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

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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 in the laboratory and field.

Figure 1. Field evaluation of bean root phenes

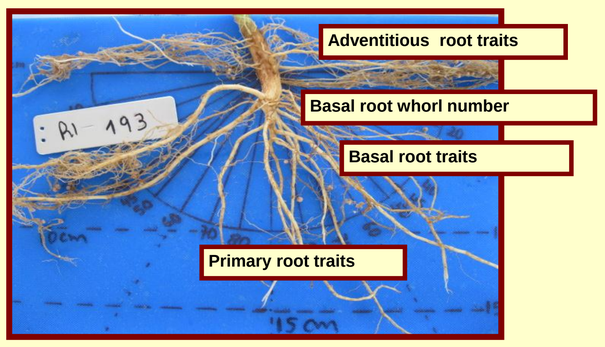

Figure 2. Root phenes evaluated in the field

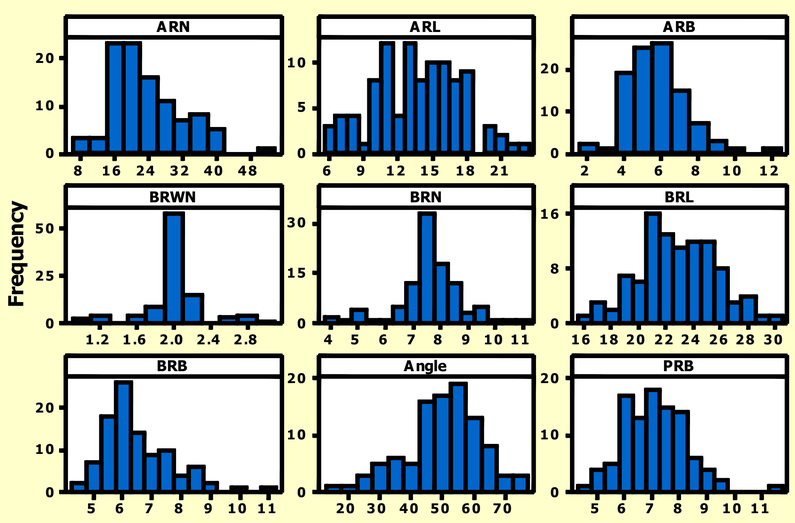

Figure 3. Variation in root phenes in Mesoamerican genotypes

Figure 4. Phenes varied from no ARN to several adventitious roots (above) and from shallow to deep rooted genotypes (down).

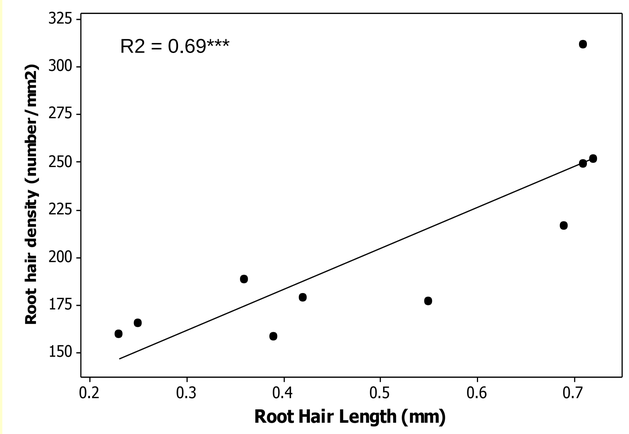

Figure 6. RHL and RHD were positively correlated

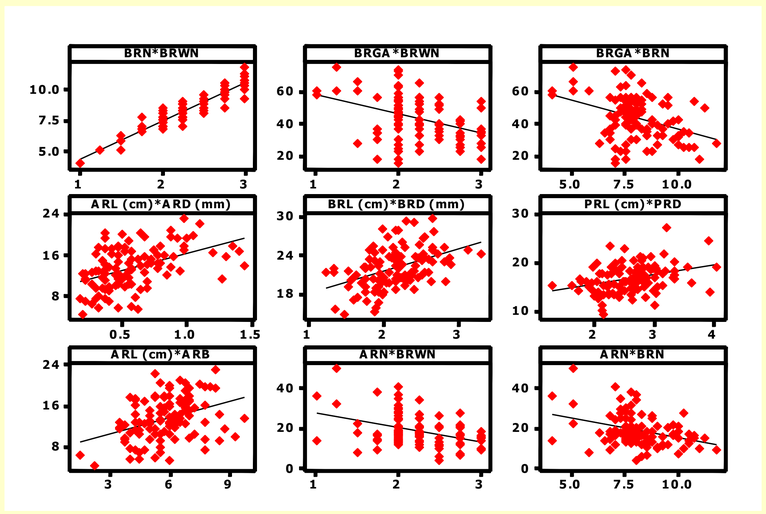

Figure 7. Correlation among root phenes were weak to strong

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 (BRL, cm) and branching (BRB), basal root growth angle, and primary root branching (PRB).

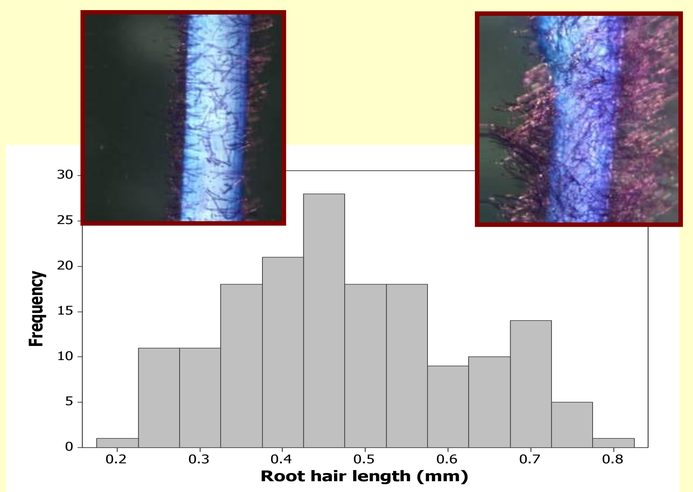

Figure 5. RHL varied from 0.19 to 0.78mm

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

Lynch, J.P., and K.M. Brown. 2001. Topsoil foraging–an architectural adaptation of plants to low phosphorus availability. Plant Soil 237: 225–237.
Lynch, J.P. 1995. Root architecture and plant productivity. Plant Physiogy.109:7-13.

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