

Workshop Argentina-Japan
“Bioscience and Biotechnology for
the Promotion of Agriculture and Food Production”
August 3rd to 7th, 2009. Buenos Aires

Application of metagenomic approaches
to soil management and microbial gene prospection
in Argentine soils

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The agro-alimentary industry is a critical sector of Argentine economy

Structure of Argentine Exports (2007)

Primary products (agriculture and livestock)	23%
Manufactured goods (agriculture)	34%
Manufactured goods (industry)	31%
Fuels and energy	12%



Gross National Product: U\$S 211.700 M

Total Exports: U\$S 40.898 M

Cereals and oil crop exports :

Soybean	U\$S 3.225 M
Soybean oil	U\$S 3.748 M
Soybean pellets	U\$S 5.178 M
Corn	U\$S 2.141 M
Wheat	U\$S 1.466 M

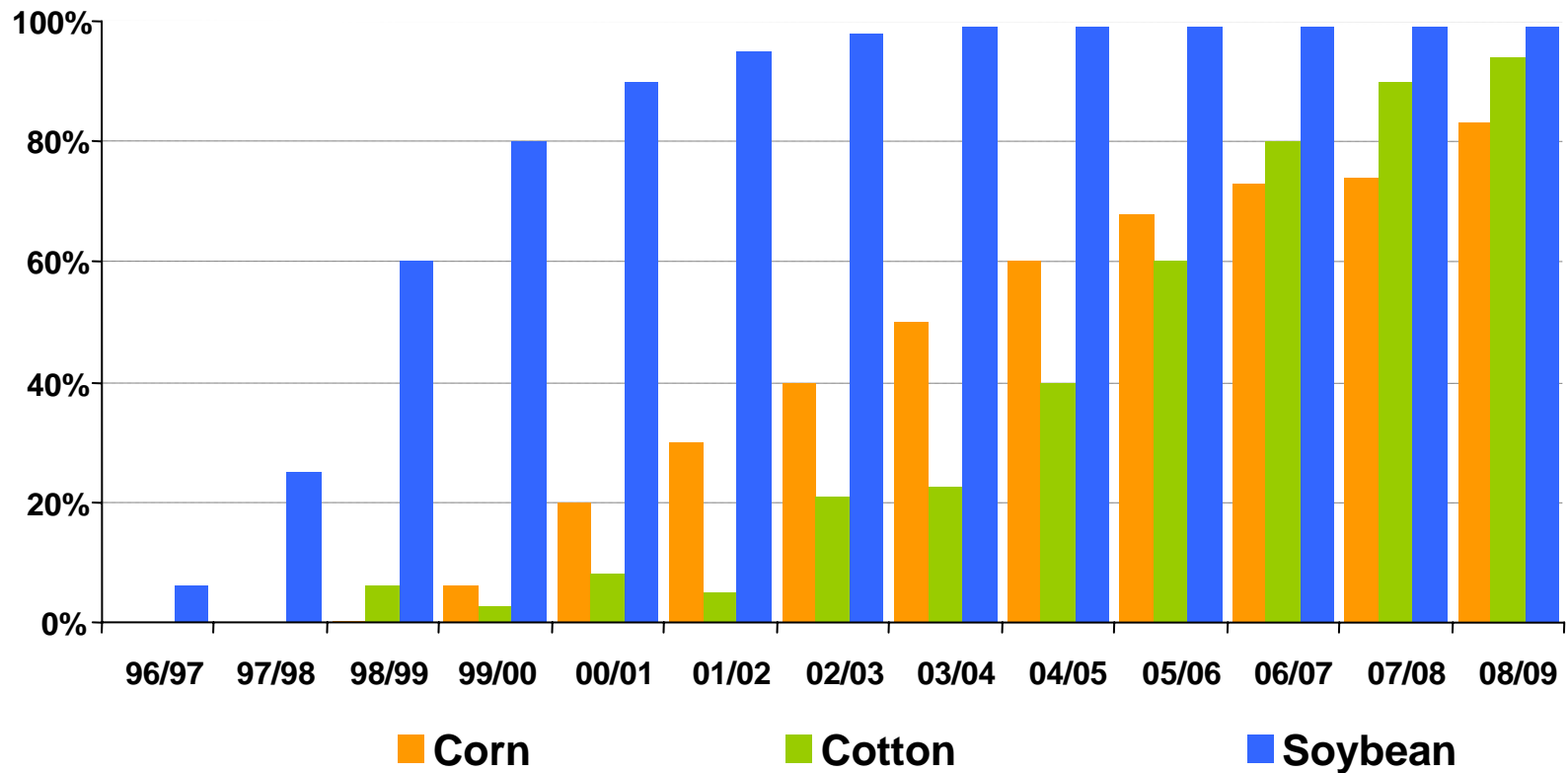
Biotechnology can play an strategic role in Argentina economic development

Application Areas

- Agriculture and livestock
- Food industry
- Human and animal health
- Chemical industry
- Bioenergy
- Fisheries and aquaculture
- Forestry
- Bioremediation

National Plan
for Science
and Technology
2005

Adoption rates of transgenic crops as percentage of global crop area in Argentina



Biotechnology is an important tool to increase the added value of Argentine primary production

- **Increase of agricultural productivity**
 - Tolerance to environmental stresses
 - Pest and disease control
 - Habilitation of semi-arid lands
- **Added economical value**
 - Improvement of animal production standards
 - Improvement of nutritional quality
 - Molecular farming
 - Biofuels and biopolymers
- **Product diversification**
 - Diversification food manufactures
 - Development of regional crops
 - Development of fisheries and aquaculture

Argentina is actively involved in agrobiotechnology

Fields of research:

Resistance to plant diseases, tolerance to abiotic stresses, genome mapping, molecular farming, food processing, plant tissue culture, bioremediation, etc.

Institute of Genetic Engineering and Molecular Biology, (INGEBI-CONICET)

Institute of Biotechnology and Molecular Biology (IBBM, UNLP/CONICET)

Institute of Molecular and Cellular Biology of Rosario, (IMCB-CONICET)

Center of Research and Development in Food Cryotechnology (CIDCA, UNLP/CONICET)

Microbiological Industrial Processes (PROIMI, CONICET)

Institute of Biotechnology of Chascomús, (IIB, INTECH-CONICET)

North East Institute of Botany of (IBONE-CONICET)

Institute of Biotechnology (INTA-Castelar)

Institute of Genetics (INTA-Castelar)

Agro-industrial Experimental Station Obispo Colombres

School of Sciences, University of Buenos Aires

School of Agronomy, University of Buenos Aires

School of Biochemistry, National University of Rosario

School of Agronomy, National University of Rosario

School of Biochemistry, National University of Litoral

L.F. Leloir Foundation

Institute César Milstein

Tecnoplant, BioSidus, Bioceres, Institute of Agrobiotechnology Rosario, Rhizobacter, Nidera

The sustainable management of agriculture is a critical factor to maintain and increase productivity

Issues related to sustainable agriculture:

- Improvement of agricultural practices
- Monitoring of soil degradation
- Soil management and remediation
- Carbon and Nitrogen fixation
- Biofertilization
- Soil bioprospection

Soil Genetics Network (PAE-37164)



Biodiversity
Bioprospection
Bioremediation

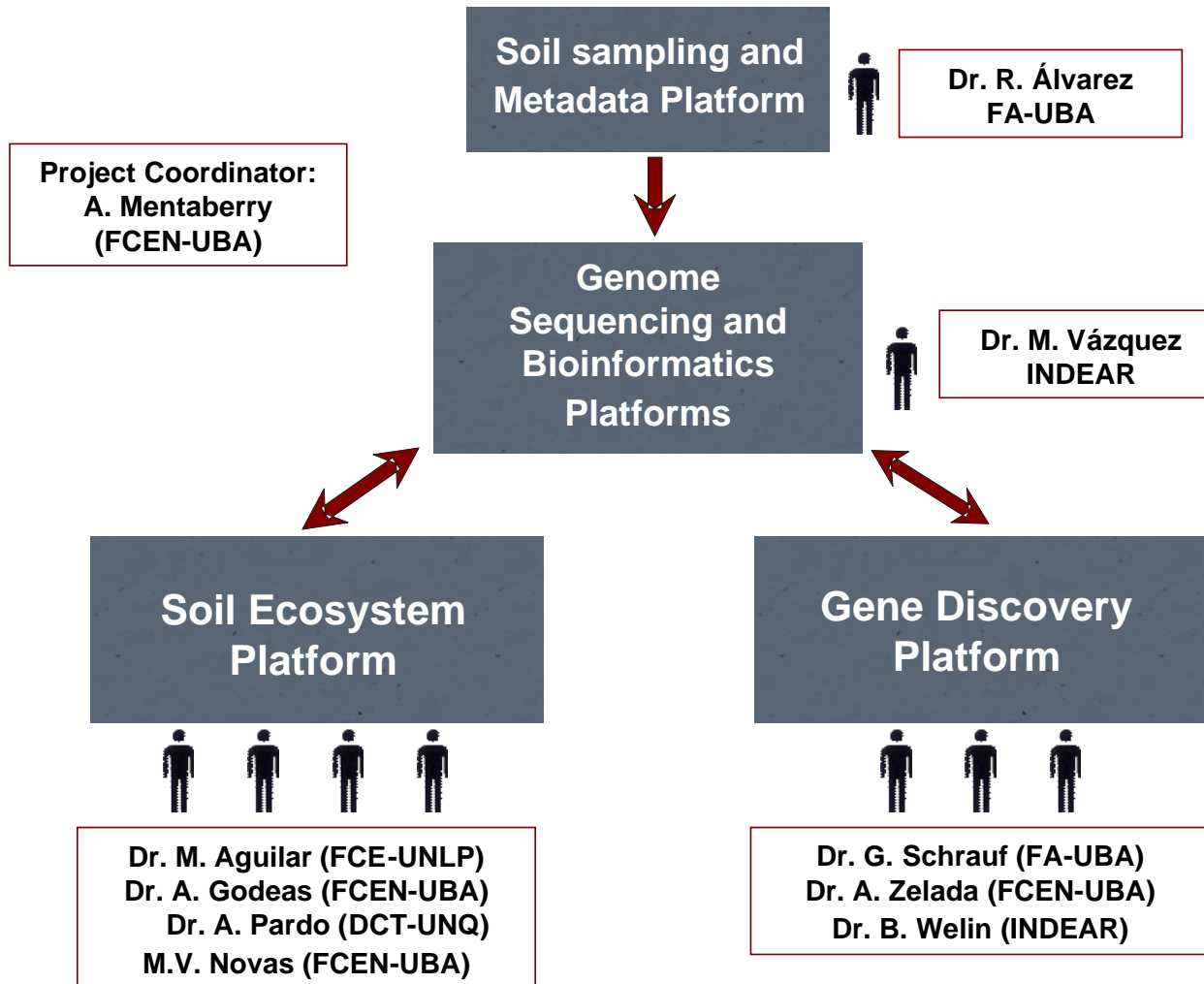
How crop management
affects soil biodiversity?
How soil biodiversity affects
crop performance?

Goals:

- To use metagenomics, metabolomics and system biology approaches to develop a multi-layered database relating biological, edafic, climatic and productive information of Pampean soils.
- To study the composition and dynamics of soil microbe populations with particular emphasis in those components related to agricultural productivity of major Argentine crops and to carbon fixation.
- To develop a catalogue of genetic resources aimed to the characterization and isolation of DNA sequences of biotechnological interest for agriculture, industry and environmental remediation.

Supported by the Program for Strategic Areas
National Agency for the Promotion of Science and Technology
Ministry of Science and Technology of Argentina

SoilGeNe consortium structure



SoilGeNe sub-projects

Sub-project 1: Productivity and carbon sequestration in Pampean agro-ecosystems. Ing. Agr. Roberto Álvarez (School of Agronomy, University of Buenos Aires)

Sub-project 2: Development of a high-throughput platform for soil metagenomics. Dr. Martín Vázquez (School of Sciences, University of Buenos Aires)

Sub-project 3: Development of bioinformatics for soil metagenomic analysis and biotechnological use of soil genetic resources. Dr. Hernán Lorenzi (School of Sciences, University of Buenos Aires)

Sub-project 4: Fungal endophytes in native gramineous plants, natural pastures and forage crops. Dr. María Victoria Novas (School of Sciences, University of Buenos Aires)

Sub-project 5: Metagenomic analysis of soil biodiversity for the development of diagnostic biochips and biofertilizers. Dr. Mario Aguilar (School of Sciences, National University of La Plata)

Sub-project 6: Post-genomic studies on micorhizae. Dr. Alejandro Pardo (Department of Science and Technology, National University of Quilmes)

Sub-project 7: Effects of soil management on the structure of micorhizal communities. Dr. Alicia Godeas (School of Sciences, University of Buenos Aires)

Sub-project 8: Bioprospection of genes of industrial interest. Dr. Bjorn Welin (Institute of Agrobiotechnology Rosario)

Sub-project 9: Gene discovery for plant disease control. Dr. Alicia Zelada (School of Science, University of Buenos Aires)

Sub-project 10: Gene discovery for abiotic stress applications. Ing. Agr. Gustavo Schrauf (School of Agronomy, University of Buenos Aires)

Sub-project 11: Soil microbial ecology in pristine soils and under different agricultural management. Dr. Marcelo Soria (School of Agronomy, University of Buenos Aires)

Genomic sequencing platform

Roche 454 pirosequencer
(500Mb/seq run)

GS-FLX Titanium series

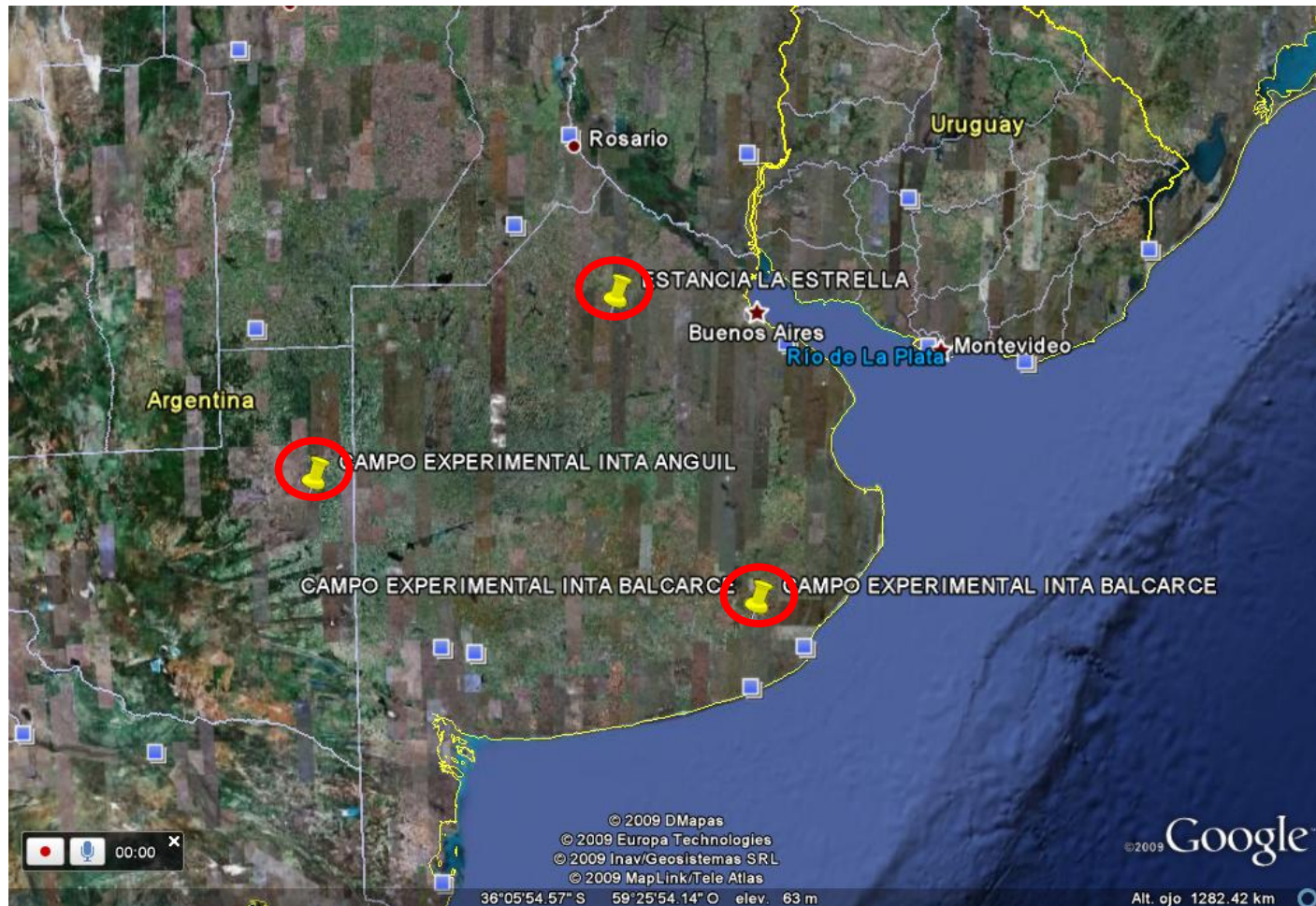
up and running by
October 2009

GS FLX System Performance with XLR HD Kits

Throughput	>500 million high-quality, filter-passed bases per run
Read Length	>400 bases
Reads per Run	>1 million
Single-Read Accuracy	>99% single-read accuracy over 400 bases
Run Time	10 hours



Collection of soil samples from 3 different locations throughout the Pampa's region



Initial soil sampling (Estancia La Estrella)



Data base of soil genomic resources
Initial input: about 5 Gb of sequence data

SoilGeNe Sub-project

Soil microbial ecology in pristine soils and under different agricultural management

Dr. Marcelo Soria, FA-UBA

Goals:

- **Characterize soil microbial communities.**
- **Asses the effect of deforestation and mono-cultures.**
- **Search microbial indicators for monitoring and diagnosis of soil quality.**



Montane forest



Pedemontane forest



Native forest



Sugar cane, 40 & 100 years

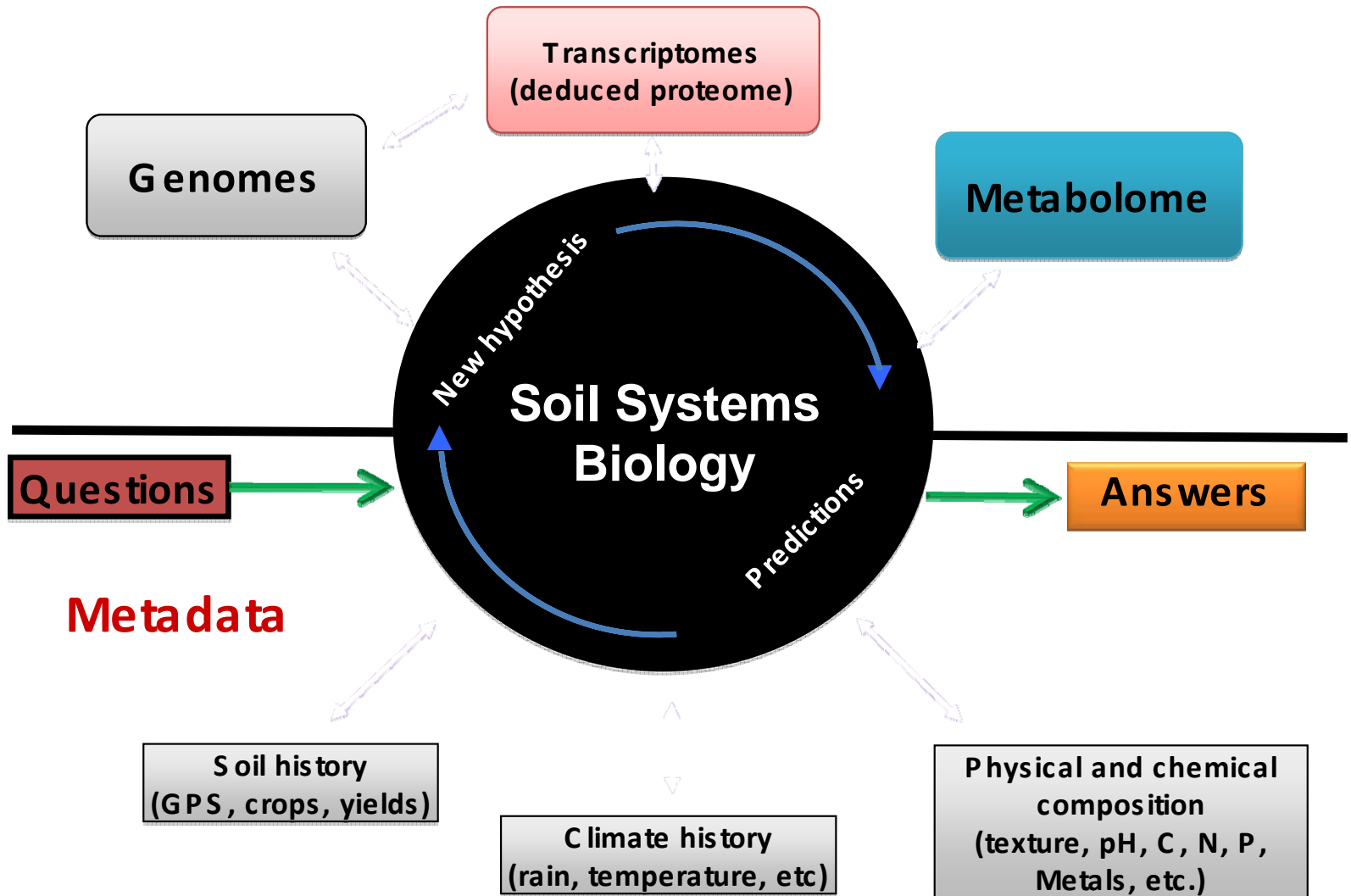


Soybean, 20 years



Cleared, 1 year

Sampling sites



BIOlogía del Suelo y Producción Agraria Sustentable (BIOSPAS; PAE-36976)

Goals:

- To study the biological basis of soil functioning in relation with its productivity and management (tilling and non-tilling practices)
- To develop Soil Quality Indicators based on biological data

Consortium:

Center for Renewable Resources of Semiarid Regions, CONICET
Institute of Biotechnology and Molecular Biology, CONICET
Institute for Genetic Engineering and Molecular Biology, CONICET
Institute of Soil, National Institute for Agronomic Research
School of Sciences, National University of Córdoba
School of Sciences, National University of Rio Cuarto
School of Agronomy, Catholic University of Córdoba
School of Agronomy, University of Buenos Aires
School of Agronomy, National University of North East
Department of Science and Technology, National University of Quilmes
Leloir Foundation

Supported by the Program for Strategic Areas
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Ministry of Science and Technology of Argentina

BIOSPAS Sub-projects

Sub-project 1. Organic matter and soil biochemistry

Dr. J. Galatini, Dr. L. Wall, Dr. C. Valverde and Dr. R. Marona

Sub-project 2. Micorhizae, pathogens, meso- and macrofauna, biocontrol

Dr. D. Ducasse, Dr. L. Domínguez, Ing. M. Carmona, Dr. L. Wall, Dr. C. Valverde Dr. J. Bedano, Dr. R. Marona

Sub-project 3. Culturable bacteria

Dr. A. Zorreguieta, Ing. M. Iglesias, Dr. L. Wall, Dr. C. Valdeverde, Dr. R. Marona

Sub-project 4. Non-culturable bacteria

Dr. M. Aguilar and Dr. L. Erijman

Sub-project 5. Soil physical properties

Ing. H. Morras and Ing. R. Gil

Possible areas of collaboration

MetaProteome data generation

MetaMetabolome data generation

Comparative studies on soil diversity

Design of bioinformatic resources

Design of biochips for soil diagnosis

Thanks for your attention