THE PEDOLOGIC ASPECT OF WORKING THE LAND: I. PLOWING

J. S. JOFFE

Plowing is a time-honored operation. It dates back thousands of years. It is the basic and most generally accepted method of working the land. It is estimated that close to one third of all the draft power on farms is spent in plowing. Nevertheless, the role of plowing in creating favorable conditions for plant growth, even though universally recognized, is not clearly understood.

The purpose of this paper is a recapitulation and statement of the problem in the light of principles of pedology. The conclusions arrived at are in some measure theoretical deductions. Some of these seem reasonably well founded; others need experimental verification. Any one interested in the relatively meager contributions on plowing in general should consult the pioneer work of Wollny (17) and others (1, 7, 10, 12) and the more recent investigations, especially those of Tornau (16), Keen (9), Apsits (2, 3), Barsukov (4), and Meerson (11).

PURPOSES OF PLOWING

The fundamental overall aim of plowing is to keep the soil from reverting back to its natural flora, grass, forest, or any other type of vegetation. Plowing is the first step in a series of operations providing favorable conditions for cultivated crops. Plowing accomplishes two purposes. First, it removes brush, stubble, and any other vegetation that may obstruct mechanically the culture of farm crops. No farmer would try to plant the standard cultivated crops without plowing on cut-over forest land, prairie sod, virgin peat or muck, or for that matter any cultivated land that has been abandoned for several years and is overrun with weeds. Second, besides mechanical obstructions, plowing takes care of the factor of competition for nutrients and water between cultivated crops and the native flora. By turning the furrow the two purposes mentioned are accomplished in a large measure. In some of the grain sections of the chernozem zone of Russia fields badly infested with weeds are plowed to depths of 15 to 18 inches and even deeper with the furrow slice turned close to 180°. By this method most of the weeds are smothered. Only a few survive and they reappear years later when a deep furrow is turned again to bury the new infestation of weeds.

Turning the furrow was inaugurated with the introduction of the moldboard plow. The angle it will turn depends on the length, height, and curvature of the moldboard. Seldom does the entire furrow slice turn the full 180°.

The two chief purposes accomplished by plowing are true for land in all soil zones; however, some effects resulting from plowing are specific for certain soil zones. These will be treated presently.

When the furrow is turned, there is a mechanical effect; the soil is loosened and mixed. The soil increases its volume. This in turn favors aeration, greater ease of movement of water, drying and warming up of the soil. The properties of the soil lead to an intensification of activity. In the enhanced decomposition of organic matter more mineral nutrients are released. New salts are formed, and more nitrogen is available. Loosening the soil favors the four factors of plant growth, moisture, aeration, temperature, and supply of nutrients.

Mixing makes the soil more or less homogenous. Mixing tends also to distribute the nutrient elements more uniformly. This is important when fertilizer has been applied to the previous crop. Uneven stands of crops are well known. Thorough mixing may overcome this.

ROTOTILLING

A thorough mixing of the soil may be accomplished by rototilling. The implements for this do not loosen it. The difference between the two methods lies in the nature of physical change brought about. In the case of loosening the soil by plowing, natural cleavage along the surface of the structural units takes place. No mechanical breakdown occurs in these units as the furrow is turned. The soil is loosened. This type of physical change increases the noncapillary pore space and facilitates aeration and movement of water. In the case of rototilling the structural units are broken down and often to a powdery state. This decreases the noncapillary pore space and thus impedes movement of water and hence aeration. Besides, the soil becomes crumbly because the finely divided (pulverized) particles coalesce and to form anew the broken structural units. The result is a caking and crusting effect followed by compaction, first on the surface and then through the pulverized material. This comes acute if heavy rains alternate with dry spells.

DEPTH AND TIME OF PLOWING

As a general rule depth of plowing is determined by the natural attributes of the zonal soils.