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Indoor-Field: A macro-mesocosm system to study the field dynamics of phenotypic spectrum of common bean (*Phaseolus vulgaris. L*).

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Root studies in controlled environments are typically conducted either in rhizotrons, pots, or small scale mesocosm systems, like PVC tubes or root boxes. These systems have two limitations for translating results to crop roots grown in fields. First, the size and shape of containers change the root phenotype when plants are in the mature stage. Second, often only one plant is planted per container without interaction among neighboring plants. Therefore, the root architecture observed in these isolated environments has low predictability for the root architecture in a community setting in fields. To better translate the root traits observed in a controlled environment to field observations, we developed a macro-mesocosm system (5.5 m (W) x 6.7 m (L) x 0.7 m (H)) to mimic the real field soil conditions in a greenhouse. We also installed 64 capacitance soil moisture sensors to monitor the whole macro-mesocosm system at 15.24 cm and 38.10 cm soil depths in real-time. We evaluated the phenotypic spectrum in one common bean (*Phaseolus vulgaris. L*) genotype, SEQ7, in a time series experiment. We grew SEQ7 for two, six, nine, and twelve weeks under sensor-controlled water-stressed and well-watered irrigation regimes. SEQ7 showed four different root architecture types across developmental stages. These four root architecture types are consistent with previous field observation. This novel macro-mesocosm system will be a great setup to study the field dynamics of the root phenotypic spectrum in a controlled environment.