

Soil Sampling on the Liverpool Plains

As part of research work conducted by NSW Agriculture, CSIRO and the Department of Land and Water Conservation, we regularly need to take soil cores to assess soil properties such as nitrate, chloride, organic carbon, salinity, structure and soil water content.

The machine for doing this is a tractor mounted hydraulically operated soil sampling rig.



Soil sampling tubes (50 mm diameter) with specially made steel tips (40 mm diameter) are pushed into the soil profile and then pulled out. The intact soil core is then carefully removed from the tube onto a plastic drain pipe cut in half lengthways. The internal diameter of the coring tip is less than that of the tube, which allows the soil core to be easily removed.

Although the maximum length of the soil coring tubes is 2 m, samples can be taken from greater depths by adding extensions onto the tube once it is in the ground. Samples are then removed at around 1.5 m depth intervals and the process repeated until the desired depth has been sampled. We routinely sample to 3 m depth and have taken samples to 6 m. Soil samples taken with 50 mm diameter tubes and a 40 mm diameter cutting edge on the tip are easily removed from the tube. However, this system usually causes distortion of the sample because the area ratio is large resulting in the samples being suitable only for soil chemistry.

For examining soil structure, a 100 mm diameter tube with a thin wall and an area ratio of less than 1.1 should be used. This wider tubing causes less distortion of the core. Because the soil core becomes distorted if the area ratio is large, it is important to measure the length of the sample and the depth of the hole it came from to calculate the recovery ratio. The formulae we use are in the box. These measurements enable more accurate recordings of the depth that sample increments have come from.

$$\text{AREA RATIO} = \frac{\text{TOTAL CROSS-SECTIONAL AREA OF HOLE}}{\text{AREA OF SAMPLE AT CUTTING EDGE}}$$
$$\text{RECOVERY RATIO} = \frac{\text{LENGTH OF SAMPLE IN TUBE}}{\text{DEPTH OF HOLE IT CAME FROM}}$$

The advantage of a push tube corer such as this compared to a rig relying on a rotary drill is that it is quicker, provided the soil is not too hard, tight or rocky, and it does not disturb the soil surrounding the core to any extent, which is important in our experimental plots from which we will take many cores over the life of the project. Both machine driven methods are very much quicker than using a hand auger.

The rig we use is entirely hydraulically operated from a hydraulic pump connected to the tractor power take-off. It is therefore independent of the tractor hydraulic system, apart from the 3 point linkage on which the rig is mounted.

The rig has several useful features:

- The hydraulic ram which pushes the coring tubes into the soil is connected to the tubes with a small hydraulic jack hammer which may be used in tight or rocky situations for better penetration.
- The rig has two hydraulic legs which allow it to be easily levelled on sloping ground.
- There is a hydraulically operated 'foot' which is attached to the rig and can be brought up firmly underneath the tractor onto the draw bar mounts to transfer the weight of the tractor onto the rig for increased weight on the tube for better penetration.

Our rig is mounted on a tractor with a front end loader. When this equipment is hydraulically pushed onto the ground, it is useful in stabilising the tractor when cores are taken. While this equipment is used primarily on our research sites, we have hired it to landcare groups for groundtruthing EM surveys carried out by Ross Beasley, DLWC.

The rig was manufactured by Tim Hughes, Redland Bay, Queensland. Tim has manufactured a number of these machines for research organisations, including CSIRO.

The coring tubes can be stainless steel or chromium molybdenum alloy, which is stronger but more expensive. The tips can be obtained from the manufacturer or can be made by a competent machinist.

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This research project is part of the [National Dryland Salinity Program](#) and is a joint effort by [NSW Agriculture](#), [CSIRO Division of Land and Water](#) and [NSW Department of Land and Water Conservation](#) in collaboration with [APSRU](#). External funds are provided by Salt Action, [The Grains Research and Development Corporation](#) and Land & Water Australia. The research was initiated at the request of local landholders through the Liverpool Plains Land Management Committee.

Salt Action is a New South Wales Government salinity management program involving the community, [NSW Agriculture](#), [Environment Protection Authority](#), [Department of Land and Water Conservation](#).
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This page last modified: August 2001