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## **Horizontal soil sampler** Designed by Yoav Bashan

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A horizontal soil test tube sampler and the related technique for horizontal quantitative determination of soil rhizosphere microorganisms are described. It is easy to construct, requires no special maintenance, and was successful in field trials over the last 20 years for collecting samples.

The tool can be adapted to other types of soil research, such as surface root distribution and distribution of soil surface contaminants. To the best of my knowledge, this test tube sampler has no counterpart among tools for soil surface sampling.

The method is based on the principle of inserting sterile tubes into the ground in the sampled area and analyzing microflora, using either traditional microbiological methods on culture medium or by molecular techniques, for determining microbial populations and mapping of the soil surface (<10 cm depth).

The tool was designed to overcome two basic problems with common manual insertion of test tubes to the soil: (i) sterile, disposable plastic tubes are fragile and frequently break, especially in dry soil and can result in injury to the field personnel; (ii) sampling sites at each plot are never exactly repeatable, which leads to different sizes of the area sampled; these variations increase the sampling error whenever replicated plots are examined.

### **The main advantages of the horizontal soil sampler are:**

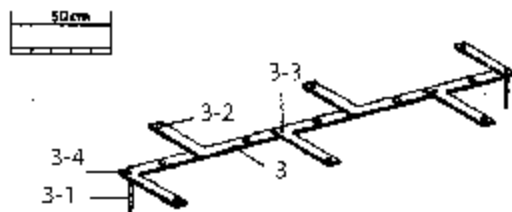
1. It is light, small, portable, rust-free, easily arranged on the soil surface, and its operation requires little strength from field personnel. Each sampling takes less than 10 minutes for the full procedure. Many samples can be retrieved each day.
2. The tool gives precise, repeatable, and equally-spaced distribution of tubes over relatively large area.

3. The tubes are standard, sterile, disposable, cheap, and no contaminant can disturb the number of microorganisms counted by this method.
4. Sampling is possible even under dense foliage, the damage to plants is minimal, and the method can be used in small experimental field plots.
5. The tool does not require maintenance, does not need cleaning or lubrication, and the parts do not wear away.
6. The soil sample is completely sterile, and the tool does not need to be sterilized.
7. A minor disadvantage of the tool is that in heavy muddy soil the outer surface of the tube may be covered with mud, which has to be removed before taking the tubes to laboratory analyses.

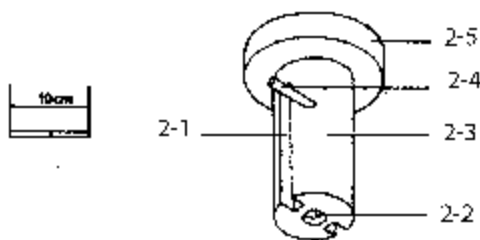
The soil sampler that we use was constructed by a team led by Eng. J. Wolowelsky at the workshop of the Weizmann Institute of Science in Israel.

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

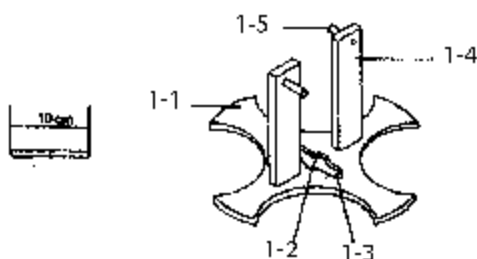
## Technical specification and construction



Horizontal test tube soil sampler parts:  
 1-1 = base; 1-2 = hole; 1-3 = bay; 1-4 = upright shaft; 1-5 = pin; 2-1 = furrow; 2-2 = hole; 2-3 = hand-push piston; 2-4 = pin; 2-5 = piston head; 3 = folding ruler; 3-1 = pin; 3-2 = hole; 3-3 = rivet; 3-4 = hole.



The sampler has two parts: a stainless steel folding ruler (part #3) and a hand-pushed piston (parts #1 and #2) made of a 10-mm-thick aluminum base (part #1) and a hard PVC piston (Part #2). The cross-shaped base provides a large contact area with the soil and minimizes the damage to the plants. To fit the test tube, an 18 mm diameter hole (1-2) was drilled in the center of the base and extended on both sides to form a 60 mm long, 12 mm wide bay (1-3) for viewing the sampling area. Two upright piston shafts, 10 mm thick,



110 mm long (1-4) were Aragon-welded on both sides of the central hole to fit into two 10.2 mm furrows (2-1) on the PVC piston. Thus, the piston can move freely along the shafts. Two stainless steel pins, 50 mm long; 8 mm in diameter (1-5) are screwed to the upper part of the shafts and two similar pins to the piston at its lowest part (2-4) to prevent separation of the piston from the base. The piston is equipped with a rounded, flat PVC head, 120 mm in diameter, for easy holding (2-5). Additionally, a hole, 16 mm in diameter and 7 mm long, was drilled into the piston base and a soft PVC was glued into its far end to form the proper receptacle for a standard polyethylene tube. The hand-pushed piston weighs 1.5 kg. The second part of the tool is a 2 mm thick stainless steel folding ruler (3) covering 200 x 50 cm when open and 43 x 28 cm closed. The ruler is constructed from segments fitted together with stainless steel rivets (3-3) to provide 360° movement. When the ruler is unfolded, 11 holes, each 2 cm in diameter (3-2) were drilled, spaced 32 cm apart in a zigzag pattern covering a sampling area of 1 m<sup>2</sup>. Finally, two stainless steel pins (10 cm long, 5 mm in diameter) (3-1) are fitted through 6 mm holes at the two edges of the ruler (3-4) to hold the ruler rigid on the soil surface while sampling is underway. The ruler weighs 2 kg.

## Sampling procedures

Sampling operation at the site is as follows: The ruler is unfolded and fixed to the soil by the two pins. Eleven standard sterile polyethylene test tubes (120 mm long, 10 mm in diameter) were marked, opened, and slightly pushed, upside down, into the soil through the sampling holes of the ruler. The piston was placed over each tube and press down to its fullest extent; about 10 mm of the tube remained above the soil surface to improve the ease of withdrawing the tubes.

After the eleven tubes are driven into the soil, the piston and the ruler were removed. Each tube is hand-pulled from the soil, closed with its original sterile cap, and marked.

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<http://www.bashanfoundation.org/horizontal.html>