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SUBSOIL TILLAGE ON FRAGIPAN SOILS IN OHIO

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Interest in subsoil tillage has fluctuated considerably in the past 60 years. Early in this century it was thought that deep tillage would increase yields. A great deal of research attempted to answer this question and in general the results were unfavorable for deep tillage. With the advent of economical commercial fertilizers the question of deep tillage again assailed research institutions and during the past two decades considerably more work has been devoted toward deep tillage and deep fertilization.

The popular concept of results of subsoil tillage is that by loosening the soil to a depth greater than by ordinary plowing, a more permeable, penetrable subsoil would result. This in turn would enhance root proliferation in the subsoil and increase soil moisture storage. These effects would then be expected to increase crop yield due to the increase in availability of soil moisture, and reduce soil erosion due to the increased water intake into the soil. Unfortunately the research in Ohio and that of others (1, 2, 6 & 9) has shown little or no increasa in yields due to deep tillage and there has been little tendency to increase the water intake into the soil (3).

Between 1915 & 1926 research was conducted in Ohio to test yields of several crops as a function of depth of plowing (7). The two soils involved were Canfield silt loam and Trumbull clay loam, which have a fragipan from 14 to 36 inch depth in their profiles. Theoretically subsoil treatments which shatter or otherwise break up the fragipan on these soils should benefit plants. The following three treatments were superimposed on a corn-oats-wheat-clover rotation which received no supplemental fertilizer:

(1) Control: Plowed with a moldboard plow 7½ inches deep.

(2) Deep Plowing: Plowed with a moldboard plow 7½ inches deep, plus a subsoil plow set for an additional 7½ in.

(3) Deep Plowing: Plow 15 inches deep with a Spalding disk plow.

Plowing was done only for corn and for wheat.

Treatment 2 did not significantly increase yields of any of the 4 crops on either soil (table 1). The Spalding disk plow depressed yields on the Trumbull soil, probably by turning up unproductive, acid subsoil.

In the last 20 years economical mineral nutrients have become available. It may be reasoned that the early work on deep tillage did not show promise because plant nutrients may have been more limiting than subsoil physical conditions. To test this hypothesis a deep tillage test was initiated on a Canfield silt loam soil in 1955. The following 2 treatments were applied to continuous corn:

(1) Control: Plowed with a moldboard plow 7½ inches deep in the spring.

(2) Subsoiling: Plowed with a moldboard plow 7½ inches deep in the spring, plus chiselling in the fall 18 inches deep at 42 inch intervals.

TABLE 1

Crop Yield as Affected by Depth of Plowing

1915 to 1927

Crop	Ordinary Plowing 7½ inches		Ordinary Plowing 7½ in. +subsoil plow 7½ inches		Spalding Disc Plow 15 inches	
	Canfield silt loam	Trumbull clay loam	Canfield silt loam	Trumbull clay loam	Canfield silt loam	Trumbull clay loam
Corn (bu)	61	35	61	37	59	30
Oats (bu)	49	37	49	38	49	36
Wheat (bu)	32	25	32	25	31	24
Clover (lbs)	5,300	3,600	5,230	3,900	5,100	3,800

The chisel used in treatment 2 was a straight, solid steel bar with the leading edge sharpened. Corn was planted directly over the chisel marks. Adequate soil fertility was maintained with an annual broadcast application of 300 lbs./A ammonium nitrate plus 200 lb./A of 5-20-20 in the row at planting time. A ryegrass interseeding in both treatments received 200 lb./A 10-10-10 at seeding time.

The subsoiling treatment did not significantly affect corn yields (table 2). The data in tables 1 and 2 indicate that simply stirring the subsoil is not sufficient to promote the plant growth necessary for improved yields on these fragipan soils. This is in accord with the extensive work recently performed in Iowa and Illinois (5), which included both highly permeable and very slowly permeable soils.

Recent studies of subsoiling which include stabilization of the subsoil channel (7) and deep placement of fertilizer, (4, 5) have shown some promise of increasing crop yield. These procedures are expensive and will need considerable testing before recommendations can be made. At present there are no proven subsoiling techniques with which midwestern farmers can be assured of improving their soil productivity.

TABLE 2

Crop Yield as Affected by Soil Chiselling

Canfield silt loam

Year	Ordinary Plowing 7½ inches	Ordinary Plowing 7½ inches + chiselling 18 inches
	bu.	bu.
1955	82	81
1957	100	96
1958	112	105
1959	83	84

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