NO-TILL CROP PRODUCTION IN THE RED RIVER VALLEY

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Crop production under conventional and no-till systems has been compared at Fargo since 1976. Barley, flax, corn, sunflower and sugarbeet yields have averaged 7, 9, 5, 8 and 8 percent higher while wheat and soybean yields have averaged 5 and 2 percent lower, respectively, with no-till compared to conventional-till systems during this six-year period. Results indicate that crop yields can be maintained in the Red River Valley without tillage.

The plow or close facsimile always has been identified with crop production in the Red River Valley. No-till or zero-till crop production has been perceived by many as futuristic. However, no-till crop production systems have been adapted on over 9 million acres of crop land in the United States with few problems (3).

Advantages of no-till farming include a reduction in fuel usage, lower equipment costs, and reduced labor (1). Also, crop residues left on the surface in a no-till crop system will reduce soil erosion, and the combination of crop residues and reduced soil disruption with no-till will increase moisture conservation (2).

The concept of minimum input for maximum output always has been a major goal in the agricultural industry, but the relatively recent introduction of effective herbicides in the past 10 to 15 years has allowed reduction of fuel consumptive tillage operations previously needed primarily for weed control.

The objective of this research was to compare crop production under conventional and no-till systems at Fargo, North Dakota.

MATERIALS AND METHODS

Research was conductd to determine crop yields under no-till (seeding direclty into standing stubble) or conventional-till (fall plowing, spring field cultivating and harrowing) systems from 1976 through 1981 on a silty clay soil with pH 7.6 and 6.4 percent organic matter at Fargo, North Dakota. Plots were established on two adjacent areas in the fall of 1975. Each year one area was planted to hard red spring wheat and the other area to the seven crops (hard red spring wheat, barley, flax, corn, soybean, sunflower and sugarbeet). On subsequent years the areas were rotated so that the seven crops were always planted in an area occupied by hard red spring wheat the previous year and hard red spring wheat was planted on the area previously devoted to the seven crops. Half of the plots have been either continuous no-till or conventional-till since the trial was initiated. The entire experimental area was fertilized yearly with 200 kg/ha of ammonium nitrate (34-0-0) in the spring prior to crop seeding. Weeds were controlled with herbicides and hand labor (the latter to control weed escapes).

Crop cultivar, seeding date and herbicide treatments used each year are presented in Table 1. Small grains and flax were seeded with a modified press drill with cutting coulters and row crops with a flex planter. Herbicides were applied with a bicycle wheel sprayer delivering 17 gallons per acre for preemergence and 8.5 gpa for postemergence treatments at 35 pounds per square inch. The experimental design was a randomized complete bloc with a split plot arrangement and four replications. Main plots were tillage systems and subplots the seven crops. Individual plots were 15 by 45 ft.

RESULTS

The yield of seven crops under conventional and no-till systems has not been statistically different when averaged over years (Table 2). Wheat and soybean yields have averaged slightly lower and barley, flax, corn, sunflower and sugarbeet yields slightly higher under no-till compared to conventional-till systems during this period. Crop yields have tended to be higher under no-till than conventional-till systems during dry seasons but the reverse in wet seasons.

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Table 1. Crop cultivars, seeding dates, and herbicide treatments, 1976-81.

	Crop						
Year	**Wheat**	**Barley**	**Flax**	**Corn**	**Soybean**	**Sunflower**	**Sugarbeet**
				(Cultivar)			
1976	Olaf	Beacon	Culbert	Agsco 4XA1	Evans	Peredovik	AC-Hybrid B
1977	"	"	"	"	"	Sputnik	"
1978	Kitt	"	"	"	"	903	"
1979	"	"	"	Agsco 2XA1	"	894	"
1980	Era	Park	"	"	"	"	Hilleshog-Monica
1981	"	"	"	"	"	"	Hilleshog-309
				(seeding date)			
1976	5/5	5/5	5/5	5/19	5/19	5/19	5/7
1977	4/25	4/25	4/30	5/17	6/4	6/4	4/30
1978	5/1	5/1	5/2	5/17	5/17	5/17	5/2
1979	5/20	5/20	5/20	5/25	5/25	5/25	5/21
1980	4/30	4/30	4/30	5/16	5/16	5/16	5/1
1981	4/28	4/28	5/4	5/19	5/19	5/19	5/15
				(herbicide treatment[1])			
1976	Diclofop[2] (Hoelon) ¾ lb 3-1f 2,4-D ¼ lb 6-1f	Diclofop ¾ lb 3-1f 2,4-D ¼ lb 6-1f	Diclofop ¾ lb 3" MCPA ¼ lb 6"	Cyanazine (Bladex) 2 lb PE Alachlor (Lasso) 2 lb PE	Alachlor 3 lb PE Bentazon (Basagran) ¾ lb 2nd trif	Chloramben (Amiben) 3 lb PE	TCA 7 lb PE Ethofumesate (Nortron) 1.5 lb PE
1977	"	"	"	"	"	"	TCA 7 lb PE Desmedipham (Betanex) 1 lb 4-1f
1978	Diclofop ¾ lb 3-1f Bromoxynil (Brominal or Buctril) ¼ lb 3-1f	Diclofop ¾ lb 3-1f Bromoxynil ¼ lb 3-1f	"	"	Alachlor 3 lb PE Metribuzin (Sencor or Lexone) ¼ lb PE	"	Diclofop 2 lb 2-1f Desmedipham 1 lb 4-1f
1979	"	"	"	Cyanazine 2 lb PE Alachlor 2 lb PE Dicamba (Banvel) 0.5 PE	Pendimethalin (Prowl) 1.5 lb PE Chloramben 2 lb PE	Pendimethalin 1.5 lb PE Chloramben 2 lb PE	"
1980	"	"	Diclofop ¾ lb 3" Bromoxynil ¼ lb 3"	"	Pendimethalin 1.5 lb PE Metribuzin 3/8 lb PE	"	"
1981	"	"	"	"	"	"	"

[1]Glyphosate was applied at 0.75 lb/A in 1976, 1977 or 1978 and at 0.37 lb/A in 1979, 1980 and 1981 on no-till plots after crop seeding but prior to crop emergence.

[2]Trade name is listed in parenthesis.

Table 2. Yield of seven crops under conventional and no-till systems at Fargo, 1976-81.

Crop	**Yield unit/A**	**System** Conventional	No-till	**No-till • of conventional**
Wheat	bu	30.8	29.3	95
Barley	bu	45.0	48.3	107
Flax	bu	10.8	11.3	109
Corn	bu	48.7	51.2	105
Soybean	bu	26.0	25.6	98
Sunflower	lb	1474	1589	108
Sugarbeet	T	16.1	17.3	108

[1]Crop yields under conventional and no-till systems are not statistically different.

Wheat yields under both conventional and no-till production systems were influenced by the previous crop (Table 3). Wheat yields were the highest under both tillage systems when the previous crop was soybeans and lowest when the previous crop was wheat. Wheat following soybeans yielded 40 percent more than wheat following wheat averaged over tillage systems. Further, wheat following flax, corn, sunflower and sugarbeet has yielded 14, 23, 26 and 24 percent more, respectively, than wheat following wheat.

DISCUSSION

Herbicides are used as a supplement to tillage for weed control under conventional systems; however, herbicides become the major means of weed control in no-till systems and must effectively control weeds for maximum crop yields. Weed control may be required at several points in a no-till system including fall weed control, initial weed control in the spring at the time of crop

Table 3. Effect of previous crop on wheat yields under conventional and no-till systems at Fargo, 1977-81.

Previous crop	System: Conventional	No-till	Mean
	(Yield bu/A)		
Wheat	130.9	29.3	30.0a
Barley	33.2	31.6	32.4ab
Flax	35.2	33.5	34.4bc
Corn	37.6	36.1	36.9c
Soybean	42.9	41.2	42.0d
Sunflower	38.4	37.2	37.8c
Sugarbeet	38.4	35.8	37.1c
Mean	36.6a	35.0a	

[1]Wheat yields followed by the same letter are not statistically different.

seeding, and postemergence weed control in the crop in order to obtain adequate weed control.

Fall weed control practices are for control of winter annual and perennial weeds. Winter annuals such as field pennycress, flixweed and shepherd's purse are resistant to most spring applied herbicides but can be readily controlled with herbicides applied in the fall when the weeds are small. Further, fall herbicide treatments have been more effective than spring treatments for controlling perennial weeds. The optimum time for herbicide application for Canada thistle, field bindweed, etc. is from the middle of August to the middle of September. However, later treatments have been successful if frost has not caused extensive damage to the weed foliage. Weeds such as field bindweed or Canada thistle should have 6 inches or more of stem tissue before treatment and still growing for adequate herbicide absorption.

Initial spring weed control is herbicide treatment at seeding and is essential in a no-till system. Weed growth present at the time of seeding must be controlled as weeds emerged before the crop have a competitive advantage. Paraquat (Paraquat, Gramoxone) and glyphosate (Roundup) are non-selective herbicides with no soil residual which may be applied alone or in combination with preemergence herbicides, depending upon the crop. Under no-till systems, incorporated herbicides such as EPTC (Eptam) and trifluralin (Treflan) cannot be incorporated so are ineffective. Preemergence herbicides are more dependent on many factors such as rainfall, soil moisture, soil temperature, soil type, herbicide formulation and weed species than weed control from preplant incorporated or postemergence herbicides. Postemergence herbicides are especially important to no-till crop production.

Initial weed control with paraquat or glyphosate in the spring should take place before or after seeding but before the crop emerges. Maximum weed control with paraquat and glyphosate will be obtained if weeds are sprayed just prior to crop emergence to alllow the maximum number of weeds to germinate and emerge. However, emerged crop plants also will be killed by these herbicides, so the risk of an untimely rain or wind preventing spraying must be considered when delaying application for maximum weed emergence.

Postemergence weed control in the crop will depend upon the crop and weed species present. Weeds could be a serious deterrent to no-till in crops where postemergence herbicides are not available for broad-spectrum weed control. Weed problems must be identified in planning weed control programs for no-till cropping. Crop rotations must also be an important component in the no-till weed control program. Crop rotations disrupt life cycles of certain weeds and allow greater flexibility in herbicide selection.

With proper management, crop yields under no-till have been similar to conventional-till. Swenson and Johnson (4) have reported that the cost of no-till small grain production under continuous cropping is only slightly higher than under conventional tillage. Savings in fuel, labor and equipment in no-till systems have offset the higher herbicide costs. Seeding directly into crop residue reduces the chance of soil erosion from both wind and water.

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