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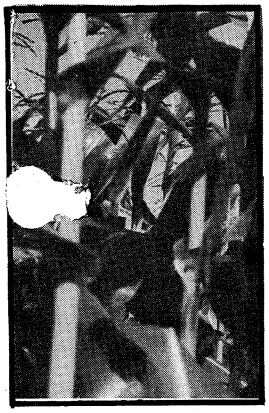
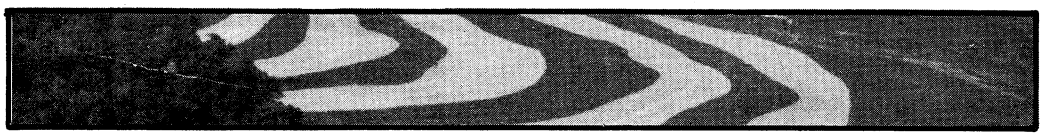
Fragipans - What Are They?

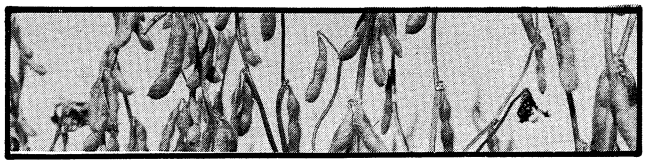
A. L. Zachary

D. P. Franzmeier





AGRONOMY GUIDE



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AY-193
Physical condition

Fragipans—What Are They?

A. L. Zachary and D. P. Franzmeier, Agronomy Department

Some soils of southern Indiana have extremely impermeable subsoils known as "fragipans." Most commonly, fragipans have distinct upper boundaries at depths of 15 to 40 inches below the original soil surface (see Figure 1).

Soils of the fragipan group are developed in several types of material in southern Indiana: (1) deep loess or wind blown silty material, (2) thin loess over Illinoian age till, and (3) thin loess over residuum materials that are products of the disintegration and decomposition of limestone and interbedded sandstone and shale.

A fragipan is a special kind of dense, firm and brittle subsoil or B horizon that has a strong development of structure, relatively low clay percentage and reversible cementation with iron, aluminum and silicate clay. The fragipan layer or horizon consists of rounded or sharp pointed wedge shaped blocks, prisms, or polygons with broad and indistinct bases. If strongly developed, the tops have a thin white silt cap of a few inches that extends downward and covers the faces of the structural units or peds. The light gray polygonal cracks extend 1 to 3 or more feet and taper off into the underlying material. These cracks are filled with light colored silts and some clay. The interior of the blocks or prisms is so dense that roots rarely grow. Water, air and root movement occurs mostly along the cracks and not through the dense prisms.

Fragipans are commonly medium texture with silt loam and light silty clay loam as the predominant texture classes. Because of the low clay content, the fragipans are only slightly plastic when wet and are hard, to extremely hard, when dry. They crush suddenly and completely under severe pressure. Change in consistency with change in moisture content is a striking feature of fragipans.

HOW FRAGIPANS DEVELOP

The development and formation of a fragipan is not clearly understood. It is theorized that in early stages wetting and drying and freezing and thawing would loosen the surface layer and make it more porous and permeable and thus a better medium for plant growth. As plants and animals become established, organic matter accumulates at the surface and gradually becomes mixed with the mineral soil to form the A_1 (topsoil.)

At this stage it seems most likely that fresh deposits of silty parent, or soil

forming material, occurred, starting a new cycle of soil development. Decay and solution of the organic matter removed the protective coating on the iron oxides and clay, thus favoring movement with the ground water. The gel-like oxides of iron and aluminum moved downward, plugging the pores and increasing the density of the pan. Leaching of bases would be most intense immediately above the less permeable subsoil, so the horizon with the gray silt coatings would begin to develop. This gray silt cap horizon is present just above the fragipan.

Over a period of years, during dry late summers the soil material would shrink slightly and crack into many-sided blocks to a depth of three or four feet. Water moving downward carries very fine sand, silt and clay from the upper horizons and deposits them along the cracks in the lower horizons. These deposits form planes of weakness so that subsequent cracking will always occur in the same place. The pore spaces between the medium blocky peds eventually fill with fine material, and the blocks adhere to one another to form large, dense prisms. From then on, when the horizon dries out, most of the cracking will occur at the boundaries of the large prisms. Thus, deposition of fine material in these cracks could be the origin of the gray streaks. Intense leaching will cause the soil to become strongly, to very strongly, acid. The continuous drying and wetting and filling of the cracks with compression could explain the much higher bulk density of the fragipan.

CHEMICAL CHARACTERISTICS OF A ZANESVILLE FRAGIPAN

The level of plant nutrients is low in the fragipan. Research on the Zanesville soil, carried on at Purdue, shows that the predominant cation on the exchange site is the H+ ion. Soil acidity (H+) represents 80 per cent of the exchangeable cations at the top of the fragipan (BX1). This is the zone of the most intense acidity or the lowest pH. The amount

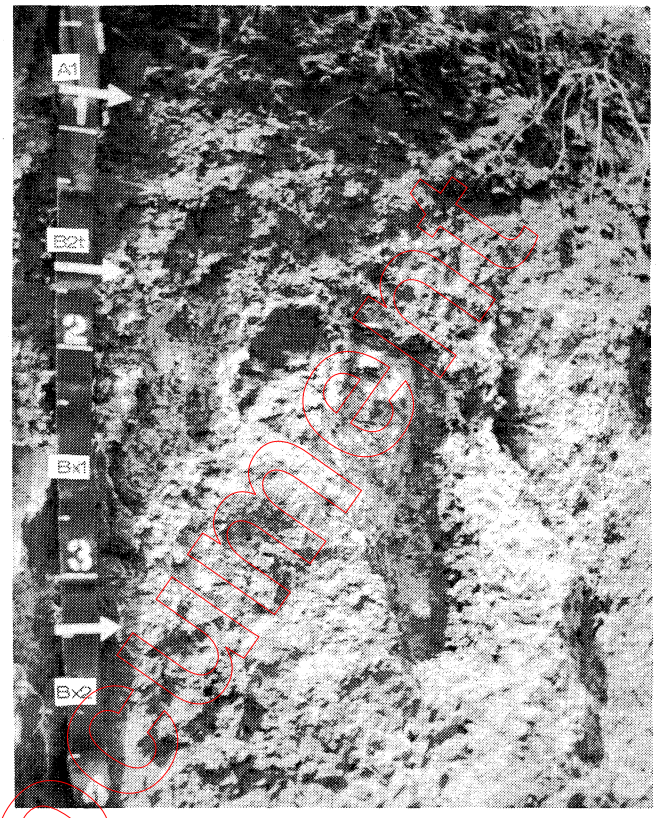

Figure 1. Zanesville silt loam. The fragipan, Bx horizons, consists of massive polygons or blocks of dense soil material. No root growth was observed in the fragipan except along the vertical cracks. The scale is marked in feet.

of nitrogen and available phosphorus in the pan is extremely low.

MANAGEMENT AND USE

Fragipans unfavorably influence growth by restricting rooting, either mechanically or by creating conditions of water saturation. Soils with fragipans usually have very wet upper horizons in the late fall and early spring, until transpiration by plant becomes appreciable.

Depth of the fragipan partially determines its significance to plant growth. The critical depth depends on the plant growth. For many plants, the influence diminishes at depths greater than 35 to 40 inches.

Erosion brings the fragipan closer to the soil surface and increases its significance. Erosion has greatly reduced the average depth of the fragipan in certain soils such as Zanesville, Cincinnati and Hasmer. Depth of the pan will determine, to a great extent, the amount of water available for plant growth.

Soils with fragipans have slow internal drainage and cause shallow rooting and winter heaving of tap-rooted plants. Such soils are commonly extremely wet in the spring and dry in late summer. Farmers with fragipan soils experience high risks using so-called "normal corn belt cropping practices."

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