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Soil residue and leafy spurge root studies

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The weed science community has as yet to come firmly to grips with the control of underground portions of perennial weeds. It is questioned by some as being necessary to develop such data in terms of controlling these problem plants. Developing root control data may prove unnecessary but control of the root system is necessary in terms of a weed control program. In light of increasing the knowledge level we have of perennial weeds and developing effective weed control programs, studies of root control are needed. Also, resultant root control from a treatment may be of little value to the land manager or weed control supervisor. But because of the root systems contribution to survival, spread and regeneration, development of treatment programs must take root control into account.

As in out-of-sight, out-of-mind, root control has not been extensively regarded as a critical factor in weed control. This is evident by the minimal amount of reference to the root system of perennial weeds in weed control publications. However, root control is a facet of weed science instruction as "in order to combat creeping perennial weed infestations, seed production must be stopped and vegetative propagation must be curtailed by killing both the above-and below-ground portions of the plant" (2). Leafy spurge root control was referred to by Baker, while researching treatment efficacy, when he reported "no attempt was made to check root kills..." (3). This reference, made almost 30 years ago reflects an early understanding of the contribution the root system makes in perennial weed control. It has also been observed that field bindweed roots remained abundant and appeared viable after several years of top growth removal (1).

As a result of minimal information concerning root control evaluation, sampling and analysis technology previously was not available. With evaluations requiring soil sampling, methods to extract, transport and process samples needed to be developed. A discussion of the sampling methods developed to evaluate root control, some of the recent data from these studies and herbicide residue data will be presented in this paper. Also, an attempt to correlate some of the means will be included.

A repetitive herbicide treatment experiment was established in 1978 to provide an area of study for developing a workable leafy spurge control program. Part of this study was to evaluate control of the root or underground portion of the plant. Earliest evaluations, made in 1979, were simple judgment values based on ease of crown pull. Also, percent live roots was determined at each sample site to a depth of 6 to 8 inches. Resistance to pull and percent live roots increased as percent shoot control decreased (9). When these data were analyzed a correlation coefficient of 0.86 resulted revealing a strong correlation of the data. In 1980, root control was randomly evaluated at this site by means of determining the depth to live root tissue at an existing leafy spurge crown. As percent shoot control increased, average depth to live root tissue increased. A correlation coefficient of 0.61 was computed from comparison of these data (5). Later in 1980 a core sampling technique was attempted to further evaluate root control. Samples were extracted with a core tool to depths of 32 inches. Each sample was screened on site and root segments counts and weights taken. Root counts and weight were reduced as compared to the check in all original and retreatment combination plots (6). The following correlations were computed from the data: root weight to root counts -0.81; root weight to shoot counts -0.61; root counts to shoot counts -0.83; root counts and root weight to shoot counts -0.84. In 1981, a soil sampling core bit powered by a hydraulic motor mounted on a small back-hoe was used to sample soil for root control. Samples were bagged and transported to Laramie. Samples were washed in a screen with the remaining roots weighed. Again, from selected original and retreatment combination plots, root weights were reduced as compared to the check (7). A correlation coefficient of 0.74 resulted from analysis of the data. This study was continued in 1982 with a correlation coefficient of 0.73 resulting from comparison of root weights and shoot counts (8).

In 1980, evaluations of herbicides on leafy spurge control were expanded to an additional three locations in Wyoming. This was done to expand the root control study effort, include location and differing soil type effect and also to samples for herbicide residues in the soil profile. Data generated from these sites in 1981 and 1982 are presented in Tables 1, 2 and 3 with Table 4 a compilation of the resulting correlation coefficients. Data presented include shoot counts and percent control of leafy spurge top growth, root weights and the concentration of dicamba and picloram one and two years after application.

Shoot count data (Table 1) shows a reduction of leafy spurge shoots in all plots with percent control ranging from 70 to 100, as compared to the check one year after treatment. However, in the following year control has decreased in all treatment areas except, for picloram at 2.0 lb a.i./A at two locations.

Root weights from the three locations (Table 2) were highly variable as compared to the check, and from year to year. The most consistent reduction in the root system appears to be provided by picloram when the two years data are reviewed. In some cases the data suggest a stimulation in below-ground tissue development.

Residue analysis (Table 3) was restricted in 1982 to picloram due to the known soil persistence of dicamba and picloram, and sampling and analysis expense. In 1982, two years following application of picloram, soil residue had fallen in all locations and for both rates of application. The residue data presented are representative of the entire soil sample profile from the soil surface to a depth of 24 inches. These data are somewhat in contrast with the report by Grover and Bowes in that they reported residues in the top 7.5 cm (3 inches) of soil. They reported the critical level of picloram to prevent leafy spurge re-establishment from seed to be about 50 ppb (4) . From the data presented in Table 3 are compared to shoot control in Table 1, the residue levels found in 1982 throughout the top 24 inches of soil appear to be under the critical level to prevent re-establishment of leafy spurge from root regeneration and seed germination.

In reviewing the correlation coefficients presented in Table 4, root weight to shoot count were poorly correlated for all locations over two years. Only moderate or good correlations resulted in comparing residue to shoot counts and residue to root weight.

Through the efforts to develop a measurement technique to determine root control as it relates to shoot control, not only is the sample method important but also the analysis is critical. Numerous sample numbers are necessary to reduce variance and offer a valid statistical test. This presents a problem in time, expense and transport. Coupled with the difficulty in root separation and measurement, there are many problems yet to be solved. A more realistic approach than weight measurement of root biomass may be a reversion to an evaluation of root viability at various soil depths. Where evaluations are limited to a select few treatment areas, a more positive correlation may be developed between shoot and root control. It is apparent that a soil residue maintenance of both dicamba and picloram is necessary for longevity of leafy spurge control. From these and other data, an annual application of 0.5 lb a.i./A may be providing a soil residual at an adequate level to maintain excellent shoot control. However, the resulting reduction in the root system remains to be unearthed.

Table 1: Leafy spurge shoot control one and two years after treatment with dicamba and picloram.

		Rate	Shoot Counts/sq ft.		% Control	
Location	Treatment[1]	(lb ai/A)	1981	1982	1981	1982
Crook	dicamba	6.0	15.8	3.6	80	67
(80-226)	dicamba	8.0	0.5	2.0	99	82
	picloram	1.0	0.1	1.2	99	89
	picloram	2.0	0	0	100	100
	Check	--	80.0	10.9	0	0
Johnson	dicamba	6.0	10.7	4.7	76	0
(80-229)	dicamba	8.0	12.9	5.6	70	0
	picloram	1-.0	0.4	3.0	99	32
	picloram	2.0	0.4	1.0	99	77
	Check	--	43.7	4.4	0	0
Fremont	dicamba	6.0	6.7	5.0	92	73
(80-227)	dicamba	8.0	3.6	2.0	95	89
	picloram	1.0	3.2	3.9	96	79
	picloram	2.0	0.3	0	99	100
	Check	--	79.4	18.3	0	0

[1]Herbicides in 1980 applied as granular formulation

Table 2: Leafy spurge root evaluations one and two years after treatment with dicamba and picloram.

Location	Treatment[1]	Rate (lb ai/A)	Root wt (oz/cu. ft) 1981	1982
Crook	dicamba	6.0	6.94	0.56
(80-226)	dicamba	8.0	4.14	0.70
	picloram	1.0	3.20	1.12
	picloram	2.0	3.36	0.81
	Check	--	3.62	1.00
Johnson	dicamba	6.0	8.34	3.35
(80-229)	dicamba	8.0	8.64	2.28
	picloram	1.0	8.87	1.06
	picloram	2.0	8.16	2.30
	Check	--	10.03	2.70
Fremont	dicamba	6.0	5.72	--
(80-227)	dicamba	8.0	7.25	--
	picloram	1.0	6.24	--
	picloram	2.0	5.66	--
	Check	--	5.90	--

[1] Herbicides applied as granual formulation in 1980

Table 3: Concentrations of dicamba and picloram, one and two years after application, in three Wyoming soils.

Location	Treatment[1]	Rate (lb ai/A)	PPM 1981	1982
Crook	dicamba	6.0	1.020	-
(80-226)	dicamba	8.0	0.086	-
	picloram	1.0	0.468	0.044
	picloram	2.0	0.647	0.073
Johnson	dicamba	6.0	0.081	-
(80-229)	dicamba	8.0	0.119	-
	picloram	1.0	0.100	0.082
	picloram	2.0	0.497	0.119
Fremont	dicamba	6.0	0.348	-
(80-227)	dicamba	8.0	0.592	-
	picloram	1.0	0.112	-
	picloram	2.0	0.088	-

[1] Herbicides applied as granual formulation in 1980

Table 4: Correlation coefficients from comparisons of shoot count, root weight and herbicide residue means.

Location	Year[1]	Root wt: Shoot cnts	Residue: Shoot cnts	Residue: Root wt.
Crook	1981	0.04	0.46	0.64
Fremont		0.21	0.50	0.74
Johnson		0.88	0.48	0.52
Crook	1982	0.22	0.96	0.52
Johnson		0.36	0.95	0.43
	Ave	0.34	0.67	0.57

[1] Plots were established in 1980

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