Use of Root Traits in Screening Common Bean (*Phaseolus vulgaris* L.) Genotypes Tolerant to Drought in Mozambique, Malawi and Zambia

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Introduction

• Common bean is an important dietary legume and source of income for the majority of the population in Mozambique, Malawi and Zambia;

• Average yield of the crop in the three countries is very low (less than 600 kg/ha);

• Mostly grown under rainfed conditions, in some areas with insufficient or unpredictable rainfall;

• Recent studies show that drought will spread to more areas in the coming years - affecting the productivity of common bean.
Climate change and Drought, 2000-2020

A. Jarvis; CIAT
Objective of the Study

• To explore the possibility of using root traits in screening bean genotypes for tolerance to drought.
Materials and Methods

3 nurseries received from CIAT were evaluated in MZ and MW under water stressed conditions (terminal drought) and irrigated (non-stressed conditions).

- 56 Andean red and White large
- 31 Andean drought and red mottled
- 64 Andean lines (8 x 8) lattice
Materials and Methods (Cont...)

• Root crowns of 3 representative plants per plot in each replicate were excavated randomly, 45 days after planting (DAP) and washed.

• Roots were evaluated for traits associated with drought tolerance:
  • Adventitious root number (ARN);
  • Basal root whorl number (BRWN);
  • Basal root number (BRN);
  • Tap root lateral number (TRLN);
  • Basal root growth angle (BRGA).
  • Tap root diameter (TD)
Materials and Methods (Cont...)

Electronic graduated caliper for measuring the diameter of the roots

Scoring board for measuring the angles of the basal roots
Results

Basal Root Whorl Number (BRWN) & Basal Root Number (BRN)

• There was positive correlation between BRN and BRWN,

• There was no difference or change in BRWN and BRN in both conditions (irrigated and non-irrigated)
Variation in Basal Root Whorl Number (MW)

- BRWN ranged between 1 to 3 in both at stressed and non-stressed conditions.
- The BRWN was not affected by the treatments.
Adventitious Root Number under stressed and non-stressed conditions (MW)

• Genotypes had more adventitious root number under no stress compared to water stressed conditions.
• However, G 18255, SER 83 and G 2686 produce more adventitious roots under stress.
Adventitious Root Number (ARN) vs Yield

Data showed positive correlation between yield and the number adventitious roots.

\[ y = 16.106x + 414.02 \]
\[ R^2 = 0.40434 \]
A positive relationship was also found between taproot diameter and yield.

Bigger taproot was associated with higher yield.
Basal Root Growth Angle (BRGA) Vs Yield

- Strong positive correlation was observed between BRGA and grain yield under stressed conditions.
- Genotypes with deep BRGA performed better under drought conditions.

\[ y = 23.246x + 249.81 \]
\[ R^2 = 0.8991 \]
Comparison of Stressed and Non-Stressed Yield (MZ)

Lines of common bean (*Phaseolus vulgaris* L.)

- yield (kg/ha)\_NS
- yield (kg/ha)\_DS
Summary

• Screening bean genotypes for tolerance to drought is a difficult task because there are many factors associated with drought tolerance.

• Genotypes with BRGA of more than 45° around the tap root (A) perform better under drought conditions than genotypes with shallow roots (B);

• In general the root traits evaluated show positive correlation with yield suggesting the potential of using these traits in screening for drought tolerance
Acknowledgement
Thank You