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DEVELOPMENT OF A HIGH-THROUGHPUT SYSTEM FOR PHENOTYPING RICE ROOT TRAITS

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A CIRAD project (Orytage) involving NARES and IRC partners aims at developing an international phenotyping network for rice adaptations to drought and thermal stresses in the context of gene discovery and genetic mapping. Root architecture is a key character for improving responses to these stresses. Identifying genes or QTLs that control root development and incorporating these loci in marker-aided selection programs is a promising strategy for the genetic improvement of root traits. However, high-quality phenotyping of a large numbers of individuals, which is necessary for precise gene mapping, remains the main bottleneck of this approach. We set up a high-throughput, low-cost, and precise methodology that allows analysis of root traits of hundreds of plants with limited measurement effort and without soil constraints. The “rhizoscope” system is based on the use of 2-D “nail board rhizoboxes" filled up with glass beads and bathed with aerated nutrient solution. The substrate permits one to study roots under uniform mechanical impedance, which can be manipulated by changing bead size. Growth is visualized in two dimensions and the measurement of multiple parameters such as root angle, number, length, and diameter is based on computer-aided analysis of digital images. The combination of 2-D boxes with glass beads simulates the soil conditions well enough to obtain relevant information, as demonstrated by our comparative studies in soil-filled tubes. Our disposition also maximizes differences among genotypes, making it an ideal system for QTL identification. Although initially developed for japonica rice, our rhizoscope system is generic and can be employed for phenotyping other plant species.