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Variation in root system developmental responses of irrigated and rainfed philippine rice varieties to water stressed environments

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Abstract

About 200 rice varieties for irrigated and rainfed lowland ecosystems were released in the Philippines, which were bred for improving yield under favorable conditions. Root plasticity plays key roles in maintaining crop productivity under abiotic stressed conditions. We hypothesized that some of these varieties possess root plasticity traits in response to water stressed conditions. This study aimed to evaluate the root system development and dry matter production of 14 randomly selected rice varieties (6 irrigated lowland and 9 rainfed varieties) under progressive drought (PDR) and soil moisture fluctuations (SMF) stress conditions. Two experiments were done in rootbox and line source sprinkler systems (LSS). Each of the varieties was subjected to well-watered (WW), PDR and SMF conditions during vegetative stage in rootbox system while the same genotypes were subjected to different intensities of drought stress under LSS. Under rootbox system, PDR and SMF significantly reduced shoot dry matter production in all varieties relative to their WW controls. Among varieties, NSIC Rc238 (irrigated lowland) showed the least reduction in shoot dry weight (SDW) in both PDR (by 11.8%) and SMF (by 26.9%) conditions. Less reductions in SDW of NSIC Rc238 were partially attributed to the promotion of L-type lateral roots, thus increasing total lateral root length by 24.2% and 30.7% under PDR and SMF, respectively. In LSS, SDW of NSIC Rc238 under mild drought stress (16-21% soil moisture content (SMC) had 31.8% reduction relative to its WW control ($\geq 22\%$ SMC) and had lower sensitivity drought index. Compared with the IR64 susceptible check and NSIC Rc9 tolerant check, NSIC Rc238 had higher SDW by 90.8% and 38.6%, respectively. Furthermore, no rainfed lowland varieties included in the experiment performed well under different water stress treatments. The results implied that some other irrigated lowland rice varieties may also possess drought dehydration avoidance root plasticity traits under water-stressed growing environments.

Keywords: drought, soil moisture fluctuation, root system development, released varieties, lateral roots

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