Field Infrastructure for Phenomics of High Night Air Temperature Stress Tolerance of Rice

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November 1, 2022

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High night air temperature stress (HNT) challenges rice production. Findings indicate 10% yield reduction for every 1°C of increase in night air temperature. The responses of rice to HNT stress have been analyzed in limited number of genotypes mostly under greenhouse conditions. One of the limits for these studies under field conditions is implementing HNT stress on critical rice growth stage. The physiological and metabolic responses of rice to HNT stress under field conditions are not fully understood, thus, field studies are needed. Field-based phenotyping infrastructure that can house rice germplasm and stress imposition using computer-based system basing on ambient temperature still do not exist. In this study, six high tunnel greenhouses were built in a field experimental station in Harrisburg, AR in a split-plot design. These movable infrastructures fitted 310 rice accessions from the Rice Diversity Panel 1 (RDP1) and 10 hybrids from RiceTec. Each high tunnel greenhouse had heating and a cyber-physical system that recorded ambient air temperature and increased night air temperature relative to ambient temperature at the flowering stage. The system successfully imposed HNT stress of 4.01°C and 3.94°C as recorded by Raspberry Pi sensors for two weeks in the 2019 and 2020 cropping seasons, respectively. These greenhouses were able to endure constant flooding and resist heavy rain and 40-50 miles/h winds. Grain quality and other biochemical assays are still ongoing to fully assess the effects of HNT in the rice accessions and the hybrids.