**3.3.1.1 Breeding lines with improved performance under P and water limitation. Parental crosses for low P in acid soil identified**

Objective and intended output: Root attributes contribute to acquisition of immobile nutrients such as P. Genotypic variation in root crown in response to P availability in soil has been observed before. The main objective of this work is to quantify phenotypic variation in shoot and root crown attributes among a 16 ALB common bean germplasm. Exploring phenotypic variation in root and shoot attributes could result in identification genotypes with greater ability to acquire P from acid soil with low available phosphorus (P) or high exchangeable aluminum (Al).

Materials and methods: A group of 16 common bean genotypes were evaluated for phenotypic variation for root and shoot attributes, under field conditions in an acid soil from Quilichao, Colombia. Two experiments were planted on April 2016. The 16 genotypes included one andean ( ICA Quimbaya) and mesoamerican (VAX 1 ) checks, 8 ALB lines (ALB 91, 213, 348, 350, 351, 352) as well as 6 breed lines {T3= SMN 57 X (SMN 24xALB 191)F1/-020F1-06P-MQ-8C-MC-MC-MQ; T4= SMN 57 X (SMN 24xALB 191)F1/-037F1-03P-MQ-8C-MC-MC-MQ ; T5= SMN 57 X (SMN 41xSXB 412)F1/-059F1-10P-MQ-3C-MC-MC-MQ; T6 (SMN 57 X (ALB 191xSMC 41)F1/-014F1-03P-MQ-2C-MC-MC-MQ); and T12= (ALB 213xALB 121/-MQ-25Q-MQ-MQ-MQ-MC-01C-MC-MQ)}.

Results and interpretation: Increasing limits to penetration from topsoil to ground depth was found in both high exchangeable Al and low P experiments (Figure 1). Lower pH and available P was found at deeper soil too. Under those limiting conditions to root, and hence plant development, 6 outstanding lines {(ALB 91, ALB 349, ALB 352, ALB 351, VAX 1 and SMN 57 X (SMN 24xALB 191)F1/-020F1-06P-MQ-8C-MC-MC-MQ} were identified with higher grain yield under low P and high exchangeable Al stress (figure 2).Grain yield was negatively correlated to resistance to penetration, and positive related to soil pH and available P under high Al and low available P environments.

 A group of root attributes was negatively related to grain yield under high Al conditions (number of lateral roots grown over tap root and basal roots, whorl and basal roots number) while shoot attributes as canopy biomass and pod harvest index were positively related to grain yield.

Under low P environment canopy biomass and pod harvest index were positively related to grain yield while whorl and basal roots number were negatively related to grain yield.

Next steps:



**Figure 1.** Resistance to penetration, bulk density, pH and available P conditions of two acid soils whit high exchangeable Al and low available P, from Santander de Quilichao-Colombia, used to identify adapted common bean genotypes. Dots and bars are mean and standard deviation, respectively.



**Figure 2.** Identification of common bean genotypes with greater grain yield, when grew under acid soil with low P and high exchangeable P conditions in Quilichao -Colombia. Genotypes with higher values of grain yield were identified in the upper, right hand quadrant.