Final report on the project

Association mapping of genes related to abiotic stress tolerance in rice

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Summary

Genome wide association studies (GWAS) were conducted for two different types of abiotic stress affecting rice production: iron toxicity and high tropospheric ozone concentration. A diversity panel consisting of 329 different rice accessions originating from 79 countries and representing all sub-populations of rice (Oryza sativa L.) was screened. Genetic marker data representing 44 100 single nucleotide polymorphisms (SNP) were used for the mapping. In the case of iron toxicity, two nutrient solution trials including a total of 8 replicates per genotype in each treatment were conducted. Plants were pre-grown for five weeks and then subjected to an iron pulse stress of 1000 ppm Fe(II) for five days. Thereafter, plants were harvested and phenotyped for leaf damage and biomass. In addition, a subpopulation consisting of 30 contrasting genotypes was tested in a supplementary field experiment in the Philippines in collaboration with the International Rice Research Institute (IRRI). In the case of ozone stress, a season-long fumigation experiment was conducted using paddy rice ponds which were newly established especially for this project. Rice seedlings were transplanted into eight 2 x 6 m ponds and ozone fumigation (60 ppm / 7h per day) was initiated five weeks after transplanting in half of the chambers and continued until grain harvest. Leaf damage and greenness (SPAD values), lignin concentration, growth parameters, grain and straw yield were determined. In both stresses, substantial genotypic variation in stress tolerance was observed within the diversity panel and association mapping revealed genetic markers significantly associated with phenotypic traits. In depth analysis of these chromosomal regions, including linkage disequilibrium analyses, haplotype analyses, and candidate gene identification, is currently ongoing. This will lead to the identification of putative tolerance genes for iron toxicity and ozone stress, which need to be investigated in further experiments. Thereby, the project will contribute to the development of stress adapted rice varieties, and ultimately to the food security of many developing countries, where rice production is severely affected by abiotic stresses.