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Published by: Great Plains Agricultural Council: Leafy Spurge Symposium.

Picloram release by leafy spurge roots

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Previous research in the field and laboratory have shown that picloram was present in soil when only leafy spurge foliage was treated, which suggested that picloram was absorbed by the shoots and then was released by roots. Laboratory and greenhouse experiments were conducted to evaluate the processes involved in release of picloram by leafy spurge roots. Factors examined included exudation over time, root temperature, picloram application rates, and the addition of 2,4-D with picloram.

General procedure. All experiments were conducted using rooted cuttings of leafy spurge accession 79-MN-008. The cuttings were grown in a peat moss:perlite mixture for a minimum of 6 weeks. Plants were selected for uniform size and age and were transferred to aerated, dilute nutrient solution for equilibration 3 days before treatment. ^{14}C -picloram at about 70,000 dpm/plant was applied to a single, mature leaf. The ^{14}C -picloram application was preceded and followed by 5 μl of a 0.1% surfactant solution. All plants were harvested by sectioning into treated leaf, stem, and roots. The treated leaf was washed to determine the unabsorbed herbicide, and the plant material was dried, weighed and combusted. Nutrient solutions were concentrated by freeze drying and were redissolved in an ethanol-water solution. ^{14}C content was determined by liquid scintillation spectroscopy.

Exudation over time. Plants were treated as above and were grown for 120 hours before harvest. The nutrient solution was changed for half of the plants at 12, 24, 48, 72, 96, and 120 hours after ^{14}C -picloram application.

Comparison of the total exudation after 120 hours for the changed and unchanged solutions found no difference in the total amount of ^{14}C -picloram exuded. Comparison of ^{14}C -picloram recovered for each 24-hour period also showed no difference. Therefore, there was a linear relationship when the recovered ^{14}C -picloram amounts were accumulated with time.

These experiments suggest that picloram release is a linear process that begins within 12 hours of application and continues beyond 120 hours.

Temperature. Plants treated as previously described were placed into water baths that maintained root and solution temperatures of 14, 19, and 31° C. The topgrowth was maintained at room temperature throughout the experiments. The plants were harvested after 48 hours.

No differences were detected in released ^{14}C -picloram in solutions from any temperature treatment. A Q_{10} value was calculated for each repetition using the means for each

temperature. The Q_{10} is a ratio of the rate of exudation for the high and low temperatures when there is a 10° C temperature difference. A Q_{10} value below 2.0 usually indicates a non-metabolically active process. The overall Q_{10} for picloram release by leafy spurge was 1.3 ± 0.77 , with a range from 0.28 to 2.29.

These data suggest that picloram release is a passive process which is not affected substantially by environmental conditions.

Picloram application rate. Unlabeled picloram was applied by a greenhouse pot sprayer to plants immediately prior to applying ^{14}C -picloram and surfactant as previously described. The picloram rates were 0, 1/64, 1/32, 1/16, 1/8, and 1/4 lb ai/A.

Analysis of ^{14}C -exudation 48 hours post-treatment found no difference in exudation rate over these picloram rates, so total exudation increased directly with application rate. Previous research in the field, where picloram rates up to 2 lb/A were used, found increases in soil residues with rate of application.

Picloram plus 2,4-D. Tank mixing low rates of picloram and 2,4-D has resulted in enhanced leafy spurge control. Picloram plus 2,4-D were applied to plants treated with unlabeled- and ^{14}C -picloram as described previously at rates of 0 plus 0, 1/8 plus 0, 0 plus 1/4, 1/8 plus 1/4, 1/8 plus 1/2, and 1/8 plus 1 lb/A, respectively.

No differences in herbicide exudation were detected between any of the treatments. The synergism of these two herbicides in leafy spurge apparently is not due to reducing picloram exudation when 2,4-D is present. Results of all ^{14}C -picloram experiments. The ^{14}C -picloram distribution in leafy spurge, averaged across all experiments, is presented in Table 1. About 58% of the picloram applied to leafy spurge never entered the plant. Of the absorbed herbicide, about 75% remained in the stem and leaves and 25% was moved to the root zone (37 vs. 12.2%, respectively). Of the herbicide in the root zone, 64% was outside the plant (8% in nutrient solution vs. 4.4% in roots). In total, only 1.7% of the applied picloram was recovered from the roots. Since picloram is released passively from the roots, it appears that increased control of leafy spurge with picloram will be accomplished through increased absorption and translocation into the root zone.

Table 1. Summary of ^{14}C -picloram distribution in leafy spurge, averaged over 284 plants from all experiments.¹

Plant section	Percent of applied		Percent of absorbed	
	Mean	Range	Mean	Range
----- (%) -----				
Unabsorbed	58 ± 17	35.7 - 89.0	---	---
Stem and leaves	15 ± 7	3.5 - 31.8	37 ± 19	20.3 - 85.6
Root zone				
Roots	1.7 ± 1	0.3 - 3.4	4.4 ± 2.8	0.8 - 11.6
Nutrient solution	4.0 ± 6	0.2 - 19.3	8.0 ± 10	1.0 - 33
Total	5.6 ± 6	0.6 - 21.5	12.2 ± 10	1.8 - 37

¹An average of 70,000 dpm/plant were applied. Overall recovery averaged 79% and overall absorbance averaged 42%, based on percent of applied.