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The Director
University of the Missouri South African Education Programme
University of Missouri
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REPORT ON COLLABORATIVE RESEARCH VISIT

Dear Prof Uphoff,

This serves as a formal report on the visit undertaken by Prof Ndiko Ludidi and Dr Marshall Keyster from the University of the Western Cape (UWC) to the College of Agriculture, Food and Natural Resources at the University of Missouri (MU) in the period May 20, 2019 to June 9, 2019.

The purpose of the visit was to explore collaborative research on marama bean (*Tylosema esculentum*), and to follow up on current collaborative research between Prof Ludidi and Prof Robert Sharp as well as to follow up on current collaborative research between Dr Keyster and Prof David Mendoza-Cozatl (which was linked to Prof Antje Heese). This also served as an opportunity for Prof Ludidi and Dr Keyster to attend the 2019 IPG Symposium.

Several meetings were held during this period to cover a range of activities pertaining to the collaborative links between plant scientists at MU and UWC.

Research on marama:
The discussions were held between Prof Ludidi, Dr Keyster, Prof Medoza-Cozatl and Prof Scott Peck. They discussed potential areas of cooperation on research into marama bean based on available skills and facilities at MU and UWC. It was agreed that the research would focus on investigating the following:

1. Mineral composition and content of marama seeds and how this changes in response to drought, with focus on differences between T*ylosema esculentum* and *Tylosema fassoglense* (two distinct species of marama). This work will be led by Prof Mendoza-Cozatl at MU in collaboration with Dr Keyster and Prof Ludidi.
2. Proteomic and transcriptomic profiling to determine how drought affects the proteome and transcriptome of marama, as a means to identify genes that determine drought tolerance in marama. The focus will be to delineate differences between T*ylosema esculentum* and *Tylosema fassoglense* to establish if they have different tolerance levels to drought and understand the molecular pathways that drive such differences.

It was decided that this research would require a substantial monetary investment that would not be met by UMSAEP funding and thus a concerted effort would be made to look out for joint calls for cooperative research grants from the National Science Foundation (NSF) in the USA and the National Research Foundation (NRF) in South Africa. Besides these funding bodies, other sources of funding would be actively explored to raise the necessary finances for the project.

Nonetheless, it was decided that low cost experiments that could be performed without large grants but still yield significant outputs would be engaged in, starting with comparative analyses of drought responses in marama accessions from a physiological and biochemical point of view. This will allow for one student (Miss Afika Mbuyiswa) to undertake such work at UWC for her PhD (already initiated) and possibly visit MU in 2020 for part of the work. It is envisaged that such physiological analyses can lead to joint publication of one paper on this topic.

Follow-up on Sharp – Ludidi collaboration:

The discussions were held between Prof Ndiko Ludidi and Prof Robert Sharp. They discussed further cooperation on research into maize and sorghum:

1. To finalize work initiated over the past few years on maize responses to drought, discussions on results obtained thus far took place and a manuscript was drafted. The manuscript was recently submitted to the journal "Plant Physiology and Biochemistry" (Impact Factor 3.404).
2. It was decided that Mr Ali Elnaeim Elbasheir Ali, who is a PhD UWC student under the supervision of Prof Ludidi, requires the growth physiology expertise that is on offer from Prof Sharp in relation to drought responses in plants. Consequently, Prof Sharp has been nominated as a co-advisor of the PhD study of Mr Ali, which will include a combination of drought and heat stress and enable student exchange between MU and UWC.

IPG Symposium:

Prof Ludidi and Dr Keyster attended the 2019 IPG symposium and used this as an opportunity to engage with Prof Dirk Inze (Ghent University) as a way of exploring revitalization of the trilateral research collaboration between MU, UWC and Ghent University. The discussions resulted in agreement that maize resources between UWC and Ghent University should be shared for drought phenomics work and that MU would be part of this work in terms of proteomic and plant nutriomics research. Dr Marshall Keyster also gave an invited lecture at the IPG Symposium entitled "Beneficial plant-microbe interactions: A possible one-size-fits-all solution for improving plant tolerance to both biotic and abiotic stress."

Follow-up on Mendoza-Cozatl and Heese – Keyster collaboration:

Discussions were held between Dr. Marshall Keyster, Prof's David Mendoza-Cozatl and Antje Heese. They discussed further collaboration on research into the role of vesicle trafficking in modulating cadmium and iron-deficiency stress tolerance in plants:

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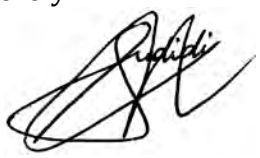
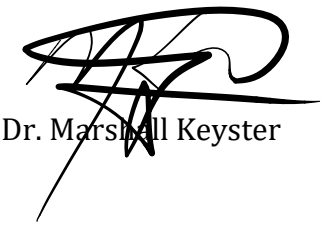
1. Dr. Keyster and Prof. Mendoza-Cozatl completed and submitted a manuscript. The manuscript was accepted for publication in the "Journal of Experimental Botany" (Impact Factor 5.360) on 20 June 2019.
2. Prof. Heese managed to attract a new MU PhD student onto the vesicle trafficking project. Alani Antoine-Mitchell gave a presentation about the progress so far which looks very promising.
3. Prof. Mendoza-Cozatl was appointed as the co-supervisor of Lee-Ann Niekerk's PhD dissertation at UWC on iron-deficiency in common bean. Lee-Ann worked on the vesicle trafficking project during an 8 month stay in MU (2017 – 2018).

Discussions with Prof. Ron Mittler about possible collaboration:
Discussions were held between Dr. Marshall Keyster, Prof's Ndiko Ludidi and Ron Mittler about the plant "ROS wave" in abiotic stress. They discussed a possibility of a collaboration on ROS signaling in the regulation of abiotic stress tolerance in soybean and maize.

Sincerely





Prof. Ndomelele Ndiko Ludidi

Dr. Marshall Keyster