

# WDCM Training Course for Microbiome Data Sharing

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WDCM, Chinese Academy of Science, Institute of Microbiology

## Personal Information

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An Ethiopian citizen by birth, currently residing and working in South Africa. Graduated initially in pure biology (BSc) then in Applied Microbiology (MSc.) in 1999 from Addis Ababa University in Ethiopia, and later completed a Doctor of Philosophy (PhD) in Microbiology and Plant Pathology from the University of Pretoria, South Africa. Previous work experience include serving as lecturer at Haramaya University, Ethiopia (2000-2003) and lectured courses such as Microbiology, Cell Physiology, Introductory Biology and Evolution in the undergraduate program. Later worked as postdoctoral fellow at the Department of Microbiology and Plant Pathology, University of Pretoria (2008-2009). Currently researcher at the Agricultural Research Council, Plant Protection Research Institute and curator of the South African Rhizobium Culture Collection (SARCC).

Name of culture collection:

**South African Rhizobium Culture Collection (SARCC)**

Member of the WDCM, member number 968

## **ABSTRACT**

The nodule microbiome contains two types of bacteria namely the nitrogen fixing symbiotic rhizobia and other endophytic bacteria that probably have some beneficial roles related to plant growth promotion in legumes. The bacteria can be analysed by culture-dependent and by metagenomics techniques to detect the proportion of the symbiotic rhizobia and the non-symbiotic endophytic bacteria. The South African Rhizobium Culture Collection (SARCC) is a custodian of the rhizobium collection and is the major supplier of microbial cultures to various clients in South Africa. It is currently a registered member of the WDCM database to participate in microbial management and sharing. The collection conducts isolation and preservation of nitrogen fixing rhizobia from the root nodules of various legumes. However, the method normally used employs isolation and characterization of only a single bacterial strain in the nodules, and not the microbiome. The training on the microbiome and its data sharing management system is therefore an important session in which participants benefit a lot with regard to microbiome research and microbiome sharing worldwide.

### **Key words:**

*SARCC, Culture Collection, Rhizobium, Microbiome, WDCM database, South Africa, Nitrogen fixation*

## 1. Introduction to the South African Rhizobium Culture Collection

The South African Rhizobium Culture Collection (SARCC) is one of the oldest microbial collections in South Africa established in an effort to promote rhizobium research in the country as well as to maintain and preserve rhizobium cultures as the component of the public good assets of South Africa. The SARCC hosts close to 1700 strains of rhizobia capable of fixing atmospheric nitrogen (N<sub>2</sub>) in various legume species ranging from crop and pasture plants to fodder trees and forests.



**Figure 1:** Rhizobium cultures at the SARCC are regularly preserved for short-term use at 4°C (a), as well as for a prolonged period using lyophilized (freeze-dried) (b) and frozen (-80 °C ultra-freezer) (c). Cultures are routinely checked for purity, viability and strain identification (c- e).

These strains improve growth and yield of economically important legumes, and are essential in maintaining sustainable agriculture and soil fertility in South Africa. Through prolonged research on the nodulation competitiveness and nitrogen fixation

efficacy, several strains have been screened in the past and developed as commercial inoculants as biofertilizers in the cultivation of legumes such as soybean, cowpea, lucern, chickpea, beans, peas and a number of other forage legumes. The collection supplies cultures to inoculant manufacturers, research institutes and farmers, which makes the culture collection an important national asset.

Being an integral part of the South African legume industry and the main source of legume rhizobium inoculants to farmers and inoculant manufacturing companies in South Africa, maintaining these beneficial microorganisms in the collection provides significant economic and social benefits as collection activities support research and provide key services to disciplines such as crop protection and production. In doing so, properly maintained national assets provide an immense contribution in sustainable crop production and protection systems and hence in safeguarding national food security. Currently there are more than 1700 different strains of rhizobia and rhizobacteria in the SARCC collection which are stored preserved in lyophilized form as well as in frozen cultures at ultra-low temperature (-80°C) and are regularly maintained and checked for purity and viability. With regard to up grading of the SARCC database, the collection has joined the Global Catalogue of Microorganisms (CGM), the data base link of the World Federation of Culture Collections (WFCC) and a new SARCC homepage is being developed to link the collections to the database of the World Data Centre for Microorganisms (WDCM).

Research conducted using the resources in the SARCC (i.e. the national assets) has also resulted in generating valuable information on the nodulation and nitrogen fixation efficiency of selected strains from the collection. To date more than 15 rhizobium cultures were developed and commercialised for use as inoculant biofertilizers in legume production in South Africa. These commercial strains have been developed from strains belonging to the alpha Proteobacteria group including *Rhizobium*, *Bradyrhizobium*, *Sinorhizobium*, and *Mesorhizobium* as well as the beta-rhizobium *Burkholderia* spp. All these species were isolated either from the root nodules of various legume hosts or trapped from the rhizosphere soil of these legumes in the glasshouse pot experiment after which nodulation authentication test was conducted to confirm their ability to infect and nodulate their original legume host. Apart from these outputs, several free-living rhizosphere bacteria, commonly referred to as plant growth promoting rhizobacteria (PGPR) are being included in the microbiome research project initiative of the ARC-Plant Protection Research Institute in South Africa. These strains of rhizobacteria are normally isolated from the rhizosphere of pristine grassland and screened for their efficacy in promoting growth in such staple crops as maize (*Zea mays* L.). About 20 potentially effective strains belonging to members of the Genera *Pseudomonas*, *Burkholderia*, *Bacillus* and *Enterobacter* are preserved at the SARCC collection for which 16S sequence analysis was done and new accession number was received from the Genbank. Owing to the rising demand to develop plant growth promoting rhizobacteria for commercial exploitation and application in sustainable agricultural systems, the incorporation of

these free-living rhizobacteria as a component of the SARCC is a vital tool in strengthening microbiome utilization and research in South Africa.

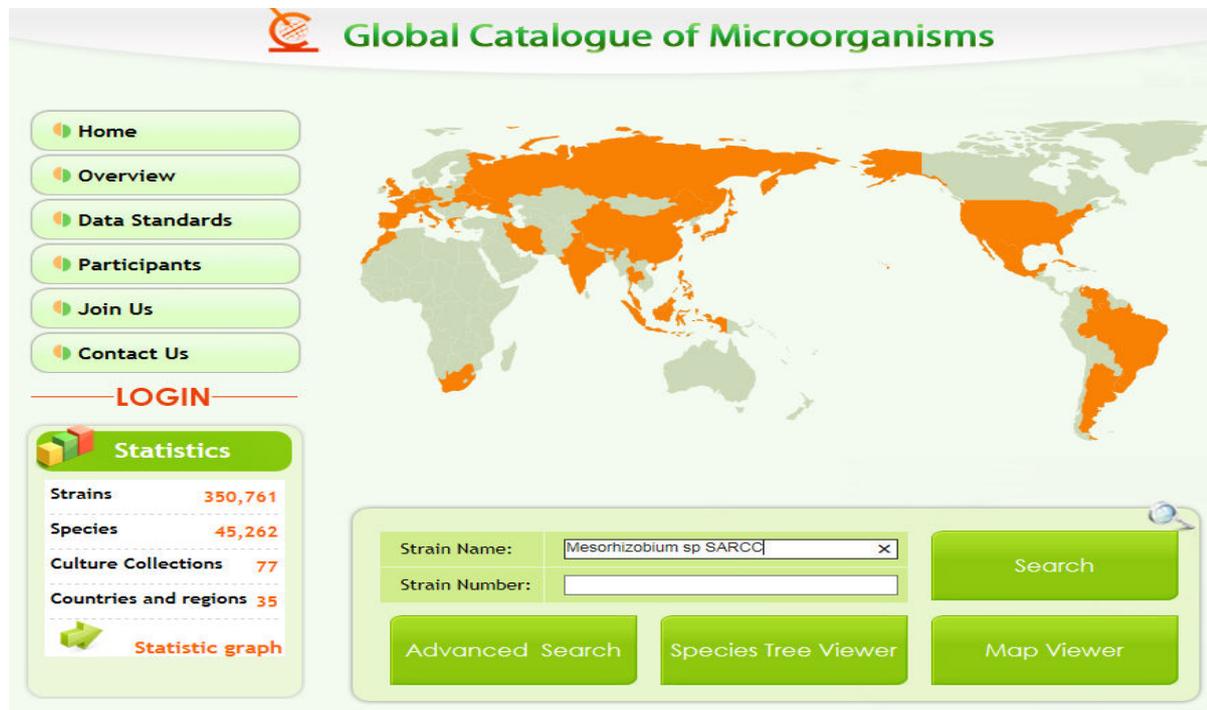
## **2. Benefit from the training courses.**

The 2017 training course on microbiome data sharing contains several important topics that ranged from data base management and application of the World Federation of Culture Collection (WFCC) global catalogue of microorganisms including WDCM home page, the CCINFO and WDCM database to the various global databases and data standards of microbial resources. In addition, the training course incorporates such important lectures that can directly be applicable for taxonomic purposes of the collections as well as for proper handling and sharing of the microbial resources globally. Some of these courses that are of vital importance for proper identification of the cultures in the collections that also support research activities by each culture collection include: microbiome data management system, characterization of bacterial strains for taxonomic purposes, polyphasic taxonomy of prokaryotes, microbial genomics and metagenomics and microbial genome analysis: SILVA/MLST. Apart from these, the lectures on the various data base platforms and tools such as the global mycological database, WDCM analyzer of bio resources citation, 16S rRNA sequences based taxonomy platform and the BOLD mirror were very vital for the participating member collections in future development of their holdings to a world standard culture collection. In order to upgrade the status of their microbial holdings to world standard, it is vital that SARCC and similar other collections, especially in developing countries, attend such microbiome and related

culture collection training and workshop on a regular basis. In general, the training in microbiome that includes management and utilization of the microbiome resources assists the staff of the SARCC and all participants to acquire better knowledge on the microbiome, its applications as well as microbial culture collection management. With regard to the SARCC, gaining the latest information regarding microbial information systems would contribute a lot to improve the rhizobium collection and make it compatible to an international acceptable standard.

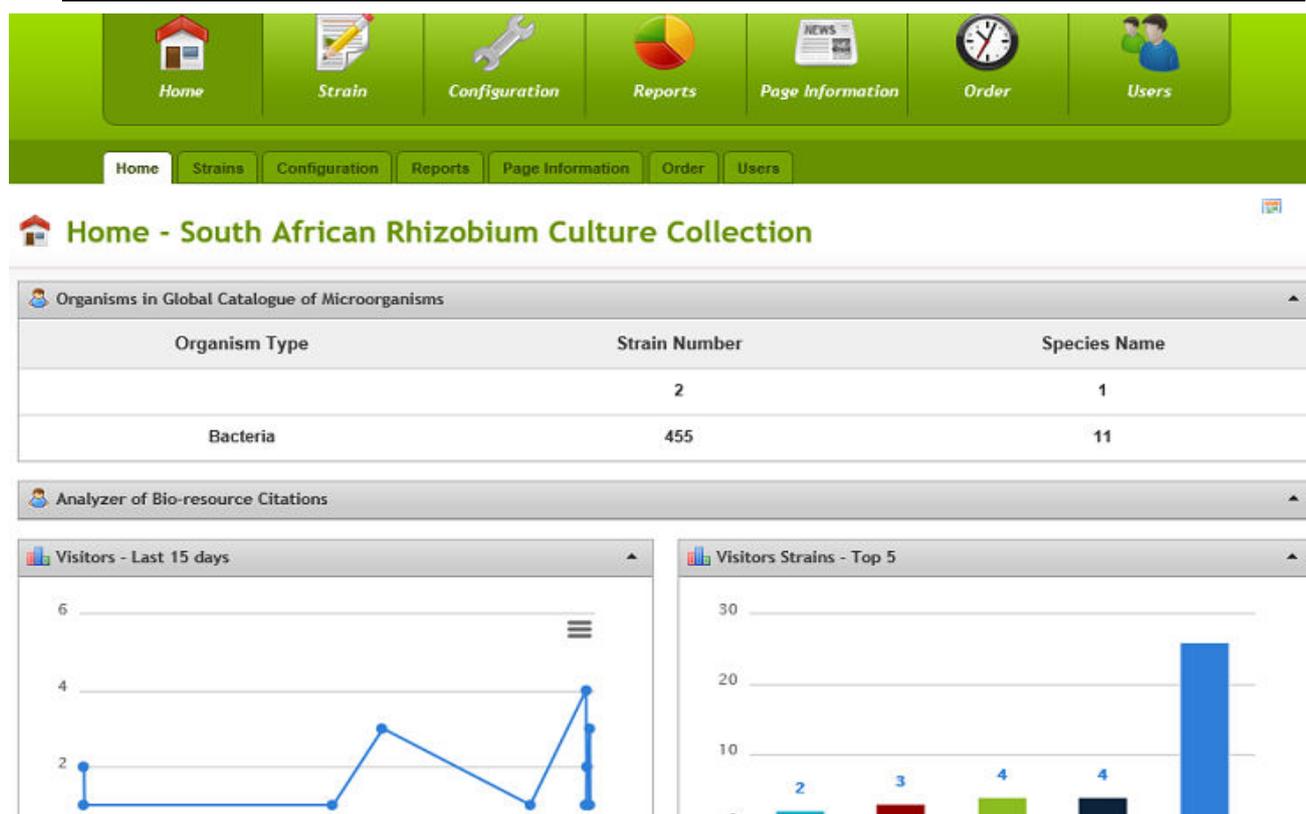
### 3. Suggestion on WDCM work.

The unreserved effort of the WDCM to introduce culture collections in the developing countries to the global catalogue of microorganisms (gcm) data base and to assist them to be members of the WDCM is so tremendous.



The screenshot shows the homepage of the Global Catalogue of Microorganisms (gcm). The page has a light green background. On the left side, there is a vertical navigation menu with buttons for Home, Overview, Data Standards, Participants, Join Us, and Contact Us. Below the menu is a 'LOGIN' section. A 'Statistics' box displays the following data: Strains 350,761, Species 45,262, Culture Collections 77, and Countries and regions 35. A central world map highlights member countries in orange, including South Africa, Morocco, and several countries in South America and Asia. At the bottom, there is a search interface with fields for Strain Name (containing 'Mesorhizobium sp SARCC') and Strain Number, a 'Search' button, and buttons for 'Advanced Search', 'Species Tree Viewer', and 'Map Viewer'.

**Figure 2:** The Global Catalogue of Microorganisms (gcm) home page showing members of the WDCM (in orange) where by the South African Rhizobium Culture Collection (SARCC) is a registered member along with culture collection from Morocco. Picture Source: WDCM home page.



**Figure 3:** The Global Catalogue of Microorganisms (gcm) home page of the South African Rhizobium Culture Collection currently under development. Photo source: WDCM web site.

Culture collections benefit from this work of the WDCM in such a manner that they will be able to have world standard in house data management system, their own home page and online catalogue. Having registered as a member of the WDCM, the South African Rhizobium Culture Collection (SARCC) has now a global catalogue of microorganisms (gcm) home page and the online catalogue is under development which can be accessed from the link: <http://gcm.wfcc.info/admin/home>

#### **4. Comments or suggestion on the training courses.**

The training course organized by the WDCM on the microbiome sharing this year contains several aspects of the microbiome lectures, which are all useful in microbiome research as well as data base management systems of our collections. The participants have made a great deal out of the visits made to the Biosafety level 3 (BSL-3) laboratories and the Chinese General Microbial Culture Collection (CGMCC) facilities. The organizational management and the overall laboratory facility are generally of world standard that can be models to many of the collections of the participants and their affiliated laboratories. Worth mentioning is, however, a comment on what the current training lacks and a suggestion on what future trainings on related topics should look like. The training courses which were completely based on oral lecture presentations contain some lectures which were hard to follow, not easy to comprehend and sometimes not clear. It is agreed and suggested by many of the participants future training should somehow involve hands on practice on some essential selected topics such as:

1. Data base practice using actual culture collection data either from a website or from the participants own sequence/culture collection data.
2. Microbiome/Single cell nucleotide sequence analysis and interpretation
3. Microbiome/NGS data annotation, sequence assembly and so on.

## 5. Suggestion on further cooperation between WDCM and the SARCC

What makes the work that the WDCM has done different from the previous training events is that a tremendous effort has been made to enable the participants to start up a new initiative for collaboration with scientists at the Institute of Microbiology, Chinese Academy of Sciences. Many of the attendees have already formed at least one contact in their respective research fields. I, as the participant from the SARCC in South Africa, have met Professor Jian Ye, a scientist at the State Key Laboratory of Plant Genomics, Institute of Microbiology who was willing to collaborate on research activities that involves characterization of beneficial soil bacteria that have roles in plant growth promotion as well as biological control by inducing resistance due to some metabolite secretion. I had also got the privilege of visiting their state key laboratory and engaged with him on valuable discussion on future collaboration.



**Figure 3:** A platform for new collaboration with the Institute of Microbiology, Chinese Academy of Science. Standing with Professor Jian Ye of the State Key Laboratory of Plant Genomics; Laboratory of Jian Ye (middle) and a growth chamber facility with a model plant *Arabidopsis* in the Laboratory (right).

**Acknowledgement:** The participants of the 2017 WDCM microbiome training duly acknowledge the WDCM for the sponsorship provided to the participants to attend the event and for the entire work being done to enable culture collections in the developing countries to acquire a well developed and standardized database management system of their collection.