Uncovering the potential of a multi-purpose legume, *Lablab purpureus* (L.) Sweet

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Background

- *Lablab purpureus* (L.) Sweet is a legume originating in eastern Africa and grown globally for use as forage, pulse, green manure, and ornamental.
- Traditionally grown for food and fodder in Africa, but production declined during colonial period when common bean was favored.
- Large genetic diversity
- Survives a wide range of environmental conditions
- Previous research suggests it has a high potential to fix N
- Promising multi-purpose legume for smallholder farmers in East Africa that can improve soil fertility and productivity of maize cropping systems
- Lack of research quantifying lablab germplasm biomass production, grain production, and N^2-fxation potential across environments

No.	Accession	Maturity	Flower color	Seed Wt (g/100 seeds)	Characteristics	Origin	Other Properties
1	CIAT 22759	Early-mid	Purple	30	Forage variety	Kenya	
3	DL1001	Late	White	23	Indeterminate	Kenya	Dual purpose
4	DL1002	Early	Purple	26	Determinate	Kenya	Popular grain variety in Kenya
6	Echo Cream	Mid	White	30		Tanzania	
8	Highworth	Early	Purple	25	Forage variety	India	Popular commercial variety
12	ILRI 13700	Very late	Purple	38	Vigorous, coarse stem	Ethiopia	
14	ILRI 14437	Early-mid	Purple	23		Unknown	
16	ILRI 6930	Early-mid	White	31	Long pods, high biomass	Unknown	Drought tolerant
17	Karamoja Red	Mid	White	36		Uganda	
21	PI 195851	Very late	White	23	High biomass	Egypt	Drought tolerant, low grain
22	Q 6880B	Very early	Purple	22	Short-season	Kenya	Dual purpose
23	Rongai	Very late	White	26		Kenya	Popular commercial variety
25	SARI Nyeupe	Late	White	28		Tanzania	
26	SARI Rongai	Mid	Purple	30		Tanzania	
31	Fadhari cowpea	Mid-late		11	Spreading growth	Tanzania	

Table 1.

Accessions described above were collected across Africa and used in this study to evaluate biomass at two sites over two seasons. These are a subsample identified as representing a range of growth types from a core collection of 32. Cowpea included as a reference crop.

Figure 1.

Lablab accessions Q 6880B, Karamoja Red, and ILRI 13700. These are examples from the 14 lablab accessions in Table 1.

Objectives

- Identify promising lablab accession types to be incorporated into smallholder farmer cropping systems.
- Evaluate lablab accessions suitability in sole and maize intercrop systems based on total biomass production, grain yield, and BNF potential in different environments.

Methods

Block 1								Block 2								Block 3							
13	21	33	27	10	3	19	4	4	26	3	32	31	8	18	12	22	29	6	11	3	12	19	25
15	3	23	10	7	27	31	16	22	3	29	17	24	13	9	36	33	3	20	9	25	36	5	12
4	17	28	14	11	20	12	24	14	23	7	33	10	25	18	4	26	21	31	16	10	17	6	13
23	31	16	22	14	24	5	11	28	22	23	19	27	13	5	10	13	8	16	33	21	7	23	26
6	28	25	1	15	8	17	36	26	31	19	5	20	1	15	11	20	31	1	27	9	14	4	17
5	13	29	18	8	1	21	25	14	29	20	16	24	6	9	1	14	28	18	11	22	7	27	1
18	26	29	7	9	12	2	20	33	17	25	2	15	21	7	11	15	29	24	23	8	4	2	19
26	9	22	6	32	2	33	19	16	12	21	27	8	6	28	2	24	18	28	5	2	15	10	32

=Intercropped

=Subsampled

- 2 Sites – Selian Agricultural Research Institute (SARI), Tropical Pesticides Research Institute (TPRI – Moshi) over 2 seasons (2016 & 2017)
- Modified split-plot design – 3 blocks with 32 accessions sole cropped and intercropped with maize
- 15 accessions subsampled for biomass at flowering stage. This included 14 lablab accessions and one reference cowpea. Accessions chosen to represent a wide range of growth types.
- Destructive biomass harvest based on net plot of 0.9m x 2m (Figure 4)
- BNF will be measured by the natural abundance method

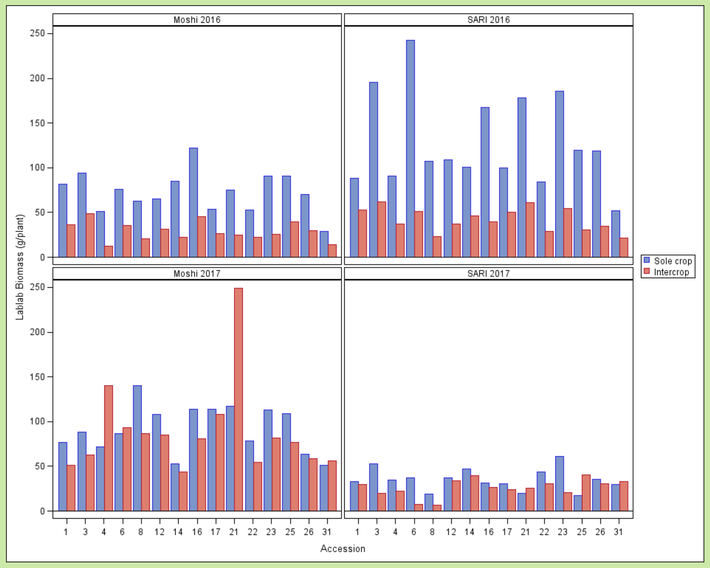

Figure 2.

Lablab biomass means across accession and environments (Moshi and SARI over two seasons) in sole crop and maize intercrop.

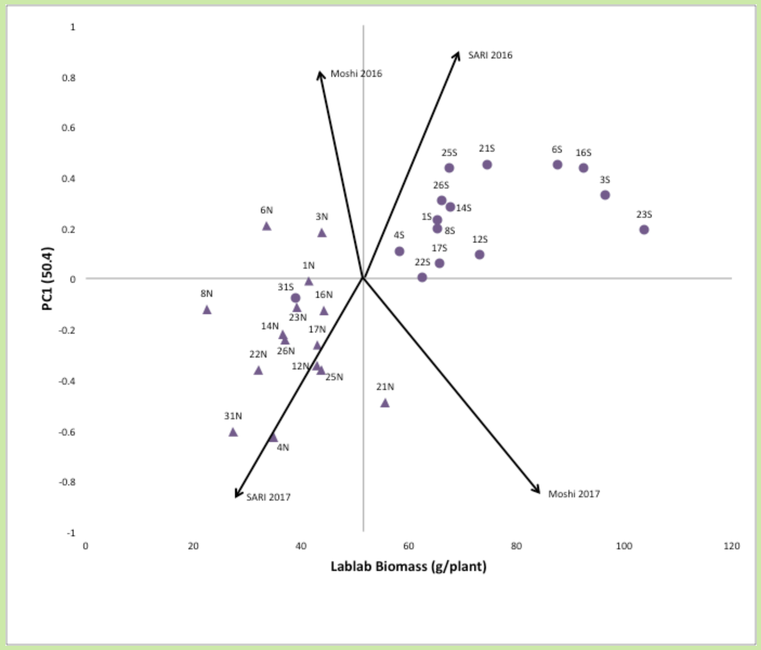

Figure 3.

Biplot representing lablab biomass main effect against PC1 scores of 15 accessions in sole (●) and intercrop (▲) system and 4 environments

Figure 4.

Pictures showing sampling frame of biomass harvest (1), lablab plot intercropped with maize (2) and sole crop plot (3).

Type 3 Analysis of Variance						
Source	DF	Sum of Squares	Mean Square	Error DF	F Value	Pr > F
Environment	3	65.54	21.85	6	32.47	0.0004
Accession	14	13.10	0.94	28	4.63	0.0003
Environment*Accession	42	25.60	0.61	202	2.06	0.0005
Intercrop	1	35.27	35.27	2	24.11	0.0391
Environment*Intercrop	3	15.11	5.04	202	17.04	<.0001
Accession*Intercrop	14	4.68	0.33	202	1.13	0.3334
Env*Access*Inter	42	9.47	0.23	202	0.76	0.8508
Block	2	0.37	0.18	2.6552	0.11	0.9033
Environment*Block	6	4.04	0.67	202	2.28	0.038
Block*Accession	28	5.66	0.20	202	0.68	0.8838
Block*Intercrop	2	2.93	1.46	202	4.95	0.008
Residual	202	59.74	0.30	.	.	.

Table 2.

Analysis of variance for lablab biomass using SAS® PROC MIXED (data transformed using natural log)

Results

- Environment (site x year), accession, intercropping, and the interactions of environment with accession and intercropping all significantly influenced biomass amounts (Table 2)
- Sole cropped lablab produced more biomass than intercropped in the first year, but sole crop biomass markedly less productive in second year (Figure 2)
- Lablab biomass production highly variable across environments for all accessions
- Most intercropped accessions more adapted to marginal SARI 2017 environment than other three environments
- Sole cropped accessions more adapted to SARI 2016 environment (higher rainfall, less disease pressure than 2017)
- Cowpea reference crop (#31) poor performer overall, however it was only sole crop that was well adapted to SARI 2017 environment (Figure 3)

Conclusions

- Environment effects on lablab biomass suggest conditions such as rainfall, temperature, and disease may have a greater effect on lablab productivity than genetics
- Sole cropping lablab in high performing environments may be more beneficial than intercropping lablab with maize.
- Further analysis of grain yields and BNF measurements needed to compare to biomass trends
- More research needed to identify lablab accession performance across different environments

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