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Upland Rice Adaptation to Variable Water Availability Along an Altitude Gradient in Madagascar

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Abstract

The growing demand for rice and the increasing pressure on irrigated land is leading to the development of upland rice to supplement irrigated rice in Madagascar. In the higher altitude environment, rainfed upland rice can only be planted between October and November due to temperature constraints (cold stress). According to climate change prediction, high-altitude environments are considered to be vulnerable. It is easy to expect positive effects on upland rice production systems such as increasing productivity due to rise in temperature and reducing sterility, considering that other climate change parameters such as rainfall patterns will not have adverse effects and consequently higher demand for water. Generally, crop is very sensitive to even short drought spells during sensitive physiological and phenological periods.

To avoid negative impacts, crop adaptation strategies will be required in terms of varietal development and crop management. The RISOCAS project of the University of Hohenheim for developing rice crop adaptation strategies for climate change in vulnerable environments has selected three different altitude/temperature gradient locations with moderately water-limited conditions, ranging from hot-equatorial conditions to the lower limit of the crop's thermal adaptation (Andranomanelatra 1625 m, Ivory 965 m and Ankepaka 25 m asl) in Madagascar for the upland rice field experiment. The experiment was conducted with two planting dates of 10 contrasting genotypes with three replications in each site. Meteorological data, site-specific soil characteristics, parameters of soil water balance such as soil water content using TDR-based system and bare soil evaporation using mini lysimeters were monitored. Variety specific canopy properties, photosynthesis, stomatal conductance, leaf chlorophyll content, photochemical reflectance index, leaf area index and specific leaf area were measured at regular intervals. Parameters of crop growth, tillering capacity, above ground biomass (stem, leaf and inflorescence separated), grain yield and yield components, harvest index and sterility are monitored to identify valuable traits and ideotype concepts for varietal improvement and adaptation. The first result on potentials and risks of unreliable water availability at different temperature gradient will be discussed and presented.

Keywords: Climate change adaptation, phenology, RISOCAS, water use efficiency

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