THE INFLUENCE OF TILLAGE ON NITROGEN MANAGEMENT FOR SOFT RED WINTER WHEAT PRODUCTION SYSTEMS

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Approximately 260,000 acres of soft red winter wheat were sown in Kentucky in the fall of 1977. By the fall of 1983. preliminary reports indicted that this acreage had risen to nearly 720.000. A large portion of these acres are being sown using conventional (plow, disc (1-3 times), plant) tillage management on soils with a significant erosion hazard **if** surface residues are not maintained.

Interest In winter cereals in Kentucky has evolved from the winter cover and green manure crops of past years to wheat and barley as important components of grain crop rotations. Winter cereals are now being looked upon as a means of generating early feed and/or cash flow. Because of this. interest in better management practices has also arisen, and use of higher nitrogen (N) rates to Increase wheat yields has coincided with increased emphasis on tillage reduction. Tillage methods have been important determinants of yield response to fertilizer N in summer annuals such as corn (1, 2), and are expected to be of no less importance to the yield response of the winter annuals.

Two experiments have been initiated to evaluate the influence of tillage on yield and other important agronomic responses related to nitrogen applications on soft red winter wheat. In the first of these, located on a Maury silt loam (Typic Paleudalf). wheat follows corn in a corn-wheat-doublecrop soybean rotation. Two tillage systems, no-till and conventional (plow. disc 2x, plant) are represented. The Caldwell wheat was planted and fertilized in such a way as to give three levels of N on the wheat (0. 40. 80 lb N/A) at each of three levels of N applied to the prior corn crop (0, 100, 200 lb N/A).

Soil nitrate nitrogen levels strongly reflected corn fertilization patterns when samples were taken in the fall prior to wheat seeding. but not the next spring. when the plots were soil sampled prior to wheat N

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fertilization (Table 1). Corn yields averaged 120 bu/A across all treatments, but crop utilization depleted soil nitrate levels much more in no-till corn than in conventionally tilled corn plots. The wheat did respond to the "residual" N fertilization pattern (Table 1) in terms of leaf tissue N concentrations and lodging patterns, regardless of wheat spring N fertilization rate. No-till wheat production resulted in less N recovery and lodging.

Table 1. Influence of corn N fertilization rate on residual soil nitrate levels, wheat leaf N concentration and wheat lodging.

Tillage System	N Rate Corn	Soil Nitrate N 10/82	Soil Nitrate N 4/83	Flag-Leaf N	Lodging* Rating
	------ -lb	N/A ---+---	- - -	%	
No-Till	0	16 e	12	3.6 b	0.2 c
	100	40 d	13	3.7 b	0.2 c
	200	128 b	14	3.9 a	0.3 c
Conventional	0	26 d	11	3.5 b	0.2 c
	100	96 c	11	3.9 a	3.3 b
	200	198 a	11	4.0 a	5.2 a

*0..2 = no lodging, 9.0 = plot lodged totally flat.
+Values within a column followed by the same letter not significantly different (P>O.05).

Wheat yield patterns were strongly influenced by both applied spring N and residual N from the previous corn crop (Table 2). No-tillage production practices resulted in a different yield pattern than conventional tillage. On plots where corn received no N fertilizer there was a strongly positive yield response to both application rates of spring N on no-till wheat. However, the response "peaked" at 40 lb N/A under conventional tillage management. Following use of 200 lbs N/A on the prior corn crop the wheat yield response pattern was generally negative with respect to applied spring N, especially in conventional tillage wheat. Wheat following corn fertilized at 100 lbs N/A required some additional N to maximize yields under no-till management. With conventional tillage, no additional N was required. Yield losses with excessive N were associated with increased lodging on conventionally planted wheat and head and foliar diseases on wheat grown under both residue management systems.

At this location the Maury soil has a large reserve of organic N that becomes available under conventional tillage. When comblned with residual fertilizer N from the prior corn crop, an excessive N supply resulted.

The second field experiment was sited on a Loradale silt loam (Typic Argiudoll) in a killed ryegrass sod. The plot area had been used for several years to evaluate inbred corn lines and had received large quantities of N fertilizer during that period of time. Thus, the potential soil N availabil ty to the wheat was also considered to be very high at this location. In this experiment, no-till and conventional tillage were evaluated at two nitrogen application rates (70, 140 lb N/A) as a part of an intensive wheat management experiment that also involved two different varieties (Caldwell, Wheeler) and the presence or absence

Table *2.* Wheat yield response to tillage, applied and residual nitrogen - **1982/83** production year.

Tillage System	N Applied to Wheat	N Rate on Corn (lb N/A) 0	100	200
	lb/A	Wheat yield (bu/A)		
Conventional	0	*52 fg	**66** bcde	**43** ghi
	40	**76** ab	**61** cdef	**42** ghi
	80	**79** a	**56** ef	**41** hi
No-Till	0	**36** i	**51** fgh	**68** abcd
	40	**55** f	**73** ab	**69** abc
	80	**71** abc	**70** abc	**57** def

Yield values followed by the same letter are not significantly different (P>0.05).

of programs of disease control (with fungicides) and plant growth regulation (with ethephon).

It was apparent that both tillage and applied N significantly affected wheat yields (Table 3). The no-till wheat outyielded the conventionally managed wheat by **9** bu/A, averaging 91 bu/A. The yield difference between the two systems appeared to be related to N availability. All fertilizer N was managed in split applications, with three-fourth's applied at spring greenup and one-fourth at late boot. Additional N resulted in yield declines in both tillage systems when no fungicide was used, and the generally poorer performance of the conventionally planted wheat was related to greater N recovery, lush early vegetative growth, and earlier lodging (Table 3).

The earliest lodging commenced with the onset of grain filling and was related to weakening of basal stems by powdery mildew (Erysiphe graminis f. sp. tritici). The fungicide program was generally effective, and the largest yield increases (15 to 16 bu/A) occurred at higher N fertilization levels. Where 140 lb N/A was used on conventional tillage wheat, the fungicide program did not raise wheat yields to near maximum levels in the experiment. This seemed indicative of the greater disease stress in these plots.

As these experiments continue the depletion of soil N reserves and the inefficient recovery of N in no-till environments should shift the response pattern. However, where wheat follows N fertilized corn, as in large areas of Kentucky, the no-till wheat appears less likely to be adversely affected by high levels of residual/available soil N and will indeed require more fertilizer N when soil N reservoirs are low or unavailable.

Table 3. Yield and lodging response of soft red winter wheat* to tillage management, applied nitrogen, and disease control.

Tillage System	N Rate	Lodging Rating†		Wheat Grain Yield	
		8 June	22 June	-fungicide	+fungicide
	lb/A			---- bu/A ----	
No-Till	70	0.4 a++	1.1 a++	**91 bc	100 a
	140	0.7 ab	2.4 b	79 d	94 ab
Conventional	70	0.9 bc	1.3 a	81 d	93 ab
	140	1.1 c	2.1 b	69 e	85 cd

*Average of 2 varieties, Caldwell and Wheeler.
†0.2 = no lodging, 9 = whole crop lodged flat.
++Ratings within a column followed by same letter are not significantly different ($P>0.05$).
**Yield values followed by the same letter are not significantly different ($P>0.05$).

LITERATURE CITED

1. Kitur, B.K., M.S. Smith, R.L. Blevins, and W.W. Frye. 1984. Fate of N-Depleted Ammonium Nitrate Applied to No-Tillage and Conventional Tillage Corn. Agron. J. 76:240-242.

2. Mengel, D.B., D.W. Nelson, and D.M. Huber. 1982. Placement of Nitrogen Fertilizers for No-Till and Conventional Till Corn. Agron. J. 74:515-518.