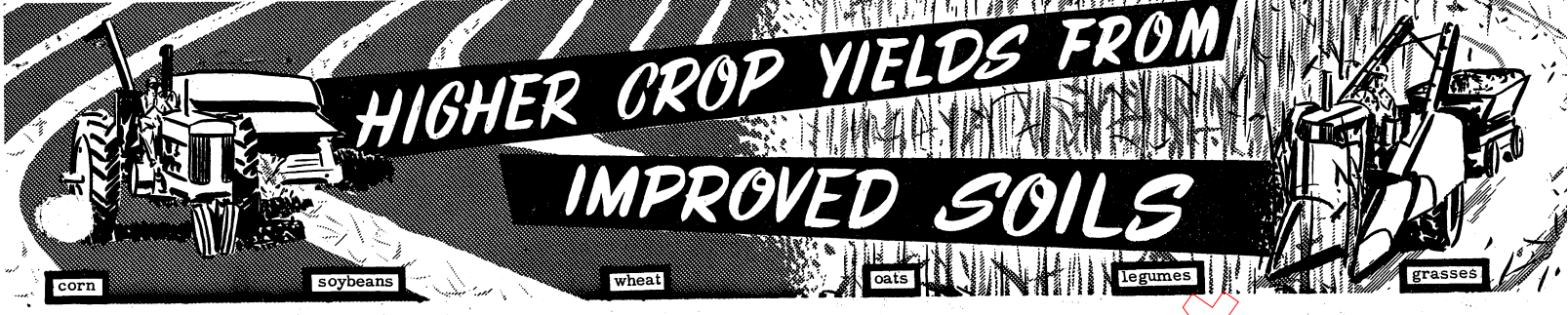
2-1-1959

Subsoil Fertilization and Vertical Mulching

H. Kohnke

J. B. Liljedahl

J. M. Spain



Purdue University
Agricultural Extension Service
Lafayette, Indiana

February, 1959
AY 144

SUBSOIL FERTILIZATION AND VERTICAL MULCHING

By H. Kohnke, J. B. Liljedahl, J. M. Spain

WHY SUBSOIL?

Plant roots need water, air and nutrients to function properly. The soil should be loose enough for the roots to penetrate readily. Surface soils can easily be fertilized to supply the nutrients required and tillage can put them into favorable physical condition for entrance of air. One big problem is water. The plow layer of our soils holds at best 1.5 inches of available water while the crop requires 10 to 20 inches of it during the summer. Rainfall supplies part of this amount but in most cases subsoil water is needed to produce high crop yields.

Frequently the subsoil is tight, infertile and acid, and not favorable to root growth. Rainfall penetrates such subsoils so slowly that the surface layer becomes saturated with the result that much of the rainfall runs off and is lost. In such cases it is desirable to improve the physical condition of the subsoil. Chiseling the subsoil usually has only a short-lived effect because the soil particles run together again and passageways for water close and become ineffective. The broken-up subsoil fragments are not natural crumbs held together by a coating of organic substances as is the case in a good mellow surface soil.

It is therefore desirable to get organic matter into the subsoil. When plant roots decay, the resulting humus coats the soil crumbs and helps to hold them together. Stable soil crumbs let water soak through. Deep rooted legumes or other crop roots may penetrate the openings made by the subsoiler if the subsoil is fertile. If the subsoil lacks lime and fertility, it may help to apply lime and fertilizer to the subsoil channel.

Experimental subsoil fertilization and liming have increased root growth and added organic matter which is helpful in developing good subsoil structure. In some cases, subsoil fertilization and liming have increased crop yields.

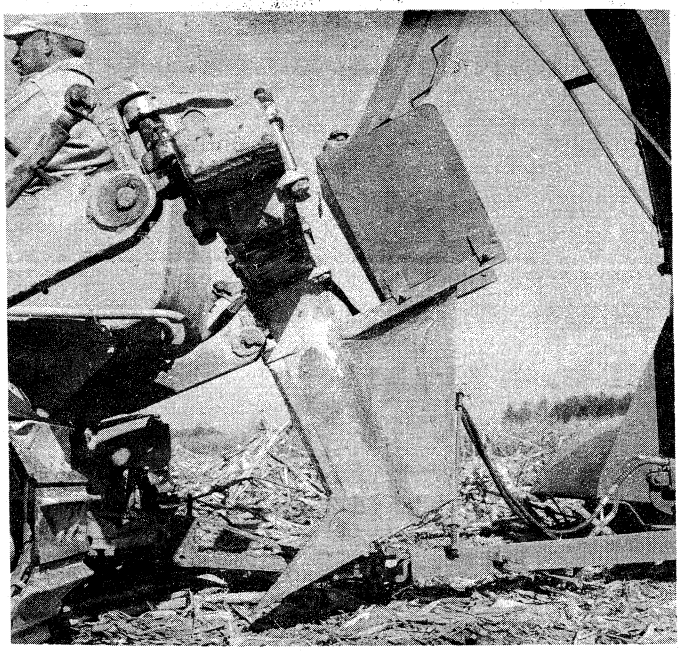


Figure 1. Vertical mulch equipment. Side view of subsoiler blade showing tool bar hitch, funnel attachment, and arched conveyor for blowing chopped material through funnel into soil slit.

Purdue researchers have developed vertical mulching as a means of improving subsoil structure and conducting surface water into the subsoil. A new Purdue-developed addition to the subsoiler makes it possible to do this in one operation. Crop residues are chopped by a forage harvester and blown through a funnel-shaped attachment into a slit in the soil held open by this attachment. Because the vertical slit is filled with crop residues, it has been dubbed a "vertical mulch." Woody material, such as corn stalks, or straw, decay slowly, and can hold these channels open for several years.

The channels created by vertical mulching have sides which will not readily cave-in. Experimentally, water infiltration has been increased even if the tops of the channels have been plowed off and covered with topsoil. In trials with acid, infertile subsoils, earthworm activity on the channel walls increased greatly.

GENERAL PRINCIPLES OF SUBSOILING

Spacing and Season: The recommended distance between individual subsoil grooves depends on their depth; the deeper the groove, the wider the spacing. For ordinary subsoiling to a depth of 20 inches, the recommended spacing is between three and five feet. When vertical mulching is used, the spacing can be two corn rows since this subsoiling method more effectively increases infiltration. Since the subsoiler must shatter the ground, subsoiling should be done only when the subsoil is dry. This is normally the case in late summer and fall. In some years, this period can extend into November.

Fertilizer and Lime: If fertilizer or lime is to be added to the subsoil, it should be done in the same operation as subsoiling to reduce the expense. In experimental trials where soil tests have shown a deficiency, nitrogen, phosphorus, and potash have been added at a rate of one hundred pounds per acre of each. Where the subsoil pH was below 6.0, a thousand pounds of finely ground limestone per acre was added. Subsoil acidity was reduced, providing better growing conditions for plant roots. With fall subsoil fertilization, urea or ammonia forms of nitrogen should be used to avoid leaching losses before spring. If the subsoil is fertilized, the surface soil should also be fertilized. Crop roots penetrate a fertilized subsoil more deeply if the surface soil is also fertilized.

With vertical mulching, no fertilizer need be added to the subsoil. The crop residues used in vertical mulching provide plant nutrients as they decay.

Equipment: Subsoilers are available with a fertilizer spout behind the subsoiler. Experimental vertical mulch equipment is shown in figure 1. At least one manufacturer is making a combination forage harvester-vertical mulcher which can be pulled by a conventional wheel tractor.

EFFECTIVENESS OF SUBSOILING

Soil Structure: Subsoiling increases the number of large pores in the soil. This effect will last about two years. Experiments with vertical mulching have not been conducted long enough to indicate how long the better soil structure will be maintained. However, it is believed that vertical mulching will remain effective for approximately five years. The concentration of organic matter in the slits, through slow decay helps maintain some looseness in the groove. In addition, this matter stimulates the development of earthworms and soil organisms which enrich the soil in the area.

Water: Subsoiling or vertical mulching on the contour has increased the infiltration of water into the soil thus reducing runoff. This effect lasted at least a year on subsoiled areas and longer on vertical mulched areas. The increased soil moisture helped supply crops with sufficient water during the growing season. In years of ample rainfall, an increase in soil moisture is of less value on high areas, but by keeping the water where it falls, large crop losses due to flooding of low areas may be avoided. In addition, erosion on slopes will be reduced.

Crop Yields: Subsoil fertilization and vertical mulching can hardly be recommended at the present time for immediate yield increases. Crop yields have been increased in some trials but not consistently. It is believed that both practices will gradually improve soils with heavy subsoils, by deepening the root feeding zone and increasing the water holding capacity.

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS
State of Indiana, Purdue University
and the United States Department of Agriculture cooperating
L. E. Hoffman, Director, Lafayette, Indiana
Issued in furtherance of the Acts of May 8 and June 30, 1914.