DIVERSITY OF ROOT PHENES OF COMMON BEAN (PHASEOLUS VULGARIS L.) FROM ANDEAN AND Mesoamerican GENE POOLS

Celestina N. Jochua1, James Burridge2, Stephen E. Beebe3 and Jonathan P. Lynch4. 
1Instituto de Investigación Agraria de Mozambique (IIAM), Av. FPLM no. 2698, P.O. Box 3658, Maputo, Mozambique. 
2The Pennsylvania State University, 102 Tyson Building, University Park, PA 16802, USA. 
3Centro Internacional de Agricultura Tropical (CIAT), A.A. 6713, Cali, Colombia.

*celestina.jochua@hotmail.com

INTRODUCTION

Low phosphorus (P) availability and drought are major constraints to common bean production in many developing countries. The root system is an important factor for plant productivity (Lynch, 1995). Plants have evolved a wide range of adaptations to enhance P acquisition from the soil (Lynch and Brown 2001). Bean genotypes with shallow roots, large number of basal and adventitious roots have advantages in acquiring P from low P soils, while genotypes with deeper and longer roots will acquire water from deeper soil horizons. Information on root diversity is crucial for development of varieties adapted to specific region. To assess the diversity of root phenes in beans, accessions from the bean core collection from CIAT were evaluated in the laboratory and field.

MATERIALS AND METHODS

• One hundred sixty five (165) bean accessions representing different geographic regions, and races from Andean and Mesoamerican gene pools were planted in a RCBD in the laboratory and field in Pennsylvania, USA in 2010.

Laboratory

• Root phenes evaluated were basal root whorl number (BRWN), basal root number (BRN), root hair length (RHL), and root hair density (RHD).

Field

• Root crowns of 3 representative plants were excavated 45 days after planting, washed and the root phenes were measured using a boarding table (Figure 1 and 2). The traits measured in the field included adventitious root number (ARN), length (ARL, cm) and branching (ARB), BRWN, BRN, length (BRN, cm) and branching (BRB), basal root growth angle, and primary root branching (PRB).

RESULTS AND DISCUSSION

• Large phenotypic variation in root phenes was found in both Andean and Mesoamerican gene pools (Fig 3 and 4). Significant differences in root phenes between and within root traits among genotypes were detected.

• RHL varied from 0.19 to 0.78mm (Fig 5). Twenty one (21%) had long and dense root hairs, traits conferring P efficiency in beans.

• RHL and RHD were positively correlated (Fig 6).

• Correlation among traits were weak but significant (p-value < 0.01) for most traits. Strong correlation was detected for BRN vs BRWN ($R^2 = 0.88$), and a tradeoff between ARN and BRN was found (Fig 7).

• Useful root traits for breeding for P efficiency and drought stresses were identified in both Andean and Mesoamerican gene pools.

• Breeding for multiple root phenes could enhance acquisition of multiple soil resources, particularly in developing countries.

REFERENCES


AKNOWLEDGEMENTS: This research was partly supported by the Dry Grain Pulses CRSP, CCRP of The McKnight Foundation and The Pennsylvania State University.