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RHT18 SEMI-DWARFISM REVEALS A NEW HEIGHT REDUCING MECHANISM IN WHEAT BY INCREASING EXPRESSION OF GA 2-OXIDASEA9 AND LOWERING GA CONTENT

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In the 'Green Revolution' wheat yields increased due to the introduction of mutant DELLA genes that reduced plant growth, and allowed both an increased response to nitrogen fertiliser and improved carbon partitioning to the grain. However, in dryland, rain-fed environments these mutant DELLA genes constrain genetic progress because they reduce early seedling growth which can lead to poor crop establishment and increased water loss from the soil surface. Alternative dwarfing genes are required that allow better early growth and crop establishment. The *Rht18* semi-dwarfing gene was first identified in Italy as a dominant and gibberellin (GA) responsive mutant in durum wheat. *Rht18* does not compromise early growth and is genetically and functionally distinct from the widely used GA insensitive mutant DELLA gene *Rht-B1b*. Agronomic assessments have shown that the gene has good potential to replace conventional DELLA dwarfing genes globally.

The *Rht18* gene was isolated by mutagenizing Icaro (*Rht18*) to generate mutants with a range of tall phenotypes. Isolating and sequencing chromosome 6A of these 'overgrowth' mutants showed that they contained independent mutations in the coding region of GA 2-oxA9, a gene predicted to encode a GA 2-oxidase that metabolises GA biosynthetic intermediates into inactive products. Functional analysis of the GA 2-OXA9 protein in *E.coli* demonstrated conversion of the intermediate GA₁₂ to the inactive metabolite GA₁₁₀. Analysis of transcript abundance and GA content in wheat showed that the expression of GA 2-oxA9 was higher, and the GA content lower, in *Rht18* compared with its tall parent. We conclude that the increased expression of GA 2oxA9 in *Rht18* results in a reduction of both bioactive GA content and plant height. We also show that an independent semi-dwarf mutant *Rht14* which was induced in durum 'Capelli' is most likely an allele of *Rht18*. This study describes a height reducing mechanism that can generate new genetic diversity for semi-dwarfism in wheat by combining increased expression with mutations of specific amino acid residues in the GA 2-oxA9 gene.

ABSTRACT