Adaptive research in N2Africa impact zones:
Principles, guidelines and implemented research campaigns

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Putting nitrogen fixation to work
for smallholder farmers in Africa

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1   Introduction

N2Africa project is an initiative in which legumes are used as an engine to revitalize productivity of cropping systems and to improve the well being of smallholder farmers in sub-Saharan Africa. The project is working to increase farm nitrogen (N) input through Biological Nitrogen Fixation (BNF), from the current 8 kg to 46 kg /ha on 225,000 farms. This additional N is expected to increase the yield of grain legumes as well as companion crops to about 2 tones /ha, resulting to excess production farm which, when sold is capable of increasing household income by about USD 465. To be able to achieve the above goal, the project is implemented following a step-wise approach, which involves selection of superior legume and rhizobia genotypes with enhanced potential for BNF; evaluation of selected legumes and rhizobia under different agronomic practices that enhance BNF; integration and scaling up best fit agronomic technologies to smallholder farmers in different farming systems and agro-ecologies in the project impact zones. This report fulfills milestone 2.5.1 "At least 9 adaptive [impact zone-specific] research campaigns focusing on major grain legume (soybean, cowpea, groundnut, beans) implemented in the impact zones by month 6 of year 2, one of the strategies to develop best fit agronomic practices that maximizes potential benefits of legume and inoculants technologies of increasing and stabilising productivity.

2   N2Africa impact zones

The N2Africa project operates in three impact zones distributed over, eight target countries namely Democratic Republic of Congo, Kenya, and Rwanda (in East and Central Africa); Ghana and Nigeria (in West Africa); and Malawi, Mozambique, and Zimbabwe (in Southern Africa). Detailed explanation of mandate areas and action sites targeted by N2Africa has been reported by Franke, et al., 2011 as part of Milestone 1.4.1. However, we summarised in Table 1, some of the characteristics of these impact zones to provide a quick reference to readers of this report. These zones have high potential for legume production and in many locations there is a pressing need for agricultural intensification due to high population pressure on land. Within each impact zone, several mandate areas and action sites (geographical areas comprising of a community or limited cluster of communities in which field activities are taking place) have been selected for implementation of project activities.

Table1. General information on the three impact zones of N2Africa and corresponding target legumes

	Impact zone		
	East and Central Africa	**West Africa**	**Southern Africa**
Agro-ecological zone	Tropical cool humid-sub-humid	Tropical warm sub-humid	Tropical warm sub-humid and semi-arid
Ecoregion	East African arc montane forest, and East African Sudanian savanna	Northern Guinea and Sudanian savanna	Southern Miombo woodlands
Farming system	Intensive cereal , banana and cassava based, and crop-livestock mixed	Extensive cereal based	Extensive cereal based
Target legume	Soybean, common bean	Soybean, cowpea, groundnuts	Soybean, common bean, groundnuts

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3 Principles and approaches to technology identification and set-up of adaptive research campaigns

3.1 Technology identification

3.1.1 Principles

Country specific priority technologies to test were identified and prioritized during project inception workshops for which various stakeholders were involved. These priorities for each country are revised before each planting season and modified according to outcome of activities implemented in the previous season. This is done to accommodate new emerging issues from farmers, market demands as well as biophysical challenges (e.g. pests and diseases, drought, etc). Overall, the process of technology identification follows the following prescribed principles.

i. Priority legume technologies are be based on published work and expert knowledge about the mandate zone(s).

ii. LEGUME VARIETIES: Varieties to include for the targeted legume species are the best available materials (best referring to farmer preferences, trader's preferences) for grain yield, pest and disease tolerance, and biomass production. Varieties developed within the TL-II project are often used.

iii. CROPPING SYSTEMS: Cropping systems that are practiced on a relatively large proportion (usually > 25%) of the agricultural land receive priority. For areas with bi-modal rainfall, care is taken to put the 'right' crops (be it legumes or associated crops) in the 'right' season.

iv. VARIETIES OF ASSOCIATED CROPS: In case legumes are integrated with other crops (e.g., maize), best varieties of the associated crops (see characteristics above) are used.

v. INOCULANT TECHNOLOGIES: Initially commercially available inoculants are used on soybean and beans; no inoculants are used on cowpea and groundnuts as yet. When there is sufficient proof (from the rhizobiology group) that a response to inoculum is likely then these will be included in the adaptive research campaigns.

vi. RELATION TO EXISTING PRACTICES: Initially care is taken for best legume practices not to deviate too much from existing practice; totally new packages or legume crops are avoided; as such packages first pass through a technology development and evaluation stage.

vii. USE OF INPUTS: Inputs (fertilizer, organic inputs) uses are to reflect locally available materials, applied at rates that are economically optimal (not necessarily biophysically optimal). Note that existing recommendations for different areas are often on the high side (skewed towards biophysical optima instead of economic optima). In absence of existing recommendations, inputs and their application rates are based on existing expert knowledge of the area and previously observed responses.

3.1.2 Process

Technology identification follows the following process

i. DEVELOPMENT OF PRIORITY LEGUME AND INOCULANT TECHNOLOGIES: An ex-ante set of priority legume and inoculant technologies are identified through

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discussion with agronomy and breeder experts that have experience in the target mandate zone. These technologies include the legume species and varieties, agronomic practices, inputs required, and these are targeted towards optimal locations (e.g., within-farm soil fertility gradients/ land use types) and optimal timing (e.g., putting the crops in the season where they will perform best when dealing with a bimodal rainfall patterns, etc.

ii. EXPOSURE TO FARMING COMMUNITIES: We then expose the draft set of technologies to participating farming communities to ensure that these technologies make sense to the farmers (related to planting time, spacing, etc) and do not include practices that farmers have serious issues with.

3.2   Adaptive research campaigns

The main objective of the adaptive research campaigns is to evaluate the performance of components of cropping systems that have not been tested yet in a specific cropping system within a specific mandate zone. Interactions between these components and inoculant application are considered whenever this is feasible.

3.2.1   Principles

i. EVALUATION: While the purpose of adaptive research is to get quantitative biophysical and economic information on the performance of new cropping system components, where feasible, such trials are installed at action sites and in close proximity to farmer associations participating in the project. This allow for the technical information to be complemented with farmer and gender participative information.

ii. DESIGN: Adaptive campaigns are implemented with replicated treatments per site or in a multi-locational mode (using the one field – one replicate model) whenever land is a problem and environments more heterogeneous. Depending on the occurrence of obvious biophysical gradients (e.g., related to soil/land use type, altitude, or pluviometry) at least 4 replicates are laid out per gradient 'classes. Where feasible, stratification along such biophysical gradients are included in the overall design.

iii. TREATMENTS AND EXPERIMENTAL APPROACH: Treatments included in the adaptive research campaigns are explorative in nature. Adaptive trials use, where feasible a Type II approach (Researcher-designed, farmer-managed). Ultimately, a Type III approach (farmer-designed, farmer-managed) is used during the scaling up phase. In case really new systems or really new cropping system components are included, then a researcher-managed on-station approach is used (Type I trial – researcher-designed, researcher-managed). Note that the term 'on-station' does not necessarily refer to a location at an agricultural research station but also to a location within a farming community but where that farming community is not engaged with the trial.

iv. INTERACTIONS WITH SEASONS: Since rainfall amount and distribution vary significantly between cropping seasons, the treatment components are evaluated for at least 2 seasons unless the treatment has a poor performance in the first season.

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3.2.2 Specific issues related to the design of adaptive research campaigns

v.   SITE SELECTION: Trials are laid out on N-deficient sites that are homogenous; do not have a very steep slope and no indicators for soil degradation (e.g. lots of gravel in the topsoil). We try to avoid areas in inland valleys with risks of water-logging.

vi.   STANDARD TREATMENTS: All trials include where feasible (in this case soybean and common beans), treatments with and without inoculant application. Interactions between inoculation and other management factors (e.g., P application) are being considered where feasible.

vii. REFERENCE CROPS: At least one but preferably two reference crops are included and treated in the same way as the legumes for assessing BNF using the natural abundance method.

viii. USE OF INPUTS: Inputs (fertilizer, organic inputs) used reflect locally available materials, applied at rates that are economically optimal (not necessarily biophysically optimal).

3.2.3 List of observations

ix.   LOCATION: GPS position of all trials

x.   DATES: of all management practices.

xi.   SOIL FERTILITY: At the start of each trial, a composite soil sample is collected from each field (taken at least 10 locations) sampled at 0-20 cm and treated using standard soil processing methods. Soil fertility assessments are carried out on a specific need basis and samples are collected accordingly.

xii. CROP PERFORMANCE: Germination, physiological dates (days to flowering, podding, maturity), biomass accumulation at 50% podding.

xiii. BNF: Attempts are made to measure BNF in all above trials using the N difference and natural abundance techniques. This requires inclusion of at least one but preferably two reference crops, treated in the same way as the legume crops. BNF assessments are done at full-seed stage (R5), where the time to this stage varies across legume species and varieties.

xiv. NODULATION ASSESSMENT AND NODULE COLLECTION: The guidelines for nodule assessment and nodule collection designed by the rhizobiology team are used to collect nodules for nodulation assessment and strain isolation.

xv.   PEST, DISEASES AND PLANT GROWTH DISORDERS: Where feasible, the occurrence of pests and diseases are scored, and we rely on standard TL-II methods and approaches.

xvi. AGRONOMIC CHARACTERISTICS: Where applicable we collect information on pod load, pod clearance, on at least 10 plants from each plot.

xvii. YIELD: Grain yields and quality are measured from all plots at all times against a 'control' yield.

xviii. RAINFALL: Where possible daily precipitation is recorded (during the growing seasons) at every action site.

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4   Implemented adaptive research campaigns

In the first 2 years of the project, adaptive research campaigns were initiated on various BNF technologies largely focussing on inoculation of soybean and common bean varieties, phosphate and potassium fertilisation of legumes; development and testing of specialised fertiliser blends for legumes; intercropping of grain legumes with other staple crops (maize and cassava), staking systems of climbing beans and liming of acid soils. By July 2011, a total of 27 research campaigns were initiated and tested at 231 action sites in different project impact zones. Tables 2-9 indicate type of trial, technology tested, season implemented, objectives, action site(s) involved, number of trials implemented and status by country. More adaptive research campaigns were initiated for countries in East and Central Africa (DR, Congo, Kenya, and Rwanda) than those in West (Nigeria and Ghana) and Southern Africa (Malawi, Mozambique and Zimbabwe), and this is because all the mandate zones in east and central Africa experience a bimodal rainfall pattern, allowing for 2 growing season per year. With more seasons, it is also possible to experiment on different technologies. So far, the implemented adaptive trials have provided an impressive amount of data and results (some reported in project annual reports and publications) which will assist in the identification of appropriate crop management strategies using best crop varieties, fertiliser and fertilisation regime and impact of inoculants on legume production.

4.1 Adaptive research campaigns implemented in Kenya

No	Trial name	Objectives	Season when implemented	Legume species	Variety/fertiliser or technology evaluated	No of trials	Sites where implemented	Status
1	Variety (VAR 1) trial	i) To evaluate varieties of target legume for response to inoculation and fertilizer application in mandate area of Kenya ii) To evaluate the impact of biophysical conditions on above responses	Long rains (Feb-June), 2010 Short rains (Sept-Dec., 2010) Long rains (Feb-June) 2011	Soybean Common bean	**Soybean** variety TGx1740-2F, TGx1895-33F,TGx1895-10E, TGx1987-62F, TGx1987-10F, NAMSOY, Maksoy, EAI3600; Nyala; Sc- Saga, Sc Sequel, Sc Squire, S823-6-16; **Bush bean variety** Kenya Umoja, New Rosecoco, KAT B1, KAT B9, KAT X56, KK 8, KK52, KK59 and **Climbing bean variety** Kenya Tamu, Kenya Mavuno, Umubano, Gasilida, RWV 1129, RWV2070, MAC 49, MAC 9, and MAC 44: inoculated and not inoculated with rhizobia grown without P and K limitation.	18	Kakamega, Butula, Butere, Noth Teso, Bungoma, Rarieda, Bondo, Kisumu West Migori	Ongoing; newly acquired varieties will be included in the trial
2	Input (INP1) trial	i) To determine the response of soybean and beans to rhizobium inoculation and fertilizer application (P, K, Mg, S). ii) To evaluate the impact of biophysical conditions on above responses	Long rains (Feb-June), 2010 Short rains (Sept- Dec, 2010) Long rains (Feb-June) 2011	Soybean Common bean	Soybean varietyTGx1740-2F; Bush bean variety Kenya Umoja and Climbing bean variety Kenya Tamu; inoculated and not inoculated grown without and with fertiliser: TSP, DAP, TSP+KCl, Phosphate rock, SYMPAL (P+K+S+Mg)	18	Kakamega, Butula, Butere, Noth Teso, Bungoma, Rarieda, Bondo, Kisumu West Migori	Ongoing, new fertiliser blend(s) are formulated and limiting nutrients are identified

No	Trial name	Objectives	Season when implemented	Legume species	Variety/fertiliser or technology evaluated	No of trials	Sites where implemented	Status
3	Rota-tion (ROT) trial	To determine the effect legume-cereal rotation (Soybean –Maize)	Short rains (Sept- Dec, 2010) long rains (Feb-June) 2011	Soybean	Soybean variety TGx1740-2F, TGx1895-33F, TGx1895-10E, NAMSOY (promiscuous) and EAI3600 (specific) are rotated with maize	3	Butere Bumala Migori	Ongoing
4	Resi-dual effect (RES) trial	Assess the residual effect of P and K applied on beans and soybean on subsequent maize crop	Short rains (Sept- Dec, 2010) Long rains (Feb-June) 2011	Soybean Common beans	Maize planted after Soybean variety TGx1740-2F; TGx1895-33F, TGx1895-10E, NAMSOY, EAI3600 and Climbing bean variety Kenya Tamu, Umubano and Kenya mavuno	6	Butere Migori Bungoma	Ongoing
5	Staking (STA) trial	To determining the most affordable and effective method of staking climbing beans	Short rains (Sept- Dec, 2010) long rains (Feb-June) 2011	Climbing bean	**Climbing bean** variety Kenya Tamu grown with the following staking methods: Tripod, one stake per plant, one stake per two plants, trellises	4	Butula Butere Bungoma Migori	Final data being collected, trial to be concluded in Sept. 2011)
6	Rust evaluati on (RUS) Trial	i) To quantify the yield potentials of rust-tolerant soybean varieties under Kenya environment. ii) To assess the economic benefits accruing from of use of fungicide(s) on soybean	Long rains (Feb-June) 2011	Soybean	Soybean varietyTGx1740-2F;TGx1987-62F;TGx198710F, NAMSOY; Nyala; Sc- Saga; Sc Sequel; Sc Squire; S823-6-16 sprayed and not sprayed with Fungicide Amistra-Extra	2	Mumias Migori	Ongoing

4.2   Adaptive research campaigns implemented in DR Congo

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
1	Variety trial (VAR 2)	i) Evaluate varieties of target legume for response to inoculation and fertilizer application in mandate area of South Kivu, DR Congo ii) Evaluate the impact of biophysical conditions on above responses iii) Identify soybean varieties tolerant/resistant to soybean rust disease	Long rains (Feb-June), 2010 Short rains (Sept-Dec., 2010) Long rains (Feb-June) 2011	Soybean Common bean	**Soybean** variety PK6; 449/16, Imperial, TGx1740-2F, MAKSOY, TGx1987-62F, TGx1987-10F; TGx1987-11F; **Bush bean** variety CODMLB001; AFR 708, MORE 8802; RWR 10; Marungi) and **Climbing bean variety** VCB81012, Kiangara; Nyaramundo; AND10; Musare Inoculated and not inoculated with rhizobia and grown without P and K limitation	12	Karehe, Bugorhe Murhesa, Birava Bwirembe, Ikoma, Walungu Mulamba, Burhinyi, Nyagezi Mushinga	Concluded for common bean Ongoing for soybeans as new varieties are acquired /introduced
2	Input trial (INP 2)	i) To determine the response of soybean and beans to rhizobium inoculation fertilizer application (P, K, Mg, S). ii) To evaluate the impact of biophysical conditions on above responses	Long rains (Feb-June), 2010 Short rains (Sept- Dec, 2010) Long rains (Feb-June) 2011)	Soybean Common bean	**Soybean** (TGx1740-2F; MAKSOY(SB 24); **Bush bean**: CODMLB001;**Climbing bean**: AND10 each grown without and with fertiliser: TSP, DAP, TSP+KCl; with and without inoculation with rhizobia	12	Karehe, Bugorhe Murhesa, Birava Bwirembe, Ikoma, Walungu Mulamba, Burhinyi, Nyagezi Mushinga	Ongoing as fertiliser blend(s) for legume is formulated
3	Need for inoculation (INO) trial	i) Assess the need-to-inoculate soybeans in South Kivu- DR Congo ii)Establish the population of soil native rhizobia in different action sites of DR Congo	Long rains (Feb-June), 2010 Long rains (Feb-June) 2011	Soybean	Soybean MAKSOY; PK6 each grown under non P and K limiting condition with and without rhizobia inoculation; and with and without application of N (N source is Urea)	12	Ikoma, Ibona, Chagombe, Mulamba, Mushinga, Burhinyi, Nyangezi, Mumosho, Murhesa, Bugorhe, Kalehe, Birava	Final data being collected (to be concluded in Sept. 2011)

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
4	Intercropping (INT) trial	i) To evaluate the contribution of soybean varieties to soil maize and cassava yields ii) To evaluate the alternative planting arrangement of maize and or cassava and soybean	Short rains (Sept- Dec, 2010) Long rains (Feb-June) 2011)	Soybean	Soybean varieties MAKSOY and PK6 intercropped with maize (alternation rows or two rows of maize and two rows of soybean) or cassava (one row of soybean when cassava spaced at 1x1 m within and between rows) or 3 rows of soybean cassava spaced at 2m x 1 m.	4	Kalehe, Bughore, Murhesa, Birava, Bwirembe/Bushwira, Cagombe, Ikoma, Walungu, Mumosho, Nyangezi, Mulamba, Burhinyi and Mushinga	Ongoing
5	Staking (STA) trial	To investigate the potential of live and dead maize stalks as support for climbing beans	Short rains (Sept- Dec, 2010) Long rains (Feb-June) 2011)	Climbing beans	Climbing bean variety AND10 and Musare grown under stalks of improved and local maize varieties	3	Bughorhe, Murhesa Chagombe	Final data being collected (to be concluded in September 2011

4.3   Adaptive research campaigns implemented in Rwanda

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
1	Variety trial (VAR2)	iv) Evaluate varieties of target legume for response to inoculation and fertilizer application in mandate area of Rwanda v) Evaluate the impact of biophysical conditions on above responses vi) Identify soybean varieties tolerant/resistant to soybean rust disease	Long rains (Feb-June), 2010 Short rains (Sept-Dec., 2010) Long rains (Feb-June) 2011	Soybean Common bean	**Soybean** varieties PK6;TGx1740-2F, MAKSOY, TGx1987-62F, TGx1987-10F, TGx1987-11F, Sprosoy; Yezumutima; **Bush bean variety** RWR1668, RWR2076, RWR2154, RWR2245,RWR1180; **Climbing bean variety** Gasilida, RWV2070, MAC 44, MAMESA, CAB 2: Inoculated and not inoculated with rhizobia and grown without P and K limitation	14	Burera (Kinoni, Nemba); Gakenke (Kivuruga, Cyabingo); Bugesera (Mareba, Musenyi, Nyamata); Kayonza (Nyamirama, Rwinkwavu, Rukara); Kamonyi (Musambira; Nyarubaka, Nyamiyaga)	Concluded for common bean Ongoing for soybeans as new varieties are acquired /introduced
2	Input trial (INP 1)	iii) To determine the response of soybean and beans to rhizobium inoculation fertilizer application (P, K, Mg, S). iv) To evaluate the impact of biophysical conditions on above responses	Long rains (Feb-June), 2010 short rains (Sept- Dec, 2010) Long rains (Feb-June) 2011)	Soybean Common bean	**Soybean variety** TGx1740-2F; **Bush bean variety** RWR1668 and **Climbing bean variety** Gasilida: grown without and with fertiliser: TSP, DAP, TSP+KCl -and with and without inoculation with rhizobia	8	Kinoni; Nemba; Kivuruga; Mareba; Musenyi; Nyamirama; Musambira; Nyamiyaga	Ongoing as fertiliser blend(s) for legume are formulated

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
3	Need for inoculation (INO) trial	i) Assess the need-to inoculate soybeans in east and south Rwanda ii) Establish the population of soil native rhizobia in different action sites of Rwanda	Long rains (Feb-June), 2010 Long rains (Feb-June) 2011	Soybean	Soybean varieties MAKSOY and PK6 grown under non P and K limiting condition with and without rhizobia inoculation; and with and without application of N (N source is Urea)	14	Mareba, Nyamata; Kayonza (Nyamirama, Rwinkwavu, Rukara); Kamonyi (Musambira; Nyarubaka, Nyamiyaga	Final data being collected (to be concluded in Sept. 2011)
4	Climbing bean-Maize rotation trial	To assess the residual effect of different varieties of climbing beans on subsequent maize crop.	Short rains (Sept- Dec, 2010) Long rains (Feb-June) 2011	Climbing beans	Climbing bean variety Gasilida, RWV 1348 and RWV 2070 rotated with maize without P and K limitation	4	Kinoni, Nemba, Kivuruga and Cyabingo	Ongoing; to be concluded in February 2011
5	Soybean-Maize rotation and intercropping trial	i) To evaluate the residual effect of soybean varieties on subsequent maize crop. ii)To assess the effect of intercropping soybean and maize on yield of companion crops. iii) To assess the impact of soybean inoculation and fertilizer application on soybean and maize yield under rotational and intercropping systems	Short rains (Sept- Dec, 2010) Long rains (Feb-June) 2011	Soybean	Soybean varieties MAKSOY and PK 6 with and without rhizobia inoculation is intercropped with maize in 2 alternating rows and rotated by changing position in the following.	4	Rukara, Nyamirama, Rwinkwavu, Musambira, Nyamiyaga, Nyarubaka, Musenyi and Mareba	On going

4.4   Adaptive research campaigns implemented in Nigeria

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
1	Variety trial (VAR3)	i) To determine the response of various soybean, varieties to rhizobium inoculation without P limitation ii) To assess the BNF potential of different varieties of soybean, cowpea and groundnut iii) To evaluate the impact of biophysical conditions on above responses.	June – November 2010 To be repeated June-November 2011	Soybean Cowpea Ground-nut	**Soybean variety** TGX 1448-2E, TGX 1835-10E;TGX 1904-6F, TGX 1935- 3F; TGX 1951-3E; **Cowpea variety** IT99K-5733-1-1, IT99K-499-35, DAN-ILA, ITK90K-277-2, ITK189KD-391 **Groundnut variety** X-DAKAR; SUMNUT 21, SUMNUT 22; SUMNUT 23 and RMP 12 Evaluated for BNF under non P limiting conditions	18	**Kano state** (Bichi, Sarina, Warawa, Albasu, Darki) **Kaduna State** (Kachia, Shika, Soba, Tudun wada, Zonkwa, Minjibir)	Ongoing for second season
2	Input trial (INP 3)	i) To determine the response of soybean and beans to rhizobium inoculation fertilizer application (P, K, Mg, S and micronutrients). ii) To evaluate the impact of biophysical conditions on above responses	June – November 2010 To be repeated June-November 2011	Soybean Cowpea Ground-nut	**Soybean variety** TGX 1835-10E; **Cowpea variety** IT99K-499-35 and **Groundnut variety** SUMNUT 23; evaluated for performance without and with application of SSP, Phosphate rock, SSP+Micronutrients (Zn, Mo)	18	**Kano state** (Bichi, Sarina, Warawa, Albasu, Darki) **Kaduna State** (Kachia, Shika, Soba, Tudun wada, Zonkwa, Minjibir)	Ongoing as fertiliser blend(s) for legume are formulated

4.5 Adaptive research campaigns implemented in Ghana

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
1	Variety trial (VAR4)	i) To determine the response of various soybean, varieties to rhizobium inoculation without P limitation ii) To assess the BNF potential of different varieties of soybean, cowpea and groundnut iii) To evaluate the impact of biophysical conditions on above responses.	June – November 2010 To be repeated June- November 2011	Soybean Cowpea Ground-nut	**Soybean variety** Salintuya 1, Jenguma, Quarshire, TGx 1834-SE, TGx1448-2E; TGx1195; **Cowpea variety**: Black eye, Omondoo, Songotura and Palentuya,- and **Groundnut variety** Chinese, Nkatie-SARI, Manipinta, SUMNUT 21 SUMNUT 22 and SUMNUT 23 evaluated for BNF and yield without P limitation. Soybean varieties are evaluated with and without inoculation with rhizobia	8	**Northern region** (Chereponi, Karanga,) **Upper East** (Kasena Namkana East, Bawku west	Ongoing for second season
2	Input trial (INP 4)	i) To determine the response of soybean and beans to rhizobium inoculation fertilizer application (P, K, Mg, S). ii) To evaluate the impact of biophysical conditions on above responses	June – November 2010 To be repeated June- November 2011	Soybean Cowpea Ground-nut	**Soybean variety** TGX 1835-10E; **Cowpea variety** IT99K-499-35 and **Groundnut variety** SUMNUT 23 are evaluated for P and K requirement by application of TSP or TSP + KCl.	8	**Northern region** (Chereponi, Karanga,) **Upper East** (Kasena Namkana East, Bawku west	Ongoing as fertiliser blend(s) for legume are formulated

4.6 Adaptive research campaigns implemented in Malawi

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
1	Variety trial (VAR5)	i) To determine the response improved soybean varieties to rhizobium inoculation without P limitation. ii) To evaluate the impact of biophysical conditions on the above responses	December 2010-May 2011 To be repeated in December 2011	Soybean	**Soybean variety** TGX1987-62F; TGX1987-11F;TGX1987-10F, TGX1835-10E;TGX1740-2F and Sc Saga are evaluated for response to inoculation, BNF and yield without P and K limitation	8	Dowa, Salima, Lilongwe, Bunda	To be repeated in December 2011
2	Variety/ input trial (VAR/ INP5)	i. To determine the response of groundnuts to the application of P, S, Ca and starter N. ii. To determine the response of cowpea to the application of P, N, and starter N iii. To evaluate the impact of biophysical conditions on above responses.	???????	Cowpea Ground-nut	**Cowpea variety** Sudan 1 and IT 16 and **Groundnut variety** Chalimbana and Nsinjiro are evaluated for response to application of TSP, Compound D and TSP + KCl and gypsum	4	Dowa, Salima, Lilongwe, Bunda	To be repeated in December 2011

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
3	Input trial (INP 5)	i) To determine the response of soybean to rhizobium inoculation fertilizer application (P, K, S). ii) To evaluate the impact of biophysical conditions on above responses	December 2010-May 2011	Soybean	**Soybean: variety** Makwacha is evaluated response to Compound D, TSP and TSP+KCl with and without rhizobia inoculation	4	Dowa, Salima, Lilongwe, Bunda	Harvest done, data processing on going To be repeated in December 2011

4.7   Adaptive research campaigns implemented in Mozambique

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
1	Variety (VAR6) trial	i. To determine the response of various improved soybean varieties to rhizobium inoculation without P limitation ii. To evaluate the impact of biophysical conditions on the above responses	December 2010-May 2011	Soybean	**Soybean** variety TG x 1740-2F, TG x 1904-6F, TG x1908-8F, TG x1937-1F; TG x1485-1D and Storm are evaluated for response to inoculation, BNF and yield with optimal supply of P and K	3	Sussundenga, Gurue and Angonia	To be repeated in December 2011
2	Variety/Input (VAR/NP6) trial	i. To determine the response of various improved groundnuts varieties to the application of P and Ca. ii. To evaluate the impact of biophysical conditions on the above responses.	Planned for December 2010-May 2011 But not implemented due to poor weather	Ground-nut	**Virginia type** Mamane; CG7 and **Spanish type** CGV-SM 99658; ICGV –SM 99541; JL 25 varieties are evaluated for responses to application of SSP, Compound D and Gypsum	3	Mangovolia.	To be implemented in December 2011
3	Input trial (INP 6)	i) To determine the response of soybean to the application of P, S, K and starter N. i) To evaluate the impact of biophysical conditions on above responses	December 2010-May 2011	Soybean	**Soybean variety** TG x 1740-2F and Storm are evaluated for response to application of TSP, KCl with and without inoculation with rhizobia	3	Sussundenga, Gurue and Angonia	Harvest done, data processing on going To be repeated in December 2011

4.8 Adaptive research campaigns implemented in Zimbabwe

No	Trial name	Objectives	Season when implemented	Legume species	Varieties evaluated/used	No of trials	Sites where implemented	Status
1	Variety (VAR7) trial	i) To determine the response of various improved soybean and bush-bean (sugar bean) varieties to rhizobium inoculation without P, K, S, Ca and Mg limitation. ii)To evaluate the impact of biophysical conditions on the above responses	December 2010-May 2011	Soybean Sugar bean	**Soybean** variety TG x 1740 – 2F, TG x 1987-628,TGx1987-11E,SC Squire, SC Saga, Magoye and **sugar bean variety** Purple card, Cardinal, PAN 148, PAN 159, Spackled Ice, Bounty are evaluated for response to inoculation, BNF and yield with optimal supply of P and K	12	Wedza, Mhondoro Murewa, Makoni west, Mudzi	To be repeated in December 2011
2	Input (NP7) trial	i) To determine the response of soybean and bush beans to the application of P, K and Ca with and without inoculation. ii) To determine the response of groundnuts and cowpeas to the application of P, K and Ca. iii) To evaluate the impact of biophysical conditions on above responses. iii. To determine the response of various improved groundnuts	December 2010-May 2011	Soybean Sugar bean Ground-nut Cowpea	**Soybean** variety SC Squire; sugar bean variety Cardinal, **Groundnut** variety Nyanda and **cowpea** variety IT18 /CBC1 are evaluated for response to application of SSP and Compound L and gypsum.	8	Whedza, Mhondoro Murewa, Makoni west, Mudzi	To be implemented in December 2011

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mandate areas in the N2Africa project, Report N2Africa project. www.N2Africa.org.50pp.

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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

12. Characterisation of the impact zones and mandate areas in the N2Africa project

13. Production and use of Rhizobial inoculants in Africa

18. Adaptive research in N2Africa impact zones: Principles, guidelines and implemented research campaigns

Partners involved in the N2Africa project
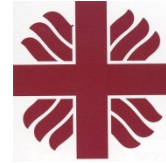
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