



## LEGIM Project

### Publishable Summary

The “Legume Improvement (LEGIM)”, project was a cutting edge research and training program based on “state of the-art”, technologies strengthening the research partnership between the University of Pretoria in South Africa, Leeds University, UK and VIB Ghent, Belgium in an area of common research interest, legume improvement, which is of major agronomic importance both in the EU and in Africa. This aim has been achieved through short and longer-term periods of staff exchanges between the African and European partners and networking activities between the three institutions.

The research objectives of this project concern the control of the lifespan of specific organs on leguminous plants called nodules that are responsible for the fixation of atmospheric nitrogen through the symbiotic union with soil bacteria (rhizobia). Nodule nitrogen fixation is an important driver of ecosystem sustainability in the face of climate change. Molecular-genetic approaches were used in this project to develop an improved understanding of the factors that control nodule development and senescence under optimal and stress conditions.

In this project, we have defined the role of CLE peptides and strigolactones in nodule development in the model legume *Medicago truncatula* and in the grain legume, soybean. Moreover, we have catalogued the transcript profiles of young and senescent soybean nodules and characterised the changes in transcripts encoding cysteine proteases and key components of the redox system that are specifically expressed during symbiosome degradation at the onset of senescence. We have shown that the development and senescence of transgenic soybean plants with ectopic expression of the rice cysteine protease inhibitor oryzacystatin I (OCI) have altered development and are more resistant to drought stress. Crucially, we have shown that the seeds of the OCI-expressing soybean lines contain significantly more protein than the wild type controls.

These results have the potential to have substantial impact on legume crop improvement programs. They show that protease inhibitors have enormous potential as molecular markers for use in the selection of improved crop varieties. The findings with regard to stress tolerance and seed protein contents are particularly important in terms of potential for socio-economic impact because these parameters are central to the sustainability of crop yields and crop quality that underpin European agriculture. The results of this project will make a valuable contribution to wider society by contributing to food security and the financial success of agriculture and agro-industries.

The teams that have contributed to this project have achieved more rapid progress in advancing current knowledge and concepts through joint endeavour, leading to joint-author high citation index publications. This is particularly important for the South Africa scientists who are co-authors on these publications. This project has formed the foundation for the establishment of much longer-term research cooperation between the three institutions based on active technology and scientific knowledge application and transfer. As a result of the substantial networking activities facilitated by this project, several research staff have recently transferred between labs for longer term activities. For example, Professor Karl Kunert from the University of Pretoria is now working at the University of Leeds on a Marie Curie Fellowship and Dr Belen Garcia is now working at VIB Gent on a three year post-doctoral fellowship. The program of exchanges has therefore established long-term research cooperation between the three institutions based on active technology and scientific knowledge application and transfer. The partners have already elaborated the formal collaboration during the course of the project through new joint grant applications.

All the South African researchers benefitted from hands-on training in state of the art technologies in the host labs through joint experiments using key technologies promoting efficient research outcomes. In particular, the exchange visits of early and late stage researchers between South Africa and Europe greatly improved the technical skill base, scientific knowledge and interaction networks of the researchers. Each exchange also advanced the experimentation and data gathering requirements of the project. This benefited all participations particularly the early stage researchers in terms of a rapid advance in career prospects. All researchers benefitted from the knowledge exchange and enhanced productivity facilitated by the exchanges. In addition to research visits, networking activities included participation in seminars and research days, technical workshops, courses, and conferences organised within in each institution by the partners. In addition, project research results have been presented at national and international meetings. Such activities have proved to be crucial to the development of the team relationships emphasising the coherence of endeavour and the commitment of the partners as well as providing tangible evidence of the collaboration.

This project has assisted each partner University, but particularly the University of Pretoria, to establish a firm foundation for future research priorities facilitating new long-term collaborative projects involving other countries in southern and sub-Saharan Africa. Each University team is now in a stronger position to act as a hub for further science and technology development particularly in the larger African context and aid long-term interactions between Europe and Africa for example through new activities within Africa College at the University of Leeds.

From the outset, this project was well-aligned with strengthening national priorities in South Africa regarding capacity building in plant biotechnology. In this project the team at the University of Pretoria has worked side by side with the teams at two leading research institutions in plant biotechnology in the UK and Belgium, to make a significant contribution to the generation of new knowledge and to skill and knowledge transfer o

South Africa. It has served to increase the recognition of South African scientists in within the highly competitive Framework 7 environment.

For further details please contact:

Professor Karl Kunert [Karl.Kunert@up.ac.za]

Professor Christine Foyer [c.foyer@leeds.ac.uk]

Professor Sofie Goormachtig [sogoo@psb.vib-ugent.be]

LEGIM Project researchers visiting the “The Cradle of Humankind”, a UNESCO World Heritage site in South Africa . This is an extensive network of dolomitic limestone caves in which have been found several fossils of plants, animals and hominids. From left to right the researchers at the back are Nick Brewin (UK) Sofie Goormachtig (Belgium), Karl Kunert (South Africa), Urte Schluter (South Africa), Christine Foyer (UK), Belén Márquez García (UK), and Chris Cullis (USA). In the front is Juan Vorster (South Africa).

