

Evaluation of fitness cost associated with different EPSPS variants in *Eleusine indica*

Heping Han¹, Martin M. Vila-Aiub^{1,2}, Adam Jallalulin¹, Qin Yu¹ and Stephen B. Powles¹

¹ Australian Herbicide Resistance Initiative, 35 Stirling Highway, Nedlands, Western Australia 6009, Australia

² Facultad de Agronomía, Departamento de Ecología, Universidad de Buenos Aires (UBA), Viamonte 430, Buenos Aires 1053 Argentina
(heping.han@uwa.edu.au)

Summary Our previous studies have identified the single EPSPS mutation (P106S) and the double mutation (TIPS) in glyphosate resistant *Eleusine indica* (L.) Gaertn. Further research has been conducted estimating the fitness of these two EPSPS mutations. The wild-type (WT) and homozygous P106S and TIPS mutants were isolated from a single resistant population, and fitness traits (e.g. vegetative and reproductive growth, seed production) in the presence and absence of rice competition evaluated in the glasshouse and outdoor conditions. The results showed that while conferring moderate resistance at the glyphosate field rates, P106S mutants displayed no fitness costs compared to WT. In contrast, the TIPS mutants while endowing a high level glyphosate resistance suffered significant fitness penalty with up to 50% reduction in vegetative growth and 69% in seed production, especially in competition with rice. The severe fitness penalty

associated with homozygous TIPS mutants is likely due to disturbance of the shikimate pathway, as a 50-fold greater tissue shikimate accumulation was observed in the TIPS than the WT and P106S plants. In addition, we have observed that non-homozygous TIPS mutants (e.g. plants containing one TIPS and one P106S alleles instead two TIPS alleles) displayed favourable traits (e.g. conferring sufficient level of glyphosate resistance at no fitness costs). Lack of fitness costs and even a fitness advantage of the P106S mutation certainly explains its higher frequency observed in glyphosate resistant weed species. In the reality, as observed, the frequency of homozygous TIPS mutants is extremely low, and outnumbered by heterozygous TIPS mutants, in the absence of glyphosate selection.

Keywords *Eleusine indica*, fitness benefit, fitness cost, EPSPS, glyphosate resistance.