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The effects of organosilicone surfactants on herbicide absorption by leafy spurge (*Euphorbia esula* L.)

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Abstract

Leafy spurge (*Euphorbia esula* L.) is a serious problem weed on rangeland in the Northern Great Plains. In field studies, imazethapyr has been determined to provide good control of leafy spurge similar to 2,4-D/picloram treatments. In laboratory experiments imazethapyr uptake by leafy spurge foliage was limited to only 18% of the actual amount of herbicide applied. Previous reports of laboratory experiments also indicate low picloram and 2,4-D absorption by leafy spurge. This study was conducted to (1) identify adjuvants that improve uptake of imazethapyr, 2,4-D amine, and picloram by leafy spurge; (2) determine imazethapyr and adjuvant performance when applied to plants grown in the field; (3) evaluate uptake of imazethapyr as effected by abaxial or adaxial application.

Plants were vegetatively propagated from a single source plant and were grown in the greenhouse for 3 months. Top growth was removed and root systems were chilled for 14 days before plants were transplanted into cone-tainers containing a fine, washed-silica sand. Plants were maintained in a controlled environment chamber with 16-hour photoperiod, 50% relative humidity, and PPFD of 650 $\mu\text{E m}^{-2} \text{sec}^{-1}$. Plants were watered daily and fertilized every 14 days.

Four experiments were conducted to address the objectives of the study. Adjuvants evaluated in the experiments were crop oil concentrate (COC), methylated sunflower oil (Sun-it II), non-ionic surfactant (X-77), organosilicones (Sylgard 309, Silwet L-77 and Silwet 408), ammonium sulfate, 28% urea ammonium nitrate (UAN), and 3:1 mixtures of three acetylinic diol ethoxylates (ADE's) with Silwet L-77. The ADE's have been shown to have a synergistic effect on reducing surface tension of Silwet L-77. Plants were at the full bloom growth stage when treatments were applied. Surfactants at 0.25% (v/v) were combined with a commercial formulation of imazethapyr, 2,4-D, or picloram to be applied at a rate of 0.07 kg ai ha⁻¹, 1.12 kg ai ha⁻¹, or 1.12 kg ai ha⁻¹, respectively, and delivered in a total volume of 187 l ha⁻¹. ¹⁴C-radiolabelled herbicide was added to the treatment solutions so that there was a total of 50,000 DPM applied to each leaf. Five

leaves starting 5-10 cm from top of the plant were treated with 10, 0.5 µl drops per leaf in experiment 1 or 1, 1.0 µl drop per leaf in experiments 2, 3, and 4. In experiment 1, surfactants combined with or without UAN were evaluated over a 2 and 8 day time course. In experiment 2, the influence of COC and the organosilicones, with and without UAN, on field-grown plants was determined. Field-grown plants were grown outside and transferred to the growth chamber 24 hours before treatment. Experiment 3 was conducted to evaluate differences in imazethapyr absorption associated with abaxial or adaxial application. Experiment 4 was utilized to determine the effects of organosilicones and organosilicone/ADE combinations on uptake of imazethapyr, 2,4-D, and picloram. At harvest, leaves were vortexed for 30 seconds in 5 ml aqueous 10% methanol, 0.25% Tween 20. Radioactivity of the solution was determined by liquid scintillation spectrometry. Percent uptake was determined by difference of amount of radioactivity applied to amount recovered from the leaf surface.

Uptake of imazethapyr was greatest (>90%) when the herbicide was applied with UAN combined with either COC or Sun-it II as compared to surfactants applied without the addition of UAN. Imazethapyr uptake by leaves from field-grown plants was greatest (>85%) when the herbicide was applied with the combination of COC and UAN. Imazethapyr uptake was limited to less than 35% when applied with the organosilicone surfactants with or without UAN. Abaxial application provided greater uptake of imazethapyr than adaxial application for both organosilicone and COC surfactants, but only in the presence of UAN (10% avg. difference). Uptake of 2,4-D amine was greatest (>76%) when the surfactants used were Silwet 408 or the ADE 40 (40 percent ethylene oxide) / Silwet L-77 mixture. Picloram absorption was similar for all the organosilicones and ADE mixtures (13-19%). COC was ineffective when used with picloram (only 3% uptake) Based on evidence from this research, crop oils combined with UAN were superior to the organosilicone surfactants in improving imazethapyr uptake by leafy spurge. Picloram absorption by leafy spurge was not improved above levels previously reported. Uptake of 2,4-D was increased in the presence of organosilicones and some ADE mixtures.