Back to our roots: Morphological variability in bean and cowpea roots influence agronomic performance

INTRODUCTION
Edaphic resources, particularly phosphorus (P) and water constrain production of bean and cowpea. Resources are stratified in contrasting patterns. Shallow rooting promotes P acquisition, deep roots promote water acquisition, root hairs are often beneficial. Root phenes have a range of heritabilities.1

RESULTS
- Bean and cowpea germplasm from the international centers offers significant variation in root traits and opportunities for genetic improvement (violin plot top left shows cowpea diversity panel trait variation).1
- Longer root hairs enhance resource acquisition and performance in common bean (top right).2 Phene synergism exists between BRGA and root hair length in common bean (bottom left).3
- For common bean, shallow root architecture favors production in low fertility soils and deep root architecture favors production in drought environments.4
- Selection for low fertility tolerance in common bean can selects for greater root hair length and density (bottom right).

DISCUSSION
Phenotyping suggests promising variation in both bean and cowpea. Simple tools can serve to deploy similar morphological phenes in cowpea as in common bean. Studies are needed to validate pheno utility in single and multiple stress environments.

REFERENCES

MATERIALS AND METHODS
Phenotype large panels using shovelomics (dig, wash, evaluate architecture and root hairs) then identify entries with contrasting phenes of interest and conduct physiology trials to determine phene utility while controlling for other factors such as phenology.

Abbreviations for cowpea root phenes: ARN adventitious root number, BRN basal root number, BD10 number of laterals between 5 and 10 cm below soil surface, ARGA adventitious root growth angle, BRGA basal root growth angle, TD tap root diameter, TO10 tap root diameter 10 cm below soil level, NS nodule score, 3BD third order branching density score, D5 disease score. All photos are of cowpea root crowns.