

Optimizing Low-Dose Post-Emergence Tank Mixtures for Weed Control in Alfalfa

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Abstract

Alfalfa (*Medicago sativa*), a globally important perennial forage legume, is widely cultivated in China, where effective weed management remains essential for sustainable production. Chemical control, primarily relying on the herbicide imazethapyr, is the most common strategy. However, the continuous and exclusive use of imazethapyr exerts strong selection pressure on weed populations, promoting herbicide resistance and often necessitating increased application rates. To address this challenge, a two-year field study (2022–2023) was conducted to reduce chemical inputs and delay resistance by evaluating post-emergence herbicide alternatives and tank mixtures. Initial screening identified imazethapyr, prometryn, imazapic, and 2,4-DB as safe and effective against broadleaf weeds (*Chenopodiaceae album* and *Amaranthus retroflexus*). Haloxypfop-R-methyl and quizalofop-P-ethyl were highly selective against grasses, providing 100% and >98.4% control, respectively, but were less effective on broadleaf weeds (<35%). To broaden the control spectrum and reduce total herbicide use, haloxypfop-R-methyl was tank-mixed with each of the four broadleaf-active herbicides. The combinations haloxypfop-R-methyl + imazethapyr (36.5 + 56.26 g ai ha⁻¹) and haloxypfop-R-methyl + 2,4-DB (36.5 + 506.25 g ai ha⁻¹) maintained >90% control of *C. album*, *A. retroflexus*, and grasses while allowing a 25% reduction in total active ingredient compared to standard solo applications. Crucially, the mixtures haloxypfop-R-methyl + imazethapyr (36.5 + 56.25 g a.i. ha⁻¹) and haloxypfop-R-methyl + 2,4-DB (36.5 + 506.25 g a.i. ha⁻¹) delivered broad-spectrum weed control without compromising—and in some growth parameters even enhancing—alfalfa performance. These mixtures represent promising, sustainable options for integrated weed management in alfalfa production systems.

Keywords

Weed Management, Post-emergence Herbicide, *Medicago Sativa*, Dose Reduction, Imazethapyr