Tropentag, September 17-19, 2018, Ghent

"Global food security and food safety:
The role of universities"

Analysis of Yield Components and Photosynthetic Limitations of a Dwarf Rice Variety in Response to Shade

Marc Schmierer, Oliver Knopf, Folkard Asch

University of Hohenheim, Inst. of Agric. Sci. in the Tropics (Hans-Ruthenberg-Institute), Germany

Abstract

Tree intercropping is said to be a promising approach to replenish poor soils, mitigate drought events and prevent erosion. However, cereals like rice, wheat and maize that comprise the major calorie sources for the world's population, show large reductions in yield when intercropped within trees. This fact is often attributed to tree-crop competition for nutrients, soil moisture and light, where the latter is a resource solely limited by environmental conditions that cannot be replenished.

While crop adaption strategies to shade regarding the adjustment of yield components and the biochemical properties of the photosynthetic complex are relatively well described, there is a lack of consensus about how far the different diffusional resistances to CO_2 (stomatal and mesophyll) are adjusted in shade. We therefore combined a yield component analysis of rice plants grown in a climate chamber experiment under 2 different levels of shade (50 and 75 percent compared to a control treatment) and an analysis of diffusional and non-diffusional (biochemical) limitations to flag leaf photosynthesis.

Grain yield of shaded plants was reduced by 80 and 100 % for plants grown under 50 and 75 % shade, respectively. The yield component analysis revealed that the total number of tillers was the main factor causing yield reduction for plants grown under 50 % shade (58 % contribution to grain yield loss) while the ratio of productive tillers remained almost constant between the treatments. Furthermore, average kernel weight contributed 19 % of the reduction in yield, followed by kernel number per panicle (10 %) and percentage of filled spikelets (9 %). For plants grown under 75 % shade, all yield components contributed equally to total yield loss (20 % each).

A photosynthetic limitation analysis showed that in all treatments leaf mesophyll conductance of CO_2 was the largest contributor to limitations in photosynthetic capacity. However, plants grown under 50 % shade consistently showed the highest photosynthetic capacity and a significant increased mesophyll conductance compared to plants grown under full light or 75 % shade during the whole vegetative phase.

Additional results will be shown and a short illustration of the methodology will be given.

Keywords: Mesophyll conductance, rice, shade, yield components

Contact Address: Marc Schmierer, University of Hohenheim, Inst. of Agric. Sci. in the Tropics (Hans-Ruthenberg-Institute), Stuttgart, Germany, e-mail: marc.schmierer@gmail.com