

# Rhizosphere 2

## Session 1 - Rhizo-technologies - Applications of rhizosphere research

### ► Keynote presentations

#### K-1139 Molecular approaches to rhizosphere research: identification and characterization of aluminum tolerance genes and their use to improve acid soil tolerance

Kochian Leon<sup>1</sup>, Magalhaes Jurandir<sup>1</sup>, Liu Jiping<sup>1</sup>, Hoekenga Owen<sup>1</sup>, Pineros Miguel<sup>1</sup>, Schaffert Robert<sup>1</sup>, Shaff Jon<sup>1</sup>, Alves Vera<sup>1</sup>

<sup>1</sup> US Plant, Soil and Nutrition Laboratory, USDA-ARS Tower Road, Cornell University 14853 Ithaca New York USA

<sup>2</sup> Embrapa Maize and Sorghum, Sete Lagoas, Brazil

<sup>3</sup> U.S. Plant and Soil Nutrition Laboratory, USDA-ARS, Cornell University, Ithaca, NY 14853

Aluminum (Al) toxicity is a major limiting factor to agriculture on acid soils that make up approximately 30% of the world's total land area and up to 50% of the world's potentially arable lands. A large proportion of the acid soils occur in developing countries in the tropics and subtropics; thus, Al toxicity reduces food security in many parts of the world where it is most tenuous. Because of the agronomic importance of crop Al toxicity, identifying the molecular determinants for Al tolerance has attracted significant interest from a number of laboratories around the world. We are now poised, based on recent discoveries by a number of researchers, to develop the molecular and genetic resources required to address a worldwide agronomic problem that is only exceeded by drought stress with regards to abiotic limitations to crop production.

In this presentation, the molecular approaches that have been used to identify Al tolerance genes in wheat, *Arabidopsis* and sorghum will be discussed. For example, in sorghum, using high-resolution mapping, we identified AITSB as a candidate Al tolerance gene and subsequently verified its role in Al tolerance based on: 1) a strong correlation between Al-inducible AITSB expression and Al-inducible tolerance and root citrate exudation; 2) a member of a gene family involved in the efflux of organic solutes; 3) protein localization to the plasma membrane; and 4) AITSB expression in transgenic *Arabidopsis* resulting in significant increases in Al tolerance and Al-activated root citrate efflux. Sequence analysis of the parental AITSB alleles and the promoter region from selected members of a sorghum diversity panel, combined with determination of AITSB expression, Al tolerance and root citrate exudation indicates that differences in gene expression are a major determinant of differential tolerance in sorghum. Furthermore, a MITE-type transposable element in the AITSB promoter appears to be a highly polymorphic motif in the promoter region and may play a role in the differential Al-inducible expression.

#### K-1094 Burkholderia diazotrophic species exhibit mechanisms involved in plant growth promotion, biological control and bioremediation

Caballero-Mellado Jesus<sup>1</sup>, Onofre-Lemus Janette<sup>1</sup>, Castro-Gonzalez Rocio<sup>1</sup>, Estrada-de los Santos Paulina<sup>1</sup>, Wong-Villarreal Arnoldo<sup>1</sup>, Martinez-Aguilar Lourdes<sup>1</sup>

<sup>1</sup> UNAM (Universidad Nacional Autonoma de Mexico) Ecología Genómica Apdo. Postal No. 565-A 62210 Cuernavaca Morelos Mexico

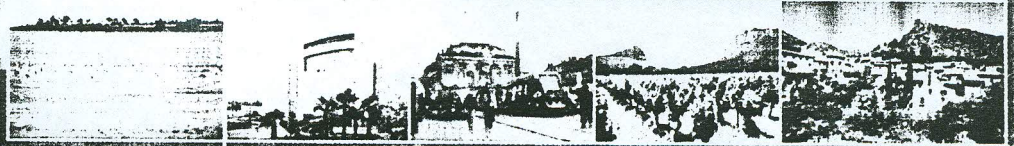
*Burkholderia* species, particularly those grouped in the *Burkholderia cepacia* complex (Bcc), constitute one of the dominant bacterial groups in the maize rhizosphere. However, Bcc bacteria have been found in high prevalence as opportunistic pathogens in cystic fibrosis patients. This fact has hampered the commercial development of some Bcc strains in biotechnological processes. In contrast, studies performed on the association of *Burkholderia* species, different to the Bcc, with important agricultural plants are limited. For a long time, N<sub>2</sub>-fixing ability in *Burkholderia* species was recognized only in *B. vietnamiensis*, a member of the Bcc. Novel rhizospheric N<sub>2</sub>-fixing *Burkholderia* species associated with plants have been described recently, e.g., *B. unamae*, *B. xenovorans*, *B. tropica*, and *B. sivallantica*. These diazotrophic *Burkholderia* are closely related, but phylogenetically largely distant from the Bcc species. In fact, *cblA* and *esmR* genes encoding transmissibility factors identified among clinical strains from the Bcc were not detected in many strains of *B. unamae*, *B. tropica* or *B. sivallantica*.

Apparently, the N<sub>2</sub>-fixing *Burkholderia* have a large capability of association with plants, as they have been isolated from the rhizosphere of maize, sugarcane, sorghum, coffee, and tomato. The widespread association of such N<sub>2</sub>-fixing *Burkholderia* with plants could represent new opportunities in biotechnological processes. Although the involved mechanism is unknown, *B. unamae* and *B. tropica* improve the maize plant growth. *B. tropica* exhibit a great mineral phosphate-dissolving capability, and *B. unamae* exhibit high ACC deaminase activity. In fact, the ACC deaminase activity is a common trait among the N<sub>2</sub>-fixing *Burkholderia* species. In addition, the siderophores production by the diazotrophic *Burkholderia* could represent an important trait for controlling plant pathogens. In the N<sub>2</sub>-fixing *Burkholderia* species is also remarkable the capability for using as carbon sources some environmental pollutants, for example, *B. unamae* is able to use phenol and benzene for its growth. This feature and the capability of *B. unamae* for promoting growth of maize and to colonize the rhizosphere and rhizoplane of plants could be suitable in bioremediation. Based on the data described, we considered that N<sub>2</sub>-fixing *Burkholderia* consortia could be used for promoting plant growth and increasing crop yields, and concomitantly in bioremediation, and biocontrol of plant pathogens.



# Rhizosphere 2

ELIANE

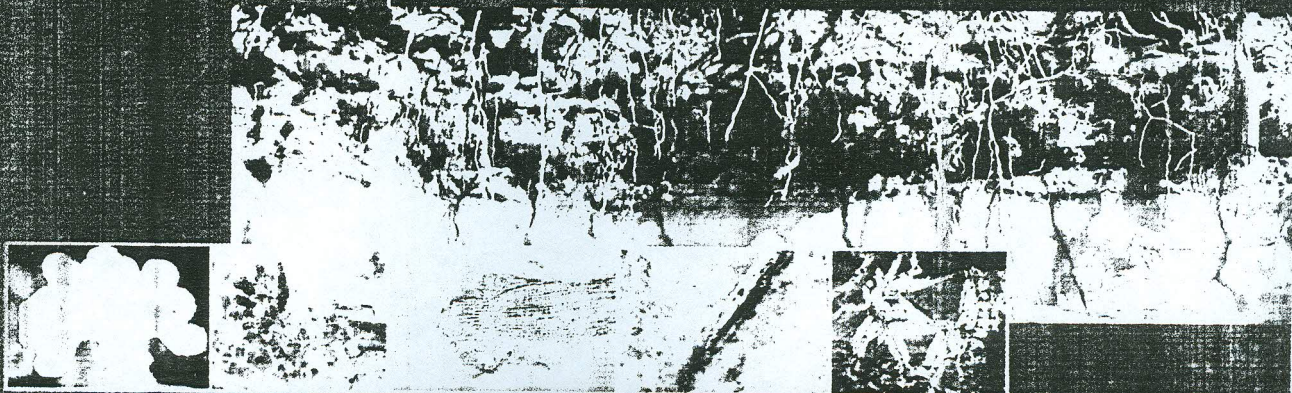


## Book of abstracts

## International Conference

Montpellier - France  
26 - 31 August 2007

Le Corum  
Palais des Congrès



Local Organising Committee  
Chair : Philippe Hinsinger  
INRA Montpellier

International Steering Committee  
Chair : Davey L. Jones  
University of Wales - UK

Photo credits : UMR LSTM, J. Guimberteau,  
UMR R&S, Le Corum



ORSTOM

INRA

SupAgro

UMR  
MONTPELLIER

<http://www.montpellier.inra.fr/rhizosphere-2/>