Vertical soil core sampler

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A soil core sampler and the related technique for vertical quantitative determinations of soil rhizosphere microorganisms are described. It is easy to construct, requires no special maintenance, and was successful in numerous field trials during the last 20 years.

The main advantages of the core sampler are:

1. Undisturbed soil samples are withdrawn without of soil compaction.
2. A relatively small force is needed to insert or raise the coring tool from the soil.
3. Sampling time is relatively short (up to 15 min for the whole procedure under field conditions) which allows intensive sampling.
4. The coring tool will not rust, is light weight, and requires no lubrication.
5. The cutting head can be removable by hand.
6. Removing samples from the tube is quick and simple.
7. Disadvantage: The coring tool does not function well in muddy soils or over-irrigated agricultural land.

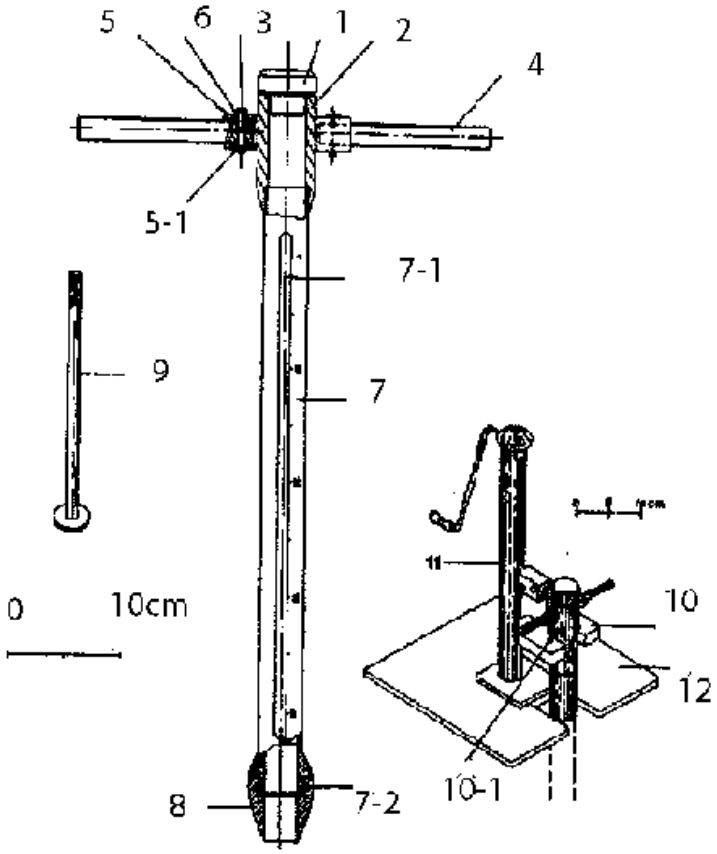
The tool may be easily adapted to other types of soil research, such as root distribution and routine soil testing.

The two soil samplers that we routinely used were constructed by: the team led by Eng. J. Wolowelsky at the steel shop of the Weizmann Institute of Science in Israel and by Mr. Guillermo Garcia-Cortes at the technical workshop of CIBNOR in Mexico.

Below are **technical descriptions** and **sampling procedures** for the tool.

Technical description (Part 1)

Vertical core sampler. 1 = cap; 2 = head; 3 = pin; 4 = handle; 5 = protuberance; 6 = pin hole; 7 = tube; 7-1 = furrow; 7-2 = thread; 8 = cutting point; 9 = compactor; 10 = jaws; 10-1 = notch; 11 = jack; 12 = base



The soil core sampler is composed of a polished stainless steel tube (diagram part 7), hardened stainless steel cutting point (8), and a head (2) adapted with replaceable aluminum caps (1) and handles (4). It also has a compactor rod (9).

The tube can be 40-80 cm long and has a 32-mm inner diameter and a 300-700 (depending on the size of the tube) x 10-mm open furrow (diagram 7-1) with depth markers engraved every 50 mm. The cutting point is a modification of the Veihmeyer design of 1929. It is screwed onto the tube by 38ª1-mm threads, offset by 2 mm from the end of the tube to protect the threads. The cutting point is shaped to form a soil core without shoving the soil ahead of the cutting edge and without compacting the core inside the tube. The inner diameter of the cutting point widens from 27 mm at the distal end to 32 mm at the other end of the cutting point, an essential feature designed to reduce friction on the inner wall of the tube, minimizing compression of the core and preventing the core from falling out after the tube is removed from the ground.

The outer diameter of the head is 50 mm (2). Its inner diameter varies throughout the head. At the top it is 33 mm wide to accommodate the sampler's cap, and tapering down to 32 mm over a distance of 40 mm. The diameter then increases to 38 mm in two graduations for distributing the force from the hammer. The head can be screwed or welded to the tube. We adopted the welded option to increase rigidity of the sampler.

Two trough-shaped shoulders (5) were welded to opposite sides of the head and two 20-cm removable handles (4) are connected to them by stainless steel pins (3 and 6). The shoulder attachment allows clockwise turning only to prevent unscrewing of the clockwise-screwed cutting point, which would then remain in the deep hole. A protuberance (5-1) on the lower surface of each shoulder was designed to fit into a small notch (10-1) in the jaws of the puller (described below). Finally, the sampler was equipped with several soft aluminum replaceable caps (1) to protect the head from hammer blows. The total weight of the sampler is 2.5-3.5 kg (depending on length).

A 6-kg hammer is used; a lighter one is useful in sandy soil; a heavier one (10-15 kg) is burdensome to operate and required a strong and fit operator if many samples are retrieved.

The soil sampler is removed from the hole with a puller because it is impossible to lift by hand except in sand dunes. The puller is a mechanical car tire jack (2-t lift with high clearance capacity, 11), that is mounted on a 10-mm-thick steel base (300ª300 mm). An opening larger than the diameter of the sampler tube was cut in the base (12). The lifting arm of the jack is equipped with U-shaped steel jaws (10) set 51 mm apart. Each jaw was engraved with a notch to accommodate the protuberance on the sampler shoulder to prevent separation of the puller from the sampler during lifting. The weight of the puller is 3-5 kg and a relatively small effort was needed to retrieve the sampler from the ground.

Technical description (Part 2)

Dismantled assembly for vertical soil core sampler with all necessary parts

Mounted vertical soil core sampler with all the pieces assembled in their correct position.

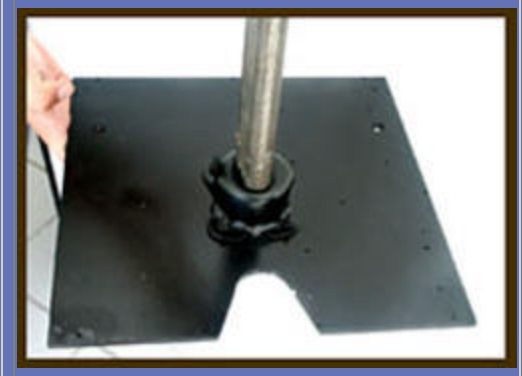
Large vertical soil sampler (60-80 cm long).

Harden steel cutting head of the vertical soil core sampler screwed to the tube of the sampler by rough threads

Soft aluminum cap to protect the vertical sampler from the blows from the heavy hammer

A compactor to help extract the soil core from within the soil sampler and maintain the integrity of the core in light soils

A U-shape jaw accessory mounted
on the car jack built to fit the cutting
head of the soil sampler. This allows
easy lifting of the sampler from the soil.



A flat, strong steel base welded to the base of the car jack to prevent the car jack from sinking into the ground during
extraction

An assembled short soil sampler (40-50 cm long).

Sampling procedure

The vertical soil core sampler
is inserted into the soil using
a heavy hammer

When the soil is hard or dry, a larger hammer is required to insert the soil sampler

In soft sandy soils,
a smaller hammer is needed.

The handles are used to maintain vertical penetration of the sampler
without risking injuries to the assistant

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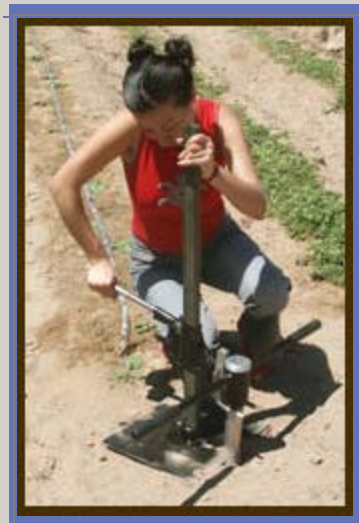

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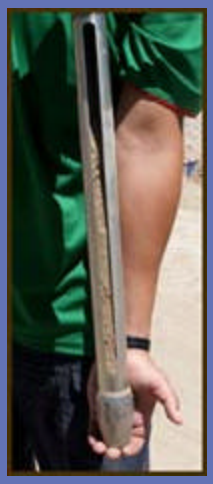
The soil core is placed in plastic bags that are delivered for laboratory analysis



Example of an extracted soil core

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