

Response of Rice to Changing Climatic Condition: (II)

Genotypic Variation in Growth Responses to Vapor Pressure Deficit

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The vapor pressure deficit (VPD) can affect rice growth by affecting water status of the plants and/or thermal conditions of leaves or the canopy. Rice responses to increasing temperatures may also be altered by changes in VPD. We are currently conducting a series of experiments to determine the interactive effects of temperature and VPD on rice growth, but we need to examine genotypic variation in growth responses to VPD to better understand the interaction and its implication for adaptation to climate change. This study aims to determine the genotypic variability in responses to VPD using four varieties that showed different temperature responses in our previous study. We used two naturally-sunlit growth chambers (Climatron) of NIAES, Tsukuba, Japan, setting day/night temperature at 32/22°C for both chambers but different relative humidity (RH) levels; one at 80% (Low VPD=0.74 KPa) and the other at 50% (High VPD=1.84 KPa). Seedlings of Akihikari, IR64, N22 and Takanari were grown outside until 21 days after sowing (DAS), then moved to the chambers and allowed to grow for 30 days. Growth and physiological responses were determined during the treatment period. Leaf temperature (T_l) measured under the mid-day cloudless conditions at 45 DAS with infra-red thermometers (Konica-Minolta, TA-0510) was significantly higher in low VPD than in high VPD ($P<0.001$), but the difference in T_l between the treatments was larger in Akihikari and N22 (3 °C) than in IR64 and Takanari (1.4 °C), resulting in a highly significant interaction between genotype and VPD ($P<0.001$). Interestingly, genotypic variation in T_l was small under high VPD, but was noted in low VPD. The reason for the VPD × genotype interaction was not clear, but this suggests that under humid conditions, T_l of Akihikari and N22 may become higher than that of other varieties even under the same air temperature. VPD also had significant effects on growth parameters: the high VPD treatment significantly enhanced tiller production ($P<0.001$) without significant interaction with genotypes. On the other hand, leaf area and plant height were significantly reduced by high VPD ($P<0.001$), but this effect appeared different between genotypes. The reduction in the leaf area was about 50 % in Akihikari and N22 but was about 30% in IR64 and Takanari, resulting in a significant VPD × genotype interaction ($P<0.001$). A similar interaction was observed for plant height and specific leaf area. We are currently determining associations amongst growth and physiological parameters observed under different VPD conditions. In the meantime, a series of experiments are on-going to determine the combined effects of temperature and VPD on growth of these contrasting genotypes.