NUMEROUS methods have been employed to study the root systems of plants in soils. Pavlychenko (5) reviewed the methods used prior to 1937 and described the soil-block washing method. Weaver and Darland (8), studying soil-root relationships of native grasses in various soils, developed a method of sampling root systems of grasses by taking large soil monoliths of any desired depth and washing the roots contained therein free of soil. Fehrenbacher and Snider (1) used essentially the same method, as used by Weaver and Darland, to study corn root penetration and distribution in various soils.

In the present study of corn roots, samples around corn hills were obtained by use of the soil-core sampling machine of Kelley, Hardman, and Jennings (3). One of these machines belonging to the Agricultural Research Service of the U.S.D.A. at Urbana, Ill., was used. The objective in using it was the development of an easier and quicker method of sampling roots by soil horizons. Soil cores for sampling roots have been used previously by Laird (4) and Fitzpatrick and Rose (2). They, however, used steel cylinders or steel pipes driven into the soil and had no conventional way of relating root development to soil profile characteristics.

In addition to sampling with a power-driven core sampler, a shaker-type washer was used for removing soil from the roots. Previous methods of washing roots have depended largely on a stream of water from special hose nozzles to dislodge soil. Upchurch (7) developed a soil-root washing method described here depends on gentle shaking action of a soil-root-water mixture to put the soil into suspension before it passes through a 16-mesh screen. Water under pressure is not required.

MATERIALS AND METHODS

Each core taken by the Kelley soil-core sampler used in this study was 4 inches in diameter and 72 inches in depth. No special adaptation of the machine for root studies was needed, but some of the precautions necessary to insure undisturbed cores are noteworthy. Clean, well-oiled sleeves are essential to prevent compaction. A shaker-type washer was used to remove soil from roots. The washing machine was constructed so that it could be easily disassembled for transportation. It consisted of a stand made of 2- by 6-inch fir on which a rack, containing 8 pans, was free to move back and forth on rollers made of 1-inch galvanized pipe (Figure 1). The pans, 12 by 12 by 18 inches deep, were made of 1/16-inch sheet metal with the bottoms perforated by 1/4-inch holes centered 1 inch apart. The bottom of each pan was covered with a 1/16-inch deep sheet metal pan filled with water. A 1/3-hp. electric motor, having a speed reducer unit coupled with a 2-inch and a 1-inch pulley and crankshaft assembly, gave a final speed of about twenty-two 4-inch strokes per minute to the rack containing the 8 pans.

In the operation of the washer, 1 horizon of 1 core was placed in each pan and allowed to shake for a period of 1/2 to 1 hour. One possible arrangement of the sampling location of the 4-inch diameter cores in duplicate in relation to a corn hill is shown in Figure 2. It was not always possible to locate duplicate cores exactly opposite each other in the 4-inch wide ring which they represented, but since it was assumed that the roots were symmetrically developed around the hill, the placement of the core at the proper distance from the center of the hill was the important consideration. Since the corn was checked in hills 40 by 40 inches, sampling in 5 concentric rings each 4 inches wide, as indicated in Figure 2, gave measurements up to 20 inches from the corn hill or half the distance to the adjacent hill. Each of the corn hills had 3 ear-bearing stalks and was selected at random from 60-hill plot sections that were delineated on the basis of soil type.

The shaker-type washer was constructed so that it could be easily disassembled for transportation. It consisted of a stand made of 2- by 6-inch fir on which a rack, containing 8 pans, was free to move back and forth on rollers made of 1-inch galvanized pipe (Figure 1). The pans, 12 by 12 by 18 inches deep, were made of 1/16-inch sheet metal with the bottoms perforated by 1/4-inch holes centered 1 inch apart. The bottom of each pan was covered with a 1/16-inch deep sheet metal pan filled with water. A 1/3-hp. electric motor, having a speed reducer unit coupled with a 2-inch and a 1-inch pulley and crankshaft assembly, gave a final speed of about twenty-two 4-inch strokes per minute to the rack containing the 8 pans.

Samples were taken on an untreated or residue (R) plot and on a treated or residue-lime-rock phosphate (RLrP) plot on the