Genetic characterisation of synthetic auxin herbicide tolerance in pulse crops

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Weed control remains a major constraint to pulse production in Australia. The rapid adoption of PBA XT lentil varieties and PBA Bendoc faba beans, and the subsequent increase in the use of AHAS-inhibitor herbicides, indicates the industry's desire for herbicide tolerant varieties. It also highlights the need for tolerances to additional modes of action to facilitate best practices of chemical rotation, in order to mitigate the incidence of herbicide tolerance in weed populations.

Synthetic auxin herbicides (SAHs) have been used in Australian farming systems for more than 70 years to control broadleaf weeds in cereal crops. Despite this strong and prolonged selective pressure, weed resistance to these chemistries is surprisingly uncommon compared to other herbicide modes of action, making them an attractive target for herbicide tolerant crop development.

SAHs mimic the plant hormone, indole-3-acetic acid (IAA), binding to the TIR1/AFB subunit of an E3 ubiquitin protein ligase complex, which stimulates the degradation of AUX/IAA transcriptional repressors. This de-repression of auxin-regulated genes results in the expression of herbicide symptoms and eventually leads to plant death.

Through mutagenesis screening techniques, we have identified chickpea, lentil, faba bean and field pea selections with improved levels of tolerance to the SAH, clopyralid (Lontrel®). Candidate gene association in bi-parental populations of chickpea and lentil identified a homologue of the *AFB4/AFB5* clade to be associated with the herbicide tolerance trait. Direct sequencing of this candidate gene in multiple tolerant lines identified a range of non-synonymous SNPs in the coding sequence of this gene. Three-dimensional models of the 'wildtype' and mutant AFB proteins reveal that C-terminal truncations are likely to result in a complete loss of function, explaining the herbicide tolerance phenotype. Further genetic and phenotypic characterisation of all tolerant selections is ongoing and is expected to provide a detailed understanding of the mechanisms of SAH action in pulse crops and allow the rapid and effective incorporation of clopyralid tolerance into new pulse varieties. This is the first report of target-site tolerance to SAHs in any crop species in the world.