rows, pre-emergence application of atrazine sprayed over whole area at a rate of 3 pounds per acre.

(6) Chop stalks, plow with moldboard plow, disk with tandem disk, plant (with till planter), two cultivations as in treatment (2). The planting mechanisms are similar for both the till planter and a conventional planter, thus using the till-planter for planting the conventional plots would not affect the results.

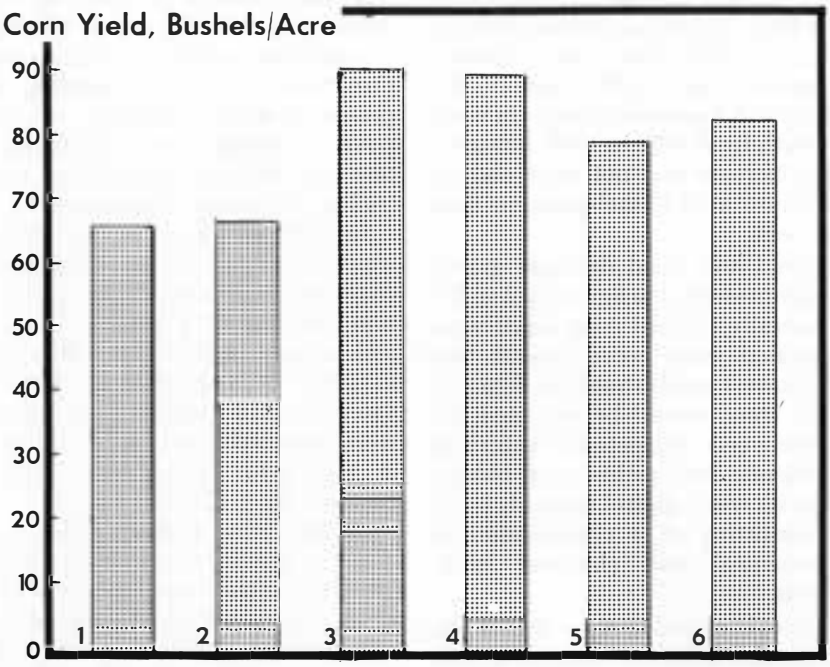
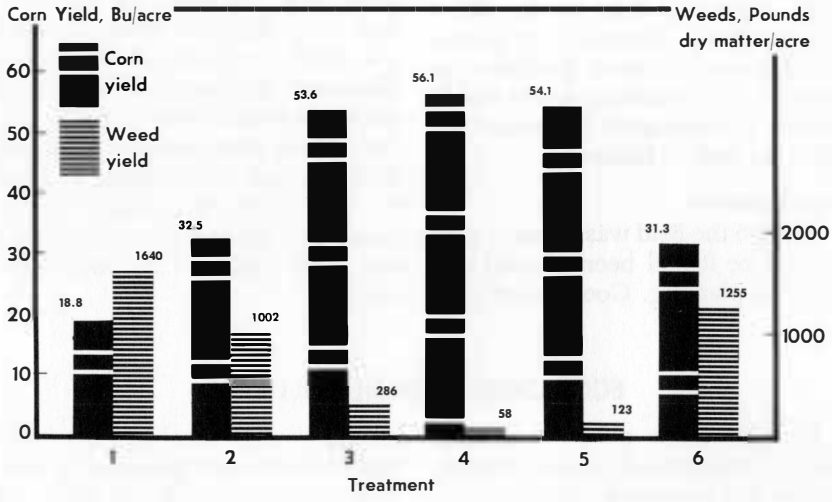


Figure 2. Corn yield average over a 4-year period. (Treatment No. 3 is a 3-year average, see Table 2 for explanation.)

Figure 3. Corn yield and weed growth for 1968.



mer of 1968. In 1968 most ears were not fully developed and had bare tip regions. Also, corn borer damage was extensive in 1968. Additionally, there was a general increase in weed growth from 1967 to 1968; however, this increase was not large enough to cause a 40-bushel-per-acre drop in yield.

Yield and weed data are graphically presented in figures 1, 2 and 3. Generally, highest corn yields were obtained when weed growth was the lowest as illustrated in figure 3. This trend would be expected because weeds compete for water and nutrients. Best yields were obtained with weed control methods 3 and 4 consisting of a combination of mechanical and chemical treatments.

Weed control is thus one of the main obstacles to success in till-planting of corn. When a farmer changes from conventional corn production to a till-planting system, he generally would not encounter more weeds than he would expect with conventional practice for the first year, especially if he starts with a plowed field. However, in subsequent years the weed problem becomes more important; and if weeds cannot be adequately controlled, till planting ends in failure.

Weed Control

In 1965 the field was clean to start with since it had been plowed just prior to planting. Good weed control was obtained by spraying the whole area with 3 pounds of atrazine without additional cultivation (treatment 5). A combination of pre-emergence bandspray of one pound of atrazine and one cultivation was also very effective in controlling the weeds (treatment 4).

In 1966 excellent weed control was obtained with a combination of chemicals and mechanical cultivation (treatments 3 and 4). Chemicals alone were not very effective in 1966. With good weed control (treatments 3 and 4), corn yields were 30 to 50 bushels per acre higher than with poor weed control (treatments 1, 2, 5 and 6).

In 1967 the chemicals did not have a significant effect on weed growth, but the corn yields were 10 to 15 bushels per acre higher where atrazine was applied. One exception was conventional practice (treatment 6) which had the highest yield of all treatments.

In 1968 weed infestation increased considerably over the 1967 levels for all plots where no chemicals were used, but excellent weed control was obtained where atrazine was used (treatments 3, 4 and 5) as illustrated in figure 3. Grass growth could not be checked by mechanical cultivation alone and the corn yield in these plots (treatments 1, 2 and 6) were 25 to 35 bushels per acre lower than those in plots where atrazine was applied (treatments 3, 4 and 5).

ECONOMIC CONSIDERATIONS

If a farmer is going to change from a conventional corn planting system to a minimum tillage system, he will expect to realize a net dollar gain over the old practice. If there were no gain, he should stay with

the conventional system because till-planting requires more management skill than conventional planting.

A gain can be obtained by a cost reduction or increased yield or both. Mathison (1) and Shubeck (2) have obtained cost figures for various cultural practices and weed control systems for corn production. Table 6 shows comparative cost figures (based on estimates by Mathison) for the six treatments used in the experiment. The cost of atrazine was $2.40 per pound, atrazine application $0.50 per acre, $1.00 per acre for each cultivation, $3.80 per acre for till-planting (30-inch row) and $8.00 per acre for conventional land preparation and planting.

Most till-planting treatments were lower in cost than conventional method, mainly because plowing was eliminated. An exception was treatment 5 which was more costly than conventional because of the high rate of atrazine application.

The last column in table 6 shows differences in return for the various weed control methods used when compared with the conventional corn planting method (treatment 6). These figures do take into consideration the differences in costs and yields obtained with the various weed control methods.

When chemical weed control was used, yields were higher than with conventional planting. When only mechanical cultivation was used, the yields were significantly lower than with conventional planting.

The atrazine and oil treatment (treatment 3) with one cultivation was $20.60 per acre greater in return and banded atrazine (treatment 4) was $16.10 per acre greater in return than conventional planting. These higher returns were due to lower production costs and higher yields.

Atrazine sprayed over the whole area (treatment 5) was more costly and yield increase was only slight compared with conventional planting. The result was about the same net return.

Till planting with one and two cultivations (treatments 1 and 2) but without chemicals resulted in lower net returns, $8.10 and $10.60 respectively, than conventional planting. Although cost per acre was lower for till planted plots, yield was also much lower than for conventional planting, resulting in the lower net returns.

The 4-year study did not include a comparison between chemical and non-chemical weed control with conventional planting. It may be possible that chemical weed control with conventional planting would have resulted in yield increase over conventional planting with mechanical weed control; in fact, in a 2-year study (reported in Part II of this publication) corn yields were increased with chemical weed control with conventional planting.

To a farmer who can obtain similar corn yields with either till-planting or conventional planting, till-planting will bring higher net return because of lower costs.

SUMMARY

Four years of research investigated continuous corn production under irrigation using a till-planting system. Five weed control methods were compared to conventional corn

Table 6. omparative land preparation, planting and weed control costs and yield for various weed control treatments.

Weed control method (treatment)	Chemical cost	Application cost	Cultivation First	Cultivation Second	Land preparation and planting	Total comparative cost	Cost difference compared with conventional $/acre	Yield (average 3 years) bu/acre	Yield difference as compared w/conventional @ $1.00/bu	Total difference in net return compared w/ conventional
One cultivation			1.00		3.80	4.80	—5.20	58.0	—13.3	—8.10
Two cultivations			1.00	1.00	3.80	5.80	—4.20	56.5	—14.8	—10.60
One cultivation, atrazine and oil, post-emergence and application 1 lb/acre	2.80	.50		1.00	3.80	8.10	—1.90	90.0	+18.7	+20.60
One cultivation, pre-emergence atrazine, band spray, 1 lb/acre	2.40	.50		1.00	3.80	7.50	—2.30	85.1	+13.8	+16.10
One cultivation, spray whole area 3 lb/acre atrazine pre-emergence	7.20	.50		1.00 (hilling)	3.80	12.50	+2.50	74.3	+3.0	+0.50
Conventional plow, disk, plant, two cultivations			1.00	1.00	8.00	10.00		71.3		

production (plowing, disking, planting, cultivating).

No reduction in yield was obtained with the till-planting system when adequate weed control was obtained.

Principal problem was weed control. Best results were obtained with a combination of chemical and mechanical weed control.

In an economic analysis, highest net returns were obtained with till-planting and a combination of chemical and mechanical weed control. Lowest returns were obtained with till-planting and only mechanical weed control because of large reductions in yield.

CONCLUSIONS

1. Till-planting of continuous corn is a practical method of corn production without reduction in yield in eastern South Dakota.
2. Weed control is the main problem in till-planted corn.
3. Mechanical weed control is more difficult to perform because of the large amount of trash on the soil surface. Special cultivating equipment is needed.
4. Mechanical weed control alone is generally not satisfactory in till-planted corn and must be augmented with chemicals, especially in the row area which cannot be reached mechanically.
5. A hilling operation is necessary to build up the ridges of the row area, thus a chemical weed control program without mechanical cultivation (ridging) is not satisfactory.
6. Production cost is reduced from conventional practice by elimination of plowing and disking operations.

Part II
Two Years Under Dryland

PROCEDURE

A field experiment was designed to compare three planting methods in combination with four weed control methods for corn production in eastern South Dakota under dryland conditions. The experiment was a split plot design in which planting methods were assigned as the whole plot treatments and the weed control methods were the sub plot (split plot) treatments. Three replications were used. The plots were near Toronto, S. D.

OBJECTIVES

Objectives of this study were to:

(1) Determine the corn yield and weed yield (pounds of dry matter per acre) for three corn planting methods and four weed control methods with other cultural practices held constant.

(2) Determine machine operation and chemical costs for each treatment combination in (1).

(3) Make cost comparisons for the specific operations involved (weed control and planting methods), relating these to the yield differences obtained.

Planting Methods

Three planting methods selected were:

(1) Conventional planting with 38-inch row spacing (control).

(2) Till planting with 38-inch row spacing.

(3) Till planting with 30-inch row spacing.

Weed Control Methods

Four weed control methods used were:

(1) Banded atrazine and oil post-emergence 0.6 pound, atrazine 80W +0.5 gallon oil per acre in a 13-inch band—2 cultivations.
(Note: In 1966 one cultivation was used and the atrazine was broadcast.)

(2) Broadcast atrazine pre-emergence, 3.5 pounds atrazine 80W—1 cultivation.

(3) Banded atrazine pre-emergence, 1 pound atrazine 80W per acre in a 13-inch band—2 cultivations.

(4) No chemical (control)—2 cultivations.

Cultural Practices

Fertilizer. All plots received equal amounts of fertilizer. Fertilizer rates applied are shown in table 7.

Table 7. Fertilizer application to plots during the experiment.

Year	Actual lbs. of nutrient applied N	P	K
1966			
Preplant	30	0	0
Planting	30	76	20
TOTAL	60	76	20
1967			
Preplant	85	0	0
Planting	5	55	40
TOTAL	90	55	40

The preplant application for both years was anhydrous ammonia. Dry form fertilizer was applied at planting time.

The anhydrous ammonia applicator set for the 30-inch rows had a tendency to plug. This operation was done after the stalks were chopped. Possibly less difficulty would have been encountered if it were done before chopping the stalks.

The placement of the dry starter fertilizer with the till-planter was not what is recommended. The fertilizer was placed 2 inches to the side and about equal in depth to the corn seed. Recommended placement is 2 inches to the side and 2 inches below the corn seed.

Planting and Cultivation: Table 8 shows the planting and cultivating dates for both years. During the 1966 season a conventional rear-mounted cultivator was used. It was not satisfactory in the till-planted plots because of the trash on the soil surface. For the 1967 season a special cultivator (described earlier in Part I) designed for till-planted corn was used. There was an appreciable amount of volunteer corn resulting from poor harvesting conditions due to lodging in 1966. With only one cultivation and abundant moisture, the volunteer corn grew quite vigorously prior to the one cultivation. Under these conditions neither the till planter cultivator nor the conventional unit performed as well as desired, mainly because of inadequate cutting, pulverizing and inverting of plant material and soil.

The planting population selected for both years was as close to 17,500 per acre as could be obtained for each planting method. In 1966 Pioneer 388 was planted and in 1967 DeKalb 306 was used.

Table 8. Planting and cultivating dates.

	1966	1967
Planting	May 20, 21	May 15-18
First Cultivation		
Treatments 3 and 4	June 20	
Treatments 1, 3 and 4		July 3
Treatment 2		July 14
Treatments 1 and 2	July 6	
Second Cultivation		
Treatments 3 and 4	July 6	
Treatments 1, 3 and 4		July 14

RESULTS

Corn Yield. The sample size was a measured .0023 acre. In the 30-inch rows, this was one row 40 feet long. For the 38-inch rows, this length was 27 feet, 2 inches. Two adjacent sub-samples were taken from each of the two inside rows of each plot (4 determinations per plot for 1967). In 1966 two determinations per plot were made for yield. The ears were harvested by hand, shelled and sample weights of shelled corn converted to bushels per acre at 15.5% moisture content. Yield data for the two years are in tables 9 and 10.

Weed Yield. In 1966 weed counts were not made because all plots were essentially weed free. As pointed out earlier weeds are no problem in the first year of till planting. The weed yield for the 1967 tests are in table 11.

Table 9. Corn yields in bushels per acre (dryland) 1966.

Planting method	Atrazine and oil	Broadcast atrazine	Banded atrazine	Control	Planting method averages
(1) 38-inch Conventional	78.8*	73.9	90.7	75.6	79.8
(2) 38-inch Till planting	80.1	80.0	86.0	68.9	78.8
(3) 30-inch Till planting	91.6	90.8	93.1	84.1	89.9
Weed control averages	83.6	81.6	90.0	76.2	

*Each number is an average of two determinations within 3 replications (total of 6).

Table 10. Corn yields in bushels per acre (dryland) 1967

Planting method	Atrazine and oil	Broadcast atrazine	Banded atrazine	Control	Planting method averages
(1) 38-inch Conventional	49.1*	47.3	46.2	44.0	46.6
(2) 38-inch Till planting	49.9	46.9	49.9	42.9	47.4
(3) 30-inch Till planting	62.9	58.8	58.8	59.4	60.0
Weed control averages	53.9	51.0	51.3	48.8	

*Each number is an average of four determinations within 3 replications (total of 12).

Table 11. Weed yield in pounds per acre dry matter, 1967

Planting method	Atrazine and oil	Broadcast atrazine	Banded atrazine	Control	Planting method averages
(1) 38-inch Conventional	139	77	90	192	124
(2) 38-inch Till planting	115	133	51	251	138
(3) 30-inch Till planting	129	155	61	151	124
Weed control method averages	128	122	67	198	

DISCUSSION OF RESULTS

Corn Yield 1966. Statistically, there was no difference at the 5% confidence level in yields due to planting methods. Although there may be a difference, the samples were too variable to indicate that such a difference exists. There is, however, a practical point to consider in connection with average yields for the planting methods. In the actual field operation, till planting cost $5.00 per acre less than the conventional. This is the cost of two tandem diskings and plowing at the common custom rates in this area. Therefore, if the yields from the two methods are the same, there is a saving of $5.00 per acre in favor of till-planting.

The difference of 11.08 bushels per acre in favor of 30-inch rows (see table 9), although not statistically significant, is of interest. It is well to note from this comparison table that in all four weed control treatments, the average yield in 30-inch rows was superior to the 38-inch row yield averages.

Although the weed control treatments tested significantly different, there was not much observable difference (weeds) during the growing season. On the average, the following additional yields over the

control were obtained: broadcast atrazine—5.4 bushels per acre; atrazine in oil—7.4 bushels per acre; and banded atrazine—13.8 bushels per acre.

Corn Yield 1967. Analysis of variance and orthogonal comparisons were made. Planting methods were significantly different. The independent comparisons indicated that the difference between the 38-inch planting treatments was non-significant. However, the comparison between the 30-inch till-planting and the average of the two 38-inch plantings was significant at the 95% level. The average yield of the 30-inch row spacing was 13 bushels per acre higher than the 38-inch spacing for the same plant population.

The "*F*" test for weed control treatments tested non-signficant. However, orthogonal comparisons of the treatment indicated that the mean of the control treatment (no chemical) was different (lower) from the average of the three chemical control treatments.

Weed Yield 1967. Analysis of variance for weed yield was made. Weed yield differences due to planting methods and weed control methods tested non-significant. The coefficients of variability were high for this measurement. The average amount of weeds was 129 pounds dry matter per acre (table 11). It is questionable that 129 pounds is sufficient to cause a measurable decrease in corn yields.

ECONOMIC CONSIDERATIONS

As indicated previously, a farmer should not change from a conventional corn planting system to a minimum tillage system unless he can realize a net gain over the old practice. For the dryland plots comparative cost figures were determined for 1967 and the results are in table 12. Atrazine cost $2.40 per pound, atrazine application $0.50 per acre and $1.00 per acre for each cultivation. The land fitting and corn planting costs per acre used for these comparisons were: (1) 38-inch conventional, $8.00; (2) 38-inch till-planting, $3.00; (3) 30-inch till-planting, $3.80. The comparative return values in table 12 should not be mistaken for net income per acre, but are a comparison of the net returns with the effect of the costs of the specific treatments removed.

The 38-inch till planting outyielded the 38-inch conventional planting by $5.80 per acre, although this difference tested non-significant. The 30-inch row spacing treatment mean was $13.70 per acre greater than the average compara-

Table 12. Comparative returns in dollars per acre.

Planting method	Atrazine and oil	Broadcast atrazine	Banded atrazine	Control	Planting method averages
38-inch Conventional	36.80	28.90	33.30	34.00	33.20
38-inch Till Planting	42.60	33.50	42.00	37.90	39.00
30-inch Till planting	53.70	44.30	48.80	53.10	49.80
Weed control method averages	44.30	35.60	41.20	41.60	40.70

tive dollar return from the 38-inch rows, both planting methods, and their means tested significantly different.

The atrazine and oil treatment was $5.90 per acre greater in dollar return than the average of the other two chemical treatment means, and this difference was statistically significant. The banded atrazine was $5.60 per acre better than the broadcast atrazine and this difference was statistically significant. There was no difference between the mean of the no chemical treatment and the average mean of the three chemical treatments. As indicated earlier, the amount of weeds in the plots was probably insufficient to cause measurable yield reduction.

SUMMARY

A field experiment was conducted over a 2-year period to investigate the adaptability of a till-planter for growing corn under dryland conditions in eastern South Dakota. This study compared the yields of corn grown using a till-planter versus a conventional planter, 38-inch rows versus 30-inch rows, and four weed control measures within these planting methods.

The average yield from the 38-inch till planted plots was 1 bushel per acre greater than the 38-inch conventional plots. The 30-inch row treatment outyielded the 38-inch rows by an average of 13 bushels per acre. All plots were planted at 17,500 plants per acre. Due to sucker stalks and volunteer corn a meaningful plant population at harvest could not be obtained.

Chemical treatment means for corn yields were greater than no chemical treatment.

Average comparative dollar return for 30- and 38-inch till-planting was greater than for 38-inch conventional. Comparative dollar returns for chemical weed control treatments were not significantly different from no chemical (control).

CONCLUSIONS

1. 38-inch till-planting resulted in about the same corn yield as 38-inch conventional for a planted population of 17,500 plants per acre under dryland conditions in eastern South Dakota.
2. 30-inch till planting out yielded 38-inch conventional and 38-inch till planting when planted at 17,500 plants per acre in eastern South Dakota.
3. Till-planting gave higher comparative dollar returns than conventional planting.
4. Chemicals and cultivation resulted in higher corn yields than cultivation alone in weed control.
5. Comparative dollar returns for chemical and cultivation was about the same as cultivation alone in weed control.
6. Till-planter cultivation must be used when till planting in order to handle the surface residues.

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