N2Africa - Putting nitrogen fixation to work for smallholder farmers in Africa

HISTORY OF RHIZOBIA INOCULANT USE FOR GRAIN LEGUME IMPROVEMENT IN NIGERIA - THE JOURNEY SO FAR

A. A. Abdullahi*[1, 2], J. Howieson[1], G. O'Hara[1], J. Tepolilli[1], R. Tiwari[1], A. Vivas-Marfisi[1], A. A. Yusuf[2]

INTRODUCTION

Use of rhizobia inoculants to improve grain legumes is limited in sub-Saharan Africa, Nigeria inclusive. Legume yield is only a small fraction of the potential. Nitrogen deficiency is frequently reported while fertilizers are costly and inadequate. Inoculants are the alternative for N-supply through N_2-fixation. Developed countries have been using commercial inoculants for over 100 years, but in Nigeria it began only in 1970s on soybean. Promiscuous soybean cultivars (TGX) were later bred in the 1980s. Research efforts then turned to their evaluation for inoculation response. Except for soybean, existing legumes rarely respond to inoculation. Inoculants are mostly used on soybean and limited to research farms (Bala, 2011). This poster reviews the situation and highlights areas for future improvement. N2Africa has already taken the lead.

LATE 19TH CENTURY TO 1970s

1. Discovery of BNF, practice of rhizobia inoculation
2. Inoculation in sub-Saharan Africa dates back to the 1950s, mostly in Zimbabwe and South Africa
3. Breeding of TGX soybean initiated in IITA, Ibadan in 1977
5 'Cowpea miscellany rhizobia' observed in Nigerian soils in 1970s
6. Inoculant strain IRj 2180A isolated from soybean in 1979

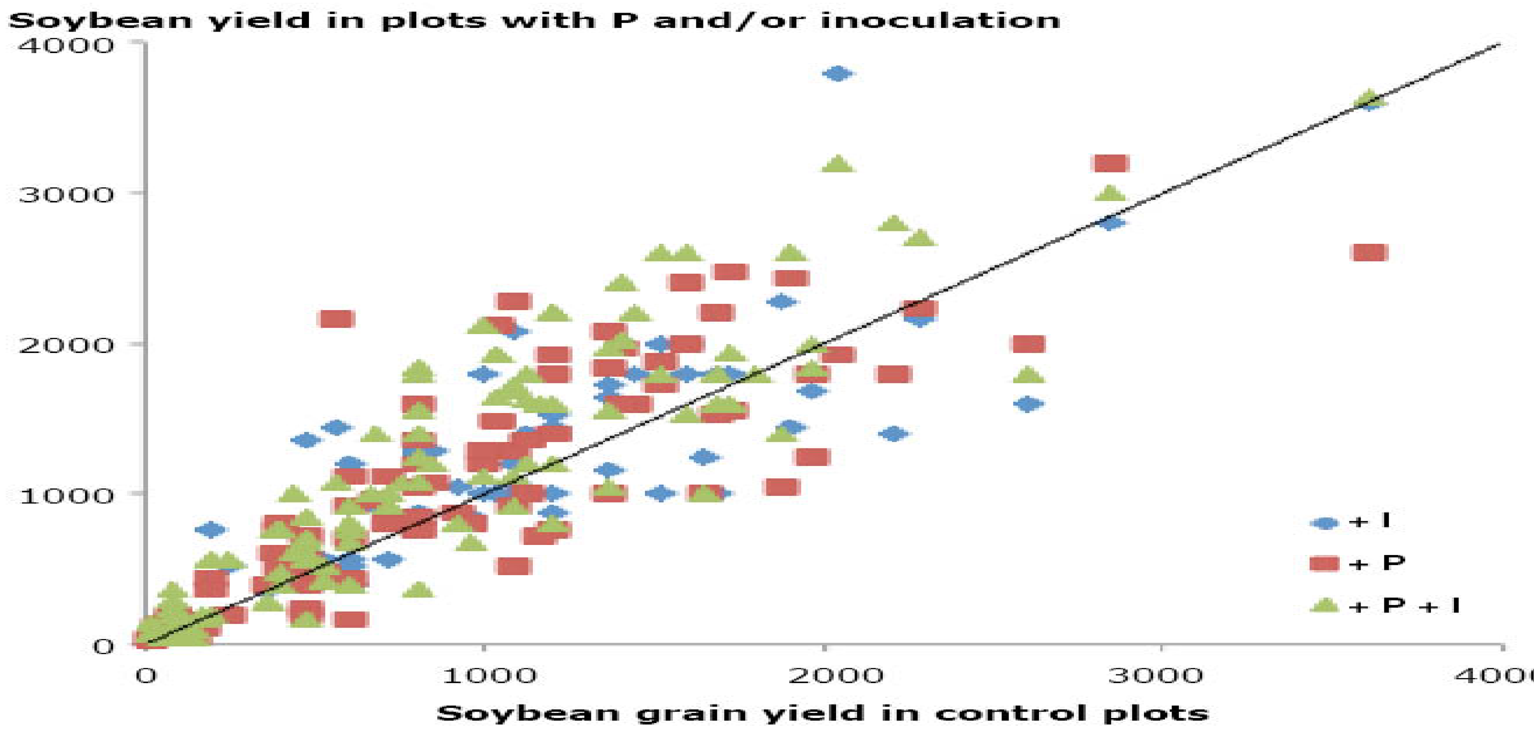

Figure 1. Range of responses of soybean to *Bradyrhizobium* inoculation and phosphorus application . Adapted from Abaidoo *et al.* (2013)

DEVELOPMENTS IN 1980s

1. Introduction of promiscuous TGX soybean cultivars
2. Active field studies on the soil microbiological aspects of soybean inoculation stopped at IITA, Ibadan Nigeria in 1983
3. Evaluation of the TGX cultivars response to inoculation .

DEVELOPMENTS FROM 1990 TO DATE

1. Evaluation of response of TGX cultivars to inoculation and P
2. Later the evaluation of TGX response to commercial products
3. Inoculation of cowpea, groundnut and bambara
4. N2Africa project commenced in 2010, involves collaboration with IAR, Ahmadu Bello University Zaria, Nigeria.
5. More awareness of N_2 fixation, inoculants and P application among farmers and extension workers

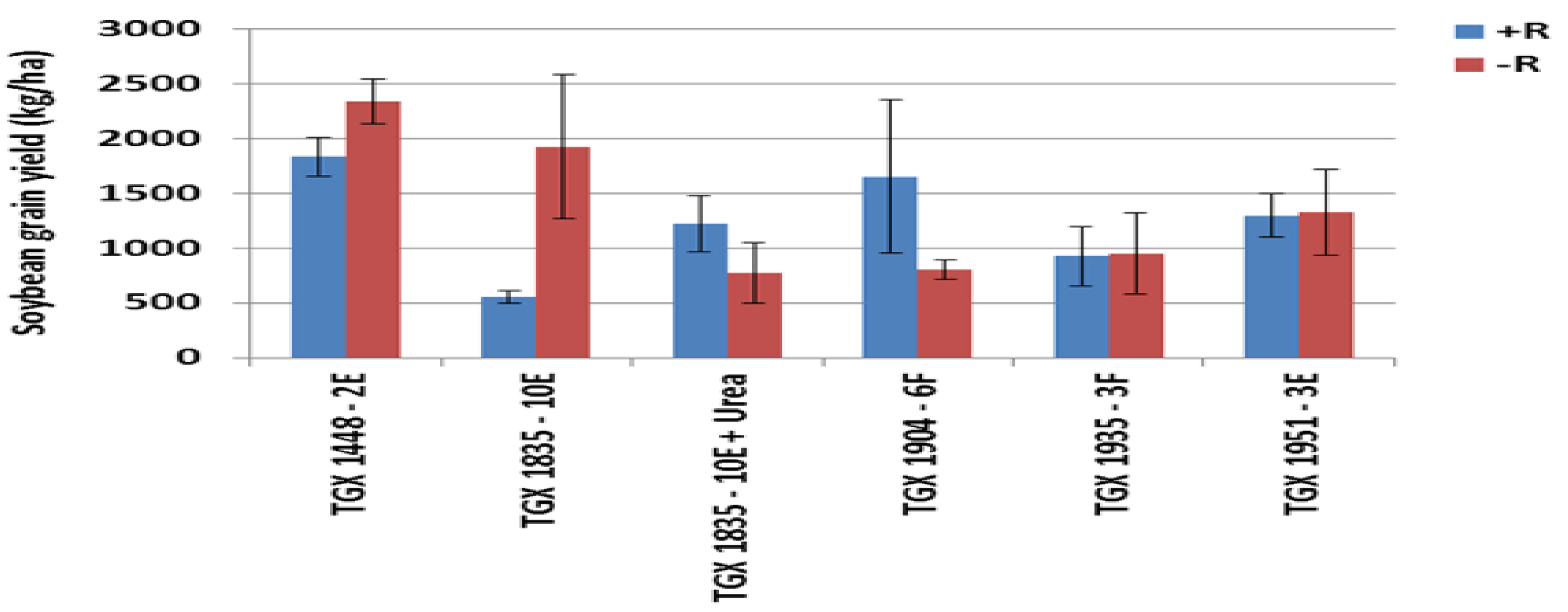

Figure 2. Soybean grain yield as affected by variety and the use of inoculants (R) at Bichi, Kano State, Nigeria, in 2010. Error bars represent standard errors of means. Adapted from Anne et al. (2011)

Table 1. Effects of rhizobium inoculation and P sources on nodulation, biomass, haulm and pod yield of groundnut at Samaru, Nigeria. Adapted from Yusuf et al. (2013)

Treatment	Nodule number plant^{-1}	Nodule dry weight (mg plant^{-1})	Shoot dry weight (g plant^{-1})	Root dry weight (g plant^{-1})	Haulm yield (kg ha^{-1})	Pod yield (kg ha^{-1})
Rhizobium Inoculant (I)						
Biofix	150	262	18.25	2.47	3436	1029
Vault	132	257	17.74	2.34	3202	1015
Biofix + Vault	150	237	16.18	1.96	2910	934
No inoculation	129	256	18.30	2.30	4071	1188
Mean	140	251	17.62	2.27	3405	1042
SED	19.17	28.00	1.19	0.19	281.51	65.07
P-Source (P)						
Agroleaf	140	269	18.62	2.19	3349	1082
SSP	126	224	16.81	2.11	3583	1068
TSP	139	252	16.39	2.37	3468	1044
No P	155	267	18.65	2.40	3219	973
Mean	140	251	17.62	2.27	3405	1042
SED	19.17	28.00	1.19	0.19	281.51	65.07
I x P						
SED	38.33	55.15	2.38	0.38	563.03	130.14

FUTURE OUTLOOK

1. Encourage farmers to make use of available inoculants
2. Isolation and selection of effective strains for each grain legume
3. Production of local inoculant
4. Target to meet the demand of increasing capacity of value chain promoters

WHY INOCULANT RESEARCH IS DOMINATED BY SOYBEAN

1. > 90 percent of rhizobial inoculants are used on soybean worldwide
2. Frequent positive response to inoculation
3. Potentially cheapest source of food protein.
4. Poor response of other legumes to inoculation

WHY INOCULANT DO NOT REACH FARMERS

1. Subsistence agriculture on marginal soils, poor knowledge
2. Lack of inoculant industries
3. Lack of large-scale commercial soybean production and intensive livestock industry

Table 2. Partner laboratories involved in N2Africa Rhizobiology activities. Adapted from Bala, (2011)

S/No	Country	Laboratory	Location	Year Established	Inoculant Production	Quantity Produced in 2010
1	DRC	Soil Microbiology Laboratory	Bukavu		No	None
2	Ghana	Soil Research Institute	Kumasi		No	None
3	Kenya	MIRCEN/University of Nairobi	Nairobi	1977 (1981)	YES	ND
4	Kenya	MEA Fertilizer Ltd.	Nakuru	1977 (2008)	YES	25,000
5	Malawi	Chitedze Research Station	Chitedze, Lilongwe	1964	YES	15,000
6	Nigeria	Institute for Agricultural Research (IAR)	Samaru, Zaria	1922	No	None
7	Rwanda	Institut des Sciences Agronomique du Rwanda (ISAR)	Robena	1984	YES	ND
8	Mozambique	IIAM	Nampula	Under Construction	No	None
9	Zimbabwe	Soil Productivity Research Laboratory (SPRL)	Marondera	1964	YES	80,000

Year in parenthesis is the year inoculant production commenced; ND = Not determined

Table 3. Percentage of Nigerian farmers using specific legume inputs in their own fields. (based on data extracted from N2Africa impact survey 2013).

Crops	Non use of inputs	+ inoculant only	+ P fertilizer	+ P fertilizer and inoculant
Soybean	6	11	57	26
Cowpea	18	-	82	-
Groundnut	24	-	76	-

ACKNOWLDGEMENT

The authors acknowledge the sponsorship of Aliyu Anchau, Abdullahi 's PhD by N2Africa and Murdoch University Western Australia .

Name Organisation[1] Centre for Rhizobium Studies, Murdoch University
Address: South Street, 6150, Western Australia
E-mail: aanchau@yahoo.com
Phone:+61406433417
URL: http://www.murdoch.edu.au/Research-capabilities/Centre-for-Rhizobium-Studies/Centre-Members/Phd-profile---Aliyu-Abdullahi/

Name Organisation[2] Department of Soil Science, Faculty of Agriculture Institute for Agricultural Research, Ahmadu Bello University
Address: P.M.B. 1044, Samaru, Zaria, Nigeria
E-mail: aanchau@yahoo.com
Phone: +2348039735066
URL: http://www.abu.edu.ng/unit/vwprofile.php?sid=8099&t=&cid=2&cnm=Agriculture&did=&dnm=Soil%20Science