les dossiers
d'AGROPOLIS INTERNATIONAL

Expertise of the scientific community

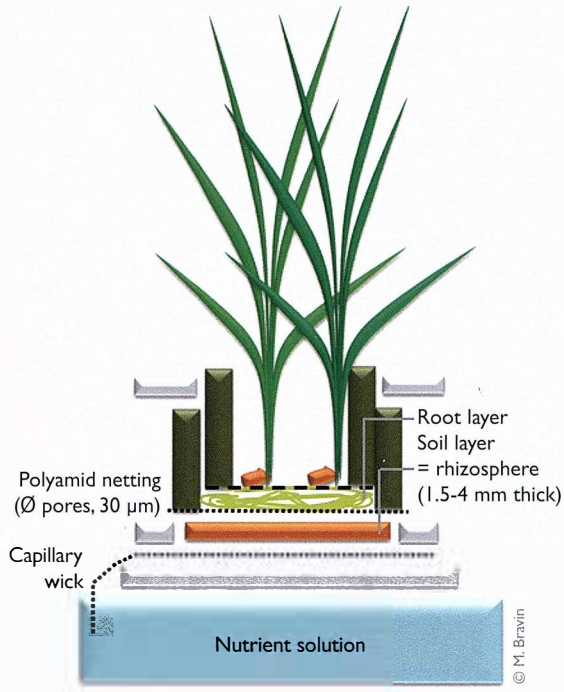
Agronomy
Crops and cropping systems

Number 12

▲ In situ *sampled durum wheat plant with soil attached to its roots, representing the rhizosphere.*

Rhizosphere–a suitable scale for assessing the phytoavailability of trace elements?

Plants are key constituents of agroecosystems, so it is essential to study soil-plant transfers (phytoavailability) of trace elements (TE) in contaminated agricultural soils. Some TE such as arsenic (As) can accumulate in plants, with a high subsequent risk of contaminating the food chain. Other TE like copper (Cu) are mainly phytotoxic and affect crop yields. Research teams are assessing these risks by focusing on the rhizosphere, i.e. a thin soil layer (a few hundreds of micrometres to a few millimetres thick) in contact with roots and whose physicochemical properties are highly affected by root activities. Rhizospheres can be studied *in situ* by collecting soil attached to roots, but experimental laboratory tests, such as the RHIZOtest, which is based on the physical separation of soil and roots, can be used for a more in-depth analysis of the impacts of rhizosphere processes on TE phytoavailability.



▶ *RHIZOtest, laboratory test set up to assess the impact of rhizosphere processes on the phytoavailability of trace metals.*

In Southeast Asia, the high availability of As derived from irrigation water in flooded rice field soils boosts the risk of high As phytoavailability. However, in these soil reducing conditions, rice favours the formation of a matrix of iron oxyhydroxides on the surface of roots, which tend to sequester As in the rhizosphere and reduce its phytoavailability. In Languedoc-Roussillon region (France), studies on rhizosphere processes are also helping to gain insight into the development of Cu phytotoxicity in durum wheat in some former vineyard soils. In very acidic soils, plants reduce Cu phytoavailability by highly alkalizing its rhizosphere. Conversely, in calcareous soils, root exudates released by the plant into its rhizosphere exacerbate Cu phytoavailability, thus promoting its phytotoxicity. These two examples highlight the importance of conducting studies focused on rhizosphere processes to assess TE phytoavailability.

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Development of production systems

The internal research unit (UPR) ***Performance of Tree Crop-Based Systems*** **(CIRAD)** focuses research on agronomic aspects of tropical tree crops, e.g. oil palm, natural rubber, cocoa, coffee and coconut, while dealing with technical agricultural production systems on different scales: cropping system, production system, farm, commercial plantation, agroindustrial site, processing unit supply area, agroecosystem, etc.

Sustainable increases in income and agricultural production are required to meet the challenges of this new millennium, but in a setting of shrinking cropland, growing populations and global warming.

The unit aims to fulfil these needs, while taking the environmental and social impacts of recommended systems into account for both family smallholdings and agroindustrial plantations.

In response to these challenges, the unit is striving to sustainably increase the productivity of tropical tree crop-based production systems. It is thus developing a multidisciplinary scientific project, with research focused simultaneously in the fields of physiology (plant functioning), ecophysiology (plant interactions with biophysical and climatic environments), agronomy (optimization of cropping practices and effective use of genetic gains), ecology (environmental service impact assessment) and socioeconomics (conditions in which stakeholders adopt systems, farm functioning).