A Low Cost Apparatus for Taking Undisturbed Soil Cores[1]

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Highlight

A low cost apparatus for sampling near surface structural properties of soil can be constructed from aluminum irrigation pipe and shop equipment. The device is suitable for taking cores in soils from fine sands to clays.

It is often desirable in grazing studies to measure the structural properties of the soil. The most common technique for measuring bulk density, pore space, and other physical properties involves the use of cores of undisturbed soil. A sampler with a brass or stainless steel cylinder inside a machined, tempered-steel casing similar to those described by Lutz (1947) and Baver (1956) is the most widely used device for obtaining the cores. The steel head is often expensive and requires the services of an experienced machinist to build.

A simple, inexpensive core sampler has been built from aluminum irrigation pipe and used in soil structural studies on the Welder Wildlife Foundation (Fig. 1). The sampler was made from the standard female coupling on 3 inch aluminum irrigation pipe and the extracting cylinders were made from sections of the pipe. The procedure is as follows.

The cast aluminum female coupling is removed from the pipe. The inside surface of the coupling is smoothed with sandpaper until the coupling slips easily over the pipe. A drainage spade handle is equipped with a steel yoke and bolted onto the coupling to complete the sampling device.

The sampling cylinders are made by cutting the irrigation pipe into 3 inch segments with a power hack saw equipped with a guide to insure a square end cut. The cylinder ends are smoothed with sandpaper.

In the original model, aluminum pipe cost 38¢/ft. Sawing the pipe

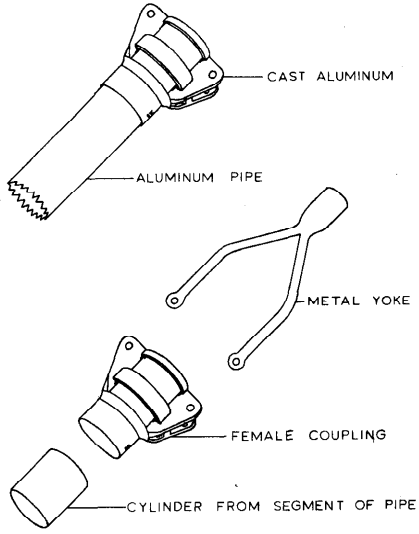

FIGURE 1. Sketch showing construction of sampling apparatus and cores from aluminum irrigation pipes.

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added an additional 4¢/cut, making each cylinder cost 13.5¢. The female coupling cost $1.20, the handle, $1.50, and the yoke, including welding, $2.50. The entire cost of the sampling apparatus and 100 cores was only $18.70. A machine shop estimate for a steel head alone was $150.00 at the time the device was made. No estimate was obtained on the cylinders.

Sampling procedure for using the apparatus consists of removing the vegetation and litter and smoothing the soil. The aluminum cylinder is placed in the device and the cylinder forced into the soil until the upper edge of the cylinder is flush with the soil surface by placing a foot on top of the sampler as one would use a spade. The lower edge of the cylinder acts as its own cutting edge. The sampling apparatus is lifted from the core, leaving the metal cylinder, imbedded in the soil. The entire core is removed with a drainage spade. The soil is smoothed flush with the bottom of the cylinder by cutting with a knife. The core is placed in a paraffined, pint-sized ice cream container and sealed with masking tape. The entire process takes about one minute per core in most soils.

The sampling apparatus works well in soils with no large woody roots or stones. It has been used successfully on soils of a wide textural range: Victoria clay, Orelia clay loam, Medio fine sandy loam, Zavala loamy fine sand, and Nueces sand. Bulk densities of soils sampled varied from 1.15 to 1.53 g/cc. (Box 1961). The sandy soils must be sampled while they are moist for the soil to remain in the core.

In extremely hard soils, the yoke and handle may be removed and the cylinder and sampler driven into the soil with a sledge hammer. A board should be placed across the sampler to absorb the shock. Forcing of the aluminum cylinders into the soils sometimes damages the lower edge. However, the low cost of the cylinders allows damaged cores to be discarded and replaced.

There are several advantages to the apparatus described here over the standard steel core sampler with removable cylinders. First, the difference in cost is obvious. The low cost of sampler and cylinders allows for many more cores to be taken on a limited budget. Second, there is less compression of the soil since the cylinder itself is forced into the soil instead of a thick steel casing plus a cylinder. Third, various length cylinders may be used in sampling the surface foot of soil. Machined steel samplers must be made for a given length core. Cores of up to one foot length may be forced into the fine sands and fine sandy loams with this sampler. Fourth, the sampler can be made by most technicians from material available at good hardware stores.

The soft metal is a disadvantage. Many cores cannot be used after a dozen or so samples are taken with them in hard soil. Likewise, each core must be dug from the soil with a spade and the apparatus is useful only in studying near surface soil characteristics. However, the low cost and ease of construction makes the equipment attractive for structural studies of surface soils.

The simple construction of the core sampler and the tension table described by Leamer and Shaw (1941) make soil structural studies within the limits of even the most meager budget. The equipment needed for sampling and testing for pore space can usually be made in one day for less than $20.00.

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