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Environmental Effects on Picloram Translocation in Leafy Spurge

Rodney G. Lym and Calvin G. Messersmith

Variable herbicide absorption due to changes in the environment or plant growth stage can result in inconsistent weed control, especially with perennial rangeland weeds such as leafy spurge. Leafy spurge grows on a wide variety of terrain from flood plains to river banks, grasslands, ridges, and mountain slopes (Bakke 1936). Leafy spurge is primarily found in untilled non-cropland habitats such as abandoned cropland, pasture, rangeland, woodland, roadsides, and waste areas. Leafy spurge causes economic losses from both reduced forage production and avoidance of weed-infested areas, by cattle. Leafy spurge can reduce carrying capacity from 50 to 75% (Alley et al. 1984, Reilly and Kaufman 1979).

Leafy spurge is difficult to eradicate, but topgrowth control and gradual reduction in the underground root system are possible. Picloram (Tordon)[R] is the most effective herbicide for leafy spurge control (Lym and Messersmith 1985). Generally, herbicides are most effective when applied during the true-flower growth stage in mid-June or during regrowth in the fall from late August until a killing frost occurs in October. However, results can be inconsistent. Picloram has given from 100% to less than 5% control 2 months after application even when properly applied at the maximum labelled use rate.

Occasional poor leafy spurge control by picloram may be due to poor herbicide absorption and translocation caused by unfavorable weather conditions or by limited carbohydrate movement within the plant. High relative humidity and an increase in air temperature of 2° F or more 24 hours before treatment can result in more picloram absorption and translocation in leafy spurge (Lym and Messersmith 1990). Since both picloram and carbohydrate movement in leafy spurge are weather dependent and roots must be killed for long-term control, the effect of leafy spurge growth stage and weather conditions for picloram movement to roots was investigated.

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Methods

Radiolabeled picloram (^{14}C-picloram) was applied weekly from mid-May until mid-October for 2 years to leafy spurge plants grown in pots in the field. Plants were harvested 72 hours after treatment and were sectioned into treated leaf, remaining stem and leaves, and roots. The amount of picloram absorbed and translocated was determined for two growing seasons at two depths and the relationship between root carbohydrate and picloram content estimated.

Results and Discussion

Picloram absorption was similar throughout most of the growing season and averaged 36% of applied picloram (Fig. 1). The poorest absorption occurred during summer dormancy. In growth chamber experiments, picloram absorption increased as the relative humidity increased during treatment but was not affected by the air temperature before or after treatment. To maximize picloram absorption in leafy spurge, plants should be treated when growing rapidly and during periods of high humidity such as early morning or late evening.

Picloram concentration in the leafy spurge topgrowth was greatest when the herbicide was applied during the vegetative growth stage in the spring but declined rapidly when the plant began to flower (Fig. 2). There was a small increase in picloram concentration around early Sep-

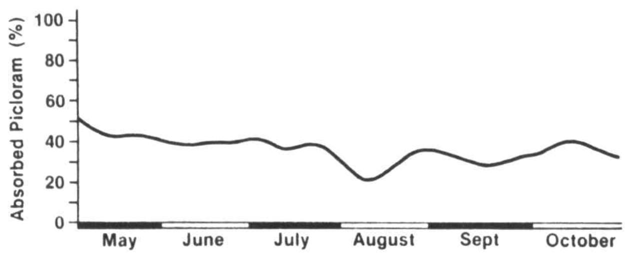

Fig. 1. *Picloram absorption by leafy spurge averaged over two growing seasons.*

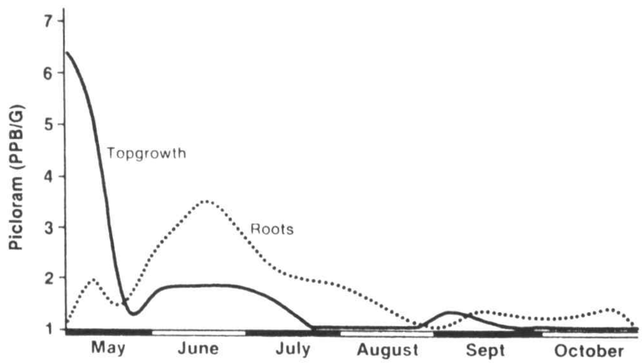

Fig. 2. *Picloram translocation to leafy spurge topgrowth and roots averaged over two growing seasons.*

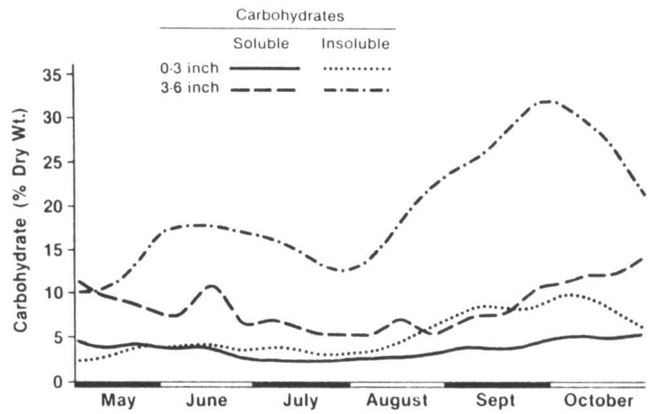

Fig. 3. *Water-soluble (mostly sucrose) and -insoluble (starch) concentration in leafy spurge roots at two depths averaged over two growing seasons.*

tember when young fall regrowth appeared. Since leafy spurge topgrowth is easily killed by relatively economic herbicide treatments such as 2,4-D, picloram concentration in the topgrowth is only important if it leads to more picloram in the roots.

Picloram concentration in leafy spurge roots was influenced more by leafy spurge growth than by any other factor. Picloram movement to the roots correlated directly with the percent control achieved in the field during the growing season. Maximum translocation occurred during the late-flowering and seed-set growth stages in June and early July (Fig. 2), the "traditional" leafy spurge treatment season. Picloram concentration in the root declined steadily during summer dormancy but then increased slightly during fall regrowth. Although about one-third of the picloram applied to leafy spurge was absorbed throughout the growing season, the maximum translocated to the roots occurred during flower development. The increased translocation was hypothesized to be due to increased flow of carbohydrates to the roots during the late-flowering growth stage.

Leafy spurge roots contain two predominate types of carbohydrates, water-soluble (mostly sucrose) and water-insoluble (starches). The carbohydrate concentration varied over the growing season and by root depth (Fig. 3). Water-soluble and -insoluble carbohydrates were present in similar amounts (by depth) in the early spring during vegetative regrowth, but insoluble carbohydrates predominated after flowering, especially for the 3- to 6-inch depth. Water-soluble carbohydrates were highest during the true-flower growth stage and in the fall, which is also the time herbicides are traditionally applied.

Picloram translocation evaluated over the entire growing season did not correlate with either the water-soluble or -insoluble carbohydrate concentration (Table 1). Auxin herbicides such as picloram often are considered to flow with plant sugars from the leaves to the roots, especially in perennial weeds (Crafts and Robbins 1962). This hypothesis apparently is not valid with leafy spurge over the growing season, but picloram translocation may be aided by carbohydrate flowing during the peak movement of picloram to the root system during flowering.

Picloram and carbohydrate content within the true-flower and fall regrowth stages were analyzed separately (Table 1). Picloram content and the water-soluble fraction both increased during the true-flower growth stage with a correlation of 78 and 95% at the 0- to 3-inch and 3-to 6-inch depths, respectively.

Table 1. Correlation of concentrations of water-soluble and water-insoluble carbohydrates and picloram in leafy spurge roots 72 hours after treatment.

Growth stage and root depth	Carbohydrate type	
	Water-soluble	Water-insoluble
	------ (Correlation %) ------	
All season		
0 to 3 inches	0	0
3 to 6 inches	0	0
True-flower		
0 to 3 inches	78	60
3 to 6 inches	95	56
Fall-regrowth		
0 to 3 inches	0	0
3 to 6 inches	0	0

Despite a large increase in carbohydrate movement to the roots in the fall, picloram translocation did not increase (Fig. 2 and 3, Table 1). This was unexpected since the hypothesis was that herbicides move with sugars when sugars are stored for overwintering. This was not true with picloram in leafy spurge and may not be true for other auxin herbicides or perennial weeds. Although some herbicides such as glyphosate (Roundup)[R] follow patterns similar to sucrose in plants, phenoxy herbicides such as 2,4-D and picloram differ from sucrose in both rate and pattern of movement (Martin and Edington 1981).

Optimum timing of picloram application for maximum translocation to the roots is during the true-flower growth stage and to a lesser degree during fall regrowth. Within these growth stages picloram should be applied during periods of high humidity. Air temperature is less important than relative humidity in determining picloram translocation to the roots. Research has shown that application during cool weather immediately following several days of hot weather may increase picloram translocation to the roots and thus increase control slightly (Lym and Messersmith 1990).

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Wildlife Depredation Policy Development

N.R. Rimbey, R.L. Gardner, and P.E. Patterson

Historical Setting

In most areas of the western United States, big game animals migrate between winter and summer use areas. Snowfall at higher elevations and the relative availability of forage, water and shelter at lower elevations lead to herd concentrations in specific areas during the winter. Prime winter wildlife habitat may be a traditional "wild" range setting or privately owned cropland, pasture, or haystacks.

In many western states, public lands are often intermingled with private lands, creating a "checkerboard" pattern of ownership. Frequently, there are no definitive boundaries, such as fences or differences in vegetation patterns, to distinguish the lands. Wildlife do not recognize these boundaries in their migration routes.

The Idaho National Engineering Laboratory (INEL) is a large tract of land (570,000 acres) in southeastern Idaho controlled by the United States Department of Energy for nuclear research. Except for corridors along several state highways, it is essentially closed to public access with no hunting. Antelope, the primary big game species in the area, have access to this refuge or "safe area". As a result, attempts to control herd numbers by public hunting in the surrounding area by the Idaho Department of Fish and Game (IF&G) have been largely unsuccessful.

Irrigation development in arid southern Idaho began in the early 1900's and resulted in over 3.4 million acres of rangeland and marginal dry cropland being converted to irrigated agricultural production. These developments removed "native" big game habitat and replaced them with newly preferred foods of hay, grain, irrigated pasture, and other crops. New wildlife migration patterns developed to access these abundant forage sources.

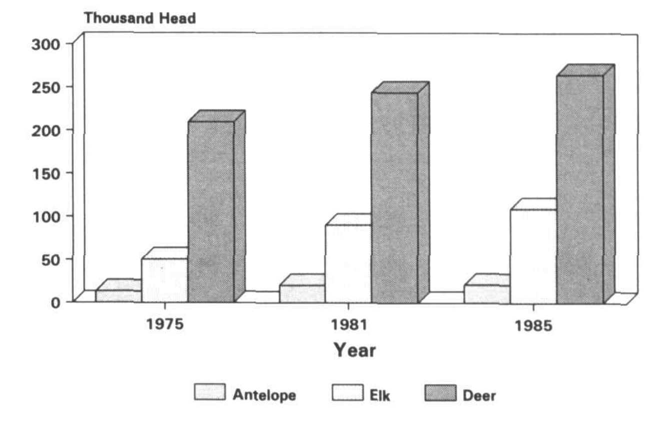

Fig. 1. *Idaho big game population estimates, 1975–1985.*

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