Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya-24-28 May 2010)

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CIAT-TSBF

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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Table of contents

Summary

This workshop was held for the purpose of training key specialists to in turn train other stakeholders in their respective countries in the principles of rhizobial inoculants and legume technologies. The workshop was held at Kisumu Hotel, Kisumu, Kenya for five days and attended by twenty-four participants (33 % women) from eight countries in Africa, namely; Democratic Republic of Congo, Ghana, Kenya, Nigeria, Malawi, Mozambique, Rwanda and Zimbabwe. The facilitators of the workshop were drawn from N2Africa and other partner organizations. The modules covered during the workshop include; nitrogen in small-scale agriculture, legumes and their uses, rhizobia as biological resources, inoculation of legumes, response to inoculation, grain legume enterprises and mobilizing communities towards biological nitrogen fixation (BNF) among others. The following methodologies were used; theoretical background where trainers shared what the modules provided as well as findings from literature, sharing own practical experiences around different topics, power point presentations, discussion points where participants responded to questions in groups and group exercises. In addition, field visits were conducted to enable the participants appreciate some of the things learned during the mini-lectures. The workshop provided a platform for discussing the strategies for increasing grain legumes yield (production and productivity) with particular emphasis to the smallholder farmers in Africa. One of its key outputs was that the participants would join hands and conduct training(s) for relevant people (master farmers) in their respective countries with the aim of scaling up the adoption of appropriate BNF and legume technologies. The course provided knowledge and skills that the participants would use at their work places and in subsequent N2Africa activities. All participants expressed eagerness to take the knowledge and skills further but would need more resource materials to be used as a reference point. In general there was a consensus that the learning objective was achieved, the programme is very relevant and that the participants had taken responsibility for their own learning. However, the general feeling was that the time allocated to cover the each of the modules and the field practical effectively was too short. In the process, most topics were hurriedly covered. It is recommended that in future trainings women participation both as trainees and trainers should be improved as well as restructuring the course content to focus also on legume agronomy, practical and community mobilization.

1 Background Information

It is expected that at the end of its implementation, the N2Africa "**Putting Nitrogen Fixation to Work for Smallholder Farmers in Africa**" project will raise average grain legumes 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 (DRC, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Zimbabwe). This will provide smallholder farmers in Africa with new income-generating crop production enterprises, present a mechanism of renewable soil fertility management and open the door to the adoption of numerous, profitable accompanying farm technologies and value-adding enterprises. One of the project objectives is to develop and strengthen capacity for BNF research, technology development and application. As part of the implementation of this objective, the Tropical Soil Biology and Fertility (TSBF) Institute of CIAT together with the other partners of the N2Africa Project convened five-days Training of Master Trainers Workshop on biological nitrogen fixation (BNF) and grain legume technologies. The aim of this training is to improve skills of specialists in order to improve inoculant and legume production techniques in Africa. The workshop attracted twenty-four participants (trainees) from the eight project countries nominated by the various partner organizations including NGOs, GOs and NARES (The names of participants are presented as annex 1). The workshop facilitators were drawn from N2Africa staff and other partnering organizations with expertise in specific fields.

2 The Objectives of the Workshop

This workshop was held for the purpose of training key personnel to in turn train others (master/lead farmers) in their respective countries in legume and inoculant technologies with the aim of scaling up the adoption of appropriate BNF and legume technologies targeting smallholder farmers in Africa. Specific objectives were:

- to equip key specialists with the knowledge and skills in legume and inoculant technologies required for conducting training programmes in their own for master farmers
- give the facilitators and trainees the opportunity to share varied lessons, experiences, perspectives based on the methodologies developed on legume and inoculants technologies as well as critique and appreciate the content, methods and tools to be utilized in training community facilitators (master farmers)
- to evaluate and adapt, for the local context, the legume and BNF training materials and plan the outline for a training programme to be delivered in the project countries (in-country training)
- to provide each participant with a full set of training modules and materials which include: legume agronomy, rhizobiology, farmer mobilization, how to run a workshop for farmers and how to manage demonstrations and trials.

3 Course Content and Approach

The content of the training was organized around nine modules (the PowerPoint presentations of the modules are available). The plenary presentation gave an overview of the N2Africa project; its targets and expected outcomes. The technical sessions were structured and delivered in away to effectively create a common understanding of: nitrogen in small scale agriculture, legume and their uses, rhizobia bacteria as biological resources, the legume-rhizobia symbiosis, rhizobia inoculants, inoculation of legumes with rhizobia, the response to legume inoculation, grain legume enterprise in small scale farming and mobilizing communities towards biological nitrogen fixation. Some training resources were sent to the participants accompanying the invitation letters for preparations for the workshop. Besides, there were two field practical that enabled the participants to learn how to do sampling and data

collection for nodulation and biomass accumulation and how to lay field demonstrations and trials among other important practical aspects. The workshop adopted a participatory and interactive approach that emphasized everyone learning from each other. Under this approach, participants shared experiences through group work and discussions. Resource persons came in to build on the participants' knowledge and skills as shared during the group work and plenary sessions. The following working forms were used: Theoretical background where trainers shared what the module provided as well as findings from literature, power point presentations, discussion points where participants responded to questions in groups, group exercises and field visit. Reference material and handouts were also provided during the workshop. The participants agreed to adhere to certain guiding principles of the workshop (ground rules) among them; respecting other participants' points of view, switching phones to silent mode to avoid disruptions, keeping time (punctuality), avoid unnecessary talking and movement, sticking to relevant topic during discussions and active participation of all participants in the workshop.

4 Overview of Workshop Sessions

4.1 Session One: Workshop Opening

After a welcome address and an overview of the N2Africa project and the workshop objectives, the Centre Director of the Kenya Forestry Service, Maseno, delivered a keynote address and officially opened the workshop.

4.2 Session Two: Training Process and Background on BNF

During this session, it was emphasized that the training workshop is unique in that everybody is a teacher and a student. It is not of the conventional "top-down" type of teaching per se but a participatory learning process whereby everyone is welcomed to share experiences, knowledge and make comments and share concerns. The project leader presented the scope, goals and the expected outcome of the N2Africa project followed by presentations on nitrogen in small scale agriculture and their uses. He emphasized that the project aims at achieving 50-50 gender participation in all its activities and benefits. The group engaged in group discussions related to the presentations.

4.3 Session Three: Rhizobium and their Symbiosis with Legumes

This session concentrated more on group work and discussion with only one module presentation mainly to introduce rhizobium as biological resources. It was noted that successful BNF by legumes in the field depends on key interactions: *L*egume genotype × *R*hizobium strain × *E*nvironment × *M*anagement (*L* × *R* × *E* × *M)* where environment includes climate (temperature, rainfall) and soils (acidity, limiting nutrients etc). Management includes aspects of agronomic management (use of fertilizers, plant density, weeding). Establishment of effective BNF depends on optimizing all of these components together. The participants were divided into two groups to discuss two questions aimed at gauging their understanding of the concepts that had been presented in module 3. Marking the end of the session and of day one was a rap-up presentation of the day's proceedings by the Zimbabwe team.

4.4 Session Four: Inoculants and their use in Legumes

This session had two modules followed by a 30 minutes discussion where participants had the opportunity to raise pertinent issues regarding inoculation and use of inoculants on legumes. After the coffee break a module on the response to legume inoculation was delivered by Dr Koala. The participants had two hours on group work to discuss and produce reports on the explanation to various field diagnostics related to inoculation before lunch break. After the lunch break the participants were taken through grain legume enterprises in small-scale farming after which they went into groups to brainstorm and report on strategies to increase grain legume production in different farming systems before daily rap-up by Nigeria team.

4.5 Session 5: Performance of Inoculated Legumes in the Field

This session started day three of the workshop with a presentation by Noordin Qureish-a resource person from one of the project collaborators in Western Kenya. Thereafter, the participants divided themselves into five groups for a practical on seed inoculation using the various approaches (appendix 4). In the afternoon the group proceeded to Butere TSBF trial/demonstration site for a field practical on the assessment of nodulation and biomass accumulation. The group later had a cocktail at Kiboko Bay before retiring for the day.

4.6 Session 6: Grain Legumes Enterprises

The session started with a recap of day three by the Rwanda team. Again this session was dominated by group discussion and fieldwork. In the morning sessions, the participants discussed and presented the feedback, in 4 groups, six questions on providing master farmer advice. After lunch the group proceeded to Sidada whereby they were led by John Mukalama on field practical on laying out a demonstration/trial plot. Participants learned how to establish a right angle in the field, randomization of treatments and procedure for treatment application. Plots generally should be rectangular and laid out side by side. Paths of 1 meter wide should be left between plots. Plot treatments should be randomized non-inoculated plots should be planted first to reduce chances of contamination. The participants also observed the leaf rust screening and input trials.

4.7 Session 7: Farmer Mobilization towards Better Utilization of BNF Technologies

After the recap of day four, Dr Hakeem led the participants through the PREA process. The process of PREA requires interaction between stakeholders that is fundamentally different from conveying standard messages from the top-down. This requires processes that must be carefully managed, facilitated, and stimulated with partners contributing particularly where they have a unique role to play. He also highlighted the benefits of this approach. Mr MacDonald Wesonga from ARDAP Kenya (a partner organization in Western Kenya) delivered a presentation on mobilizing farmers associations and NGOs emphasizing on the master farmers concept. In the final stages of the workshop participants grouped into their respective countries to draft in-country training plans for master farmers. Mrs Christie Kpatuwak from Nigeria passed a vote of thanks on behalf of the participants before the Provincial Director of Agriculture; Nyanza Province, Kenya made a few remarks before issuing certificates to the participants and officially closing the workshop.

5 Summary of Workshop Evaluation and Conclusion

There was a post-evaluation of the workshop that involved individual participants filling in a form that was designed to assess the mood of the participants with regard to the workshop modules, presentations, activities and organization. Participants were also asked to suggest on how the workshop could be improved. The forms were sent to the trainees electronically to fill and return back because there was no adequate time to fill the forms as most of the participants were scheduled to departure just after the closure and needed some time for pre-departure preparations. However, there was also face to face discussion and feedback with the participants over lunch and coffee breaks and in the evenings on the progress of the course. The evaluations revealed that the course provided knowledge and skills that the participants would use at their work places and in subsequent N2Africa activities. All participants expressed eagerness to take the knowledge and skills further but would need more resource materials to be used as a reference point. In general there was a consensus that the learning objective was achieved, the preparations were excellent, the programme is very relevant and the participants had taken responsibility for their own learning. The trainers also feels that the workshop went very well and that several of the participants can now be asked to assist N2Africa in training delivery in countries where it is engaged.

However, analysis of views of participants, trainers/resource persons and workshop organizers on specific issues leads to the following conclusions:

Course content: Participants felt that the course content was relevant and practical because it focused on real issues on the ground affecting small-scale farmers and legume production in particular. The topics were designed to build on each other but the flow of some topics was not consistent. However, no examples were given here. There was a feeling that more time could be allocated to farmer/community mobilization and agronomy as the modules were dominated by BNF and rhizobiology.

Facilitation: The Workshop employed different facilitation methods that continuously engaged participants to give input or to share experiences. The course delivery method used and involvement of participants depended on the resource persons covering the session but overall, facilitation was very good. Competencies of the resource persons/trainers were rated to be excellent. Some loose printed manual, books and were given to participants in form of handouts. The presentations were also distributed to the participants in compact discs.

Participation: Among the 24 participants eight were women representing 33% of the total number of participants. However, there was no female trainer. Second, there was good participation in terms of engaging in the delivery of the sessions by sharing the experiences (either through group work or plenary). On administrative/logistical issues, the workshop elected two representatives (a male and a female) from the participants to coordinate participants' concerns with the workshop organizers. This ensured that the workshop minimized time spent on addressing individual participant's concerns on administrative aspects of the workshop and instead to focus on the course contents.

Timing: 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 field practical as possibly starting in the morning hours.

Language: The language of presentation and discussion was not ideal for a few French speaking participants could not communicate effectively in English and hence needed translation. This slowed down the presentation and discussion a little bit at some point but one of the trainers with knowledge in French always intervened making sure that the workshop progressed as planned.

Logistics: The participants felt that the logistics were well coordinated except that the notice of invitation to the workshop was too short to effectively arrange for pre-departure preparations. Furthermore, some participants complaint that they could not make it on time to the workshop just because the flights did not operate as per schedule.

6 Way Forward

At the end of workshop both the participants made action commitments for in-country master farmer trainings that are generally quite ambitious and relevant to this programme. The outputs from these commitments will help in limiting the capacity gaps experienced in the legume sector in Africa. The trainers agreed on the following:

- The modules put so much emphasis on rhizobia while the agronomy component was just being mention superficially. In this regard, future trainings should focus more on the agronomy of legumes.
- There is need to restructure the manual with more understandable and simplified content.
- A guideline on all what is expected the master farmers to do to be developed.
- The training manual to be translated to other languages giving priority to French, Hausa, Kiswahili, Portuguese and Twi
- A participatory research and extension approach (PREA) manual to be drafted

7 Acknowledgements

The workshop “Training of Master Trainers in the Legume and Inoculant Technologies” was a useful interchange of information between the facilitators and the participants and between the participants themselves. Vote of thanks to all those who were involved in the coordination and planning of the workshop, the resource persons and the trainees for their active and creative participation during this workshop. Special gratitude to the Kisumu Hotel for hosting this workshop and for their excellent organization and facilitation throughout the five days of the workshop. Finally, thanks to the institutions that participated in the Workshop by sending a participant. It is the sincere hope that these institutions will continue to provide conducive framework and environment that allow the participants to practice what was learnt at the workshop.

8 Appendices

8.1 Appendix 1: Workshop Programme

Program

Training of Trainers in BNF Technology and Grain Legume Enterprise

Kisumu, 24 – 28 May 2010

Day one: Monday 24 May 2010

Training Opening and Introduction of Participants

08:30 – 10:30:	Registration of Participants	**Patrick Ngokho**
10:30 – 10:45:	***Coffee Break***	
10:45 – 11:00	Introduction of Participants	**Patrick Ngokho**
11:00 – 11:20:	Overview of N2Africa Project	**Kenton Dashiell**
11.20 – 11.30:	Objectives of Training	**Saidou Koala**
11:30 – 12:00:	Official Opening of Training:	**Director KEFRI – Maseno**)

12:00 – 13:30: Lunch Break

Session 2: Presentation of Training Process and Background on BNF – A. Bala

13:30 – 13:50:	Training Process and Activities	**Fredrick Baijukya**
13:50 – 14:20:	N2Africa Project: Scope, Goals and Expected Outcomes	**Kenton Dashiell**
14:20 – 14:50:	Module 1: Nitrogen in Small Scale Agriculture	**Paul Woomer/Kenton D**
14:50 – 15:30:	Module 2: Legumes and Their Uses	**Fredrick Baijukya**
15:30 – 16:00:	Discussions, Questions and Answers	**Hakeem Ajeigbe**

16:00 – 16:15: Coffee Break

Session 3: Rhizobium and their symbiosis with legumes – Fredrick Baijukya.

16:15 – 16:55:	Module 3: Rhizobium Bacteria as Biological Resources	**Abdullahi Bala**
16:55 – 17:30:	Group Work on Discussion Questions 1 and 2	
17:30 – 17: 40:	Presentation and Discussion of Group Work	
17:40 – 18: 00:	Rap-up for Day 1	

Day Two: Tuesday 25 May 2010

Session 4: Inoculants and Their Use in Legumes - Hakeem A.

08:00 – 09:00:	Module 4: The Legume-Rhizobia Symbiosis	**Abdullahi Bala**
09:00 – 09:30:	Module 5: Rhizobium Inoculants	**Fredrick Baijukya**
09:30 – 10:00:	Discussion	
10:00 – 10:15:	***Coffee Break***	
10:15 – 11:00:	Module 7: The Response to Legume Inoculation	**Koala Saidou**
11:00 – 13:00:	Group work on explanation of field DIAGNOSTICS	
13:00 – 14:00:	***Lunch Break***	
14:00 – 14:30:	Group Reports	
14:30 – 15:30:	Module 8: Grain Legume Enterprises in Small Scale Farming	**Hakeem Ajeigbe**
15:30 – 16:00:	Group Brainstorming on Strategies to Increase Grain Legume Production in Different Farming Systems	
16:00 – 16:30:	***Coffee break***	
16:30 – 17: 30:	Presentation of Group Work Continues	
17: 30 – 17:40:	Rap-up of Second Day	

Day Three: Wednesday 26 May 2010

Session 5: Performance of Inoculated Legumes in the Field Kenton D.

08:30 – 09:30:	Module 6: Inoculation of Legumes with Rhizobia	**N. Qureish**
09:30 – 10:30:	Practical on Seed Inoculation	**Fredrick Baijukya**
10:30 – 11:00:	***Coffee Break***	
11:00 – 11:30:	Presentation of Group Work Preparation for Field Practical	
11:30 – 12:00:	Preparation for Field Practical	
12:00 – 13:00:	***Lunch Break***	
13:00 – 17.30	Field Practical (Butere): Assessment Response to Inoculation on Nodulation, Biomass e.t.c	**John Mukalama**
19:00 – 21:00:	**Cocktail**	

Day Four: Thursday 27 May 2010

Session 6:	**Grain Legumes Enterprises**	**Koala Saidou**
08:10 – 08:30:	Recap-day 3	
08:30 – 09:30:	Group Discussions: Questions 1-6 on Providing Master Farmer Advice	
09:30 – 10:30:	Presentation of Group Work	
10:30 – 11:00:	***Coffee Break***	
11:00 – 12:00:	Group Work Presentation and Preparations for Field Practical	
12:00 – 13:00:	***Lunch Break***	
13:00 – 17:30	Field Practical (Sidada):	
	Agronomic Trials/Seed Multiplication/Variety Trials	**John Mukalama**

Day Five: Friday 28 May 2010

Session:	**Farmer Mobilization towards Better Utilization of BNF Technologies**	**Fredrick B.**
08:00 – 08:10:	Recap-day 4	
08:10 – 09:00:	Mobilizing Communities: The PRAE concept:	**Hakeem Ajeigbe**
09:00 – 10:00:	Mobilizing Communities: Farmer Associations, Field Days and Seed Production	**McDonald**
10:00 – 10:15:	***Coffee Break***	
10:15 – 11:00	Participatory Monitoring and Evaluation: *Sharing Experiences and Self Evaluation*	**Hakeem Ajeigbe**
11:00 – 11:45:	Planning for in-country Training	
11:45 – 12:45:	Report from Each Country	
Closing		
12:45 12:55:	Comments from Representative of Participants	
12:55 – 13:05:	Vote of Thanks	**Patrick Ngokho**
13:05 – 13:15:	Closing Remarks	**Koala Saidou**
13:15 – 14:30:	***Lunch Break***	

8.2 Appendix 2: List of Participants, Trainers and Support Staff

No	Name	Title	Nationality	Position	Institution	City/Town	Country
1	Esnart Nyirenda	Miss	Malawi		Chitedze Agricultural Research Station	Lilongwe	Malawi
2	Esnart Kanyenda	Miss	Malawi		Bunda College of Agriculture	Lilongwe	Malawi
3	Agness Mantchichi	Mrs	Malawi		Salima RDP	Salima	Malawi
4	James Mnjerema	Mr	Malawi		LINTHIPE GPA	Linthipe Dedza	Malawi
5	Dieudonne Mongane	Mr	DRC	Farm Liaison Specialist	CIAT-TSBF	Bukavu	DRC
6	Ramazani Luhinzo Serge	Mr	DRC	Agronomist	PAD-Bukavu	Bukavu/Sud-Kivu	DRC
7	Martins Odendo	Dr	Kenya	Senior Researcher	KARI, Kakamega	Kakamega	Kenya
8	Fred Wandama	Mr	Kenya			Bar Ober	Kenya
9	Kaleha Celister	Mrs	Kenya		Resource Projects-Kenya	Maragoli	Kenya
10	Geofrey Augo	Mr	Kenya				Kenya
11	Tarwirei Faraday Kahiya	Mr	Zimbabwe			Hwedza	Zimbabwe
12	Joram Tapfuma	Mr	Zimbabwe	Chief Research Technician	Soil Productivity Research Laboratory	Marondera	Zimbabwe
13	Speciose Kantengwa	Mrs	Rwanda	Farm Liaison Specialist	CIAT-TSBF	Kigali	Rwanda
14	Felix Nzeyimana	Mr	Rwanda		CIAT-TSBF	Kigali	Rwanda
15	Pascal Rushemuka	Mr	Rwanda		ISAR/AGRA	Kigali	Rwanda
16	Hakizimana Rwisebura Jacques	Mr	Rwanda	Programme Coordinator	Sustainable Rural Development (DRD)	Musanze	Rwanda
17	Stephen Gimba	Mr	Nigeria		KADP Headquarter	Kaduna	Nigeria
18	Anyebe Onu Yusuf	Mr	Nigeria		IITA Kano	Kano	Nigeria
19	Christie Kpatuwak	Mrs	Nigeria		Agricultural Dept, Kachia Local Government	Kaduna Estate	Nigeria
20	Shaimin Vieira	Miss	Mozambique		Technoserve	Maputo	Mozambique
21	Aurelio Toao Antonio	Mr	Mozambique		CLUSA	Maputo	Mozambique
22	Bernadette Naab	Mrs	Ghana		MOFA	Wa	Ghana
23	Edwin Akley Korbla	Mr	Ghana		C/o Dr Benjamin Ahiabor SARI	Tamale	Ghana
24	John Bokaligidi Lambon	Mr	Ghana		ACDEP	Tamale	Ghana
25	Edgar	Mr	Kenya	Soybean Development Assistant	TSBF-CIAT	Maseno	Kenya
26	Rumbidzai Nyawasha	Miss	Zimbabwe	Student	TSBF-CIAT	Maseno	Kenya
27	Josephine Olwal	Mrs	Kenya	Admin Assistant	TSBF-CIAT	Maseno	Kenya
28	John Mukalama	Mr	Kenya	Research Assistant	TSBF-CIAT	Maseno	Kenya
29	Stanley Okoko	Mr	Kenya	Account Assistant	TSBF-CIAT	Maseno	Kenya
30	Kenton Dashiell	Dr	USA	Project Leader	TSBF-CIAT	Nairobi	Kenya
31	Saidou Koala	Dr		AfNet Coordinator	TSBF-CIAT	Nairobi	Kenya
32	Abdullahi Bala	Dr	Nigeria	Inoculant Delivery Specialist	IITA Kano	Kano	Nigeria
33	Hakeem Ajeigbe	Dr	Nigeria	Agronomist	IITA Malawi-Chitedze Research Station	Lilongwe 3	Malawi
34	Noordin Qureish	Mr	Kenya	Programme Officer	World Neighbours	Nairobi	Kenya
35	Fredrick Baijukya	Dr	Tanzania	System Agronomist	TSBF-CIAT	Maseno	Kenya
36	MacDonald Wesonga	Mr	Kenya	Exedutive Director	ARDAP	Bar Ober	Kenya
37	Patrick Otieno Ngokho	Mr	Kenya	Training & Information Specialist	TSBF-CIAT	Nairobi	Kenya

8.3 Appendix 3: Seed Inoculation Practical Guide

Seed Inoculation: Master Farmer Training Practical

Based upon "Applied BNF Technology", University of Hawaii NIFTAL Project, Singleton et al. 1990

Purpose. To demonstrate the preparation of stickers, methods of coating seeds with inoculant and a seed pelleting technique.

Conceptual Background. Sticker materials are recommended to bind the rhizobia to the seed. The stickers used in the following demonstrations are gum arabic and sugar, and are compared to water. Both of these adhesives must be dissolved in water before use. Two seed coating methods are used. The **slurry method** and the **two-step method**. In the **slurry method**, inoculant is first mixed with the sticker. The resulting slurry is then applied to the seeds. The **two-step method** requires seed coating in two stages. First, the seeds are coated with the sticker. The inoculant is then added and coated onto the sticky seeds. Note that the amounts of sticker used for each method vary with seed size (Table 1) and in this practical soybean seeds are used.

Under certain conditions, it is advisable to **pellet inoculated seeds** with a protective layer of powdered calcium carbonate or rock phosphate. This treatment is most commonly done with seeds of pasture legumes, but may also be practiced with grain legumes, particularly where grown in highly weathered and nutrient depleted soils. The pellet is applied after seed coating by either the slurry method or the two-step method. The seeds are rolled in the pelleting material immediately after inoculation while they are still wet and sticky.

Table 1. The amounts of sticker, inoculant and mineral coating required for selected grain legumes.

legume	seed	----- slurry method ----		-- two-step method -		---------- two-step pelleting ----------		
seed	weight	sticker	inoculant	sticker	inoculant	sticker	inoculant	coating
	g/seed	ml/kg seed	g/kg seed	ml/kg seed	g/kg seed	ml/kg seed	g/kg seed	g/kg seed
soybean	**0.14**	**30**	**10**	**20**	**10**	**40**	**10**	**200**
bush bean	0.42	22	10	19	10	33	10	160
climbing bean	0.45	20	10	18	10	30	10	150
groundnut	0.50	18	10	16	10	25	10	100
cowpea	0.14	30	10	25	10	40	10	200

Materials. The amounts of materials needed should be gauged according to the number of participants in the exercise. The list of materials below is based on 15 to 21 participants divided into three groups.

1. 500 ml bottled water (x9)
2. Tablespoon for measuring (x3)
3. Teaspoon for measuring (x3)
4. Two liter plastic bags (x12)
5. Wooden stirring spoon (x3)
6. Small plastic funnel (x3)
7. Marking pen (x3)
8. Plastic buckets, 3 liter capacity (x3)
9. Plastic bucket, 20 liter capacity with lid
10. Gum Arabic, granular (3 x 200 g)
11. Sugar, granular (3 x 100 g)
12. Agricultural lime (calcium carbonate), finely powdered (3 x 200 g)
13. BIOFIX Soybean inoculant (3 packages x 100 g)
14. Soybean seed (12 kg in 1 kg bags)
15. Paper sheets (x27)

Note that measurements are provided in grams, liters and milliliters. In the field it is more practical to convert these volumes and measurements into more convenient units. One level teaspoon holds five ml of sticker and one heaped teaspoon of inoculant contains five grams. Three teaspoons make one tablespoon.

1. Preparing the sticker

Gum arabic. Heat 500 ml water in plastic containers by placing them in the sun (or on the dashboard of a auto) for 1 hour prior to the demonstration. Open bottle, remove 200 ml of water, add 200 g of gum arabic (or 5 teaspoons) using the plastic funnel and shake until dissolved. Set aside to cool. This procedure results in a 40% gum arabic solution. Mark the plastic bottle as containing gum arabic solution. If the weather is cloudy and cool, it may be necessary to warm the water over a stove to dissolve the gum arabic, and replace it into the plastic bottle using the funnel.

Sugar. Remove about 100 ml of water from a 500 ml water bottle. Add 100 grams of sugar using the plastic funnel. Shake until dissolved. This procedure results in a 20% sugar solution. Mark the plastic bottle as containing sugar solution. It is not necessary to warm the water before dissolving the sugar into it.

2. Inoculating legume seeds using the slurry method

Preparing the slurry. For coating soybean seed, slurry consisting of 1 part of inoculant and 3 parts sticker is recommended. For demonstration and practice of this procedure, only a small amount of seed will be coated. Remove 10 g of BIOFIX inoculant (two heaping teaspoons) from the packet and place it into a 300 ml container. Add 30 ml of water (or two level tablespoons). Mix the inoculant and the water until uniform mixture is achieved

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Slurry inoculation. Place one kg of soybean seeds (about 1200 ml or 2½ 500 ml mugs and place them into the 3 liter bucket. Add 40 ml of the slurry. Stir the seeds with a wooden spoon until they are uniformly coated with the inoculant slurry. After coating, spread the seeds onto clean paper and allow them to dry. Mark the paper sheet as holding a slurry-water preparation. Repeat the seed coating procedure with slurries made from other sticker solutions to achieve the treatments as summarized below:

- 1 kg of soybean seed coated with 40 ml of a slurry prepared by mixing 10 g of BIOFIX inoculant with 30 ml of 40% gum arabic solution. Mark the paper sheet as holding a slurry-gum arabic preparation.
- 1 kg of soybean coated with 10 ml of a slurry prepared by mixing 10 g BIOFIX inoculant with 30 ml of sugar solution. Mark the paper sheet as holding a slurry-sugar solution preparation.

After coating compare the three different slurry preparations, inspect them for evenness of coating and for adhesion quality. The best coating is usually achieved with gum arabic. Sugar should be second best. Water as an adhesive appears good initially but the inoculant tends to flake off the seed after drying. *Conclusion, whenever possible, a gum arabic sticker should be used for seed coating.*

3. Inoculating seeds using the two-step method

Place 1 kg of soybean seeds into a plastic bag. Add 20 ml of water (1 level teaspoon plus 1 level teaspoon). Inflate the bag and twist it shut in such a way that the walls of the bag are rigid. Shake the bag vigorously for about one minute until the seeds are uniformly coated. Open the bag and add 10 g of BIOFIX inoculant (two heaping teaspoons). Close the bag as before and shake again, but more gently for one minute. Note that too vigorous or prolonged shaking may dislodge the inoculant from the seeds. Immediately after coating, spread the seeds on paper and allow them to dry in a shady place. Mark the paper sheet as holding a 2-step-water preparation. Repeat the coating procedure with the following treatments:

- 1 kg of soybean seed wetted with 20 ml of the 40% gum arabic solution and then coat with 10 g of BIOFIX inoculant. Immediately after coating, spread the seeds on paper and allow them to dry in a shady place. Mark the paper sheet as holding a 2-step-gum arabic preparation.
- 1 kg of soybean seed wetted with 20 ml of 20% sugar solution and then coat with 10 g of BIOFIX inoculant. Immediately after coating, spread the seeds on paper and allow them to dry in a shady place. Mark the paper sheet as holding a 2-step-sugar solution preparation.

There should now be six different preparations of inoculated seed spread on marked paper sheets. Compare the three different two-step inoculated seeds to one another and the slurry inoculations. When we compare the two-step and slurry treatments, the seeds from some of the preparations appear darker in color. This indicates that more inoculant was applied to each seed by this method. Rank the six preparations by appearance on a scale of 1 (no inoculant on seed) to 5 (darkest appearance).

Adhesive	Inoculation procedure	
	Slurry	Two-step
	---------- ranking (1 to 5) ----------	
Water		
Gum Arabic solution (40%)		
Sugar solution (10%)		

Comments. The two-step method allows for more inoculant to be applied to the seed, especially when gum arabic is employed as an adhesive. If we used for instance, 30 ml of the sticker, we could coat as much as 100 g of inoculant onto 1 kg seeds, which results in 10 million rhizobia per seed if the inoculant contains one billion rhizobia per gram. Such a rate is, however, excessive as it is not cost effective for farmers under normal conditions. To apply more than this amount of sticker is not practical because the seeds would clump if more than 30 ml of sticker per kg of soybean seeds is applied

4. Inoculating larger amounts of seed

The upper limit for inoculating seed using plastic bags is about five kg using the two-step method, otherwise the risk of puncturing the bag and spilling seed and inoculant grows too great. A more useful container for larger amounts of seed (e.g. 10 kg batches) is a 20 liter plastic basket with a lid. In this case, place 10 kg of seed into the plastic bucket and add 200 ml of 40% gum arabic solution. Close the lid and shake for one minute. Open the container and inspect to assure that the seeds are evenly coated, not clumped together and that no sticker is clinging to the walls. Add 100 g of inoculant (or an entire packet of BIOFIX inoculant) and again close the lid. This time shake more gently for one minute, open the lid and inspect seeds for uniformity coating. If coating is not complete, immediately continue shaking for 30 seconds. After coating, spread the seeds out on a clean canvas. After the seeds have dried, place them back into the bucket and store under cool, shaded conditions until sowing as soon as possible. Even larger amounts of seed (e.g. 20 to 40 kg) may be inoculated using a large plastic or canvas sheet, mixing the seed and adhesives and inoculants by rolling.

5. Pelleting Seeds

Pelleting after slurry application. Make a slurry from 40 ml of gum arabic solution and 10 g of inoculant. Place one kg of soybean seeds in a 3 liter plastic bucket and add the slurry. Stir the mixture until uniformly covered. Spread the seeds on a clean paper sheet and add 200 g of finely ground limestone (or rock phosphate). Roll the seeds on the paper sheet until they are evenly pelleted. Spread the seeds across the paper sheet and allow them to dry

Pelleting after the two step method of inoculation. Place one kg of soybean seeds into a plastic bag and add 40 ml of gum arabic sugar sticker. Close bag and shake until the adhesive evenly coats the seed. Add 10 g of inoculant and shake gently for one minute. Open the bag and add 200 g of limestone and again shake gently until all seeds are uniformly coated. Spread pelleted seeds on paper and allow to dry.

Compare the two preparations for evenness of coating, firmness of pellet and amount of calcium carbonate adhering to the seed. Note that to accommodate the pelleting material, more sticker must be applied. Water alone is unsuitable for pelleting because it does not produce a firm, evenly coated pellet.

Amplifying farmer training. Each of the Master Farmers is provided a set of materials and instructions so that they may repeat the inoculation demonstration within their own associations. To do this, a package is prepared that contains the following materials:

1. 500 ml bottled water (x3)
2. Tablespoon for measuring
3. Teaspoon for measuring
4. Two liter plastic bags (x4)
5. Wooden stirring spoon
6. Small plastic funnel
7. Marking pen
8. Plastic bucket, 3 liter capacity
9. Plastic bucket, 20 liter capacity with lid
10. Gum Arabic, granular (200 g)
11. Sugar, granular (100 g)
12. Agricultural lime (calcium carbonate), finely powdered (3 x 200 g)
13. BIOFIX Soybean inoculant (1 package x 100 g)
14. Soybean seed (9 kg in 1 kg bags)
15. Paper sheets (x9)
16. Inoculation protocol

The seed inoculation is conducted as a demonstration by the Master Farmer and records are kept concerning the time, place, number of participants and overall impressions of the training activity. These results are reported to the N2Africa Inoculant Delivery Specialists through the Farm Liaison Officer.

8.4 Appendix 4: Workshop Evaluation Form

WORKSHOP EVALUATION FORM

Workshop Title: **Training of Master Trainers on Legume and Inoculant Technologies**

Date: **24-28 May 2010**

Venue: **Kisumu Hotel, Kisumu, Kenya**

For each of the following areas, please indicate your reaction:

Content	**Excellent**	**Good**	**Needs Improvement**	**Not Applicable**
Covered Useful Material	[ ]	[ ]	[ ]	[ ]
Practical to My Needs and Interests	[ ]	[ ]	[ ]	[ ]
Well Organized	[ ]	[ ]	[ ]	[ ]
Presented at the Right Level	[ ]	[ ]	[ ]	[ ]
Effective Activities	[ ]	[ ]	[ ]	[ ]
Useful Visual Aids and Handouts	[ ]	[ ]	[ ]	[ ]

Presentation	**Excellent**	**Good**	**Needs Improvement**	**Not Applicable**
Facilitators Knowledge	[ ]	[ ]	[ ]	[ ]
Facilitators Presentation Style	[ ]	[ ]	[ ]	[ ]
Facilitators Covered Material Clearly	[ ]	[ ]	[ ]	[ ]
Facilitators Responded Well to Questions	[ ]	[ ]	[ ]	[ ]

Application

This workshop met your expectations.

- ☐ Strongly agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly disagree

You feel comfortable applying the methods and techniques shown in this workshop

- ☐ Strongly agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly disagree

Workshop Venue

Excellent	**Good**	**Fair**	**Poor**
[ ]	[ ]	[ ]	[ ]

How could this workshop be improved?

Any other comments or suggestions?

Overall, how would you evaluate this workshop training session?

Excellent	**Good**	**Fair**	**Poor**
[ ]	[ ]	[ ]	[ ]

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)

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)