

SUBSOILING OF NO-TILLED CORN

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No-tillage corn production has become very popular in Kentucky because of the advantages it offers producers. Currently, over half of the corn in Kentucky is planted by this method and even a higher percentage is no-till planted on erodible lands. Because of this, many fields have received little tillage in the last 10 to 20 years. Many producers wonder if soil compaction increases with time on these long-term no-tilled fields due to annual trafficking by heavy equipment. Subsoiling implements have become available that allow subsurface tillage while preserving the surface mulch layer. This practice allows for continued no-till planting while introducing some tillage into the cropping rotation. Some producers are subsoiling every second fall after soybean harvest in a corn-wheat-soybean rotation.

Research by the University of Kentucky has shown that soil compaction in a no-tillage system does not commonly occur. Organic matter content at the surface has increased in long term no-tilling fields. This greatly reduces the ability of the soil to be compacted by heavy equipment .

Many producers who regularly subsoil do not take field measurements to determine if compaction exists. This is unfortunate because research has shown that subsoiling fields that are not compacted only increases the expense of crop production but does not improve grain yields.

An experiment was designed to test the effect of subsoiling on yields of long term no-tilled fields and help answer questions that producers have concerning this practice.

How it was done

The study was conducted on 3 fields in Caldwell County with a long history of no-tillage crop production.

Field 1 — No-tillage for the last 15 years except for one light disking.

Soil types: Pembroke silt loam, Crider silt loam, and a small area of Melvin silt loam

Field 2 — No-tillage for the last 10 years with the exception of 1 disking and a subsoiling 7 years prior to this trial.

Soil type: Crider silt loam

Subsoiling method: paraplow

Field 3 — No-tillage for the last 10 years with the exception of a disking and a subsoiling 4 years and 8 years, respectively, prior to this trial.

Soil types: Crider silt loam, Pembroke silt loam, and a small area of Lindsie silt loam.

Subsoiling method: paraplow

The treatments were paired comparisons with the subsoiled and non-subsoiled side by side. The paraplow subsoiler used in this experiment leaves most of the residue on the surface and allows no-till planting the following spring. The subsoiling was done the first half of November of 1997 when the soil was dry enough for excellent soil shattering. The treated areas were 30 feet wide and were 1185 feet long on field 1 and 1474 feet on field 2, and 2000 feet on field 3. The subsoiling was 12 inches deep. There were 7 replications on field 1, 3 replications on field 2, and 2 replications on field 3.

Soil penetrometer measurements were made to a depth of 15 inches in each replication at 90 feet intervals along the length of each replication in March, 1998, when soil moisture conditions were near field capacity. Plant stand counts were made in 30 feet of row on 4 rows at several different locations in each replication. Early season soil temperature measurements at a 2 inch depth were made weekly on field 1.

Yields were measured by mechanically harvesting and weighing (weigh wagon) all 12 rows in each treatment.

Results

Penetrometer Reading

The highest penetrometer reading found in the surface 15 inches of soil was recorded at each site. These data are shown in [Table 1](#). Except for a small low area of Melvin soil in field 1, the percentage of sites with readings exceeding 300 psi or greater was low. The University of Kentucky does not recommend subsoiling fields if less than 30% of the field has readings of 300 psi or greater in the surface 15 inches. Subsoiling is recommended if 50% or more of the sites read 300 psi or more.

In the small area of poorly drained Melvin soil in field 1, which had over 50% of the readings above 300 psi, the high readings began at 9 inches below the surface. This suggests that the compaction was probably caused by conventional tillage and had existed for many years.

Location	Number of Sites	Sites Reading 300 psi or greater %
Field 1	103	3
Field 1 (low wet area)	9	69
Field 2	49	24
Field 3	68	19

The paraplowed treatments were measured using a penetrometer at 9 different sites in field 3 and, as expected, none of the sites exceeded 300 psi.

Based on the results of the penetrometer readings, subsoiling would not be expected to increase yields significantly except in the small area of Melvin soil in field 1.

Soil Temperatures

Subsoiling loosens the soil and may allow for better air exchange at the surface and an increased surface area for radiant heat interception. Soil temperatures were measured to determine if early season soil temperatures were affected by subsoiling.

The temperatures are shown in [Table 2](#) and indicate very little difference between the two treatments. The no-till planter used in this experiment had Martin row cleaner attachments which left almost no crop residue above the planted row in either treatment. This may help account for the lack of difference.

Treatment	Date					
	Apr. 8	Apr. 17	Apr. 21	May 1	May 8	May 15
-----Degrees F-----						
Subsoiled	52	44.5	47.8	49.5	56.5	53.5
Undisturbed	51.6	45.2	48.6	50.0	57.2	53.6

Stand Counts

The stand counts are shown in [Table 3](#). In every case, the stands were higher where subsoiling was used. They were also significantly higher, due to subsoiling, in the compacted Melvin soil in field 1. They were also higher, due to subsoiling, in field 3 and also when results from all of the sites from the three fields were combined.

This indicates that the environment for germination and emergence was better where subsoiling had occurred, possibly due to loosened soil allowing a more uniform placement of the seed by the planter. The overall difference is about 5% and may need to be taken into consideration in determining seeding rate at planting if subsoiling is a consistent practice in a producer's management system.

Table 3. Effect of subsoiling on plant stands				
Location	Number of Sites	Plants/acre		Statistical Significance of Difference
		Subsoiled	Undisturbed	
Field 1	18	22,942	21,780	NS
Field 1(low, wet area)	4	21,780	18,876	*
Field 2	6	23,038	22,070	NS
Field 3	4	24,575	22,506	*
Average of all replications	32	22,848	21,792	*
*Stands were significantly different at the 0.1 level.				

Yields

The yields from subsoiled and undisturbed areas in all fields were not significantly different in any case. There seemed to be a trend for the subsoiled treatment to increase yield, but it was very small. When all the replications were averaged, the subsoiled treatment was 1.3 bu/ac higher. Even if this were a real difference, this would not be sufficient to cover the \$10/ac expense of the subsoiling

operation.

The largest difference between the two treatments was found in the small area of Melvin soil in field 1. This low, wet area had penetrometers reading of over 300 psi 69% of the time. This indicates an area of significant compaction. Only 2 replications were possible in this same area and this reduced the statistical sensitivity. However, the difference was 4.2 bu/ac and was consistent across both replications. If this number were real, subsoiling would only be marginally profitable on this compacted area of the field. This area also had the largest difference in stand count of any of the harvested areas.

Location	Replications	Yield (bu/ac @ 15.5% Moisture)	
		Subsoiled	Undisturbed
Field 1	7	168.3	168.2 N.S.
Field 1 (low, wet area)	2*	177.2	172.9 N.S.
Field 2	3	164.8	162.3 N.S.
Field 3	2	133.3	129.4 N.S.
Average of all replications	12	161.6	160.3 N.S.

*The yields in this part of the field were harvested separately but are included within the yields shown as Field 1.

Conclusion

Subsoiling long term, no-tilled fields has become a common practice in some areas of Kentucky. This study tested 3 long term no-tilled fields for the benefits of subsoiling. Except for a small low, wet area in one field, the fields had only a small amount of compaction as indicated by soil penetrometer measurements. Plant stands were about 5% higher, on the average, when subsoiling was used. There was a small trend of 1.3 bu/ac in favor of the subsoiling treatment but this was not significant and is not sufficient to cover the cost of the subsoiling operation. Subsoiling is expected to be profitable only on fields or areas of fields where significant compaction can be found to exist. Long term, no-tillage of fields was not found to be sufficient grounds on which to base a subsoiling decision.

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