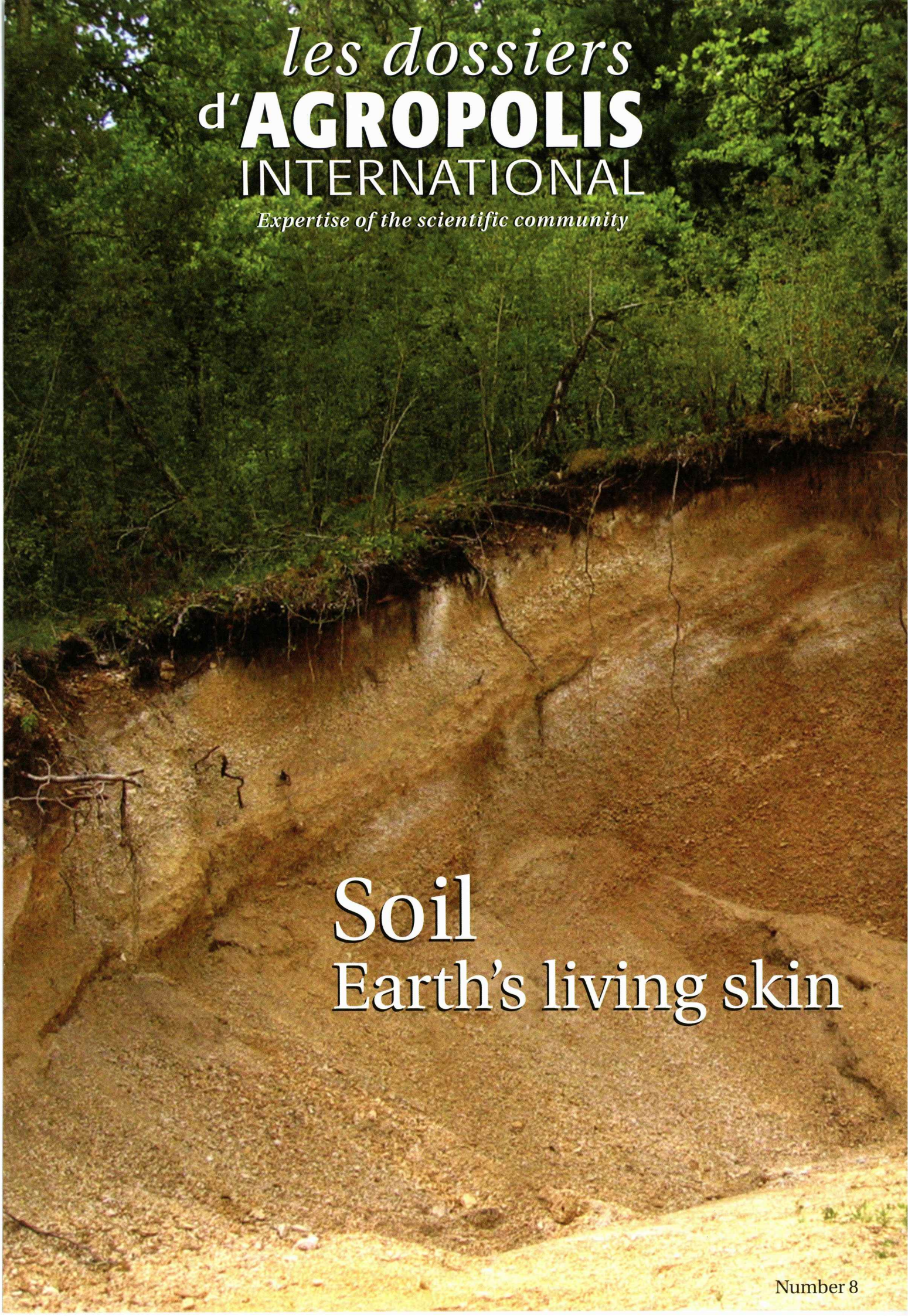

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Soil
Earth's living skin

Number 8

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Rhizosphere– the site of soil to plant nutrient flows

The rhizosphere is the soil volume influenced by roots and also the site of exchanges between soil, roots, microorganisms and associated fauna. These intense exchanges lead to bi-directional flows of water and nutrients within biogeochemical cycles. Around 40% of the carbon fixed during photosynthesis is allocated to roots. Half of this carbon is released into soil, which stimulates microbial activities. The architecture of the root system and its plastic development depend on the allocated carbon and on the environmental conditions encountered, while also determining the rhizosphere volume.

This volume varies according to the type of elements and biogeochemical processes. Water and elements such as nitrate nitrogen are highly mobile in the soil–their root uptake leads to bulk and diffusion displacement of several centimetres. All soil horizons highly colonized by roots are subjected to their influence and can therefore be considered as rhizospheric.

Roots of the same plant and neighbouring plants (of the same species or not) are thus frequently competing for this resource. Conversely, potassium, and even more so phosphorus, are much less mobile in soil–their root uptake induces a diffusion gradient spanning just a few millimetres, or even less than a millimetre. The rhizosphere volume can therefore only represent 1–3% of the soil horizon volume, even in the surface horizon. For instance, in a 5-year-old oil palm plantation, the AMAPsim root architecture model highlighted that specific soil volumes for sampling phosphorus and potassium throughout the profile were 33 and 235 m^3 ha^{-1}, respectively. Estimating and modelling root growth rates, and the resulting spatial and temporal rhizosphere dynamics, is thus essential for integrating flows measured around the rhizosphere of root segments on the soil profile and plot levels.

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The laboratory was authorized by the regional crop protection service to import non-European soils, thus broadening its scope for intervention in Mediterranean and tropical countries.

Three additional activities supplement and enhance its core activity:

- Tailoring methods: conducting one-time studies to address specific needs arising in the course of normal analytical activities, adapting existing methods that are not listed in its catalogue to the laboratory facilities, and developing experimental designs to meet specific client requests. This also includes a study that is currently under way on the determination of particle-size fractions in andosols.
- Knowledge transfer to individuals not on the laboratory staff, in the framework of diploma or practical training on analytical methods, techniques and laboratory organization principles and management.
- Expertise may be focused on different topics of varying complexity, ranging from simple advice on improving laboratory operations (or other domains within the range of the laboratory's expertise) to complete studies that are carried out with the aim of setting up an analysis unit. These operations target CIRAD staff or external clients and are conducted over periods of varying length (1 day to several weeks).

The laboratory's organization system for all of its activities was certified under the ISO 9001 standard in 2000, thus ensuring that it will be constantly improved and remain attentive to, and thus able to better meet, clients' needs. ■

▲ *Iron oxide accumulation around a eucalyptus root several metres below the soil surface in a sandy soil in western Australia.*