



Increasing Carbon Capture by Optimising Canopy Resource Distribution

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Abstract

Wheat yield is limited by carbohydrate supply to the filling grain, which in turn depends on whole-canopy photosynthesis. Pre-breeding for photosynthetic traits typically focuses on traits of sun-exposed leaves in the upper canopy. However, potentially far greater gains could be made by focusing on the distribution of photosynthetic nitrogen, and photosynthetic capacity (PC), among different canopy layers. A vast body of literature, overlooked in crop pre-breeding, shows that whole-canopy photosynthesis is substantially reduced by inefficient vertical distribution of PC in relation to irradiance: specifically, upper-canopy leaves tend to have too little photosynthetic N, and lower-canopy leaves tend to have too much. Redistribution of this capacity could increase canopy carbon uptake and NUE by nearly 20% without affecting the total supply of N available for grain filling.

We propose to identify variation in the efficiency of canopy PC distribution, coupled to yield, by applying a novel and innovative rapid phenotyping screen for canopy PC distribution to a set of 310 diverse wheat genotypes, including lines in agronomically acceptable backgrounds developed from wild wheat, wheat relatives and ancestors, and all parental materials. We will then characterise canopy physiology and structure in detail for a subset of the most contrasting genotypes to identify key underlying traits and genetic markers, and deliver the resulting knowledge, germplasm and tools to our partners in the breeding industry in Australia and India, CIMMYT and to the IWYP.