Training Course of Microbial Resources Information Management and Utilization for Developing Countries

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WDCM, Chinese Academy of Science, Institue of Microbiology

Personal introduction

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Born in Addis Ababa, Ethiopia and an Ethiopian National with a permanent resident and work permit in South Africa. Initially graduated in pure biology (BSc.1989) and Applied Microbiology (MSc. 1999) from Addis Ababa University and later in Microbiology and Plant Pathology (PhD, 2007) 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)

ABSTRACT

The ARC-PPRI hosts the South African Rhizobium Culture Collection (SARCC), an important component of the public good assets of South Africa which hosts several hundreds of rhizobial strains capable of fixing atmospheric nitrogen (N_2) in various legume species ranging from crop and pasture plants to fodder trees and forests. 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. Currently, the collection hosts more than 700 strains of rhizobia and has been registered as member of the World Federation Culture Collection (WFCC) with a membership number WDCM 968 and CCINFO link. The collection supplies cultures to inoculant manufacturers, research institutes and farmers which makes the culture collection an important national asset. In order to achieve this, the cultures should be regularly maintained and catalogued in a reliable data basing system.

Key words:

WFCC, SARCC, Culture Collection, Rhizobium, Nodulation, WDCM database, South Africa, microbial resources.

1. Brief introduction of the SARCC

The establishment of the South African Rhizobium Culture Collection (SARCC) dates back to the 1960s with the initiation and beginning of legume-rhizobium interaction studies at the universities of Pretoria and Stellenbosch. In 1965, exploitation of the nodule bacteria symbiosis studies on South African soils resulted in the isolation and screening of hundreds of *Rhizobium* and *Bradyrhizobium s*trains associated with the nodulation and nitrogen fixation of indigenous legumes and legumes of agricultural importance. South African soils are rich in indigenous *Bradyrhizobium* spp. that nodulate Peanuts (*Arachis hypogaea*) & Cowpea (*Vigna unguiculata*). Many soils are also rich in strains of *Sinorhizobium* species nodulating and fixing atmospheric nitrogen in Lucerne (*Medicago sativa*), one of the most important forage and pasture legume worldwide. Populations of *Sinorhizobium meliloti* effective on lucerne naturalized in most areas with suitable pH and are also effective on annual medics *Medicago truncata, M. littoralis*. Several strains of *Mesorhizobium* spp. which are the microsymbionts of chickpea and related legumes have also been detected in soils where these legumes have been planted for long.

The South African Rhizobium Culture Collection (SARCC), hosted by the ARC-PPRI, is one of South Africa's Agricultural National Public Assets (ANPAs) which

are managed by Department of Agriculture Forestry and Fishery (DAFF) and Department of Science and Technology (DST).

Figure 1. The ARC-PPPRI building in Pretoria, South Africa that hosts the South African Rhizobium Culture Collection (SARCC).

The collection hosts several hundreds of Rhizobial strains capable of fixing atmospheric nitrogen (N_2) in various legume species ranging from crop and pasture plants to fodder trees and forests. These rhizobial strains improve growth and yield of economically important legumes and are essential in maintaining sustainable agriculture and soil fertility in South Africa. More than 20 years of screening and research on the Rhizobium-legume symbiosis at the biological nitrogen fixation unit of the ARC-PPRI resulted in the selection and of several effective strains of about 15 strains have been developed into commercial inoculants for agriculturally and economically important legumes. Among the important inoculant strains developed into commercial inoculants include

Bradyrhizobium strain WB74 for soybean. (*Glycine max*), *Bradyrhizobium* sp. XS21 for ground nut (*Arachis hypogea*), *Bradyrhizobium* sp. XCV14, *Rhizobium* sp. TJ14 for peas (*Pisum sativum*), *Rhizobium* sp. SR4 for clover (*Trifolium repens*) and *Sinorhizobium meliloti* RF14 for lucern (*Medicago sativa*).

Figure 1. Display of the major sections of the Laboratory of the South African Rhizobium Culture Collection showing: Isolation and characterization lab (a), bacterial growth lab (b), Nikon DIC fluorescent microscope (c) and PCR and gel electrophoresis facilities (d).

These strains have been used for several years with their identity having been determined using only conventional methods and by means of their growth rate and characteristics due to lack of facility and expertise. Recently, as part of developing and adding new information to the culture collection, the strains are being identified to the genus and species level using phylogenetic analysis of the

nucleotide sequence of the rhizobial 16S rRNA gene. Additional effort is also being made to characterize the rhizobial strains using some major symbiotic genes such as the *nod*C, *nod*A and *nif*H genes unique to nodulating strains of rhizobia. This does not only facilitate the selection and screening of highly effective nitrogen fixing strains for the development of legume inoculants in South Africa. It is also very important to improve and develop the database of the South African Culture Collection by adding new information.

Culture collections of beneficial microorganisms are national good assets which provide significant economic and social benefits. Collection activities support research and provide key services to disciplines such as crop protection and production thereby safeguarding national food security. Rhizobium cultures developed into legume inoculants are not only cost effective to both commercial and small scale farmers, but are also the best alternatives to minimize or replace the use of inorganic nitrogen fertilizers which are harmful to the environment. In order for such national public assets to be used for sustainable agriculture and food security and to fulfil ARC's mandates, proper maintenance, enhancement by addition and characterization of new accessions as well as sufficient utilization of the assets is necessary. Among the strategies to ensure optimal resource utilization and sustainable growth involves the proper maintenance and developments of national assets.

2. Benefit from the training courses.

The training course will assist the staff of the SARCC collection at ARC-PPRI to acquire knowledge on the microbial culture collection and taxonomic experiment skills. It also helps us learn and develop a trend and technical advancement in the field of microbiological information and learn and manipulate culture collection database and their management platforms. Moreover, the training on quality management systems, data management and information networks is very valuable to strengthen the collection development in any given culture collection.

The course has provided ample benefits to the participants in four major aspects: 1) How to handle data base management system including the WFCC and the WDCM data base for culture collections; 2) Basic techniques in characterization of bacterial strains for taxonomic purposes as well as typing methods for bacteria; 3) How to annotate and integrate retrieval of microbial gnome sequences 4) How to join the Global Catalogue of Microorganisms (GCM) of the WDCM.

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to both commercial and small scale farmers, but are also the best alternatives to minimize or replace the use of inorganic nitrogen fertilizers which are harmful to the environment. In order for such national public assets to be used for sustainable agriculture and food security and to fulfil their mandates, proper maintenance and data base management, enhancement by addition and characterization of new accessions as well as sufficient utilization of the assets is necessary. Among the strategies to ensure optimal resource utilization and sustainable growth involves the proper maintenance and developments of the culture collections. Data management and information networks are so valuable to strengthen the collection developments in the collections. Generally, the training sessions provided by the WDCM on microbial resource information management and utilization for developing countries has helped all participants to acquire important knowledge and learn some major techniques on how to manage, handle and exchange the microbial strains in their culture collections.

3. Suggestion on WDCM work.

The efforts and dedication so far made by the World Data Centre for Microorganisms (WDCM) to develop a state of the art but again, user friendly data base for culture collections worldwide is to be highly appreciated. Collections can now easily manage, share and disseminate information related to their holdings. For this the WDCM has made it simpler for the scientific communities to access vital and detailed microbial resource information.

4. Comments or suggestion on the training courses.

From the very beginning, the communications made to the participants by the WDCM personnel before our arrival to Beijing is very feasible and so interactive which made everything smooth. All vital information has been communicated to the participants on a timely basis and the required documents were received as expected with no delays and misunderstanding. In light of this, VISA processing was so quick with no complications. However, unlike many other such training programs, the weak part of the training course is that there was no arrangement made to pick the participants from the airport on arrival date which has caused a big problem for us to take a taxi to the hotel due to language and communication barriers with the taxi drivers. The other drawback of the training is that it is more of theoretical than practical training. Some of the power point presentation are somewhat similar to normal scientific presentations rather than training.

5. Suggestion on further cooperation between WDCM and your collections

It is understood that most of the culture collections from the developing countries have very limited resources, expertise and tools to characterize the very many strains in their holdings and manage the collections in accordance with the minimum data set required by the WDCM Global Catalogue of Microorganisms. This training course is therefore presumed to be an important platform to establish collaboration between the WDCM and the different collection. During this

training session and the discussions with the WDCM personnel, some of the participants have already laid the foundation for such type of collaboration. The South African Rhizobium Culture Collection on this occasion is glad to express its gratitude and happiness for having a concept agreement for future collaboration with the WDCM. The collaboration is based on a mutual benefit between the two parties in which SARCC will send some of its holdings to the CGMCC through the WDCM for high throughput sequencing and characterization of the strains once the proper MTA and MOU are signed. This will enable the SARCC strains to meet at least the minimum data sets required by the global catalogue of microorganisms on the WDCM data base. Moreover, applied research (nodulation and nitrogen fixation activities) of these strains conducted at the SARCC laboratory and results from the high throughput sequencing could be integrated and published bilaterally on peer reviewed scientific journals.