

Lotus activities:

Background and present research

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[Aïssa Abdelguerfi](#)

ALGERIA

I am working on Fabaceae (forage and pastoral plants) since 1976; the aspects study are: Ecology, Agronomy, Variability, Taxonomy, Biology, Physiology (salinity, drought...)

[Nora Altier](#)

URUGUAY

My research program is focused on developing management strategies for minimizing the impact of diseases on forage legume production and persistence. I work in close collaboration with the breeding programs in the development of new varieties with improved disease resistance. My research also facilitates the development of new techniques and

standardized tests to characterize germplasm and to assist in the identification of disease resistance in plants. Projects involve interdisciplinary approaches to understanding the ecology of forage legume microbes and disease epidemiology as influenced by cultural practices. Current research also explores the biological control of *Pythium* seedling diseases using native fluorescent *Pseudomonas*.

[Seishiro Aoki](#)

JAPAN

I studied the horizontal gene transfer from *Agrobacterium* to *Nicotiana* species in their evolution. I am interested in the evolution and phylogeny of legume and rhizobia. I am collecting *Lotus* species in Japan and all over the world and isolate symbiotic bacteria from their nodules.

[Manuel Becana](#)

SPAIN

The research of our group is focused on free radicals, antioxidants and oxidative stress in legumes, and particularly in nodules. For our studies we use the model legume *Lotus japonicus*, both under nodulating (nitrogen-fixing) and non-nodulating (nitrate-fed) conditions. We use a multidisciplinary approach, by combining physiology and biochemistry with cell and molecular biology. Currently, we have

concentrated our efforts in three types of antioxidant enzymes (glutathione synthetases, glutathione peroxidases and superoxide dismutases) and are investigating the role(s) of those enzymes in the protection of nitrogen fixation as well as their involvement in the plant's response to several types of abiotic stress (salinity, heavy metals, oxidative stress). To this end, we are identifying the whole set of isoforms, studying their expression (mRNA, protein, activity) and localization (tissue, cell, organelle), and producing recombinant proteins for detailed biochemical characterization.

Edgar Cárdenas Rocha

COLOMBIA

I have been working from 1985 in the tropical forages research, with emphasis in adaptive evaluation of grass, legumes and other forages species germplasm, in the tropical low lands in the Centro Internacional de Agricultura Tropical (CIAT). Last 7 years I am dedicated to teaching and I continue with the investigation but in cold climate forages, in the Colombian high altitude Andean region, with the purpose to obtain multipurpose species (cover crops, forages, wood and others), and to make the bovine production in high altitudes (between 2000 to 3400 m, 18 to 8 °C). I have interest to evaluate subtropical plant species that have well develop in our altitudes and latitudes, with the objective to obtain alternative forages to kikuyo and ryegrass, which are the only base of the feeding in our milk region.

Francesca Cardinale

ITALY

My background is that of a plant biologist who got interested in plant-microbe interactions during her studies. After working briefly on VA mycorrhizas, during my PhD I switched to plant-pathogen interactions focussing at first on the recognition events. During the post-doc years, I worked on the role of new oxylipins in plant defense and on the signal transduction events following biotic and abiotic stress perception. Since my arrival in Turin in the year 2001 as a staff researcher in Plant Physiopathology, I started working on post-transcriptional regulation of ethylene biosynthesis and on cross-protection mechanisms between different stresses, besides joining the existing group on ongoing plant pathology projects. I've been working on *Medicago sativa*, *Arabidopsis*, tobacco and tomato so far. I got interested in *Lotus japonicus* because it's becoming a model plant but it's not so exploited yet as far as molecular pathology.

Federico Condón

URUGUAY

Phd candidate at the University of Minnesota, Agronomy and Plant Genetics Department. Special interest in allelic diversity, population structure and genetic resources utilization.

Cristina Cvitanich

DENMARK

Project Title: Isolation and characterization of *Lotus japonicus* genes involved in iron and zinc homeostasis. Researchers: Cristina Cvitanich, Winnie Jensen, and

Erik Østergaard Jensen. The goal of this project is to find ways to improve the nutritional value of legumes by identifying genes and proteins important for iron and zinc regulation in the model legume *Lotus japonicus*. Legumes are important staples in the developing world and are a major source of nutrients in many areas. Legumes are frequently grown in soil with limited nutrient availability. Plants use finely tuned mechanisms to keep appropriated levels of iron and zinc in each of their organs. Several genes involved in iron and zinc homeostasis have been described in yeast, and a few orthologs have been studied in plants. We have used these sequences to search for *L. japonicus* ESTs and genomic loci that are likely to be involved in iron and zinc metabolism. We have identified sequences corresponding to three ferritins, two putative ferric reductases, seven metal transport proteins of the ZIP family, and six cation transporters of the NRAMP family. The expression patterns of these genes are being studied. Novel plant genes regulated by iron or zinc availability in the soil will also be identified and analyzed in details.

[Mariana Melchiorre](#)
ARGENTINA

At the present, the group is transforming *L. japonicus* in order to overexpress the enzymes Mn-Superoxide dismutase and Glutathione reductase. Both enzymes are involved in the antioxidant system in plants. Our goal is improve the plant response under salt stress and correlate this behavior with the control of oxygen active species generation.

[Martin Parniske](#)
GERMANY

My background is the molecular and genetic analysis of plant microbe interactions. The focus of my laboratory is the genetics of plant root symbiosis and we are using *Lotus japonicus* as genetic model organism. We have developed large populations of EMS mutagenised seed and have isolated several hundred mutants affected in root symbiosis. We also have established a TILLING reverse genetics tool for *Lotus japonicus*, which is accessible for other laboratories through collaboration.

[Andy Pollard](#)
FALKLAND ISLANDS

Three years out of university, studied at Seale-Hayne Agricultural College in Devon UK. I have worked in the area of agronomy for the last 2 years. Research at present in regards to *Lotus* (particularly Maku cultivar) has been focused on establishing, only now are we able to study production and quality of the plant. Falkland Island soils are of a low pH and lime at present is not an economic option. *Lotus uliginosus* seems to establish with less difficulty in FI conditions than many other legume/grasses. Recent set up of an EU approved abattoir offers it potential in the production of lamb for export. Growth rates need to be determined for the various FI breeds.

[Mark Robbins](#)
UNITED KINGDOM

Work in the laboratory focuses on polyphenolic metabolism in *Lotus* spp. Proanthocyanidins (syn. condensed tannins) protect plant proteins from

breakdown when grazed by ruminant animals. Additionally, condensed tannins appear to have a protein protectant effect during the ensilage of tanniferous forages. Our current studies include: (1) Animal feeding experiments using *Lotus* spp. with varying CT contents. (2) Analysis of CT pathway regulation by the expression of transgenes in clonal genotypes of *Lotus corniculatus*. (3) Molecular analyses of genes that regulate the tissue-specific accumulation of CT-containing cells in *Lotus japonicus* and *Lotus corniculatus*. We have ongoing projects on genes of the basic-helix-loop-helix class and also on R2R3MYB transcription factors (in collaboration with John Innes Centre, Norwich).

Simone Scheffer-Basso

BRAZIL

I have worked with morphophysiology and evaluation of forage production of *Lotus corniculatus* (cutting/grazing tolerance, growth habit, nutritive value, competition, mixtures with grasses).

Norio Suganuma

JAPAN

Biological nitrogen fixation is an important process that provides nitrogen to all living matter on the earth. Rhizobia form root nodules on legumes. The bacteria are endocytosed into nodule cells, and then have the ability to fix atmospheric nitrogen. Nitrogen fixed by rhizobia is supplied to host plants for their growth and further is utilized for the growth of other organisms. In most cases, rhizobia alone do not fix nitrogen in the soil. They are able to fix nitrogen only by building a symbiotic relationship with legumes, indicating that host plant genes are required for rhizobial

nitrogen fixation in nodules. However, little is known about the host plant genes that are involved in the establishment of symbiotic nitrogen fixation. Plant Fix⁻ mutants that form ineffective nodules are useful for studying the regulatory mechanism of symbiotic nitrogen fixation by host plant genes. Numerous Fix⁻ mutants have been isolated from major leguminous crops. However, they have a large genome and are difficult to be transformed. In contrast, *Lotus japonicus* has several characteristics suited to the model for legume research, and thus its genetic information has been accumulating. This allows us to study host plant genes responsible for symbiosis by map-based cloning or gene manipulation. We focus on *L. japonicus* Fix⁻ mutants. Mutants are generated by chemical mutagenesis and are characterized by phenotypes and gene expression profiles. Furthermore, each defective gene is cloned by map-based cloning. Our goal is to reveal how host plants control rhizobial symbiotic nitrogen fixation in nodules.

Nancy Terryn

BELGIUM

Together with my colleagues at the Institute for Plant Biotechnology we have a research unit on leguminous plants. Our main focus crops are *Phaseolus*, cowpea and *Lathyrus*. Our goal is to exploit modern biotechnology for the identification and use of novel genes to broaden the genetic base of these crops. This includes the development of genetic transformation protocols, and the introduction of useful (foreign) genes to address key problems such as nutritional aspects and insect tolerance. We have developed and improved a *P. acutifolius* agrobacterium based transformation protocol (De clerq *et*

al., 2002; Zambre *et al.*, 2005). With this protocol *P. acutifolius* or the tepary bean can now routinely be transformed. As *P. acutifolius* can be hybridised (through embryo-rescue to *P. vulgaris*) this is an indirect way to genetically improve the common bean. We are also continuing to improve the regeneration and transformation protocols for *Phaseolus* species in general and particularly *P. vulgaris*, as well as for cowpea and *Lathyrus*. Our studies have focused on the seed storage proteins known as arcelins. These are very abundant seed storage proteins found in some wild *P. vulgaris* genotypes. Seeds of *A. thaliana* and *P. acutifolius* plants transformed with *arcelin-5* gene constructs, synthesise *arcelin-5* to levels of 15 and 25% of the total protein content, respectively. This high expression level of *arcelin-5* is being exploited in two projects, one aiming at improving insect resistance, another aimed at expressing *arcelin-5* genes modified to contain extra methionine codons.

DE CLERCQ J., ZAMBRE M., VAN MONTAGU M., DILLEN W. and ANGENON G. 2002. An optimized Agrobacterium-mediated transformation procedure for *Phaseolus acutifolius* A. Gray. *Plant Cell Reporter*, **21**, 333-340.

ZAMBRE M., CARDONA C., VAN MONTAGU M., TERRY N. and ANGENON G. 2005. A reproducible genetic transformation system for cultivated *Phaseolus acutifolius* (teparry bean) and its use to assess the role of arcelins in resistance to the Mexican bean weevil. *Theoretical and Applied Genetics*, **110**, 914-924.
