AN IMPROVED MINIRHIZOTRON FOR OBSERVING OIL PALM ROOT DEVELOPMENT AND TURNOVER

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A large fraction of palm-environment interactions occurs below-ground in the rhizosphere. This includes palm roots and the portion of the soil and soil microbes that are influenced by roots. Unfortunately, rhizosphere processes are nearly invisible from the surface and destructive root excavations could modify the physiological processes. Minirhizotrons are research tools used by plant biologists to study plant roots. They are made up of clear glass or plastic tubes that are installed in the soil under plants. A special camera is used to take pictures of roots growing along the outside walls of the tubes. The minirhizotron is a relatively non-destructive method for studying root systems. It enables repetitive observations of a given set of roots and provides the opportunity to study changes in root activity through time. The progress of roots can be followed as they emerge, mature and eventually die and decay.

The use of minirhizotrons and carbon tracers has proven to be powerful tools for determining carbon partitioning between different below-ground carbon pools. In wheat, where about 29% of fixed carbon was allocated below-ground, 16% of this below-ground carbon pool was lost as fine-root turnover (Swinnen *et al.,* 1994). Understanding oil palm root dynamics is important in order to comprehend root interaction with the environment and crop yield.

An improved minirhizotron system was developed for observing oil palm root development and turnover.

DESCRIPTION OF SYSTEM

The improved minirhizotron system capture root images directly from a charge couple device (CCD) colour camera to a laptop computer hard disk *(Figure 1)*. The camera is housed in an aluminum handle, which can be folded during transportation. A 12-volt power pack supplies power to the CCD camera, laptop computer and lamps. The camera is easily moved from one observation tube to another.

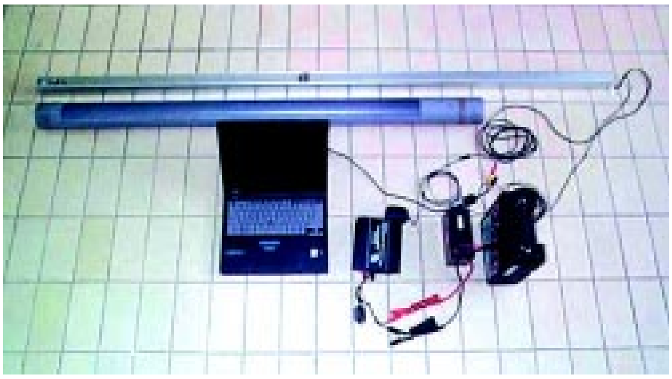

Figure 1. Minirhizotron system. a) CCD camera with aluminum handle, b) PVC observation tube, c) laptop computer and d) power pack.

Observation tubes were made out of 140 cm long by 8 cm diameter PVC pipes with a window of 8 cm wide by 112 cm long, following the design used by Pratiknyo and Wagimin (1997). Soil was prevented from collapsing into the tubes by inflating a modified motorcycle inner tube placed inside the observation tube. The modified motorcycle inner tube was removed from the tube during root observation *(Figure 2)*.

Figure 2. Capturing root images from a PVC observation tube (OT) after removing the motorcycle inner tube (MT).

a b

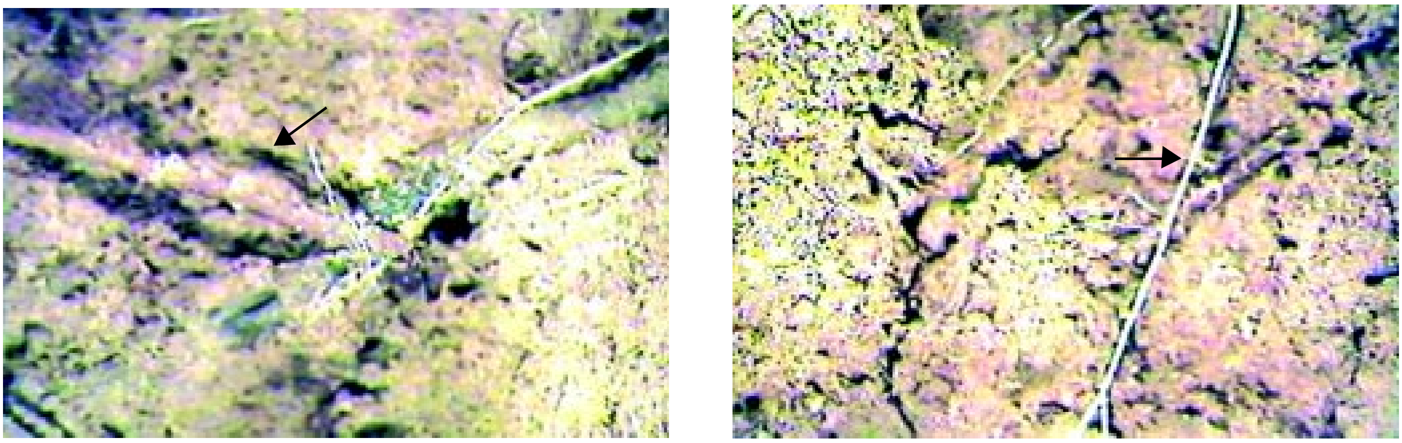

Figure 3. Captured images of oil palm root (a) and grass root (b) from the PVC observation tube.

Root images can be collected at suitable depths along the buried PVC observation tubes *(Figure 3)*. Analysis of the images can be done by several existing image processing softwares, which convert the images (*i.e.* root lengths) to productivity.

BENEFITS

- Non-destructive observations of root growth and development;
- Determination of root productivity (turnover and longevity) which has an important role on soil carbon sequestration;
- Important information for modelling the root system; and
- Enable studies on root relationships to ecological processes, such as environmental adaptation of plants, nutrient acquisition, plant competition, interactions of plants with soil organisms, and soil structure and formation.

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