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Herbicide sensitivities of mutated enzymes expressed from artificially generated genes of acetolactate synthase

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Abstract:
Mutated acetolactate synthase (ALS) genes of rice and Arabidopsis, which confer resistance to ALS-inhibiting herbicides, were generated using PCR and overlap extension. Recombinant ALSs from these mutated genes were prepared as glutathione S-transferase-fused proteins, and sensitivities of the proteins to ALS-inhibiting herbicides were examined. Nine kinds of rice ALSs that have mutations at the P171 position (each amino acid is represented by one letter) showed high resistance to a herbicide, bensulfuron-methyl, but the resistance level to a herbicide, bispyribac-sodium (BS), changed among ALSs. S627I ALS of rice expressed high resistance to herbicides: pyriminobac and pyrithiobac-sodium. P171H/R172S ALS of rice showed greater resistance to a herbicide, chlorsulfuron than the additive effect predicted from the resistance of each single mutated ALS. P171H/W548L ALS and P171H/S627I ALS of rice showed similar synergistic resistance to BS. On the other hand, P197S, W574L, S653I, P197H/R198S and W574L/S653I-mutated ALSs of Arabidopsis expressed similar sensitivities to herbicides as those of rice ALSs with the corresponding mutations. These results proposed that P171-mutated ALSs of rice can be used as model enzymes for resistant weed management to ALS-inhibiting herbicides, and rice-mutated ALS genes encoding mutated ALSs such as S627I, P171H/R172S, P171H/W548L, P171H/S627I, and Arabidopsis-mutated ALS genes encoding mutated ALSs, such as S653I, P197H/R198S and W574L/S653I, are useful as new selectable marker genes for genetic transformation of plants when used together with ALS-inhibiting herbicides to which mutated ALSs express high resistance.

Keywords:
acetolactate synthase, acetohydroxyacid synthase, ALS, AHAS, pyrimidinylcarboxylates, bispyribac-sodium, pyriminobac, pyrithiobac-sodium

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