Development of bean varieties tolerant to high temperatures in Mozambique

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Outline

- Introduction
- Planned activities (Pilot project)
- Preliminary results
- Challenges/perspectives
- Final considerations


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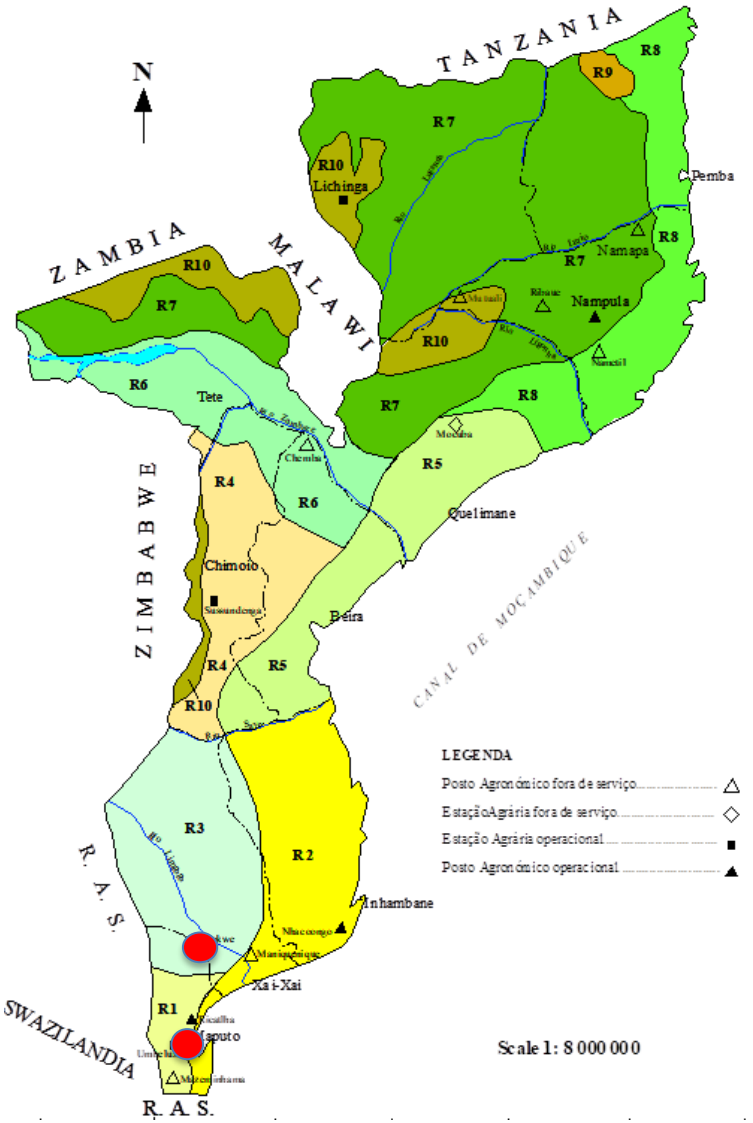
Introduction

- Important source of protein fiber and minerals
- Source of income for most household (commercialization)
- Consumption
  - Food security
  - Nutrition (source of protein, fiber and minerals)

Main production regions in Mozambique

- North/Central (rainfed): Nov - February
- South (irrigation in lowland areas): April – May
- Mostly Andean beans
- The average grain yield is about 500 -800kg/ha

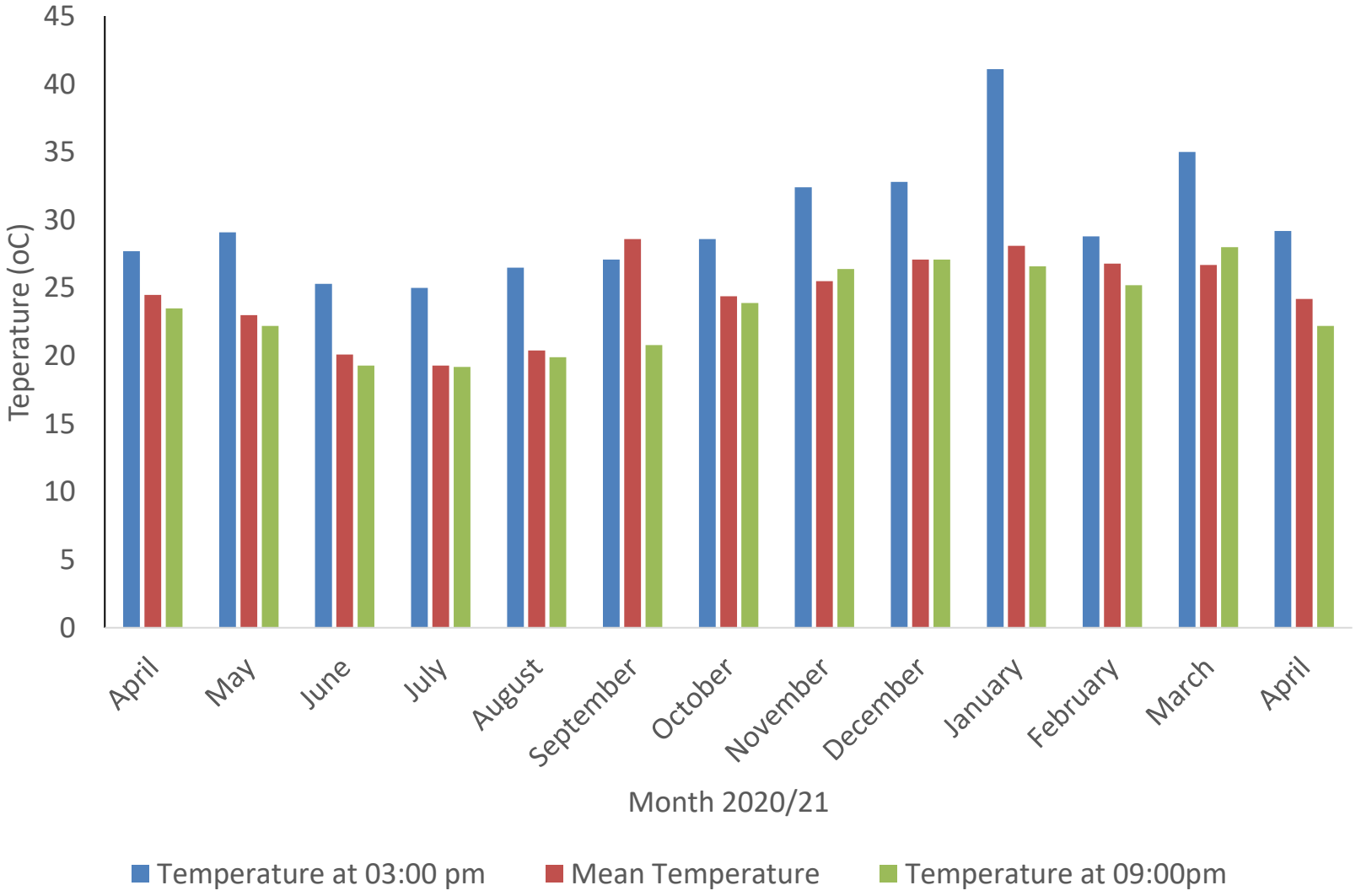
- Sites: Gaza (Chokwe, Guija) and Maputo (Umbeluzi, Boane)



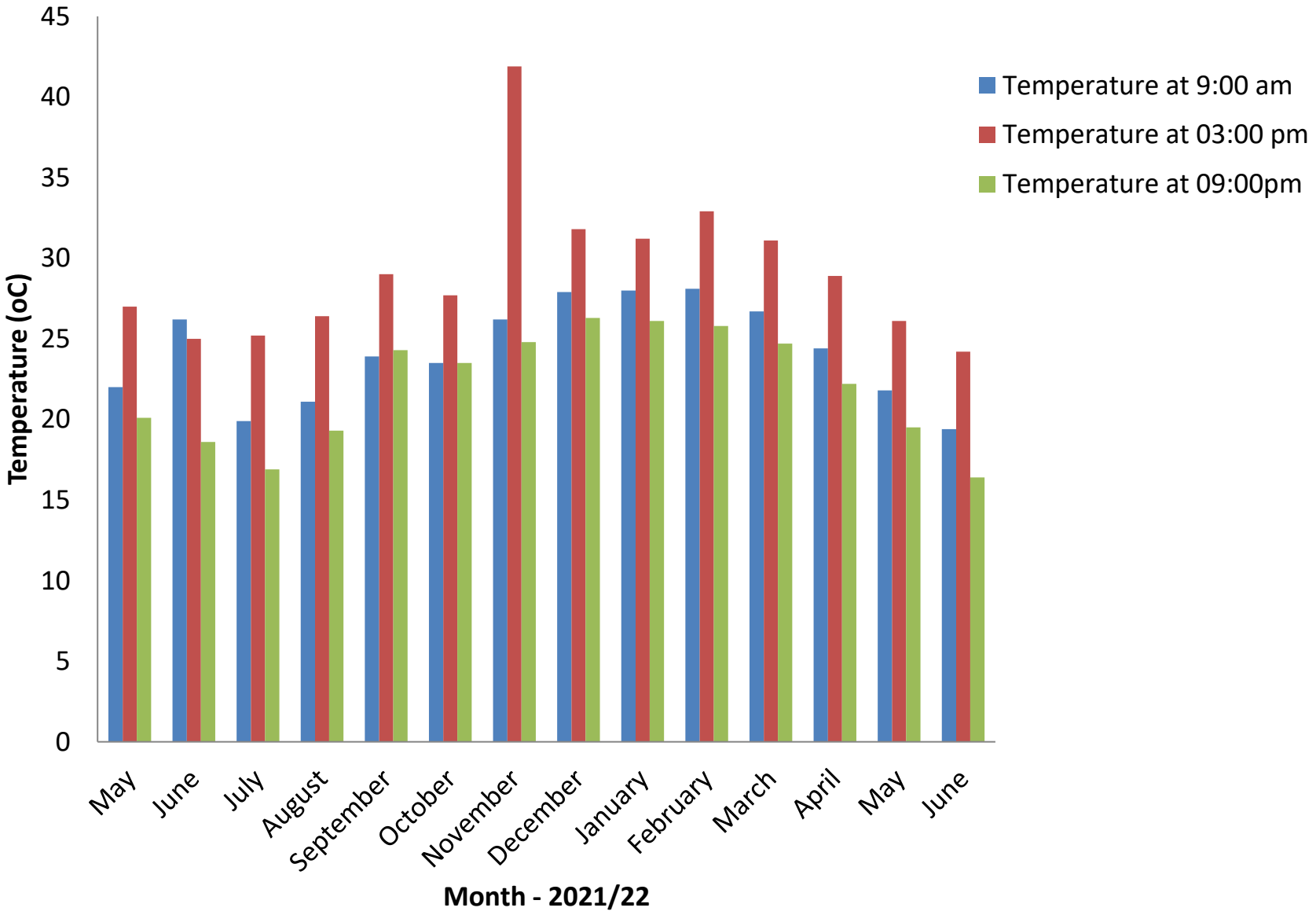
Constrains to bean production

- Abiotic and biotic stresses contribute to the low yields of common bean in Mozambique
- High temperatures (>30 ^{o}C day and >20^{o}C night) limit bean production, mainly in lowland regions in the tropics (Singh, 2001)
- In current years the temperatures are increasing worldwide
- There is a need of developing common bean varieties tolerant to high temperatures and adapted to Mozambique

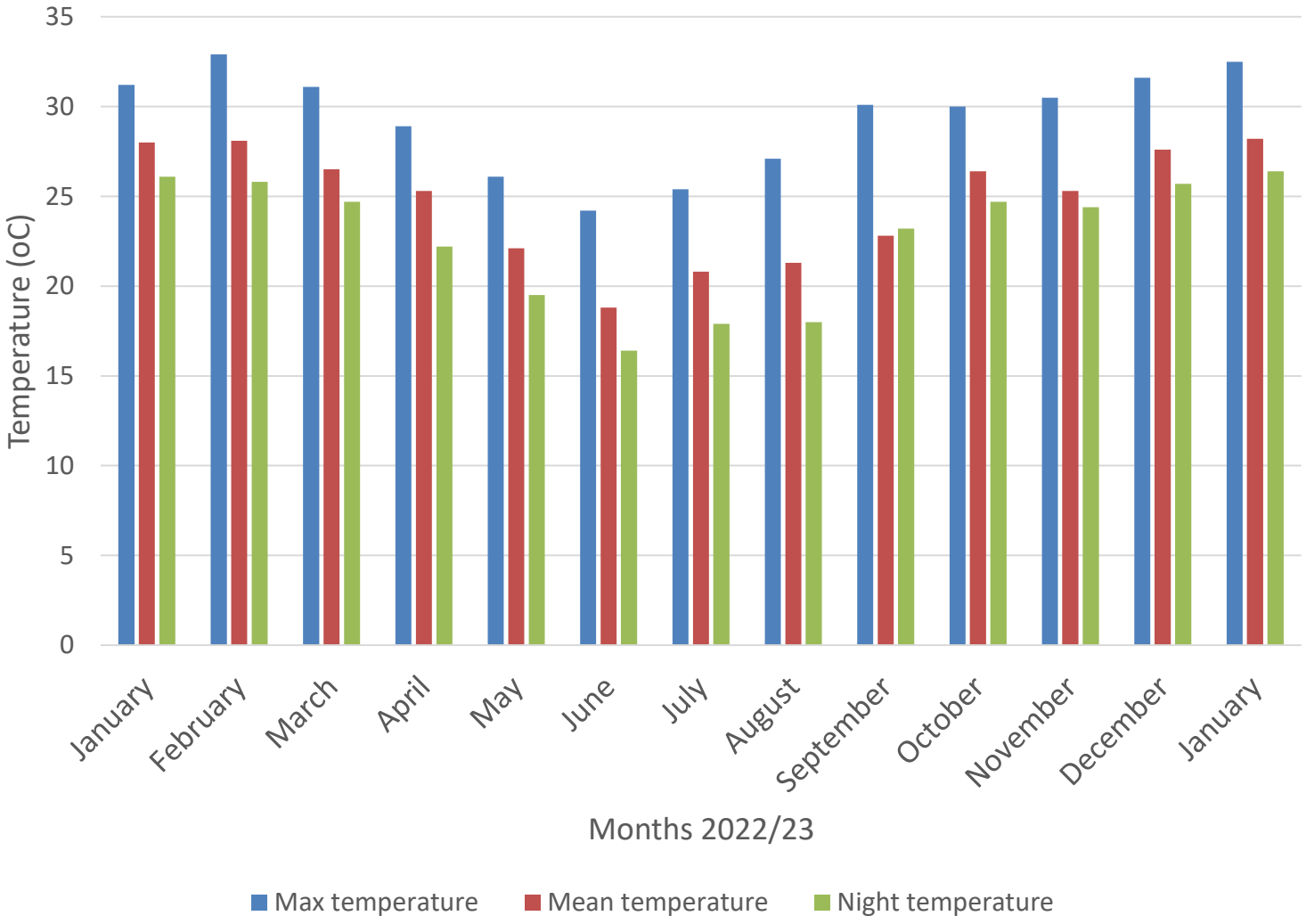
Temperatures in Chokwe - 2020/22



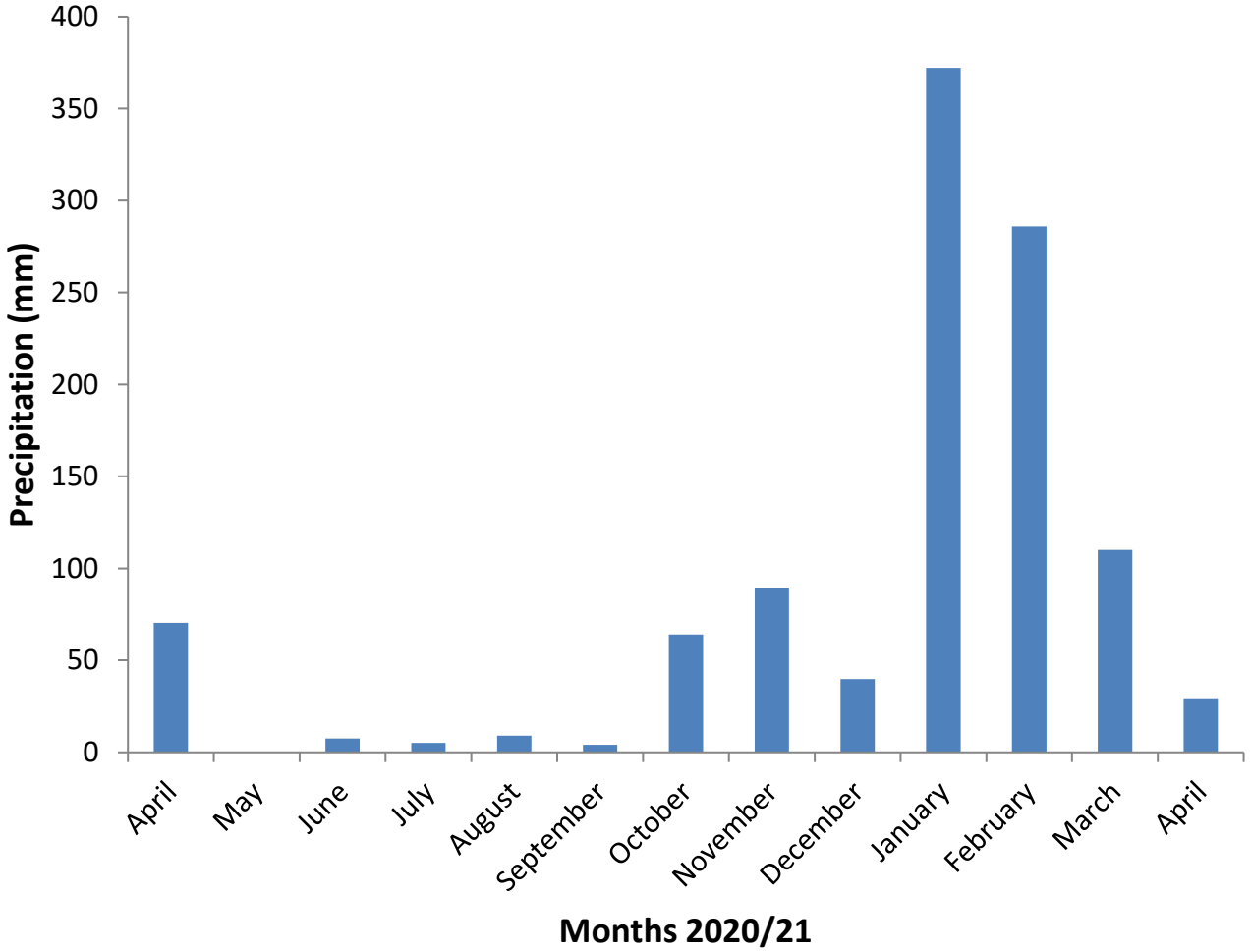
Temperatures in Chokwe 2021/22



Temperatures in Chokwe 2022/23



Precipitation: 2020/21



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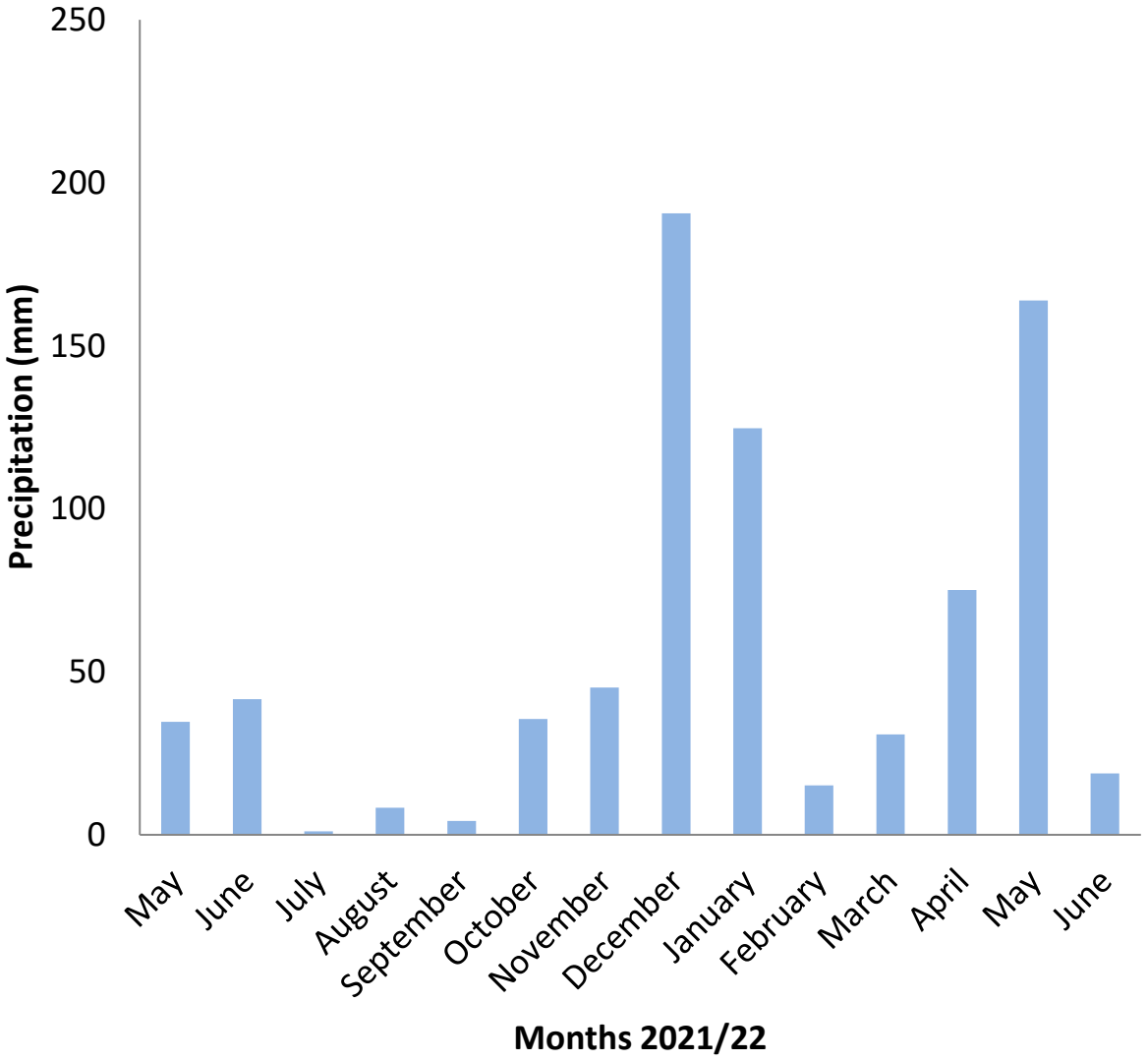
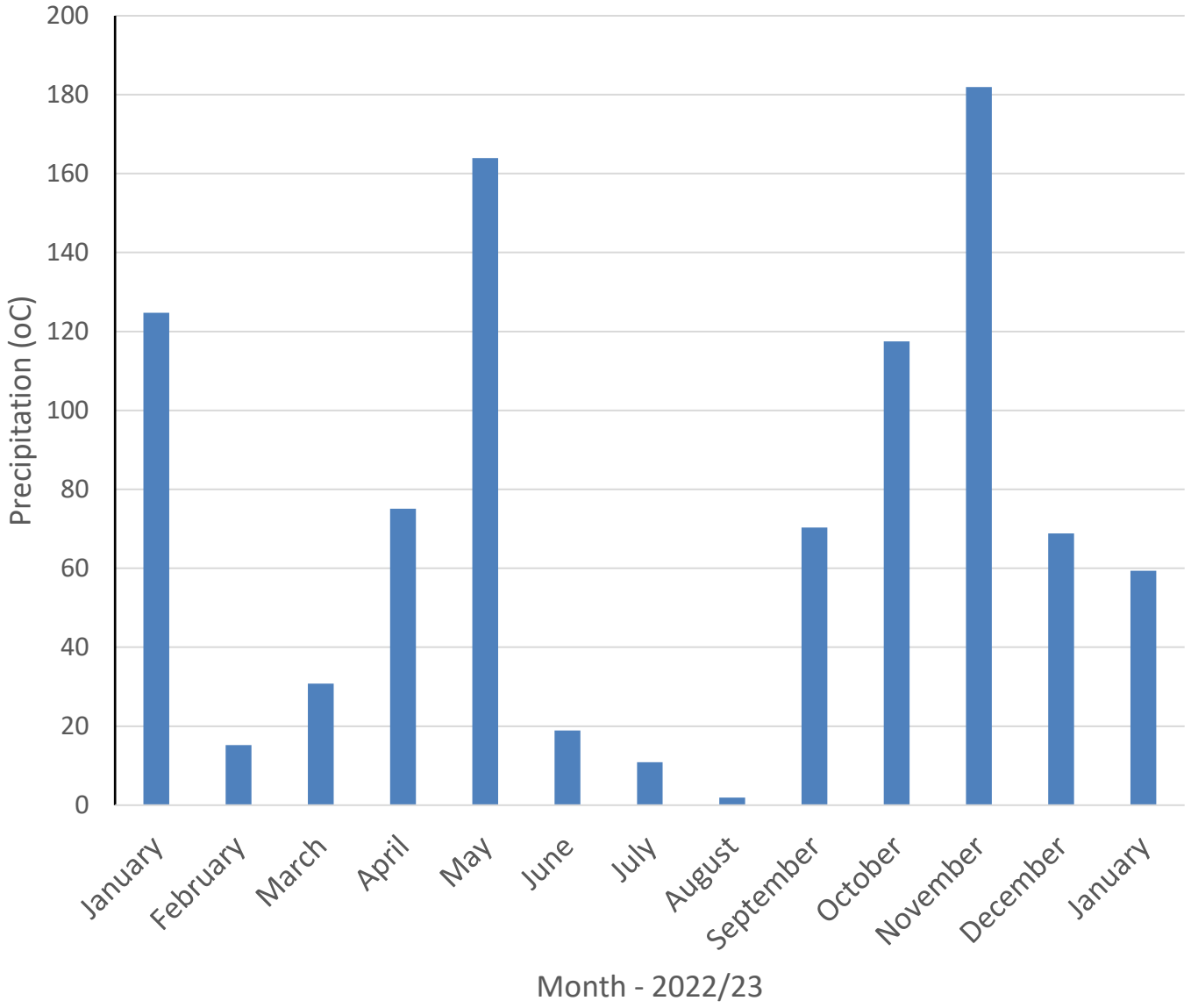


Precipitation: 2022/23



Objectives of the project

- **Main objective:** To develop common bean varieties adapted to high temperature and preferred by consumers, in Mozambique
- **Specific objectives:**
- 1. To evaluate heat tolerant common bean lines derived from crosses from *Phaseolus acutifolius* and preferred by consumers;
- 2. To identify sources of tolerance to high temperature that can be used in common bean breeding program, in Mozambique.
- *--- > Increase yield stability and extend the geographic area of bean production in Mozambique*

Research approach

- Selection based on field evaluations: summer season in southern Mozambique (high temperatures - Chokwe)
- Data collection:
- Days to flowering, Days to maturity
- Pollen shedding
- Number of pods per plant
- Number of seeds per pod
- Pod harvest index (PHI)
- Hundred seed weight
- Grain yield
- Pest and disease incidence

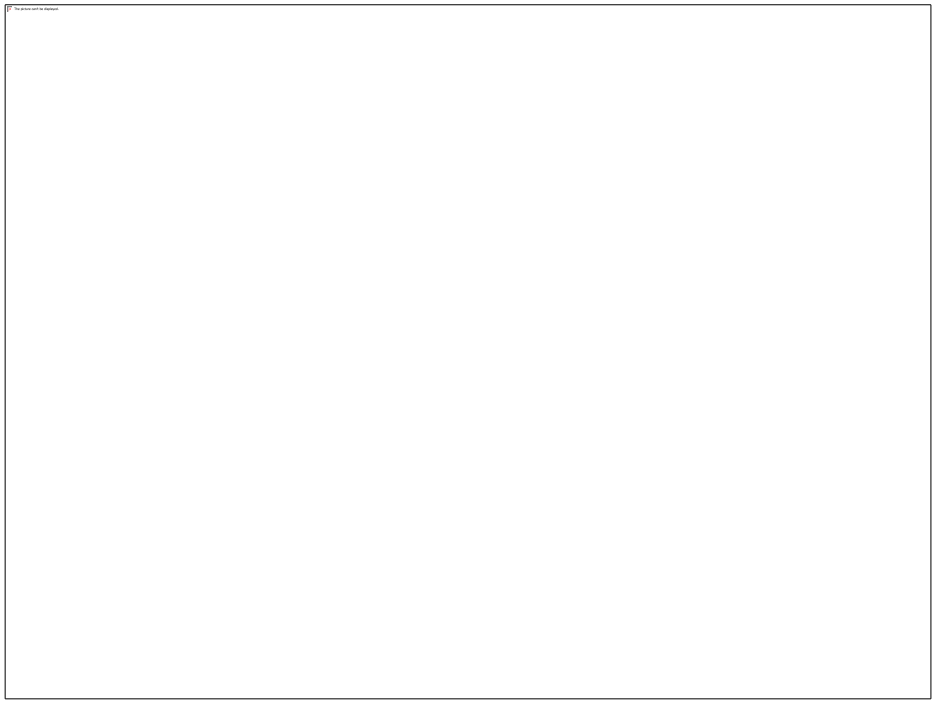
Planned activities

- 1.1. Increase of common bean seed lines during dry season at Chokwe Research Station
- 1.2. Evaluation of 128 common bean lines derived from crosses of *P. acutifolius* at Chokwe and Umbeluzi Research Stations under high temperatures in Chokwe
- 1.3. Evaluation of 6 best common bean lines under farmer's conditions during hot season in Chokwe and Boane Districts
- 1.4. Conduct participatory variety selection (PVS) of selected common bean lines in Chókwè during hot season

- 2.1. Screen about 160 common bean genotypes for traits related to tolerance to heat and yield performance under heat stress conditions

Obj 1: To evaluate heat tolerant common bean lines derived from crosses from *P. acutifolius*

- **1.1. Increase of common bean seed lines during dry season at Chokwe Research Station**
- Increased seed of several bean lines (> 300) at Chokwe Research Station during cool season (0.5 – 1.0 kg per line ~ 300 kg)



1.2. Evaluation of 128 common bean lines derived from crosses of *P. acutifolius* at Chokwe and Umbeluzi Res. Stations under high temperatures (1st planting date)

- Lines from interspecific crosses developed by CIAT
- Two trials planted in Chokwe and Umbeluzi
- Chokwe planted on Nov 29th, ,2022 (harvested on Feb 17th, 2023 – *on going data processing*

Umbeluzi: Trial was planted on Dec 28th, 2022 (*lost due to floods on Feb 10th, 2023)*

Evaluation of 128 common bean lines derived from crosses of *P. acutifolius* at Chokwe Research Stations under heat stress conditions (Second planting date)

Evaluation of bean lines derived from *P. acutifolius* population in Chokwe, Mozambique in 2020 (cool season)

The lines derived from P. accutifolius also had good yields under non stressed conditions in Chokwe (**400 to 4100 kg/ha**)

1.3. Evaluation of common bean lines under farmer's conditions in Chokwe, Boane and Guija

- Two (2) trials with 6 selected best bean lines were planted on February 8th , 2023 in Chokwe and Guija *(on going*)
- **1.4. PVS will be conducted in March-April (pod filling stage)**

Obj. 2. To identify sources of tolerance to high temperature

- **2.1. Screen common bean genotypes for traits related to tolerance to heat and yield performance under heat stress conditions**
- Different bean germplasm, lines from Feed the Future Climate Resilient beans (CRIB/USAID), local varieties
- **One trial for evaluation of 90 bean lines (two replications) was planted on Nov 30th, 2023 in Chokwe *(on going*)**

Evaluation of 24 common bean lines under high temperatures in Chokwe

- Lines developed for abiotic stresses
- Two trials installed in Chokwe in November 29th and Umbeluzi in December 28th, 2022
- Chokwe: harvested on Feb 17 *(on going data processing)*
- *Umbeluzi: lost due to floods*

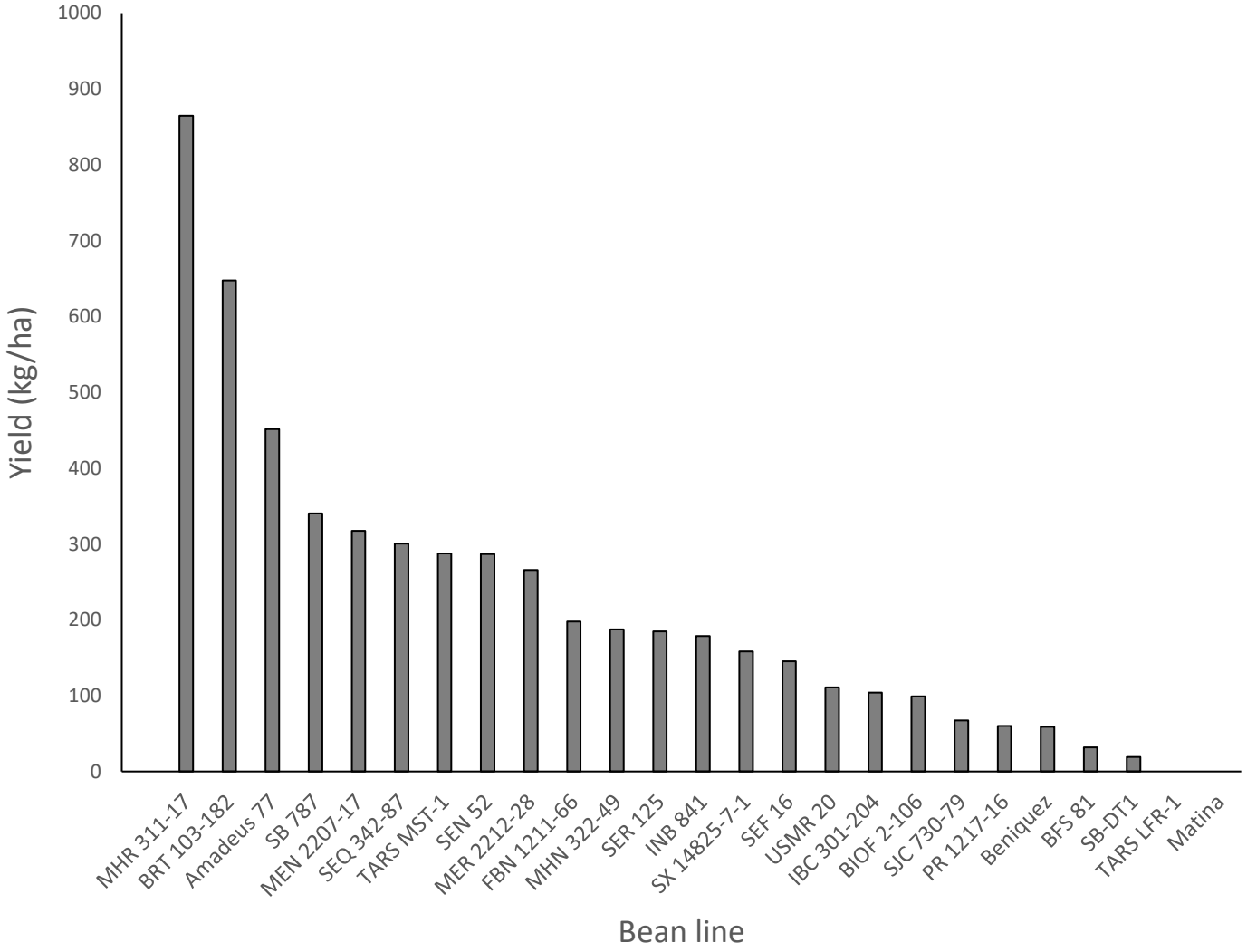
	Bean line	Name of the variety	Drought	High temperatures	Low soil fertility
1	**Beniquez**	Beniquez		x	
2	**BIOF 2-106**			x	x
3	MHN 322-49		x		x
4	BFS 81	INTA Productivo Sequía	x		x
5	SER 125	INTA Fuerte Sequía	x		x
6	**SJC 730-79**	CENTA EAC		x	x
7	**MER 2212-28**	Paisano PF		x	
8	SB-DT1		x		
9	IBC 301-204	INTA Centro Sur			x
10	TARS LFR-1				x
11	TARS MST-1				x
12	PR 1217-16	Bella			x
13	**FBN 1211-66**			x	x
14	**SEF 16**		x	x	X
15	**MHR 311-17**			x	
16	SEQ 342-87		x		
17	MEN 2207-17	Sayaxché	x		x
18	SEN 52	Naybí	x		
19	**INB 841**	Interespecifico	x	x	
20	**BRT 103-182**			x	
21	SB 787		x		x
22	SX14825-7-1	Campechano	x		x
23	**USMR 20**		x	x	
24	Amadeus 77	Testigo			

ERTEA – Ensaios Regionais de Linhas de feijao tolerantes a Estresses Abioticos
Bean lines for abiotic stresses (Honduras)

Preliminary yield results of 24 lines evaluated in Chokwe under high temperature, 2022

Bean line	Days flower	Days maturity	Yield (kg/ha)	Macrophomina
MHR 311-17	39	68	**864.8**	7
BRT 103-182	39	71	**647.5**	4
Amadeus 77	40	69	**451.5**	8
SB 787	39	71	**340.4**	7
MEN 2207-17	42	73	**317.4**	7
SEQ 342-87	45	73	**300.6**	7
TARS MST-1	40	70	287.6	7
SEN 52	39	67	286.7	7
MER 2212-28	40	69	265.9	7
FBN 1211-66	39	69	197.7	7
MHN 322-49	39	69	187.4	8
SER 125	38	73	184.6	7
INB 841	38	69	178.8	6
SX 14825-7-1	39	69	158.5	5
SEF 16	39	72	145.3	7
USMR 20	39	70	111.1	9
IBC 301-204	42	71	104.1	8
BIOF 2-106	39	70	99.3	5
SJC 730-79	42	76	67.6	7
PR 1217-16	44	70	60.2	7
Beniquez	40	71	59.2	9
BFS 81	39	71	31.7	6
SB-DT1	42	69	19.4	7
TARS LFR-1	41	70	0.0	7
Matina	40	71	0.0	6

Yield performance of 24 common bean lines evaluated under high temperatures in Chokwe

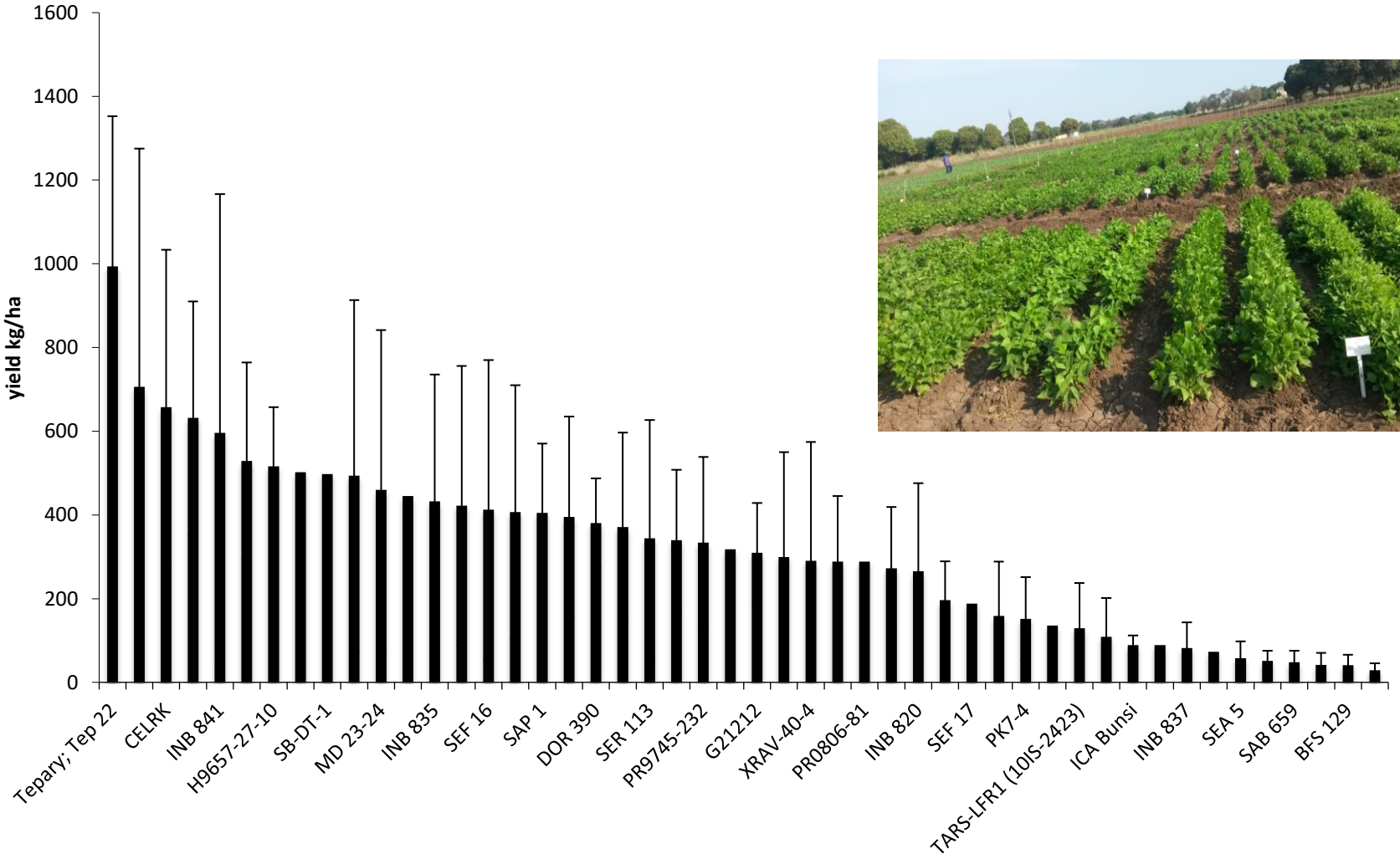


Second planting date in Chokwe on Feb 13th , 2023)

Pod and seed setting

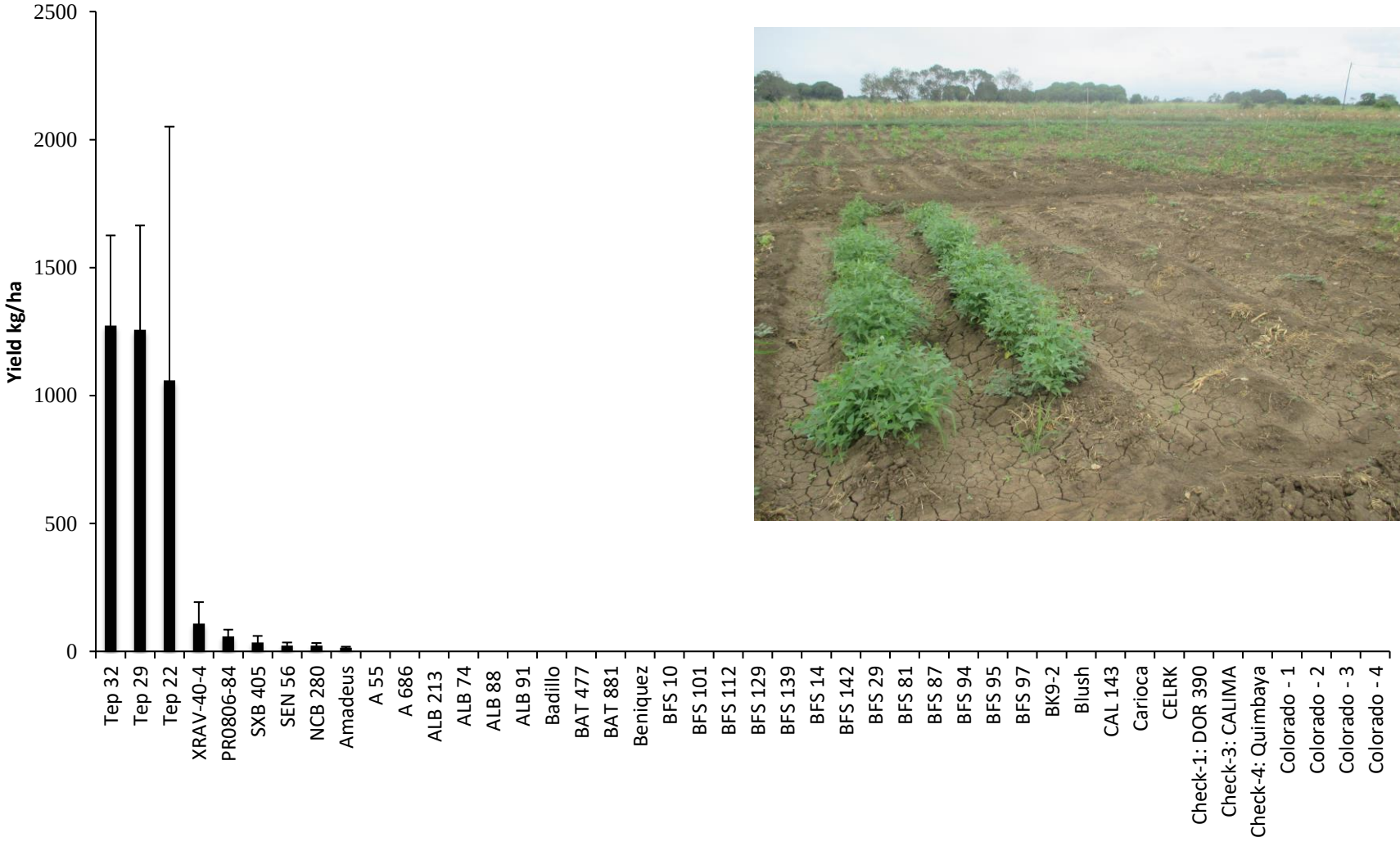
Some genotypes produced flowers but did no set pods and seed

Results from previous studies: Evaluation of BASE lines under high temperatures

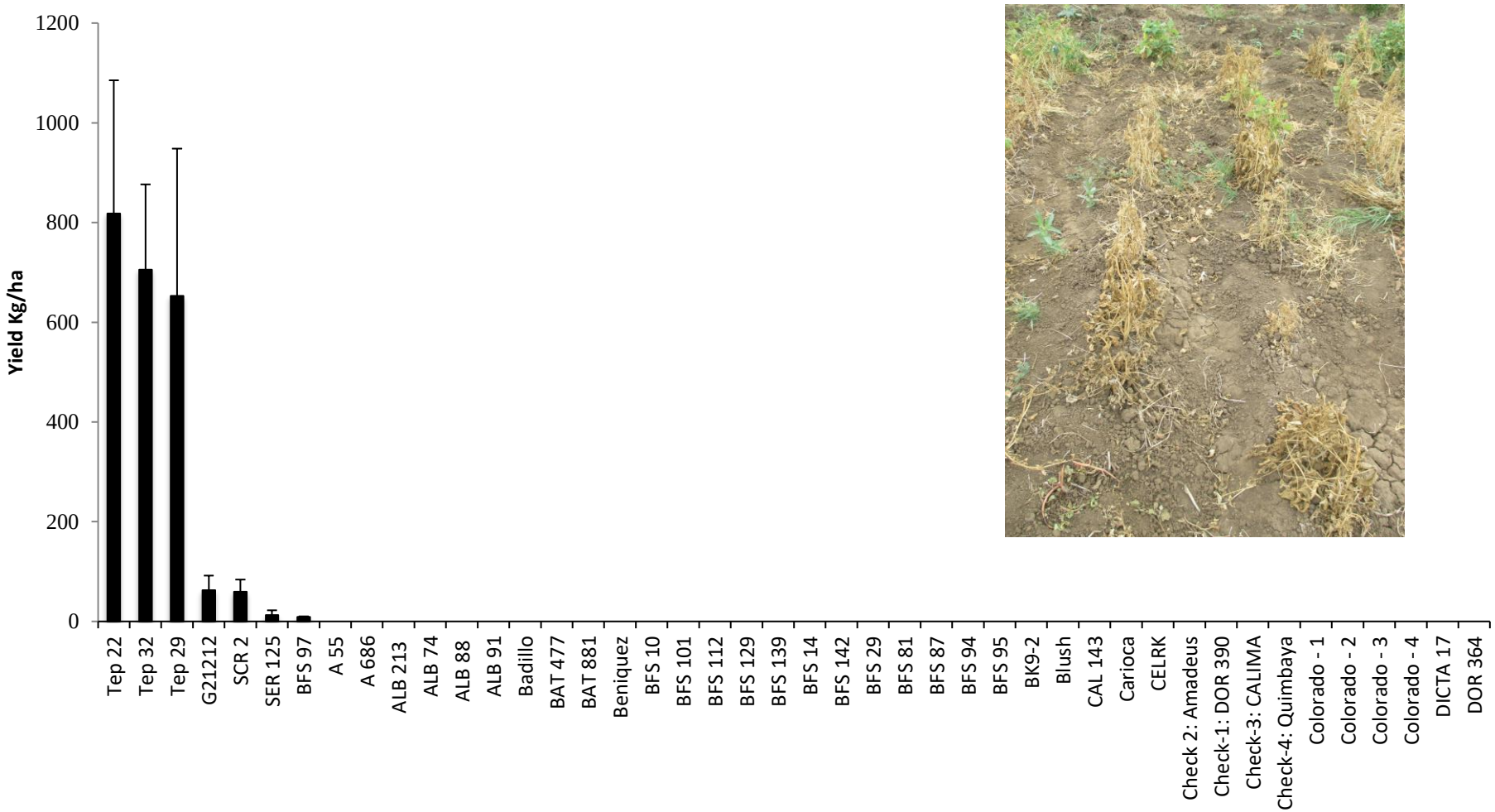


Chokwe: First Planting date – November 14th, 2015

Second Planting date – December 15th



Third Planting date – January 10th



Challenges/Perspectives

- Excessive soil moistures resulted from excessive rainfall affected negatively the performance of the bean lines (poor germination)
- Incidence of Macrophomina and root rots during summer
- Consider different options of planting dates
- *Data analyses: a lot of missing data associated with excessive rain (yield)*

Final considerations

- There is a potential of identifying commo bean lines tolerant to high temperatures in Mozambique and select bean with traits preferred by farmers
- Expect to identify sources of tolerance to high temperatures - breeding program for introgression of tolerance to high temperature in local varieties (need to identify traits and genes associated with heat tolerance)
- Include selection/introgression of resistance to root rots and Macrophomina
- *Delivery of heat tolerance bean varieties will increase production and productivity and expand the geographic range of bean production (southern Mozambique where bean is currently grown only in lowland areas during dry season)*

Acknowledgements

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CIAT
Centro Internacional de Agricultura Tropical
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