Methods for wheat root observation in field conditions

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ABSTRACT

Principal methods to study root system of a winter wheat crop in field conditions are reviewed. Methods observations of root system after sampling are also presented. The method for study wheat root system actually developed at Gembloux to conduct a PhD research is detailed.

1. METHODS FOR ROOT STUDY

Exploration of root wheat system can be done by different ways.

1.1. Profile wall method

The principal steps for this method are digging a trench, preparing the profile wall and exposing the root system by mechanical tools, air or water pressure (Böhm, 1979). After the root system is exposed, the mapping and counting roots can be done using different systems and grid size (Scully, 1942; Böhm and Köpke, 1977).

1.2. Methods in situ observation

Wheat root growth can be observed by using a root periscope (minirhizothron) to peer through a glass or acrylic tube inserted in the soil. This technique involves the use of cameras coupled with endoscopes or miniaturized color video cameras, and thus is more costly (Upchurch and Ritchie, 1983). A large computer system and special software are needed to analyze large numbers of root images quantitatively.

1.3. Methods using the sampling tools

1.3.1. Destructive techniques (collect a large amount of soil)

Monoliths of soil with a large size range are taken off soil by different processes. Sometimes monolith samples can be obtained with pinboards (fakir beds), where the pins hold the root system in an approximately correct position during washing (Floris *et al*, 1984).

1.3.2. Non destructive methods (collect a small amount of soil)

Auger sampling by hand and core sampling machine are detailed by Böhm (1979) and Russell (1977). Using by these method depend to the depth of samples to take.

2. OBSERVATIONS OF ROOT SYSTEM IN SOIL SAMPLES

2.1. Direct observation

Estimating density of roots intersecting with a horizontal plane of observation can be done directly in samples cores without separating roots for soil. The core break method is detailed by Böhm (1979).

2.2. Indirect observation

Especially in heavy and dry soil, samples should be soaked overnight in a saturated NaCl or soap solution to increase buoyancy and disperse soil aggregates (Böhm, 1979). Washing by hand and a root machines (hydro-pneumatic elutriation (Smucker *et al*, 1982) can be use. Distinguishing between living and dead roots (residues) is usually done subjectively based on criteria such as color, and by color methods (Joslin *et al.*, 1984).The indirect observation can be done without washing root system such as the observation by tracers methods. ^{32}P (Hall *et al*, 1953), ^{86}Rb (Raimond *et al*, 1993), ^{15}N (Polley *et al.*, 1992), and using herbicide injection (Trebuil *et al*., 1996).

3. METHOD FOR ROOT STUDY A DYNAMIC DEVELOPMENT OF WINTER WHEAT DEVELOPED AT GEMBLOUX

In our study root development of winter wheat is followed and compared to the evolution of mineral nitrogen profile. Soil samples are collected using a hydraulic machine of soil coring till a depth of 150 cm. Four bore holes per plot at all stages of the plant development at a two weeks frequency. Each sample of 15 cm layer is dipped in a bucket containing water and sodium chloride in the salt table form (94% Nacl) at a 20 g/L during two days. The washing machine used is a device which was adapted from researches carried out in forest soils in Gembloux at 2005 (Perrin, 2005). The principle of this method is to inject water jet into a bucket containing samples and create a water pressure and a vortex effect that will allow roots and debris of soil floating on the surface of the water and overflow gradually in the PVC tube with a detachable filter. Roots are manually separated from soil debris and drying in an oven (90 °c). For measuring the root parameters, we deposed clean roots at the transparent paper, we scanned her, and we can use image analysis systems for determining root length and root density.

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