

USE OF A WHEAT COVER CROP TO TRAP RESIDUAL SOIL N FOR NO-TILL CORN

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ABSTRACT

In continued work on long-term no-till plots, wheat was tested as a winter cover crop to determine how much carryover soil N it would accumulate from the preceding no-till corn crop and make available to the successive no-till corn crop. Wheat biomass at time of planting no-till corn was about 1.7 times greater following 240 lbs N/A on the preceding corn than following 80 lbs N/A. However, maximum wheat biomass was only about 1 T/A, and contained only 15 lbs N/A more than wheat grown following corn which received no N. Although ear leaf content of no-till corn grown in the killed wheat was slightly increased over that of no-till corn grown without a wheat cover crop, this effect did not carry through on either total corn biomass production or on corn grain yields. This work is continuing.

## BACKGROUND AND OBJECTIVE

Interest has developed during the past several years about use of winter cover crops to trap carryover available soil N and reduce its leaching into subsurface water. We conducted an experiment designed to measure the amount of soil N accumulated by a winter wheat cover crop on the long-term no-till corn plots at Quicksand, Kentucky. An N rate study (0, 80, 160, 240 lbs N/A) had been conducted in 1991, making it possible to test for carryover effects of N from those plots. However, the number of available plots placed some limitations on the number of reps which could be used for some of the treatments. Since there were only 4 control plots (0-N) in the original study, and due to their juxtaposition to surrounding plots, 3 of them were seeded to a wheat cover crop, leaving only 1 to serve as a control for the corn stubble (no cover crop) treatment. Additionally, for the same reasons, we were able to arrange only 2 reps of the 160-0, and 240-80 N treatments on the corn stubble (no cover crop). This resulted in 4 reps for the 240-0 and 160-80 N treatments on the corn stubble (no cover crop). With these exceptions, all other treatments were replicated 3 times. The N treatments refer to amount of N applied in 1991 and the amount of N subsequently applied to corn in 1992. In all cases, either no additional N or 80 lbs/A of additional N (topdressed 5 wks after planting) was superimposed on the cover/no cover and 1991 N rate plots. The objective was to measure the effect of a wheat cover crop in trapping any residual soil N following harvest of no-till corn and

trapping any residual soil N following harvest of no-till corn and to measure what effect this might have on yield of next year's no-till corn crop.

#### DESCRIPTION OF STUDY

The study site is on a Pope silt loam soil and has been used continuously for no-till corn studies since 1981. Soil samples taken in March, 1992 showed composite values in the test area of pH 6.6, Mehlich III P and K of 100 and 198 lbs/A, respectively in the surface 3 inches. Values for the 3 to 6 inches depth were pH 6.5, and 19, and 114 lbs/A P and K, respectively. The plot area was topdressed with 36 lbs  $P_2O_5$  and 116 lbs  $K_2O$  per acre just prior to planting corn on May 7, 1992.

Wheat was no-till seeded into appropriate plots on October 10, 1991, using a Tye drill and "Cardinal" wheat at 150 lbs seed per acre. Due to an abnormally cold November and December, there was not much wheat growth, wheat being only 2.5 inches tall on December 12. Even by March 24, 1992, wheat was only 6 inches tall and had not tillered. Stand was considered to be only "fair" and in some areas had been thinned by clumping of corn residues. Biomass of the wheat was estimated on May 6, immediately prior to planting no-till corn, by harvesting two rows, 18 inches long from the center of each plot. Wheat density ranged from 13 to 33 stems per square foot and averaged 20 stems per plot (18 for 0-N, 20 for

80 N, 18 for 160 N, and 22 for 240 N). At this time (May 6), wheat was generally 18-24 inches tall, in the early boot stage of growth, appeared to be severely N deficient, and had not tillered. Total N analysis of cover crop dry matter was determined, and based on this, total amount of N contained in the cover crop at the time it was killed and corn planted was calculated. These data are summarized in Table 1.

Corn was no-till planted into the wheat cover crop on May 7, at 24,900 seeds per acre using the cultivar Pioneer 3140. Appropriate plots were topdressed with 80 lbs N/A on June 15, when corn was about 18 inches tall. Corn ear leaf samples were taken from all plots at anthesis (July 28) and analyzed for total N content. Summary of these data is shown in Table 2. Corn was harvested both for grain and total dry matter accumulation on September 29. Average stand count was 23,036 plants per acre. Grain moisture content was 30% and foliage was 25-30% green (the cultivar, Pioneer 3140, is a "stay green" variety). Grain yields are summarized in Table 3, and total "above-ground" corn biomass is summarized in Table 4. Content of N in the "above-ground" corn biomass is shown in Table 5, and total N uptake by corn biomass is shown in Table 6.

## RESULTS AND SUMMARY

Despite having been sown on October 10, just prior to the "average" hessian fly-free date for Kentucky, there was very little wheat growth during the fall of 1991, a reflection of abnormally cold weather during November and December, and N stress. Even when killed on May 7, 1992, biomass of wheat was light, largely reflecting N deficiency and only a modest stand. As shown in Table 1, there was little apparent carryover of N from rates applied to corn during the preceding year, except for the 240 lb/A N rate. The amount of soil N "trapped" ranged from 12 (0 N) to 27 (240 N) lbs/A. Ear leaves of the subsequent corn were sampled at anthesis (July 28, 1992) and analyzed for N content. These data (Table 2) show that presence of the wheat generally increased ear leaf N concentration either on corn which had received 0 fertilizer N in 1992 or on corn which had received 80 lbs N/A in 1991. This had little effect on corn grain yields (Table 3) or total corn biomass yields (Table 4) which were harvested on September 29, 1992.

Concentration of N was slightly higher in the biomass from plots which were not fertilized with N during 1992, but which had the cover crop as compared to no cover crop (Table 5). However, where 80 lbs N/A was applied to the 1992 corn crop, there was no difference in biomass N concentrations due to the cover crop.

Total N uptake by above-ground corn biomass is summarized in Table 6. This shows a little value for the presence of wheat

cover from the 1991 80 N on plots that received no N in 1992, but none beyond that. When apparent N recovery is estimated (Table 7), within data limitations indicated, it is apparent that the wheat cover crop provided little N toward production of the 1992 crop. We feel this is mostly due to either low carryover of N from 1991 applications, or to slow growth of wheat after seeding in 1991 or a combination of these factors.

The on-going experiments are designed to more specifically elucidate these factors.

Table 1. Total Biomass and Amount of N Accumulated by Wheat Cover Crop

<u>Lbs N/A Applied to Corn in 1991</u>	<u>Oven-Dry Wt (lbs/A) of Wheat Cover Crop When Killed to Plant Corn (5-7-92)</u>	<u>Lbs Total N/A in Wheat when Corn was Planted</u>
0	989	12
80	1287	16
160	1387	19
240	2192	27

Table 2. Effect of Wheat Cover Crop on Ear Leaf N Concentration of Corn

<u>Lbs N/A Applied to Corn in 1991<sup>1/</sup></u>	<u>No N on Corn in 1992</u>		<u>80 lbs N/A on corn in 1992<sup>2/</sup></u>	
	<u>Corn Stubble</u>	<u>Wheat Cover</u>	<u>Corn Stubble</u>	<u>Wheat Cover</u>
	- - - - - %N - - - - -			
80	1.76	1.83	2.54	2.74
160	1.61	1.68	2.47	2.66
240	1.66	1.88	2.65	2.53
AV	1.68	1.80	2.55	2.64

<sup>1/</sup>There were 4 zero N plots in this study; 3 were in wheat cover in 1992 and averaged 1.76%N. The one zero N plot in corn stubble contained 1.59% N.

<sup>2/</sup>Topdressed over corn on June 15 (corn was planted May 7).

Table 3. Effect of Wheat Cover Crop on No-Till Corn Yield

<u>Lbs N/A Applied to Corn in 1991<sup>1/</sup></u>	<u>No N on Corn in 1992</u>		<u>80 lbs N/A on corn in 1992<sup>2/</sup></u>	
	<u>Corn Stubble</u>	<u>Wheat Cover</u>	<u>Corn Stubble</u>	<u>Wheat Cover</u>
	- - - - - Bu/A - - - - -			
80	51	66	147	141
160	64	60	137	141
240	66	69	154	149
AV	60	65	146	144

<sup>1/</sup>There were 4 zero N plots in this study; 3 were in wheat cover in 1992 and averaged 39 bu/A corn. The one zero N plot in corn stubble yielded 32 bu/A corn.

<sup>2/</sup>Topdressed over corn on June 15 (corn was planted May 7).

Table 4. Effect of Wheat Cover Crop on Total Dry Matter Accumulation by No-Till Corn

Lbs N/A Applied to Previous Yr <sup>1/</sup>	No N on Corn in 1992		80 lbs N/A on corn in 1992 <sup>2/</sup>	
	Corn Stubble	Wheat Cover	Corn Stubble	Wheat Cover
	Lbs/A			
80	6994	8297	16,336	14,743
160	8650	7827	16,063	15,588
240	9887	8465	18,316	16,930
AV	8510	8196	16,905	15,754

<sup>1/</sup>There were 4 zero N plots in this study; 3 were in the wheat cover tmt in 1992 and averaged 6,597 lbs d.m./A. The one zero N plot which was in corn stubble yielded 5,808 lbs d.m./A.

<sup>2/</sup>Topdressed over corn on June 15 (corn was planted May 7).

Table 5. Effect of Wheat Cover Crop on N Concentration of Whole Corn Plants

Lbs N/A on Corn in Previous Yr <sup>1/</sup>	No N on Corn in 1992		80 lbs N/A on corn in 1992 <sup>2/</sup>	
	Corn Stubble	Wheat Cover	Corn Stubble	Wheat Cover
	%N			
80	.49	.54	.50	.50
160	.44	.52	.51	.51
240	.48	.52	.55	.55

<sup>1/</sup>There were 4 zero N plots in this study; 3 were in the wheat cover tmt in 1992 and averaged 0.46% in total N content. The one zero N plot which was in corn stubble averaged 0.47% total N.

<sup>2/</sup>Topdressed over corn on June (corn was planted May 7).

Table 6. Effect of Wheat Cover Crop on Total N Uptake by Corn

Lbs N/A on Corn in Previous Yr <sup>1/</sup>	No N on Corn in 1992		80 lbs N/A on corn in 1992 <sup>2/</sup>	
	Corn Stubble	Wheat Cover	Corn Stubble	Wheat Cover
	Lbs/A			
80	34	45	83	73
160	38	41	82	80
240	48	44	100	95

<sup>1/</sup>There were 4 zero N plots in this study; 3 were in the wheat cover tmt in 1992 and averaged 30 lbs N uptake/A. The one zero N plot which was in corn stubble took up 27 lbs N/A.

<sup>2/</sup>Topdressed over corn on June 15 (corn was planted May 7).



Table 7. Apparent Recovery<sup>1/</sup> of Residual and Fertilizer N by No-Till Corn as Affected by Previous N Rates and Wheat Cover Crop.

Lbs N/A on Corn in Previous Yr <sup>1/</sup>	No N on Corn in 1992		80 lbs N/A on corn in 1992 <sup>2/</sup>	
	Corn Stubble	Wheat Cover	Corn Stubble	Wheat Cover
	----- Lbs N/A -----			
80	7	15	56	43
160	11	11	55	50
240	21	14	73	65

<sup>1/</sup>Estimated by subtracting N accumulation by the 0 N control plots from cover or no cover at 80, 160, or 240 lbs N/A applied in 1991, or 0 or 80 lbs N/A applied in 1992. The value for the control for the no cover treatment is diminished by there being only 1 rep of that treatment.

<sup>2/</sup>Topdressed over corn on June 15 (Corn was planted May 7).

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