



**Kenya Agricultural & Livestock Research Organization (KALRO)**

# **Genetic improvement of Sugar Type Common Beans for Bean Scab (*Elsinoë phaseoli*) resistance through Marker Assisted Selection**

**Shamir Misango**

**ABC- ACP Annual Meeting 2023**

**Livingstone, Zambia**

# Team

- Dr. Reuben Otsyula
- Shamir Misango
- Yona Masheti
- Shadrack Odikara
- Diana Gumba
- Faida Kelele





# BACKGROUND OF KALRO PROJECTS

Markers Assisted Selection in developing common bean varieties with multiple resistance to major diseases in Kenya

BCMV/NV- MCM2001

CBB- VAX3

Anthraxnose- G2333

Pythium root rot Fixed in CAL 194

47 lines with various combinations under AYT



GENOTYPE	Yield T/Ha
KK-BC4F3-27	2.118
KK-BC4F3-13	1.975
KK-BC4F3-10	1.957
KK-BC4F3-28	1.858
KK-BC4F3-20	1.857
KK-BC4F3-46	1.828
KK-BC4F3-32	1.827
KK-BC4F3-18	1.805
<b>CAL194</b>	<b>1.799</b>
<b>RED16</b>	<b>1.799</b>
KK-BC4F3-31	1.725
KK-BC4F3-7	1.653
KK-BC4F3-44	1.645
KK-BC4F3-37	1.607
KK-BC4F3-21	1.605
KK-BC4F3-23	1.59
KK-BC4F3-33	1.58
KK-BC4F3-3	1.533
KK-BC4F3-6	1.47
KK-BC4F3-2	1.455
KK-BC4F3-30	1.417
KK-BC4F3-45	1.37



## **Performance Of Bean Genotypes Under Disease Pressure In Different Environments And Planting Dates In Western Kenya**

- Conducted by Yona for his Masters
- Screened for common bean disease across environments
- Studied the effect of planting dates on performance
- Disease pressure across different planting times

## **Prevalence, Variability and Management of Bean Scab (*Elsinoë phaseoli*) of Common Beans (*Phaseolus vulgaris*) in Kenya**

- Prevalence of *Elsinoë phaseoli* in Kenya
- Variability of *Elsinoë phaseoli* in Kenya
- Effective management options for the control of bean scab



## Identification of Novel Candidate Genes Associated with Scab Disease Resistance in Common Bean

- To determine the phenotypic variation among common bean accessions for scab resistance.
- To identify genetic variants and genes associated with scab resistance using a diverse set of common bean accessions using GWAS analysis approach.
- To develop high-throughput PCR-based markers for MAS targeting scab resistance improvement in common bean.

# Characterization and Selection for Anthracnose and *Pythium* Root Rot Resistance in Common Bean Landraces Grown in Kenya

- Genetic diversity of landraces in Kenya (89 landraces)
  - Origin and relationships between landraces have been documented
- Screening for *Pythium* root rot and Anthracnose resistance
  - Significant differences observed in disease reaction
- Introgression of diseases resistance in landraces- PRR (KK8) and Anthracnose (G2333)
  - Lines developed are under PYT

Publication: Misango S., Otsyula R. & Arunga E. E. (2022): Resistance to *Pythium* root rot and anthracnose among Kenyan common bean genotypes and marker-assisted introgression of resistance genes, Journal of Crop Improvement, DOI: 10.1080/15427528.2022.2158978

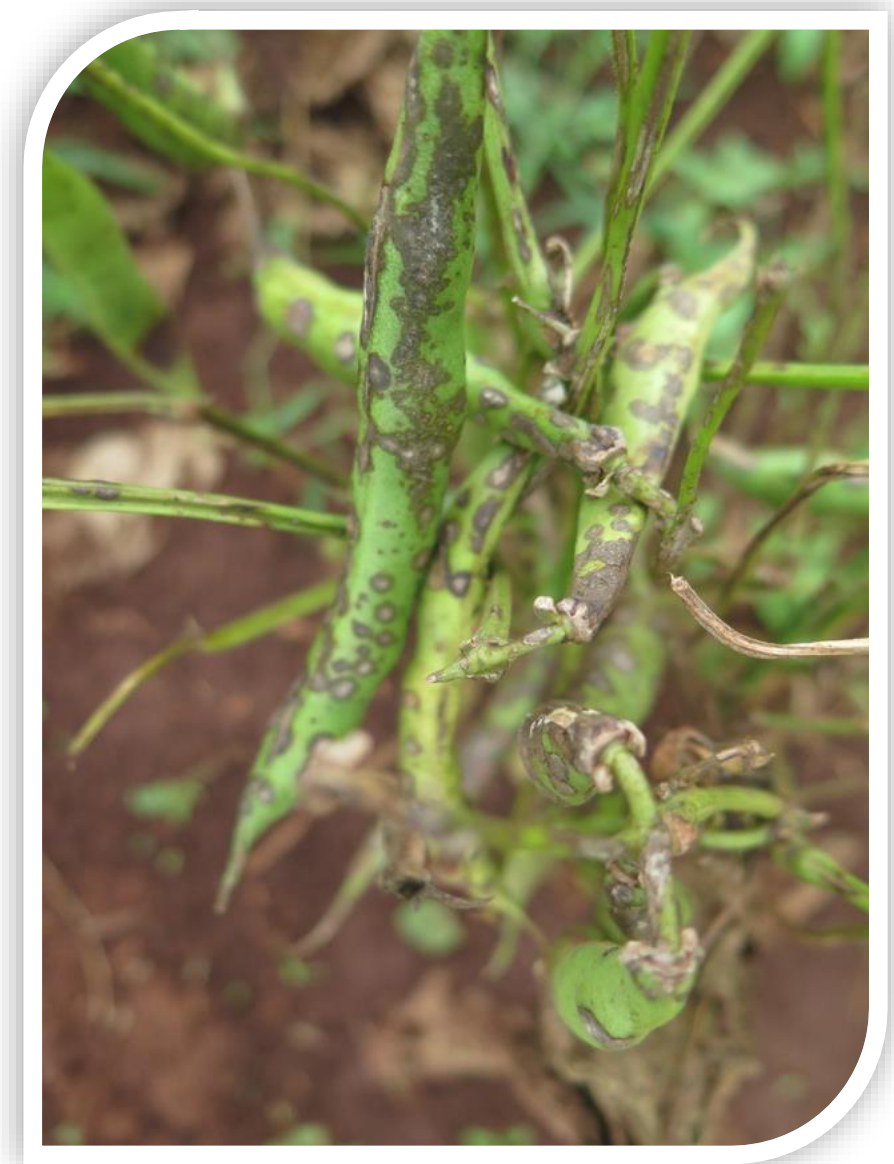




# PROPOSED RESEARCH

## Introduction

- Scab disease is a fungal disease of common beans caused by the pathogen *Elsinoë phaseoli* (Philips, 1994).
- The pathogen was first identified by Jenkins in 1933 which was observed on lima beans
- Bean yield losses of as high as 100% under favorable conditions (Philips, 1994; KALRO Annual Report, 2018).
- Bean scab is the most important disease in western Kenya



# Problem statement

- Bean Scab is major constraint to common bean production in western Kenya
- 100% yield losses of common bean (Masheti, 2019, KALRO Annual Report 2018)
- One study conducted on ADPs
- No reported resistant genotypes





# Justification

- Breeding resistant varieties to scab disease is the most practical, ecofriendly and economical method to manage the disease
- Need to screen more accessions to identify different reactions
- Developed PCR-based markers need to be validated for use in MAS





# Objectives

- **Main Objective**

To develop target market class common bean lines resistant to bean scab

- **Specific Objectives**

1. To determine bean scab reaction among common bean accessions
2. To validate developed PCR-based markers targeting scab resistance
3. To introgress bean scab resistance in sugar type beans



# MATERIALS AND METHODS

## To determine bean scab reaction among common bean accessions

### Plant materials

1. 47 lines developed for multiple disease resistance through Markers Assisted Selection; BCMV/NV, CBB, Anthracnose, PRR. (Phase 1)
2. ADPs
3. Landraces

### Exerimental Sites

- 3 agroecological zones
  - Lower midland
  - Upper midland
  - Lower highlands
- Screen house experiment
  - Isolates identified from previous study will be used

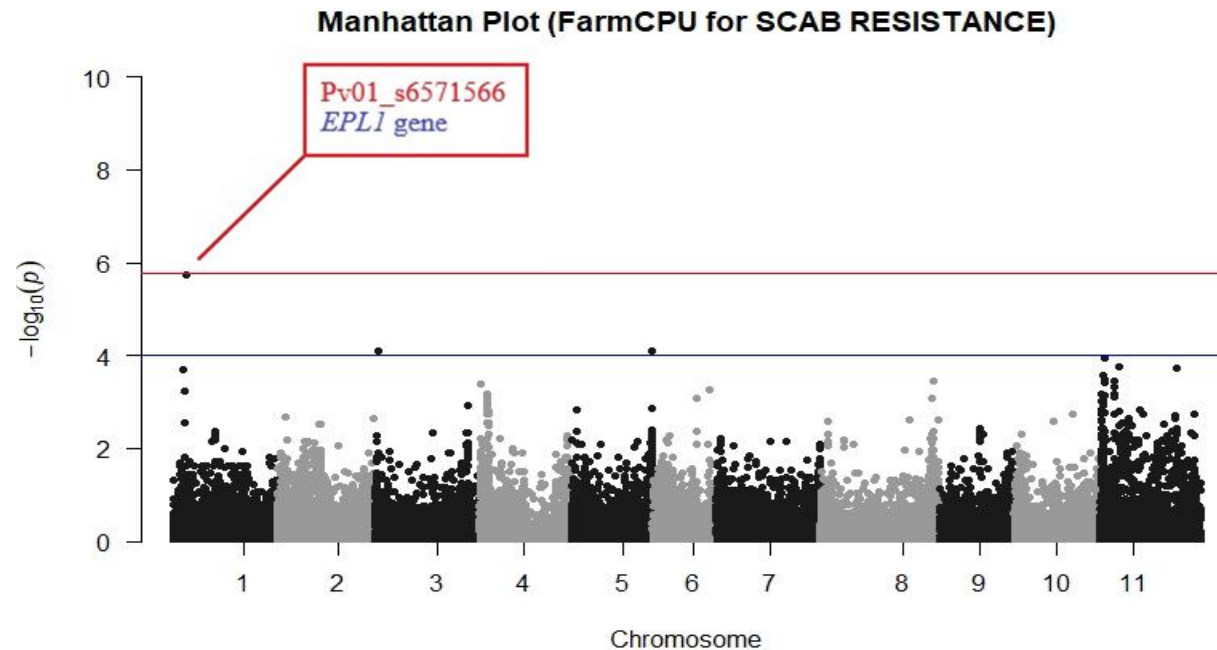
# Cont'

- Yona's focus:
  - Assessment of phenotypic characteristics
  - Genotypic variations
  - Pathogenicity of *Elsinoë phaseoli* isolates
  - Will aid in screening through inoculation



# To validate developed PCR-based markers targeting scab

- Shadrack's identification of novel candidate genes associated with scab disease resistance and development of PCR based markers will aid in molecular screening
- Resistant gene locus associated with scab disease resistance to be in chromosome on 1, LOC0003 (MCM 2001)
- 6 primer pairs have been designed and synthesized for each of the targeted genes *EPL1*, *ABC* transporter and the PHD-finger genes.



- *EPL1* gene and *ABC* transporter associated with scab disease resistance was identified on chromosome one of *Phaseolus vulgaris*.
- A sample of the population screened in objective 2 will be used in validation of the primers targeting the *EPL1* gene (enhancer of polycomp-like 1)



# Cont'

## **Plant materials**

- Selection of 3 sets from the screened panel
  - Resistant
  - Moderate resistant
  - Susceptible
- **Primer sets**
  - 6 primer pairs developed from the previous study

# To introgress bean scab resistance in sugar type beans



- Direct crosses between identified potential donors and susceptible sugars with resistance to PRR and anthracnose
- A series of backcrosses to the recurrent parent
- Application of MAS at every stage



# Outputs

- Identification of potential resistant sources among various genotypes
- Development of farmer preferred scab resistant lines
- Potential release of resistant lines
- Enhance the used of designed primer sets in molecular breeding





**THANK YOU**



**Kirkhouse  
Trust** Supporting research and education  
in the biological sciences