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Spikelet Sterility of Lowland Rice Related to Temperature at Booting Stage in Different Thermal Environment in Madagascar

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Abstract

Rising global mean temperatures increasingly open opportunities for including crops in high altitude production systems that so far could not be grown due to temperature limitations. Lowland rice is one of those crops. Currently the window for cropping rice in higher altitudes is still quite small and thus genotypes that tolerate a certain degree of chilling to fit them into the high altitude cropping calendars, are needed. Crop growth models often allow simulating growth responses to environmental conditions if general physiological processes apply or the genotypic specific responses to those conditions are known. One prominent aspect of chilling effects in rice is cold induced spikelet sterility which is known to be depended on the temperature rice experiences during booting stage. Since crop growth models in general are based at air temperature measurements at 2 m height, since any other temperature profiles are not monitored, spikelet sterility simulations depend on air temperature measured well above the crop. However, after panicle initiation, the meristem from which the panicle develops is raised out of the irrigation water into the canopy by internode elongation. Thus, the effective temperature governing growth and development processes shifts from water to air temperature. A two years experiment was conducted in lowland rice systems in Madagascar at two contrasting altitudinal locations. Twenty varieties differing in their tolerance to cold were sown monthly in a non-replicated rice garden trial. The main objective of the study presented here was to determine the effective temperature affecting spikelet viability in high altitude rice systems. Air temperature at 2 m height, air temperature within the developing canopy and the temperature at the soil/irrigation water interface were monitored using a weather station and TinyTag dataloggers. Phenology and spikelet sterility was monitored and related to the different temperature profiles. Results show, that threshold temperatures for spikelet sterility estimated from air temperatures at 2 m height strongly overestimated the effect of temperature on spikelet sterility. Minimum soil temperature resulted in a much better fit for both spikelet sterility and threshold temperature. How to derive the effective temperature for spikelet viability during stem elongation from air temperature will be discussed.

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