ABSTRACT: 343

RECENT DEVELOPMENTS IN SOYBEAN RESEARCH AND BNF TECHNOLOGIES IN RWANDA

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Soybean research is revitalized in Rwanda, largely through collaboration with the N2Africa Program. Four improved soybean varieties were assessed for biomass accumulation, BNF potential and yield. These varieties, under good soil and climatic conditions, respond to both seed inoculation and provide yields ranging between 1,800-4,000 kg ha^{-1}. Variety SB 24 (Namsoy) is earmarked for release in 2012 while three other promising varieties are under National Variety Performance Testing at 16 sites in preparation for release in 2013. Trials were also conducted to examine the combined use of inoculants and fertilizers. Yield increases between 21% and 90% were observed in the best managements. In an effort to identify elite strains for future use in legume inoculants, the rhizobiology laboratory at RAB-Rubona isolated, authenticated and characterized 90 isolates from soybean. These isolates are being screened for effectiveness against the commercial rhizobial strain USDA 110. Bio-prospecting continues to include diverse ecosystems ranging from the lowlands of Akagera, the Burera highland and the Nyungwe forest in South West. Efforts to develop inoculants at RAB-Rubona continue. It produced 2,800 packets of rhizobium inoculant, however, their counts were low, between 10^3 and 10^6 rhizobia per g, well below the international standard of 10^9 cells. This is attributed to several factors including incomplete sterilization and excessive acidity of the peat carrier material and poor curing storage conditions. These shortcomings are being addressed as the laboratory is expected to produce 437,500 80 g packets next season, sufficient for use on 35,000 ha of soybean. One of the strengths of our efforts in Rwanda is the close collaboration between agronomists and rhizobiologists.

Recent Developments in Soybean Research and BNF Technologies in Rwanda

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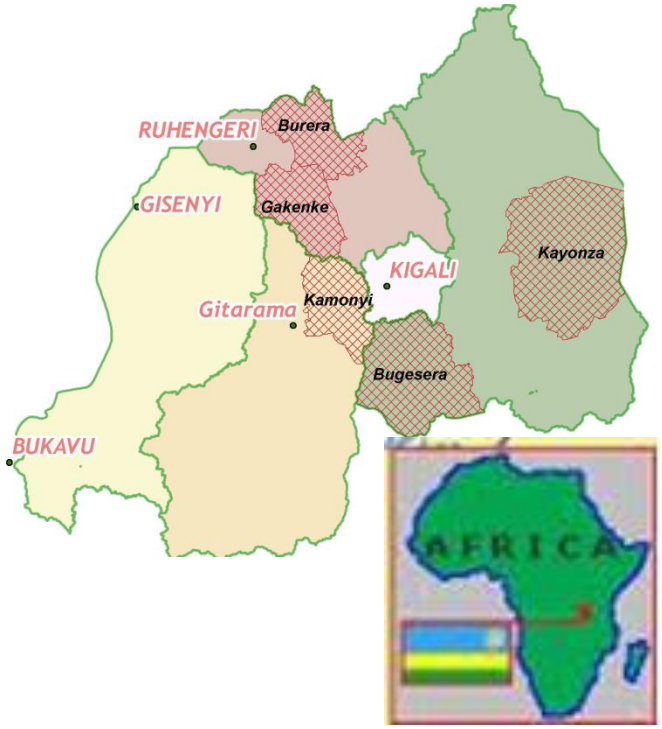
A: Bacground



- Arable land 1,205,090 ha (85% cultivated) populated
- Farms on hilly terrain (the land of thousands hills).
- Human population estimated at 12 million
- Population density…… (high pressure on land).
- Altitude 1200 – 2000 m asl.
- Rainfall bimodal (range 1100 – < 2000 mm /yr)

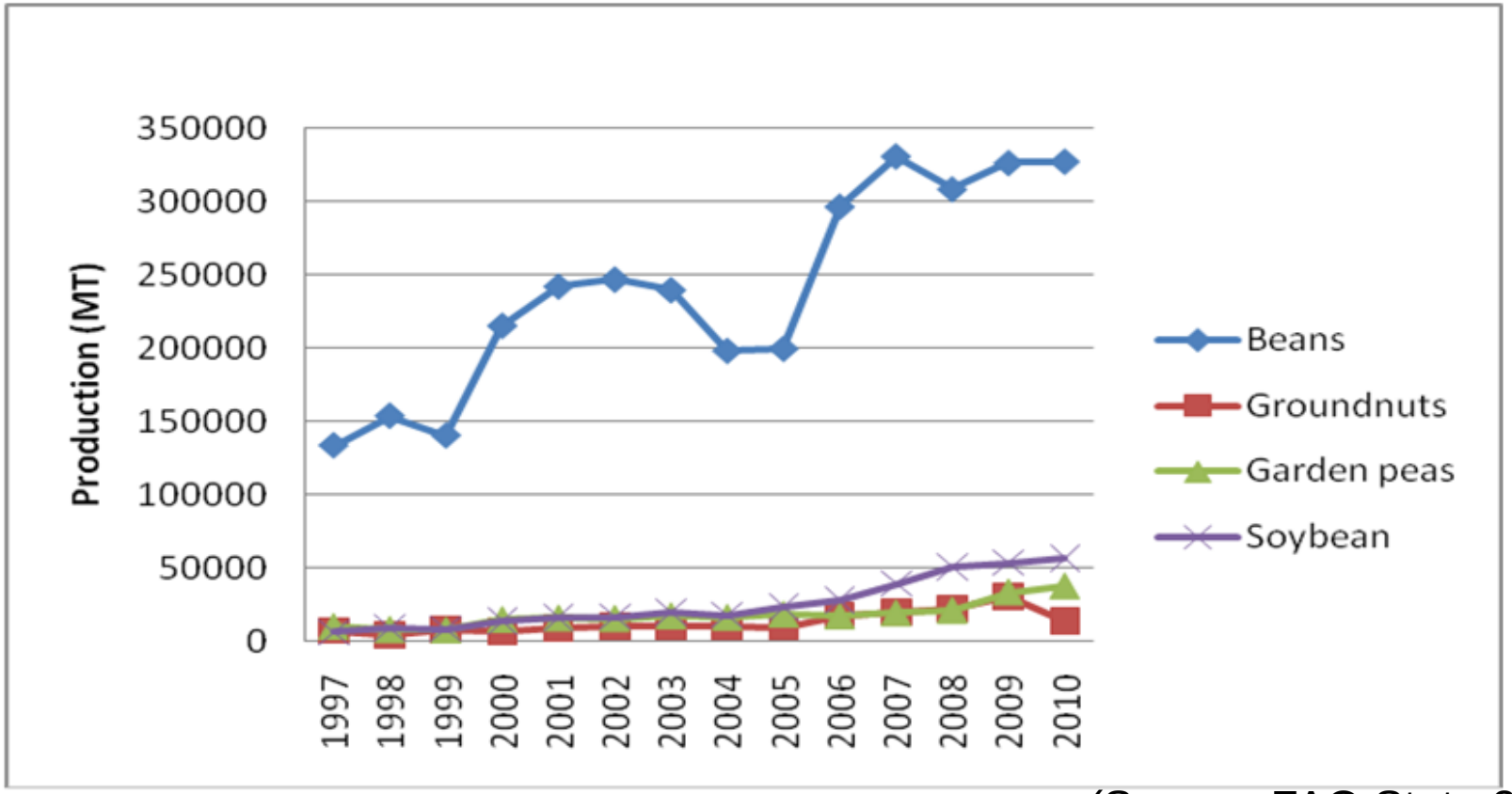
- 99% of the cultivated land is under smallholders practicing mixed cropping.
- 75% of household own less than 1 ha of land.
- Intensive agriculture on delicate land.

History of soybean cultivation

- Soybeans were introduced in Rwanda in 1930.
- In 1969, 550 ha was cultivated with soybean by smallholder farmers.
- By 1993; 23,096 ha was cultivated producing 25,000 MT.
- Production ceased between 1994 and 1996 due to civil war.
- By 2010 about 75,000 has was cultivated producing 30,000 MT.

B: Trend on production and productivity of grain legumes in Rwanda

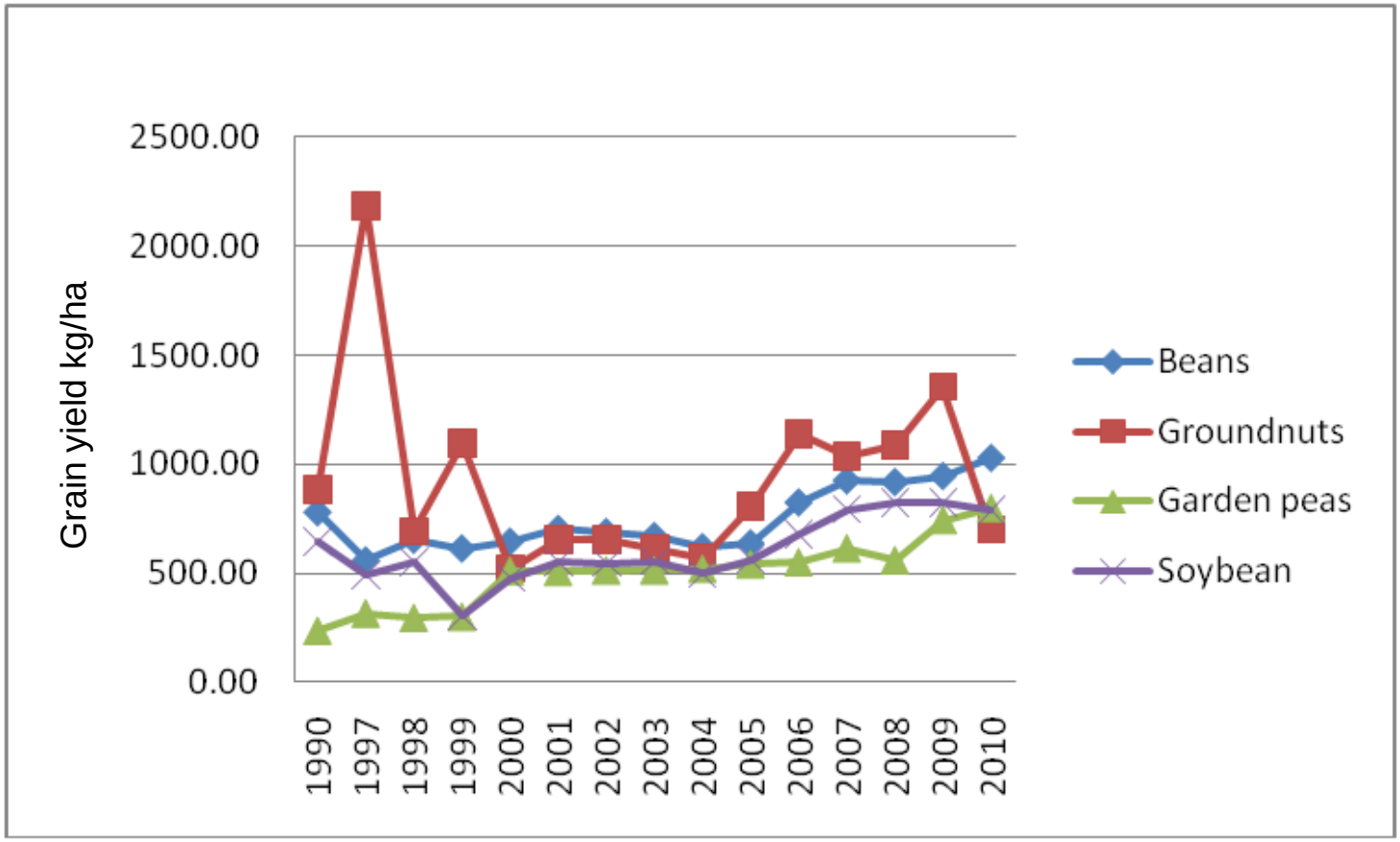
Production



(Source: FAO Stat., 2011)

Productivity of grain legumes

Grain yield trend of important grain legumes in Rwanda (FAO, 2011)



Some reasons for low productivity

- Inherently poor soil fertility (poor parent material, highly weathered and leached soils).
- Production is market oriented with inadequate use of external inputs (**net nutrient mining**).
- Lack of adapted cultivars for different production environment.
- Lack of remunerative market.
- Poor agronomic practices.

C: Recent development in soybean research

Soybean research is revitalized in Rwanda, largely through collaboration with the N2Africa Project by:

- ✓ Identification and field-testing of soybean varieties for enhanced N_2-fixation and integrating them into farming systems using best fit agronomic practices.
- ✓ Collection and characterizing superior rhizobia strains for enhanced N_2-fixation and developing inoculum production capacity.
- ✓ Delivering legumes, inoculant technologies and associated N_2-fixation technologies to farmers.
- ✓ Developing and strengthening capacity for N_2-fixation research, technology development, and application.

Genotype × Environment × Management

$$(G_L \times G_R) \times E \times M$$

Where:

G_L = legume genotype

G_R = rhizobial strain

E = environment

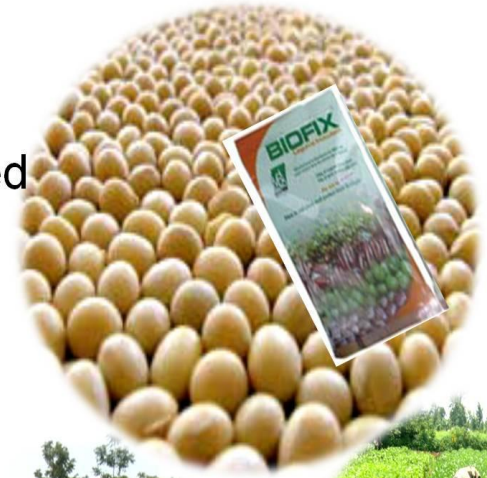
- climate (temperature x rainfall x daylength etc) - to encompass length of growing season etc
- soils (nutrient limitations, acidity and toxicities)

M = management

- agronomy - seeding rates, plant density (row spacing etc), weeding,
- (Diseases and pests are also a function of *G* x *E* x *M*....)

1. Variety selection and best fit agronomic practices

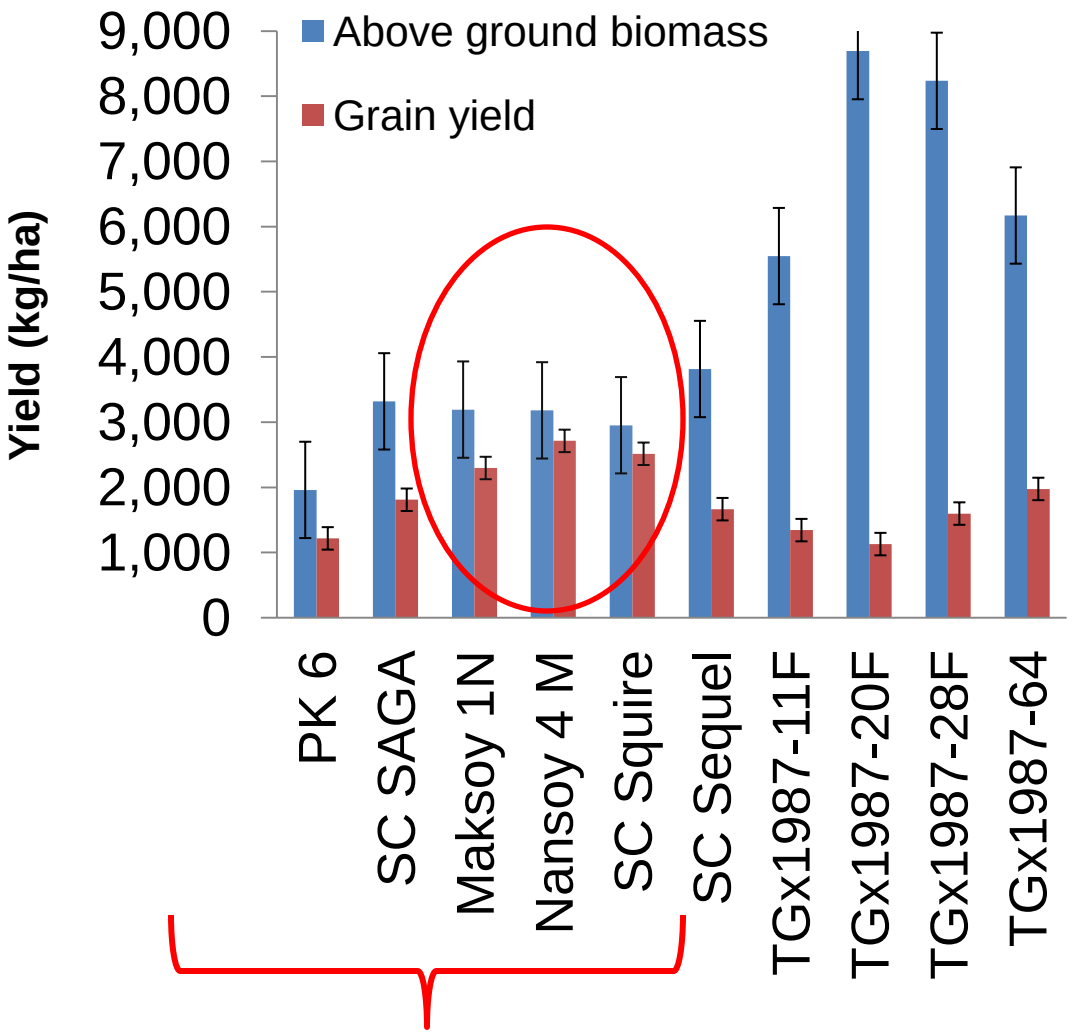
1. Seed of improved varieties and inoculants identified



2. Use of P, K fertilizers and best agronomic practices

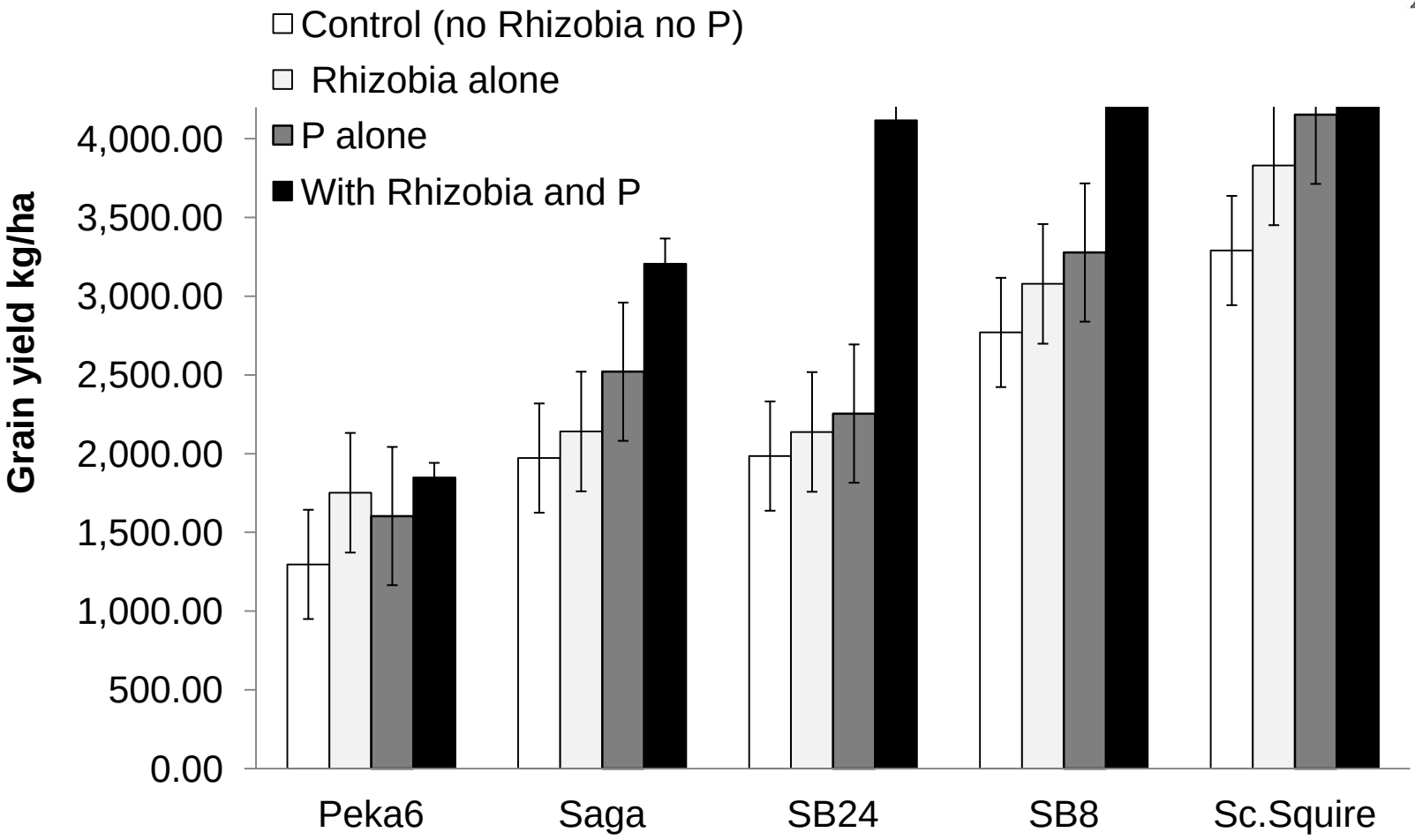
3. Farmers assess trials and select best-fit varieties

Some of our achievement



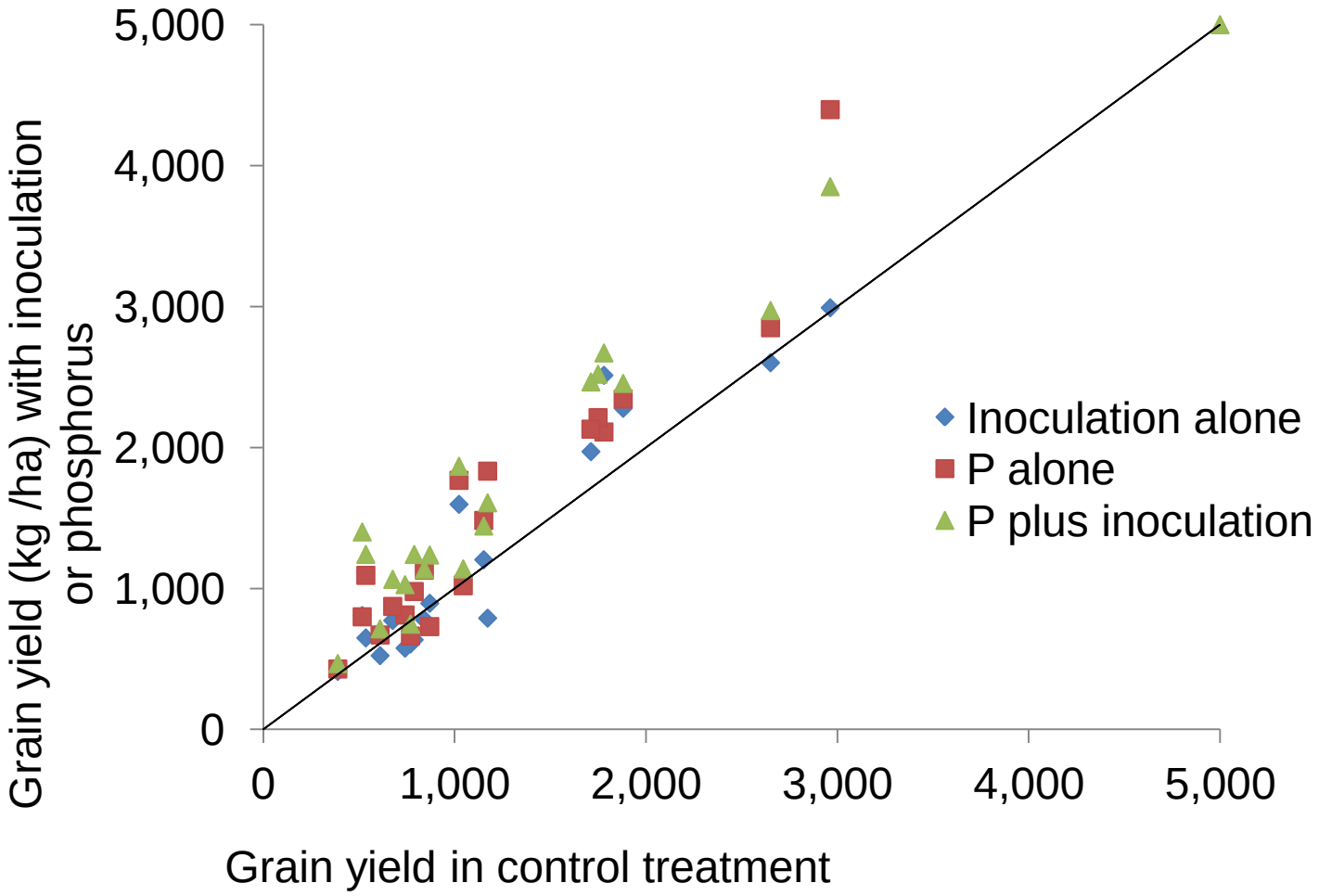
- Large variation in yields of varieties within and across sites.
- Variability largely due to soil fertility; environmental factors.
- High biomass accumulation not necessarily leads to higher grain yields

Soybean response to inoculation and P fertilizers



Putting nitrogen fixation to work for smallholder farmers in Africa

Soybean response to Inoculation, P and their combination



Farmer ranking of test soybean

Maturity period (days)	Variety	(n=280)
Early (75-90)	**PK6**	**2**
Intermediate (91-110)	Maksoy 1N (SB 24)	4
	Sc Sequel	3
	Sc Squire	1
	Sc Saga	5
Late (> 110 days)	Namsoy 4 M (SB 25)	6
	TGx 1987 - 11F (SB 8)	9
	TGx 1987 - 20F (SB 19)	8
	TGx 1987 - 28F	10
	TGx 1987 - 64F	7

Rhizobilogy work

- RAB-Rubona has characterized 252 isolates screening for effectiveness on going.
- Cost effective inoculant production methods are under examination.
- RAB-Rubona conducts quality control assessment on its own inoculants.
- RAB is undergoing mass

production of inoculants

to meet the increasing demand.

- 2 technician and 1 scientist trained

on rhizobiology technologies

New happenings to take advantage on

N2Africa efforts complemented by Government and development organisations e.g. USAID through Clinton Hunter Foundation.

• Soybean elevated as second important grain legume after common bean (*P vulgaris*). Soybean farmers to receive fertilise subsidy.

• Local medium and large scale soybean processing factories in place including new factory by SOYCO. Total capacity < 150,000 MT / year.

• Equipment for large scale inoculant production provided by AGRA.

Future work

- Rerelease of promising varieties (Squire, Saga and Namsoy) by 2014.
- Research on non-responsive soils to identify and correct other limiting factors.
- More agronomic work to close the yield gaps of farmer valued early and intermediate varieties to increase BNF and adoption.
- Screening of isolated rhizobial stains against commercial strains to identify candidate elite strains.
- Backstopping RAB on production and of quality inoculants while looking for a private investor.

Ackowledment

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- Organizers of 9th WSRC for providing opportunity to present our work.
- You, the audience for listening to our presentation.

Thank you for your attention