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TraitMill: high throughput phenotyping of transgenic rice

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The advent of the “omics” sciences in the last decade has raised the expectation that better understanding of gene function will lead to the creation of new plant varieties with improved agronomic performance. This can be achieved through the introgression of the most suited alleles by marker-assisted breeding or by transformation of crops with optimized transgenic alleles. However, assessing the impact of alleles, whether natural or transgenic, on the agronomic performance of cereal plants like rice remains a difficult task. To meet this challenge CropDesign has developed TraitMill™, a platform that allows the evaluation of the effect of alleles on agronomically valuable traits of rice such as growth rate, leaf biomass, root biomass, heading time, seed yield and harvest index. TraitMill™ is thus designed to identify new targets for crop improvement and to deliver comprehensive and quantitative data on individual allele effects.
Plant evaluation in the TraitMill is performed in a highly controlled greenhouse environment that can be adapted to either provide optimal growing conditions or to inflict stresses such as drought stress or nutrient deprivation stress. Rice plants are grown on a conveyor belt system and most plant handlings are performed by robots. Plants are passed each week through a digital imaging cabinet. Agronomic parameters are extracted from the digital images using various segmentation algorithms. Once plants are mature, seeds are harvested and processed through automated equipment for cleaning, counting and weighing of the seeds. All data are downloaded in a central relational database and automated statistical algorithms are deployed to compare the performance of the plants. Over 1000 different plant-based transgenes have been tested in the TraitMill™ and statistically significant effects on yield components have been observed for dozens of transgenes. Our results not only point to the clear impact that single genes can have on quantitative traits, but also prove the relevance of genetic engineering approaches for improving yield and yield stability components and for generating additional genetic diversity.