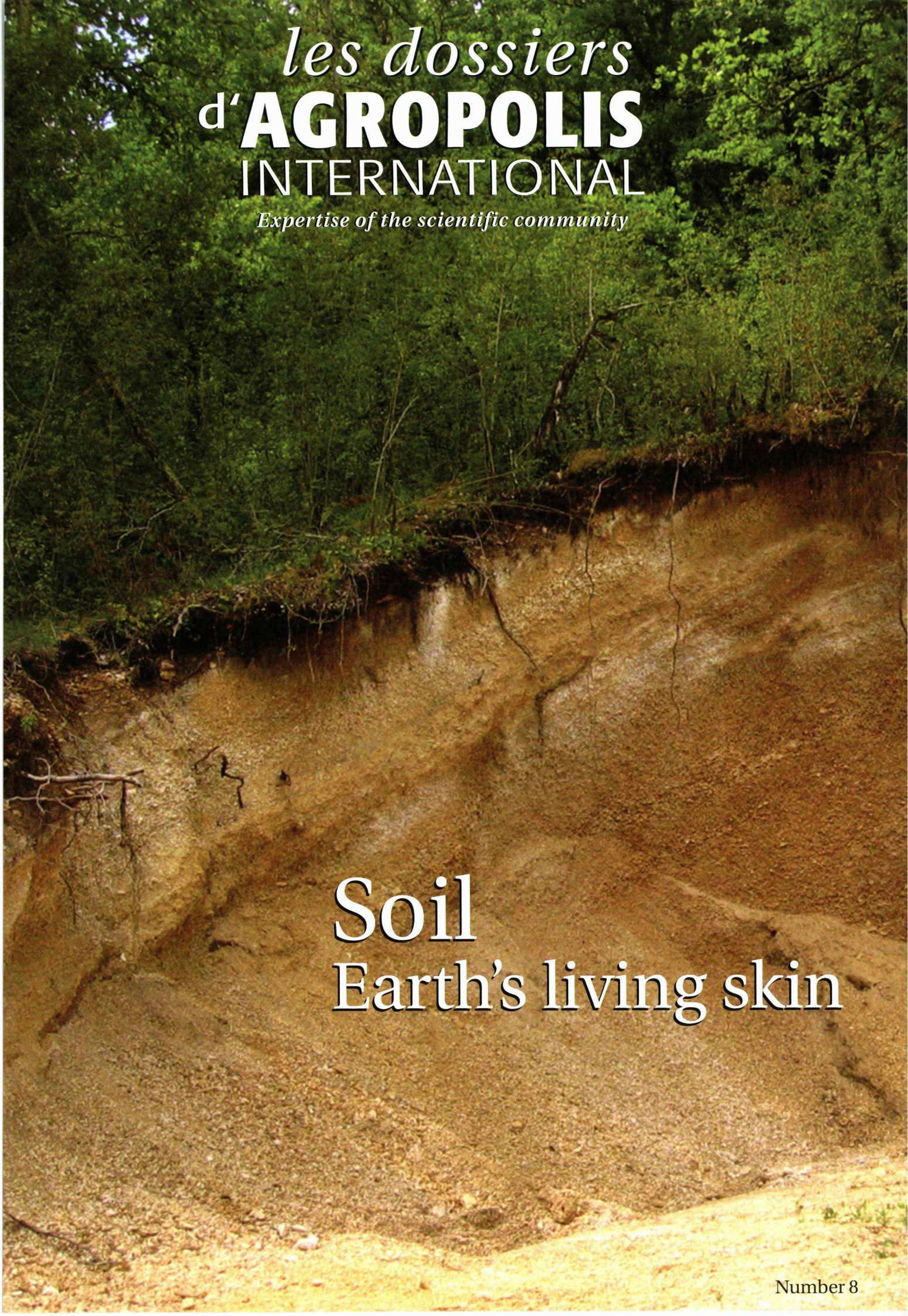

les dossiers
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Soil
Earth's living skin

Number 8

nitrate concentration of the soil solution), or as a structured medium with fissures and pores of different sizes and geometric features. This modelling combines deterministic and stochastic approaches.

Concerning absorption, the unit collaborates with soil physicists (UMR EMMAH, *Environnement Méditerranéen et Modélisation des Agro-Hydrosystèmes,* INRA Avignon) for modelling water and mineral transfers between soil and roots. Moreover, within the root architecture, specific absorption sites have been analysed according to their permeability and conductivity (especially for water) or as a function of the plant's transport capacities and needs (nitrates). Other collaborations have also been organised with absorption physiologists studying transporters (e.g. UMR BPMP, *Biochimie et physiologie moléculaire des plantes,* CNRS, INRA, Montpellier SupAgro, UM2).

In addition, the unit participates in research on 'rhizodeposition', i.e. the transfer of organic compounds from roots to the soil substrate (dead roots, exudates). These studies are conducted in collaboration with INRA Bordeaux (UMR TCEM, *Transfert sol-plante et Cycle des Eléments Minéraux dans les écosystèmes cultivés).*

New cropping systems: direct seeding mulch-based cropping systems

Developing countries must increase their agricultural production and ensure its spatiotemporal sustainability in order to be able to cope with global population growth.

The internal research unit (UPR) Direct Seeding and Cover Crops (CIRAD) designs new cropping systems based on the function of forest ecosystems that enable in situ organic matter production and management.

By introducing multifunctional plant communities in direct seeding mulch-based cropping systems (DMC), biological tools take the place of mechanical tools. This permanent cover protects soil from erosion and restores biological activity, which helps ensure balanced and stable crop mineral nutrition. •••

** A mathematical method whereby statistical data are processed on the basis of probability calculations.

Potential of direct seeding mulch-based cropping systems

for ecological intensification of cropping systems in a Brazilian family farm setting

Harsh physical and socioeconomic conditions often prevail in developing countries: fragile soils and severe climate, and limited access to input markets and credit. Because of these constraints, international agricultural research has been oriented towards developing innovative systems to protect and make optimal use of available natural resources in the short and long terms. These systems are based on the ecological intensification concept. Direct seeding mulch-based cropping systems (DMC), for instance, offer a broad range of technical options, especially for organic matter management (crop residue left in the fields to create a mulch layer, or sowing crops directly in live plant cover).

The joint research unit (UMR) SYSTEM has set up controlled test plots on smallholdings in Unaí region (Brazilian *cerrados*) with the aim of assessing these cropping systems in actual field conditions. Water savings may be achieved by introducing grasses and plants of the pea family in relay in maize crop fields under DMC. This strategy reduces runoff water loss by 50%, soil evaporation water loss by 10–20%, and drainage water loss by 30% thanks to the mulch layer and water consumption by the cover plants. Moreover, DMC improves nitrogen nutrition of the commercial crop. Finally, the high phytomass recovery achieved through these systems can increase the soil carbon content (0.3–1 t ha^{-1} $year^{-1}$). Simulation models have also been developed to analyse the complex function of such DMC systems and to assess their actual impact on crop production and natural resources.

É. Scopel © CIRAD

Direct seeded maize crop in association with relay sown pigeon pea (Cajanus cajan) *in Brazil.*

These models are helpful for designing new cropping systems that: i) meet smallholders crop yield requirements, and ii) are in line with local socioeconomic conditions.

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