IWYP International Wheat Yield Partnership
Research to Deliver Wheat for the Future

IWYP SCIENCE BRIEF

NUMBER 15 MAY 2021

Supported by CSIRO GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Optimizing Crop Canopy Architecture to Enhance Yield

Wheat canopy architecture traits are not typically prioritized in breeding. Lines with an erect canopy are rare in spring wheat breeding programs. However, there is evidence that under favorable growing conditions, an erectophile (erect) canopy architecture will yield more grain and biomass than those with planophile (floppy) one. Further, lines with erect leaves are less prone to lodging, have higher canopy photosynthesis and tolerate heat better. **Three years of field data collected in Australia have demonstrated a yield advantage of up to 25% for lines with a desirable erect canopy architecture.** An IWYP Aligned Project "**Altering Canopy Architecture to Increase Crop Photosynthesis and Yield**", led by Richard Richards at CSIRO, Australia, with colleagues at CIMMYT aims to further evaluate this hypothesis by comparing the performance of elite wheat lines with erect or floppy canopies under different planting conditions to confirm if a change in canopy architecture results in consistent and significant gains in grain yield in different cropping systems and environments. If so, the researchers seek to further understand the causes for these differences as well as implementing selection for an erect canopy architecture in breeding programs.

What Solutions have been Identified?

- Canopy structure 14 days before flowering is highly influential in determining grain number and grain yield in wheat.
- Erect canopies allow more crop light penetration and can enhance total photosynthesis therefore producing more biomass, more fertile tillers, higher grain set and reduced lodging.
- Many genetic loci determine canopy architecture and selection for QTL is less efficient than visual selection for canopy type. For example, several thousand lines can be rapidly screened and data indicate that this scoring is highly repeatable in different environments (broad sense heritability averaged over 2 environments was 92%).
- Floppy canopies have large edge effects compared with erect canopies and this can bias yield selection in favor of floppy genotypes in certain planting configurations.

What has been transferred to the wheat improvement pipelines?

- Elite spring wheat germplasm with an erect canopy structure.
- Know-how for high-throughput phenotypic selection for canopy architecture.
- Information on how canopy architecture can positively interact with different cropping systems.

Canberra 2014 and 2015	Grain Yield ($g\ m^{-2}$)	Biomass ($g\ m^{-2}$)	Harvest Index	Grain Number (m^{-2})	100 Grain Weight (g)	Days to Flower	Plant Height (cm)
Erectophile (36 lines)	620	1860	0.34	20771	3.0	172	88
Planophile (38 lines)	534	1649	0.33	16517	3.26	170	93
Significance	$P \leq 0.001$	$P \leq 0.01$	NS	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.01$	$P \leq 0.001$
% Change from Planophile	16	13	3	26	-8	1	-6

Table 1. Effect of canopy architecture on key yield traits. Data suggests that erectophile canopies can increase grain yield by increasing biomass, grain number, potentially harvest index with little effect on flowering time and plant height.

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