Matching the need for biological nitrogen fixation of grain legumes with most appropriate varieties: evidence from highlands of East and Central Africa

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Background

- Smallholder households in East and Central Africa have small land holdings, cultivated twice a year.
- Crop yields are low partly due to low levels of plant nutrients in the soils including nitrogen (N).
- Grain legumes are key entry point for sustainable intensification of the farming systems as they can convert atmospheric N_2 into plant protein and help build soil fertility.
- Available varieties vary in terms of N_2-fixation, adaptation to biotic and abiotic factors and meeting farmers' preferences.
- It is important to target varieties specific to environments while considering farmers' preferences in order to facilitate early adoption.

Our approach

- Multi-location adaptive trials conducted in South Kivu, DRC; Western Kenya; North, East and South Rwanda with Soybeans (only reported) and common beans (bush and climbers).
- We maximize the interactions($G_L \times G_R$) × E × M where G_L = legume genotype, G_R = genotype(s) of rhizobia, E = environment and M = Management .

Results

Soybean performance in different environments

- Yields varied among varieties within and across sites.
- Variability largely due to soil fertility and environmental conditions.
- In most sites, high biomass accumulation did not necessarily lead to higher grain yields due to mid-season droughts (Figure 1 and 2).

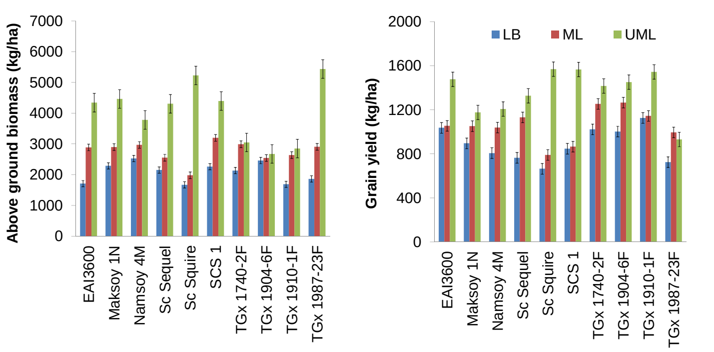

Figure 1. Above-ground biomass accumulation and grain yield s of test soybean varieties in different agro-ecological zones of Western Kenya. LB =Lake Basin (< 1300 m); ML = Midland (1301-1500 m) ; UML = Upper Midland (15001-1800 m).

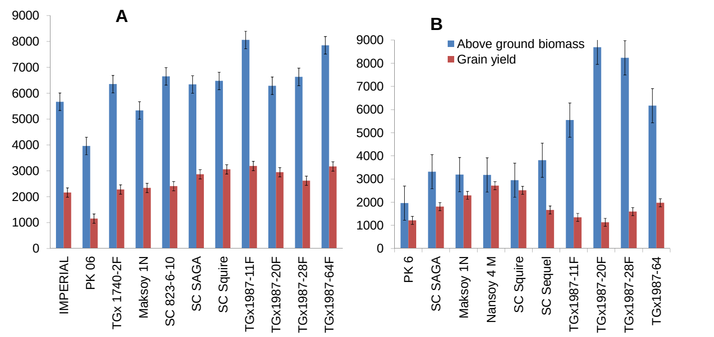

Figure 2. Above-ground biomass accumulation and grain yield (kg/ha) of different soybean varieties in North axis of South Kivu DRC (**A**) and Kamonyi District, south Rwanda (**B**).

Farmers selection of test varieties

- Important criteria farmers used to select soybean varieties are yield, time to maturity, drought resistance, pod filling, number of pods per plant, disease tolerance, biomass and grain size in that order.
- Principal Component Analysis (PCA) indicated that maturity, high yield, pod filling and pods per plant explained 76%, 82% and 67% of variance for Kenya, Rwanda and DRC, respectively.
- Farmer most preferred varieties are summarised in Table 1.

Table 1. Farmer ranking of test soybean varieties by country

Maturity period (days)	Variety	Kenya (n=360)	DRC (n =340)	Rwanda (n=280)
Early (75-90)	EAI3600	1	-	-
	TGx 1740-2F	2	6	-
	TGx 1910-1F	3	-	-
	PK6	-	4	2
	TGx 1904- 6F	4	-	-
Intermediate (91-110)	SCS 1	5	-	-
	Maksoy 1N	6	5	4
	Sc Sequel	7	2	3
	Sc Squire	8	-	1
	Imperial	-	1	-
	Sc Saga	-	3	5
	CS 823-6-10	-	-	-
Late (> 110 days)	Namsoy 4 M	9	-	6
	TGx 1987 - 23F	10	-	-
	TGx 1987 - 11F	-	8	9
	TGx 1987 - 20F	-	9	8
	TGx 1987 - 28F	-	10	10
	TGx 1987 - 64F	-	7	7

Derived messages

- Using genotypes that are well adapted to a given site will increase BNF.
- Inoculants, P and K fertilizers improved soybean performance but not to all sites and to the potential yields of varieties implying that other factors are limiting.
- Long duration soybean varieties have high BNF potential but gave low yields where mid-season was experienced.
- Long duration varieties are less preferred by farmers as they delay field operations in the double cropping systems prevailing in the region.
- More work is needed to close the yield gaps of farmer valued early and intermediate maturing varieties to increase BNF and adoption.

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