Target-site and metabolic resistance mechanisms to dinitroaniline herbicides in a *Lolium rigidum* population

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Summary The dinitroaniline herbicides (particularly trifluralin) have been used in Australia as a pre-emergence herbicide to effectively control weeds that have evolved resistance to common post-emergence herbicides. One *Lolium rigidum* population (hereafter as R) collected from Western Australian grain belt was found to be resistant to various dinitroaniline herbicides as compared to a standard susceptible (S) population SVLR1. Individual plants surviving the field rate trifluralin (960 g ha^{-1}) were sequenced and most of the survivors (35 out of 39) were identified to possess the Val-202-Phe α-tubulin mutation.

Rice genetic transformation was used to test if the Val-202-Phe mutation confers resistance. Rice calli transformed with the mutant 202-Phe α-tubulin gene were found to be more tolerant to trifluralin and other dinitroaniline herbicides than calli transformed with the wild type α-tubulin gene from *L. rigidum*.

In addition, enhanced trifluralin metabolism was also detected in the R population. ^{14}C-trifluralin was introduced to S and R plants via rooting media, total ^{14}C radioactivity was extracted and partitioned against 80% methanol (polar phase) and 100% hexane (nonpolar phase), percentage of radioactivity distribution in the two phases was calculated and compared. Results showed that more of the total radioactivity from the R plants was distributed in the methanol layer than S plants, indicating enhanced metabolism of the parent trifluralin in R plants. HPLC work confirmed a higher percentage of polar metabolites in the methanol phase in R versus S plants.

Our work demonstrated that both target-site and non-target-site metabolic resistance are involved in the trifluralin-resistant *L. rigidum* population investigated. This is for the first time we demonstrate metabolic resistance to trifluralin in weedy plants. We consider that metabolic resistance to dinitroaniline herbicides is common in *L. rigidum*.

Keywords α-tubulin mutation, trifluralin resistance, dinitroaniline, *Lolium rigidum*, trifluralin metabolism.