

Effectiveness of saflufenacil (Sharpen) mixed with imazapic (Plateau) to manage leafy spurge

Eric A. L. Jones, Assistant Professor and SDSU Extension Weed Management Specialist
Jill K. Alms, SDSU Agronomy, Horticulture and Plant Science Ag Research Mgr/Specialist
David A. Vos, SDSU Agronomy, Horticulture and Plant Science Ag Research Mgr/Specialist

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Introduction

Leafy spurge (*Euphorbia esula* L.) is a statewide noxious weed of pasture and rangeland in South Dakota. If not effectively managed, leafy spurge may decrease land value and displace desirable vegetation (Figure 1). Herbicides are the most common management tactics for weeds in South Dakota pasture and rangeland (Jones et al. 2025a). Few herbicides are available to effectively manage this species. Most of the available herbicides belong to the synthetic auxin herbicide group (i.e., 2,4-D or picloram [Tordon], Group 4) due to selectivity and safety on grass vegetation common in pasture and rangeland (Grossman 2010).



Figure 1. Leafy spurge infestation in South Dakota. Little grass hay or other desirable vegetation is present in these infested patches due to extreme competition from the leafy spurge plants.

Saflufenacil (e.g., Detail or Sharpen) is a protoporphyrinogen oxidase (PPO)-inhibiting herbicide (Group 14) that has primarily been utilized as a preplant burndown herbicide to manage broadleaf weeds (Owen et al. 2011; Soltani et al. 2009). Due to limited activity on grasses, saflufenacil is labeled for applications in pasture and rangeland (Anonymous 2024). Current labeling and research suggest that saflufenacil has utility to improve the activity of imazapic (Plateau, Acetolactate synthase (ALS)-inhibiting herbicides, Group 2) when mixed to manage leafy spurge (Anonymous 2023; Datta et al. 2013). Herbicide mixtures are generally more effective and reduce selection pressure compared with a single herbicide, especially when an additional mode of action is included (Barbieri et al. 2022). The fast activity of saflufenacil may inhibit the absorption and/or translocation of herbicides with slower activity such as imazapic (Ashigh and Hall 2010; Eubank et al. 2013). Knowledge of how saflufenacil influences the activity of imazapic on leafy spurge under field conditions is critical for effective management. The objective of this research was to determine the effect of mixing saflufenacil with imazapic to manage leafy spurge in pastures and rangeland of South Dakota.

Materials and methods

Experiment sites

Experiments were established in Codington (2023) and Brown County (2024), South Dakota. Experiments were arranged as randomized complete block design with treatments replicated three times. Plots were 10 ft wide and 30 ft long. The Codington County site was treated on June 27, 2023 and the Brown County site was treated on

June 13, 2024 with a CO₂-powered backpack sprayer at an output of 20 gallons per acre with TT 11003 nozzles (TeeJet Industries, Wheaton, IL) approximately 20 inches over the vegetation canopy. Leafy spurge plants were in the yellow bract stage and approximately 5 to 28 in in height at the time of application. Imazapic (Plateau, BASF Corporation, Research Triangle Park, Raleigh, NC) (8 fl oz per acre) or saflufenacil (Sharpen, BASF Corporation, Research Triangle Park, Raleigh, NC) (2 fl oz per acre) were applied alone or in mixture at the same rates. Crop oil concentrate (1% volume per volume) was included in all herbicide treatments.

Visual control estimations were conducted one year after treatment (YAT) on a rating scale ranging from 0 to 100%; where 0% equals no control and 100% equals complete control. Plant heights were quantified by measuring the height of three arbitrarily selected plants from soil surface to the meristem (growing point). Stem densities were quantified by arbitrarily placing a sq ft quadrat two times near the center of each plot. Reductions for plant height and stem density were calculated using the equation [1]:

$$\% \text{ reduction} = 100 \times \left(\frac{(\text{nontreated value} - \text{treated value})}{\text{nontreated value}} \right) [1]$$

Quadrats were arbitrarily placed in the centers of plots to ensure sampling was conducted on plants that received adequate herbicide coverage.

Statistical analysis

Visual control estimates, height reduction, and stem density reduction data for each species were subjected to analysis of variance using the *GLIMMIX* procedure in SAS 9.4 (Statistical Analysis Software Institute, Cary, NC, USA) at a significance level of $\alpha = 0.05$. Herbicide treatment was considered a fixed effect, while location was considered a random effect to increase the inference of the analyses (Moore and Dixon 2015). Treatment means were separated using Fisher's Least Significant Difference ($P \leq 0.05$). The visual control estimates from the nontreated plots (e.g., 0%) were removed from the analysis to avoid violation of constant variance assumptions required for analysis of variance.

Results and Discussion

Herbicide influenced the visual control estimates ($P = 0.03$) and stem density reduction ($P = 0.002$), but not the height reduction ($P = 0.13$) of leafy spurge 1 YAT. Saflufenacil+imazapic provided greater control (85%) than either herbicide applied alone (Figure 2). Control

with each herbicide applied alone never exceeded 63% (Figure 2). Height reductions ranged from 20 to 47% and were not different across tested treatments (Figure 3). Saflufenacil+imazapic and imazapic reduced stem density the greatest followed by saflufenacil (Figure 4).

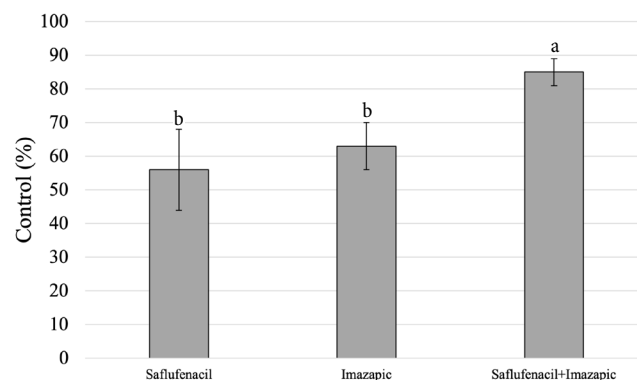


Figure 2. Leafy spurge control with saflufenacil or imazapic applied alone or in mixture one year after treatment. Research was conducted in Codington (2023) and Brown (2024) County, South Dakota. Bars that share similar letters are not statistically different. Error bars represent the standard error of the treatment mean.

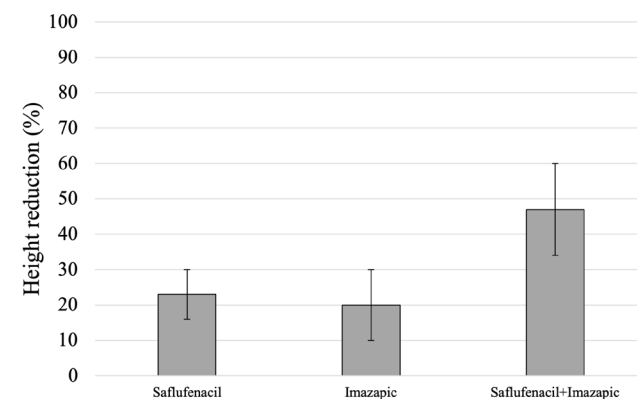


Figure 3. Leafy spurge height reduction with saflufenacil or imazapic applied alone or in mixture one year after treatment. Research was conducted in Codington (2023) and Brown (2024) County, South Dakota. All treatments reduced height similarly. Error bars represent the standard error of the treatment mean.

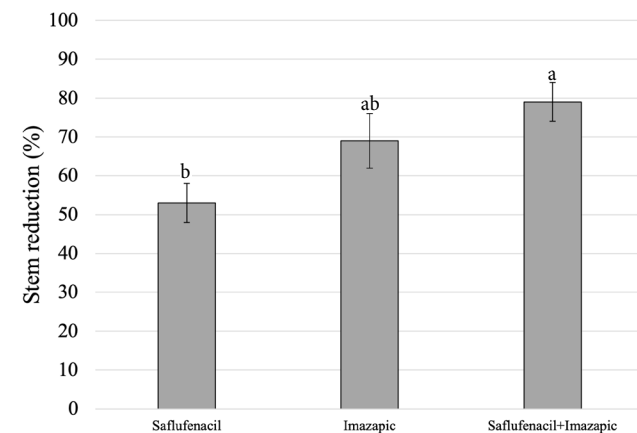


Figure 4. Leafy spurge stem reductions with saflufenacil or imazapic applied alone or in mixture one year after treatment. Research was conducted in Codington (2023) and Brown (2024) County, South Dakota. All treatments reduced height similarly. Error bars represent the standard error of the treatment mean.

Picloram alone picloram + 2,4-D is commonly applied to manage leafy spurge. Previous research has demonstrated that picloram (32 fl oz per acre) or picloram (32 fl oz per acre) + 2,4-D (32 fl oz per acre) provides 56 – 83% control of leafy spurge 1 YAT (Hein and Miller 1991; Jones et al. 2025b; Lym and Messersmith 1987). While picloram nor picloram + 2,4-D were not applied in this experiment for a direct comparison, the results of this experiment suggest that saflufenacil + imazapic can be applied to manage leafy spurge at a similar level of effectiveness. However, this herbicide mixture provided leafy spurge stem density reductions of 79% 1 YAT, suggesting that follow-up management tactics will be needed (Lym 1998). While stem reductions were present, the lack of differential height reductions suggest that plants surviving the herbicide application will exhibit similar regrowth as nontreated plants which may not impede spread of the infestations (Liu et al. 2023).

Since saflufenacil is not widely applied to manage this weed species, applications of this herbicide in mixtures could disrupt management history that placed great selection pressure on leafy spurge (Liu et al. 2023). Future research should evaluate the activity of mixtures of saflufenacil and commonly applied herbicides on other weed species in pasture and rangeland as no published data currently exists. Despite the effectiveness of herbicides, leafy spurge management plans should also include nonherbicide tactics.

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