Advancing technical skills in rhizobiology: training report

A two week training course conducted in the East and Central Africa Hub of the N2Africa Project at the College of Agriculture and Veterinary Sciences, University of Nairobi, Kenya, (13-24 September 2010)

Milestone reference number 5.1.1

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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Summary

Improved technical capacities in rhizobiology are required to design, evaluate and commercialize legume inoculants in East and Central Africa. A training course was held for the purpose of training key laboratory personnel and MSc students to gain the knowledge and skills to enhance inoculant production in their respective countries. The workshop attracted twelve participants (50% women) from Democratic Republic of Congo, Kenya and Rwanda. In this workshop, various discussions and material presentations were given by experts and practitioners in rhizobiology, microbiology and biotechnology.

The approach chosen was one of mixing theoretical,.interactive and practical sessions throughout the training..The participants were able to discuss various views on rhizobiology, inoculant production and quality control,.lab-based PCR methods, nitrogen fixation quantification, and laboratory, greenhouse, and field techniques, exchange experiences and lessons between participants, and learn from inoculant industry practitioners about production system efficiency and product sustainability. Materials provided to participants included a training resource manual, PowerPoint presentations, literature and sample technical papers on biological nitrogen fixation (BNF) both in printed and electronic copies. These materials were used for lectures and discussed with respect to each practical session. Visits were taken to the Kenya Forestry Research Institute, Muguga and the CIAT-TSBF laboratories in Nairobi.

All participants agreed that the workshop achieved its stated objectives and that they would be able to carry out the skills learnt during the course. At the end of the training participants discussed and developed country specific action plans which shall facilitate rhizobiology activities in their respective countries (See Annex 3)Please use Arial 10 (style Normal) for the text.

1 Introduction

1.1 Background Information

Bacterial associations with certain plant families, primarily legume species, make the largest single contribution to biological nitrogen fixation in the biosphere. The N fixing rhizobia-legume system contributes around 50–600 kg N/ha/year while rhizosphere associations and free living bacteria supply 5–25 and 0.1–25 kg N/ha/year, respectively. An important component of the project "Putting nitrogen fixation to work for smallholder farmers in Africa" is to select superior rhizobia strains for enhanced biological nitrogen fixation (BNF) and develop inoculum production capacity in sub-Saharan Africa, with public and private sector partners (Project Objective 3). It is expected that the N2Africa project will raise average grain yields by 954 kg/ha in four legumes (groundnut, cowpea, soybean, and common bean), increase average biological nitrogen fixation (BNF) by 46 kg/ha, and increase average household income by $465, directly benefiting 225,000 households (1,800,000 individuals) in eight countries in sub-Saharan Africa (Democratic Republic of Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Zimbabwe)

The aim of this training was to improve the microbial skills relevant to inoculant and legume production techniques of technical staff from the partner institutions and MSc students in Democratic Republic of Congo, Kenya and Rwanda. Activities at the training included practicing in the laboratory, visiting an inoculant production plant and attending lectures. The training was designed by Dr. Paul Woomer and Prof Nancy Karanja with consultation from other N2Africa team members. The instructors of the training were drawn from N2Africa staff, MIRCEN of the University of Nairobi and other partner organizations with expertise in microbial skills and inoculant production.

1.2 Course Objectives

This training was held to train N2Africa laboratory technicians and MSc. students to advance their technical skills in rhizobiology. Specific objectives were to:

- Equip participants with knowledge and skills in inoculant production, quality control and field inoculation of grain legumes.
- Give the facilitators and trainees the opportunity to share varied lessons and experiences, related to methods and tools used at an inoculum production plant and how inoculums are used at farm level.
- Provide each participant with a full set of activities and materials which include: basic rhizobiology, strain selection and inoculant production and use.
- Evaluate and improve the rhizobiology training materials and plan the outline for a training programme to be delivered in the Southern and West Africa hubs.
- Discuss and develop a draft action plan for project objective 3 activities in the respective countries.

1.3 Participants and Resource Persons

Twelve participants (50% women) from the Democratic Republic of Congo, Kenya and Rwanda were in the course. The participants were selected with preference given to those who have an interest and potential to support the development of inoculant production in their country. The resource persons were from the N2Africa team and its key partners including Prof Nancy Karanja, Dr. Paul Woomer, Dr Fredrick Baijukya, Dr Kenton Dashiell and Dr Saidou Koala. University of Nairobi-MIRCEN staffs were responsible for preparation and

facilitation of laboratory, greenhouse and field practical sessions. Other invited resource persons were Mr. Joseph Machua, Senior Research Officer at the Kenya Forestry Research Institute (KEFRI) and Mrs. Teressah Wafullah, an AKTP Associate at MEA Limited. The list of participants and resource persons is in Annex 2.

1.4 Organization and Structure of the Course

The programme (Annex 1) consisted of lectures, practical and group discussion. Every lecture was followed by a related hands-on practical and the facilitators maintained a continuous dialogue with participants. This enabled participants to better understand the concepts being given and to apply these to the work they will be doing in their countries. The lecture modules addressed the following subjects; basic rhizobiology, BNF in small scale agriculture, the legume-rhizobia symbiosis, rhizobia inoculants and inoculation, strain characterization, identification, authentication and selection, and quality control of inoculants. Each lecture would start from basics to help bring all participants to the same understanding of concepts and to a shared level of knowledge by the end of the training activity.

The practical session helped participants to better understand the lecture material presented. In general, laboratory practicals were conducted during morning sessions and field work performed during afternoons as a means of balancing course contents and reducing microbial contamination. Demonstration and practical materials were inoculated between 21 and 28 days prior to their use during the course.

Towards the end of the course, participants met in country groups for developing a rhizobiology plan (Objective 3) for each country. A hard copy folder and an electronic version of all the presentations and other useful reference materials were distributed to the participants.

2 Course Proceedings

Day One: An opening ceremony with short remarks from one of the leading scientists in Africa in the BNF field, Prof Shellemiah Okoth Keya of the University of Nairobi, was carried out. The expected output from the training was outlined after a brief overview of the N2Africa project was given by the project leader and the objectives of this course were given by the objective 5 leader. Next was a lecture introducing nitrogen fixation and taxonomy of Rhizobium by Prof. Nancy Karanja. It was noted that in order for N to be used for growth it must be "fixed" (combined) in the form of ammonium (NH4) or nitrate (N03) ions. To break N2 apart so that its atoms can combine with other atoms requires the input of substantial amounts of energy. There are three processes which are responsible for most of the nitrogen fixation in the biosphere: industrial fixation, atmospheric fixation and biological fixation. In industry, the N fixation needs very high temperature and pressure. In nature, the ability to fix nitrogen is found in certain bacteria. Some live in a symbiotic relationship with plants of the legume family (eg. soybean, alfalfa). Some establish symbiotic relationship with plants other than legumes (eg. alders). Some nitrogen fixing bacteria live free in the soil. Biological nitrogen fixation requires a complex set of enzymes and a huge expenditure of ATP. The lecture also mentioned about nitrogenase, the enzyme that converts N2 to NH3, its function and the genetics of its synthesis and activation.

The second component of the lecture was the taxonomy of rhizobia. Only about 15% of the.19,700 species of legumes have been evaluated for nodulation. Rhizobia are gram positive bacteria with a rod shape. They are the most studied symbiotic N2-fixing bacteria and are now subdivided into several genera..The first rhizobial species was identified in 1889 and most new species were put in the Rhizobium genus until more advanced methods of analysis placed the species in to new genera. The molecular genetics tool using 16S ribosomal RNA uncovered many new species. An introductory lecture on nitrogen and legumes was delivered by Dr Paul Woomer.

In the first day of laboratory work, participants were reminded of general laboratory safety rules as these were presented and discussed. After splitting into six working groups of two, participants prepared growth media, inoculated broth cultures and isolated rhizobia.

Day Two: A Lecture on culturing rhizobia, strain characterization and identification was presented. This was followed by a practical on serial dilutions, quantifying rhizobia by plate count and plant infection. In the afternoon, the participants visited the KEFRI laboratories to observe rhizobia growth on indicator media, gram staining, culture storage and a PCR demonstration. The participants were fascinated by the rhizobia identification technique using the DNA molecular markers.

Day Three: The lecture was on Rhizobia, symbiosis, inoculants and inoculation and production and marketing of inoculants. The practical focussed on seed inoculation techniques and carrier material selection and processing. Characteristics of a good carrier for liquid inoculant production should be: non toxicity, low in cost, readily available, could be used under normal fermentation conditions, nearly neutral pH or easily adjusted, amenable to nutrient supplements, rapid release of rhizobia in the soil, supports rhizobial growth and survival, and is manageable in the mixing and packaging operation. The most suitable carrier for Rhizobium production is peat but peat is not always available, and can be exhausted. Therefore, alternative carriers must be explored.

After the practical session, the participants visited Ondiri peat marsh where they had the opportunity to observe peat in the field. However, they were reminded that the site is a protected water catchment and so one must get permission from the relevant government authority before harvesting peat for research work.

Day Four: Lectures on the fourth day focused on Rhizobium strain authentication and selection and product testing. In the afternoon the participants had a practical on greenhouse management, Leonard jars, growth pouches and preparation of soil for potting. They noted that the plastic Leonard jars are more convenient in terms of weight and space. They were also advised that they can use other materials such as sawdust to fill the Leonard jars in case sand is not readily available. The participants were provided with guidelines on site selection and how to design a good field experiment or demonstration. Participants shared experiences with each other and with the trainers during lecture presentations and in the field.

Day Five: Participants inspected and purified nodule isolates and were shown agglutination and immunodiffusion procedures, preparation of antigens and injecting a rabbit. This session was preceded by a lecture on rhizobia strain identification. The afternoon session focussed on maximizing BNF and response to inoculation.

Day Six: The participants visited the inoculant production plant at MEA limited in Nakuru that enabled them to learn about quality control mechanism in inoculant production, how to prepare the stickers from gum arabica, packaging and distribution of the inoculant.

Day Seven: Free day

Day Eight: Mid-course review was conducted with particular emphasis on the strengths and shortcomings of the course in the first week for improvement in the following week. This session was facilitated by Dr Kenton Dashiell. The key issues raised are highlighted in the section on recommendations. Thereafter the participants observed colony morphology, inspected and purified nodule isolates.

The team visited CIAT-TSBF in Gigiri to observe and learn how inoculant products are tested in the greenhouse and laboratory. The preliminary results from the Commercial Products Project (COMPRO) indicate that some products are more effective than others.

Day Nine: The day started with a group discussion on aligning lab capacity and technicians' skills to N2Africa project activities and milestones before a morning practical on reading plate counts and estimating cell counts with optical density. A lecture on most probable number (MPN) by dilution extinction method was presented prior to MPN set up with growth pouches, building racks, planning MPN, aseptic irrigation, inoculating the pouch and reading the result.

Day Ten: Prof Nancy Karanja delivered a lecture on quality control of legume inoculants. She appreciated the current sophisticated and advanced techniques used in culture storage and quality maintenance. However, she also emphasized on the need to embrace some of the technologies that are readily accessible and affordable by the smallholder farmers. In the afternoon there was a lecture and practical on rhizobia exploration where the participants learnt how to set up a Rhizobia exploration that included collection, isolation, purification, authentication and characterization.

Day Eleven: Participants discussed in groups according to their countries. The discussion was guided by Dr Paul Woomer and Prof Nancy Karanja and focussed on developing action plans for in country rhizobiology activities. After the discussions the participants were asked to prepare a draft action plan for their respective countries. As part of the course practical, the participants read plate count of inoculants and inoculated seed (culture 3). They also gained experience in the MPNES and Inoculation Requirements software utilities.

Day Twelve: Participants presented rhizobiology (project objective 3) action plans for each country. Input was given by the facilitators and other participants, including looking at the feasibility of the plan. (Annex 3).

3 Course Review and Conclusion

There was a post-evaluation of the workshop that involved individual participants filling in a form that that was designed to assess the views of the participants with regard to the workshop modules, presentations, activities and organization. Participants were also asked to suggest how the workshop could be improved. Analysis of views of participants, resource persons and workshop organizers based on the evaluation form and face to face discussions on specific issues lead to the following conclusions;

Methodology: Participants were unanimous in saying that the learning by doing interactive approach adopted as well as the sharing of experiences and ideas between participants and facilitators was effective.

Course Objective: Overall it is possible to state that the methodological approach adopted was regarded as a success and that most participants did achieve a shared understanding of inoculant and legume production skills at the end of the training. The assessment of the participants training feedback (Annex 4) shows that the objectives proposed from the outset were attained and they would be able to carry out the gained skills at their workplace, become a facilitator and guide colleagues in their institutions in rhizobiology activities. The main elements highlighted to have contributed to the achievement of the training objectives were: Practical sessions, individual face-to-face sessions with the training facilitators and group discussions.

Knowledge Transfer: Based on the evaluation form, participants agreed that the workshop has improved their level of knowledge on rhizobiology and further suggest that this training to be continued on a regular basis.

Course Content: All participants gave a high rating on the course content and effectiveness of delivery of the topics. However, they felt that modules on laboratory and data management should be added.

Facilitation: The Workshop employed different facilitation methods that continuously engaged participants to give input or to share experiences. Competencies of the resource persons/trainers were rated to be excellent. Probably, an expert that is not working in the N2Africa project such as J. Howieson. would have strengthened the course and provided a broader perspective.

Timing: Careful planning and timing allows for a two-week course. However, the general feeling was that the time allocated to cover the content of the course effectively was too short. In the process, most topics were hurriedly covered. Moreover, the participants felt that more time should have been allocated for the laboratory practical and possibly starting in the afternoon hours so that the morning hours are devoted to lectures. Furthermore, participants were forced to work with undersized root nodules because practical materials were inoculated too late.

Logistics: The participants felt that the logistics were well coordinated except that the distance between the training venue and the KARI Retreat Centre (where they were lodger) was too long. This caused morning sessions to start later then planned. They also complained of lack of internet service at the KARI Retreat Centre.

4 Recommendations

- The practical sessions enabled the participants to cope with the amount of information being delivered. In this regard future trainings should take into account that lectures should be no longer than one hour and theoretical sessions should always be followed by a practical exercise. Moreover, practical sessions should be in the afternoon so that morning hours are devoted to lectures.
- The training venue should be within or near the hotel where participants are accommodated to reduce time spent travelling between the training venue and hotel.
- Furthermore, it is also critical to maintain continuous communication with participants so participants are constantly reminded to reflect on the project and individual work, and to support participants in evolving into higher levels of understanding.
- The language of presentation and discussion was not ideal for a few French speaking participants that could not communicate effectively in English and hence needed translation. This slowed down the presentation and discussion a little bit at some point but trainees with knowledge in French always intervened making sure that the course progressed smoothly. In addition, Kiswahili was used to overcome weakness in communication with the Francophone participants. Arrangement for translation from English-French and vice versa for participants speaking different languages is necessary in future trainings in case participants come from both Anglophone and Francophone speaking countries. Preferably, TSBF staff fluent in French should take a greater role in day-to-day instruction.
- Further training on inoculant preservation, laboratory and data management is recommended.

5 Post Training Follow-ups

As important as the training is, what is more important is that it is applied, at the country and institutional level based on project needs. To ensure that the participants are in a position to carry out the skills gained in the training they are requested to consult with their respective Heads of Organizations and the N2Africa hub leasders to ensure that country project activities and follow-ups will be carried out..Participants will be expected to;

- Pass the knowledge and skills gained from the training to other staff in their institution.
- Have keen interest and be available to participate in the activities of the N2Africa project particularly on rhizobiology and contribute to the implementation of the project objective 3 work plans.
- Maintain communication with other participants, the training facilitators and N2Africa project staff and its partners on the progress of carrying out the skills gained in the training.
- Play an active role in providing inputs and feedback on the project implementation, especially for objective 3.

6 Acknowledgements

We wish to thank George Mwenda and Stanley Kisamuli, for organizing and facilitating the practical sessions of the course and providing excellent support during the two weeks of the course. We are grateful to the Dean Faculty of Agriculture and the Chairman Department of Land Resource Management and Agricultural Technology (LARMAT) of the University of Nairobi for providing us with the opportunity to use their premises and facilities to conduct the training.

Annex 1: Course Schedule

Advancing Technical Skills in Rhizobiology

A two week training course conducted in the East and Central Africa Hub of the N2Africa Project

(13-24 September 2010)

Course Schedule

	Topic/Activity	Facilitator
	Sunday 12 September 2010	
	Arrival of participants and transfers to KARI Retreat Centre-Muguga	
	Day One: Monday 13 September 2010	
	Registration of participants	J. Odongo
	Introduction of participants	N. Karanja
Morning Lecture	Overview of N2Africa project	K. Dashiell
	Objective of the training and Objective 3 technical milestones, skill set for project technicians and graduate students.	S. Koala
	Key note address and official opening	Principal-CAVS/Dean Faculty of Agriculture
	Overview of the training process and activities	P. Ngokho
	BNF in African agriculture	S. Keya
	Basic rhizobiology, isolating, characterizing and maintaining rhizobia in the laboratory	N. Karanja
	Tea/Coffee Break	
Morning Practical	Laboratory intro, workstation and partner assignments, media preparation, set up glass fermenters, inoculate broth cultures	N. Karanja & MIRCEN Team
	Lunch Break	
Afternoon Lecture	Nitrogen and legumes	P. Woomer

	Tea/Coffee Break	
Afternoon Practical	Legume identification, nodule exploration, recovery and preservation, rhizobium isolation (culture 1), streaking technique, surface sterilizing & pre-germinating seed	P. Woomer & MIRCEN Team
	Day Two: Tuesday 14 September 2010	
Morning Lecture	Culturing rhizobia, growth requirements and carbon sources, strain characterization & identification	J. Machua
	Tea/Coffee Break	
Morning Practical	Serial dilutions, quantifying rhizobia by plate counts (culture 2) and plant infection (MPN 1)	S. Kisamuli & G. Mwenda
	Lunch Break	
Afternoon Lecture	Rhizobia, symbiosis & BNF	P. Woomer
	Tea/Coffee Break	
Afternoon Practical	Rhizobial growth on indicator media (culture 2 continued), Gram stain, culture storage, PCR demonstration at KEFRI-Muguga	Joseph Machua
	Day Three: Wednesday 15 September 2010	
Morning Lecture	Inoculants & inoculation	P. Woomer
	Tea/Coffee Break	
Morning Practical	Seed inoculation technique (slurry, 2-step & pelleting), plate counts of inoculants and inoculated seed (culture 3)	S. Kasamuli & G.Mwenda
	Lunch Break	
Afternoon Lecture	Producing, marketing and distributing BIOFIX inoculants	T. Wafulah
	Coffee Break	
Afternoon Practical	Carrier material selection and processing, mixing broth and carrier, field trip to nearby Ndera peat marsh	T. Wafulah, S. Kisamuli & G. Mwenda
	Day Four: Thursday 16 September 2010	
Morning Lecture	Rhizobium strain authentication and selection, and product testing in the greenhouse.	Joseph Machua
	Tea/Coffee Break	
Morning Practical	Greenhouse management, Leonard jars, potted field soil	S. Kisamuli & G. Mwenda
	Lunch Break	
Afternoon Lecture	Rhizobium strain selection in the field	F. Baijukya
	Coffee Break	
Afternoon Practical	Field inoculation trials. Experimental design, data collection and analysis	F. Baijukya
	Day Five: Friday 17 September 2010	

Morning Lecture	Rhizobium strain identification	J. Gitahi
	Tea/Coffee Break	
Morning Practical	Inspect and purify nodule isolates as needed (cultures 1&2). Agglutination and immunodiffusion. Visit to Vet antiserum lab and rabbit facilities. Preparation of antigens and injecting animals (demonstration)	S. Kisamuli, J. Gitahi
	Lunch Break	
Afternoon Lecture	Maximizing BNF & response to inoculation	F. Baijukya
	Tea/Coffee Break	
Afternoon Practical	Objective 2 Field Trials and rhizobiology needs. Linking the rhizobium lab to N2Africa field activities	F. Baijukya & N. Karanja
	Cocktail	
	Day Six: Saturday 18 September 2010	
Morning	Field visit to BIOFIX factory (Nakuru)	T. Wafulah
Afternoon	Rift Valley excursion (Lake Naivasha & Hells Gate)	
	Day Seven: Sunday 19 September 2010	
	Free day	
	Day Eight: Monday 20 September 2010	
Morning Lecture	Mid-course review, group discussion and mid-course evaluation. What were the strengths and shortcoming of the course's first week.	K. Dashiell & N. Karanja
	Tea/Coffee Break	
Morning Practical	Observe colony morphology, inspect and purify nodule isolates as needed (culture 1)	S. Kisamuli & G. Mwenda
	Lunch	
Afternoon Lecture	Travel to CIAT-TSBF Headquarters in Gigiri. Inoculant product testing: The COMPRO approach	P. Woomer
	Tea/Coffee Break	
Afternoon Practical	Product testing in the greenhouse and laboratory, comparing available inoculant products	S. Kisamuli & G. Mwenda
	Day Nine: Tuesday 21 September 2010	
Morning Lecture	Aligning lab capacity and technician skills to N2Africa project activities and milestones. Lecture and group discussion.	N. Karanja & P. Woomer
	Tea/Coffee Break	
Morning Practical	Read plate counts (culture 2) and calculating cell densities. Estimating counts with optical density (demonstration)	S. Kisamuli & G. Mwenda

	Lunch	
Afternoon Lecture	Most Probable Number by dilution extinction	P. Woomer
	Tea/Coffee Break	
Afternoon Practical	MPN set up with growth pouches, building racks, planting MPN, preparing –N nutrient solution, aseptic irrigation, selecting for plant uniformity, inoculating the pouch, reading results	P. Woomer, S. Kisamuli & G. Mwenda
	Day Ten: Wednesday 22 September 2010	
Morning Lecture	Quality control of legume inoculants	N. Karanja
	Tea/Coffee Break	
Morning Practical	Inoculant quality testing	S. Kisamuli & G. Mwenda
	Lunch Break	
Afternoon Lecture	Rhizobium exploration: finding better strains	P. Woomer
	Tea/Coffee Break	
Afternoon Practical	Rhizobium exploration set up, isolation, purification, authentication and characterization	P. Woomer, S. Kisamuli & G. Mwenda
	Day Eleven: Thursday23 September 2010	
Morning Lecture	Course review and discussion (1)	N.Karanja & P.Woomer
	Tea/Coffee Break	
Morning Practical	Read plate counts of inoculants and inoculated seed (culture 3). Calculating populations	S. Kasamuli & N. Karanja
	Lunch Break	
Afternoon Lecture	Facilitating grain legume enterprise and mobilizing BNF technologies	P. Woomer
	Tea/Coffee Break	
Afternoon Practical	Computer laboratory, calculating populations using excel, the inoculation requirement utility, MPNES practice	P. Woomer
	Day Twelve: Friday 24 September 2010	
Morning Lecture	Course review and discussion (2)	Team
	Tea/Coffee Break	
Morning Practical	Completion of lab activities, arrangement for distributing cultures and other materials	Team
	Lunch Break	
Afternoon	Group discussion, course evaluation Comments from participants representative	Team

Vote of Thanks	P. Ngokho
Closing Remarks	K. Dashiell & N. Karanja
Official Closing and award of certificates	Principal-CAVS/Dean Faculty of Agriculture

Annex 2: List of Participants

TRAINING OF TRAINERS IN RHIZOBIOLOGY (ECA)-PARTICIPANTS DETAILS

No	Participant Name	Gender	Nationality	Position	Organization
	Trainees				
1	Maureen Waswa	F	Kenya	Student	Univ of Nairobi
2	James Nderitu	M	Kenya	Lab Technician	Univ of Nairobi
3	MacDonald Wesonga	M	Kenya	CEO	ARDAP
4	Wycliffe Waswa	M	Kenya	Research Technician	TSBF
5	Anne Wekesa	F	Kenya	Technician	KEFRI
6	Uwimana Jeanne	F	Rwanda	Lab Technician	Ministry of Agric & Animal Resources
7	Uwizerwa Mathilde	F	Rwanda	Student	Makerere
8	Rumonge Tabaro Alfred	M	Rwanda	Lab Technician	Ministry of Agric & Animal Resources
9	Nocy Kijana	F	DRC	Scientist	INERA
10	Balume Kayani Isaac	M	DRC	Student	UCB
11	Rukiranuka Bienvenu	M	DRC	Lab Technician	UCB
12	Nabintu Ndusha	F	DRC	Assistant Lecturer	UEA
	Resource Persons/Facilitators/Support Staff				
13	Dr Paul Woomer	M	US	Consultant	CIAT-TSBF
14	Prof Nancy Karanja	F	Kenya	Professor	Univ of Nairobi
15	Prof Shelemiah Keya	M	Kenya	Professor	Univ of Nairobi
16	Joseph Machua	M	Kenya	Senior Research Office	KEFRI
17	Stanley Kisamuli	M	Kenya	Technician	Univ of Nairobi
18	George Mutegi Mwenda	M	Kenya	PhD Student	Univ of Nairobi
19	Dr Saidou Koala	M	Burkina Faso	AfNET Coordinator	CIAT-TSBF
20	Dr Fredrick Baijukya	M	Tanzania	ECA Hub Coordinator	CIAT-TSBF
21	Teressah Wafullah	F	Kenya	AKTP Associate	MEA
22	John Gitahi Nduhiu	M	Kenya	Technologist	Univ of Nairobi
23	Dr Kenton Dashiell	M	US	Project Leader	CIAT-TSBF
24	Jacqueline Odongo	F	Kenya	Admin Assistant	CIAT-TSBF
25	Mary Nderitu	F	Kenya	Finance Assistant	CIAT-TSBF
26	Patrick O. Ngokho	M	Kenya	Training Specialist	CIAT-TSBF

Annex 3: Objective 3 Preliminary Work Plans

DR Congo: Preliminary Objective 3 work plan

Led by Bienvenu at UCB

Site identification (45 sites) 12 field experiments, 33 legume communities. Collect from Obj 2 field sites and different agro-ecological zones (November)

Collect soils and nodules (Nov-January).

Conduct MPNs (January – April)

Isolate and preliminary characterization of rhizobia (January – June)

Upgrade greenhouse (November)

Test strains in greenhouse (April – September)

Field test strains, best strains sent to Nairobi

Recover carrier material, prepare inoculant

Bintu: UEA, MSc student, isolate and characterize rhizobia

Nocy Kijana: INERA, MSc student, inoculant production, formulation, quality control

Isaac: UCB, technician, MPNs, liaise with Obj 2

Bienvenu: UCB, technician, conduct MPNs, isolate and characterize rhizobia

Problem: three cooperating institutes, UCB agriculture moving into the TSBF building at the new campus

Incoming students require remedial English course (3 months) and can do work with soils and nodules at MIRCEN

Coordination from the TSBF office at Bukavu through Isaac

Kenya

Led by Nancy Karanja at MIRCEN

Site identification (45 sites) 18 field experiments, 27 legume communities. Collect from Obj 2 field sites and different agro-ecological zones (November), coast to lake basin

Upgrade laboratory: UoN MIRCEN, Maseno (no lab planned for Maseno)

Greenhouse at UoN very overdue, no MPNs and strain testing until completed

Many isolates available from BGB project, isolated from sirato

Collect soils and nodules (Nov-January).

Conduct MPNs (January – April)

Isolate and preliminary characterization of rhizobia: UoN (January – June)

Upgrade greenhouse (done)

Test strains in greenhouse (April – September)

Inoculant supply: BIOFIX from MEA, quality control by UoN, continue this arrangement?

Course follow up: more strain ID, PCR fingerprinting, quarterly updates

Maureen: UoN MSc, pending

Wycliffe: TSBF Maseno, liaise with obj 2, MPNs

Macdonald: Moi U MSc, promiscuous SB, starter N, need to inoculate,

James

Anne

George

Rwanda

Led by Matilda at ISAR Rubona

Focus on isolations from bean and soybean

Facility improvement at Rubona a necessity

ID sites (October), 4 EAZ , collecting from north to south, recover nodules

Collection from MPN, start plants prior to soil collection, isolation from resulting nodules

Prepare isolates in a continuous manner, N to S, W to East

Screening in greenhouse at Rubona

Matilde: ISAR, Rubona, exploration, isolation, characterization, bean

Jeanne: ISAR, exploration, isolation, characterization, soybean, soybean

Alfred: ISAR, MSc, student, UoN, inoc formulation, quality control

MPNs still needs to be assigned, Rubona, liaise with Felix

Annex 4: Comments and Feedback Summary

Advancing Technical Skills in Rhizobiology

A two week training course conducted in the East and Central Africa Hub of the N2Africa Project at the College of Agriculture and Veterinary Sciences, University of Nairobi
(13-24 September 2010)

Comments and Feedback Summary

NA=Not applicable, 1=Strongly disagree, 2=Disagree, 3=Neither agree/nor disagree, 4=Agree, 5=Strongly agree

	Percentage (%)					
Item	**NA**	**1**	**2**	**3**	**4**	**5**
Course Content						
Aware of the prerequisite of the course	0	0	8	25	67	0
Had prerequisite knowledge and skills for the course	0	0	0	42	33	25
Well informed about course objectives	0	0	8	25	25	42
This course lived to my expectation	0	0	0	0	50	50
Course content relevant to my job	0	0	0	8	17	75
Course Design						
The course objectives are clear to me.	0	0	0	0	75	25
The course activities stimulated my learning.	0	0	0	0	17	83
The activities in this course gave me sufficient practice and feedback.	0	0	0	0	75	25
The difficulty level of this course is appropriate.	0	0	0	33	67	0
The pace of this course is appropriate.	0	0	0	17	67	16
Course Facilitators						
The instructors were well prepared.	0	0	0	8	25	67
The instructors were helpful.	0	0	0	0	58	42
Course Environment						
The training facility at this site was comfortable.	0	0	0	17	83	0
The training facility at this site provided everything I needed to learn.	0	0	8	0	75	17
Course Result						
I accomplished the objectives of this course.	0	0	0	8	50	42
I will be able to use what I learned in this course.	0	0	0	8	42	50

Suggestions for Improvement
Most participants suggested that the course could be improved by the following;

- Provide better and more information before course
- Increase content covered in course
- Update content covered in course
- Make the course less difficult
- Slow down the pace of the course
- Allot more time for the course

General Comments and Feedback

- Very good chance to exchange experiences among countries on rhizobiology and laboratory infrastructure
- A well organized, structured and presented course, content well balanced and excellent participation
- Participants gender balance a sign of equal opportunities to all
- Practical sessions were very interesting
- Allot more time on DNA isolation practical
- More time should be allocated for practical
- Lectures be conducted in the morning and practical in the afternoon
- MPN could be effectively practiced if the course was over one month
- No internet facilities hence difficulties in communication back home
- Overwhelmed at the pace and standards at which scientists in Kenya have made in the field of rhizobiology
- Establish a communication group (e.g yahoo group) for rhizobiologists and other professionals

List of project reports

1. N2Africa Steering Committee Terms of Reference
2. Policy on advanced training grants
3. Rhizobia Strain Isolation and Characterisation Protocol
4. Detailed country-by-country access plan for P and other agro-minerals
5. Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya-24-28 May 2010)
6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis
7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan
8. General approaches and country specific dissemination plans
9. Selected soybeans, common beans, cowpeas and groundnuts varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launch and workshop report
11. Advancing technical skills in rhizobiology: training report

Partners involved in the N2Africa project

Diobass

Université Catholique de Bukavu

University of Zimbabwe

- Programme d'appui au developpement durable **PAD** (DRC)
- Service d'Accompagnement et de Renforcement des capacities d'Auto promotion de la Femme en sigle – **SARCAF** (DRC)