Changes in the Yield of Forage Following the Use of Herbicides to Control Aspen Poplar

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Abstract

Yields of forage were measured 3 to 5 years after the use of 2,4-D, 2,4-D + 2,4,5-T, and picloram + 2,4-D applied at brush control rates. The yield of brome grass and alfalfa on the herbicide treated areas was either reduced or remained unchanged. This occurred because alfalfa can not tolerate the high herbicide rates required for brush control. On an area which never received a herbicide treatment, alfalfa was unable to compete with invading aspen poplar and prickly rose. Ranchers should use herbicides to prevent secondary succession from grasslands to the aspen poplar vegetation type which has a low amount of forage available for cattle. Arguments are presented for including alfalfa in a seeding program when a mixture of 2,4-D + picloram is used for brush control but not when a mixture of 2,4-D + 2,4,5-T is used.

In the aspen parkland vegetation zone of Saskatchewan, rangeland is improved when mature aspen poplar¹ (*Populus tremuloides* Michx.) trees are bulldozed so the land can be seeded to tame forage species (Rowe 1972). Good stands of brome grass (*Bromus inermis* Leyss.) and alfalfa (*Medicago sativa* L.) are easy to obtain but they often contain regrowth of aspen poplar and the shrub, prickly rose (*Rosa acicularis* L.). Picloram (4-amino-3,5,6-trichlorophenol) and a mixture of 2,4-D (2,4-dichlorophenoxy acetic acid) and 2,4,5-T (2,4,5-trichlorophenoxy acetic acid) have proven effective against the woody species (Bowes 1975, 1976). However, alfalfa did not tolerate the rates required to control aspen poplar and prickly rose. Alfalfa is a very desirable component in a pasture because it increases forage production as much as 50%. Ranchers are faced with the problem of controlling woody regrowth with herbicides that will kill their alfalfa. Depending on the amount of alfalfa in a stand, this may result in lower forage yields.

The objectives of the research project were to measure: (1) the yield of forage following the application of herbicides for the control of aspen poplar and prickly rose and (2) the competitive effect the two woody species have on the yield of forage.

Methods and Materials

The site (50° 22'N and 103° 16'W) of the three experiments was located 193 km northeast of Regina, Saskatchewan, in an area which once supported a solid stand of mature aspen poplar and was converted to an excellent stand of brome grass and alfalfa. The trees were bulldozed and piled during the winter of 1964-65. The area was disced twice during 1965 and seeded to tame forage species. The amount of woody regrowth was previously reported (Bowes 1975, 1976).

In the first experiment, the herbicides were applied on June 7, 1967, June 9, 1968, and June 19, 1969. Herbicides and rates used were the butyl esters of 2,4-D at 2.2 kg/ha, the iso-octyl ester of 2,4,5-T at 0.7 kg/ha and a mixture of the iso-octyl ester of 2,4-D + 2,4,5-T (2:1) at 2.2 kg/ha. In the second experiment the herbicides

were applied on June 15, 1967. Herbicides used were the dimethylamine salts of 2,4-D + picloram. All herbicides were applied with a four nozzle back-pack sprayer using compressed air to propel the liquid solution. Both experiments were randomized complete blocks replicated four times. Individual plot size was 6.4 × 9.1 m. The degree of control was previously reported (Bowes 1975, 1976).

In experiments one and two, the standing crop of forage was clipped at ground level from four 1.0-m² quadrats per plot on July 18, 1972, and July 20, 1972, respectively. All samples were placed in plastic bags for transport to the laboratory, stored in a freezer until processed, sorted into three vegetation types (grasses, alfalfa, and forbs) and placed in an oven at 100°C for 48 hours. Results are expressed as g/m² of oven-dry weight tissue.

The area selected for experiment three was isolated from the herbicide treated plots and was never treated with herbicides. In the third experiment, the standing crop of forage was clipped at ground level from under individual trees of aspen poplar, clumps of prickly rose, and in the openings between the woody plants. In each of the three locations, 80 samples each 25 × 25 cm were obtained on July 9, 1973, and 120 samples of the same size were obtained on July 10, 1974. During 1973 the height of woody plants was recorded to the nearest cm. Canopy cover was estimated by recording the average width of the canopy of the woody plants. Forage samples were processed in a fashion similar to that reported for experiments one and two. Sample sites for aspen poplar, prickly rose, and the openings between the woody species were obtained from a 1-m belt transect randomly placed across the selected area.

Yield data collected from experiments 1 and 2 were analyzed with an *F* test (ANOVA) and orthogonal comparisons were used to detect significant differences among treatment means (Steel and Torrie 1960). In experiment one, a single orthogonal comparison explained statistically significant differences (Table 1). In experiment two, three orthogonal comparisons were found to be important (Table 2). In experiment three, the means are presented with their standard errors.

Results

In experiment one, the amount of alfalfa was statistically lower on plots treated with herbicides for the control of aspen poplar, balsam poplar, and prickly rose than on the untreated plots (Table 1). Also, the combined alfalfa and grass yield and the total yield was statistically lower on the treated than the untreated plots. The grass and forb components were similar on all plots.

In experiment two, the yield of grass was statistically greater on areas (1) which received picloram rather than 2,4-D treatments and (2) which received a combination of the two herbicides rather than only picloram or 2,4-D (Table 2). Alfalfa was almost eliminated and forbs were greatly reduced on any plots which received picloram treatments. The combined yield of grass and alfalfa and the total yield was statistically similar following any of the treatments.

Alfalfa growing in the openings between aspen poplar and prickly rose was four to fourteen-fold greater than directly under the woody plants (Table 3). There was a similar amount of grass

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¹The botanical nomenclature follows that of the Canada Weed Committee 1969.

Table 1. Yield of forage in 1972 following the multiple application of herbicides from 1967 to 1969 for the control of aspen poplar and prickly rose.

Treatment	Application rate (kg/ha)	Year sprayed	Yield of forage (g/m ²)				
			Grasses	Alfalfa	Forbs	Grass & alfalfa	Total
1) Check			172	66	17	238	255
2) 2,4-D ¹ followed by 2,4-D + 2,4,5-T (2:1) ²	2.2	1967					
	2.2	1968	163	4	14	167	181
3) 2,4-D followed by 2,4,5-T	2.2	1967					
	0.6	1968	173	12	13	185	198
4) 2,4-D followed by 2,4-D + 2,4,5-T (2:1)	2.2	1967					
	2.2	1969	177	3	9	181	190
5) 2,4-D followed by 2,4,5-T	2.2	1967					
	0.6	1969	195	5	16	200	216
Sx (N = 20)			11	4	3	13	13
F test ³			ns ⁴	***	ns	**	**

¹Butyl esters²Iso-octyl esters³Orthogonal comparisons used were as follows:

a. Check vs. treated plots (Treatments 1 vs. 2,3,4 and 5).

⁴ns = non-significant, ** = statistically significant, P = .01, and * = statistically significant, P = .05.

and forbs growing directly under small aspen poplar shoots, under clumps of prickly rose, and in the openings between the woody species.

Discussion

When producers use brome grass and alfalfa as their forage, they should not expect increased yields (Table 1 and 2) following the control of aspen poplar, balsam poplar, and prickly rose with herbicides (Bowes 1975, 1976). Grasses did not change (Table 1) or increase (Table 2) following the use of herbicides, whereas alfalfa was severely reduced. However, when compared to the untreated area, the total yield was reduced following various combinations of phenoxy herbicides (Table 1) and was similar following herbicide

treatments which included picloram (Table 2). Therefore, the valid reason for using herbicides is to obtain long-term rather than short-term benefits.

An important reason for controlling woody regrowth is to prevent the occurrence of secondary succession which is known to climax in the aspen poplar vegetation type. Under a mature aspen poplar canopy, forage yields ranged from 34 to 52 g/m² compared to 135 to 336 g/m² in areas seeded to a grass-legume mixture (Anonymous 1974, Barley and Wroe 1974, Smoliak et al. 1976, Wiens and Lodge 1972). By using herbicides to control woody regrowth, the forage yields were maintained within the expected range for areas seeded to tame forage species (Table 1 and 2).

The common practice of establishing alfalfa with brome grass, where prickly rose and aspen poplar regrowth is a problem, must

Table 2. Yield of forage in 1972 following the application of herbicides in 1968 for the control of aspen poplar and prickly rose.

Treatment	Application rate (kg/ha)	Yield of forage (g/m ²)				
		Grasses	Alfalfa	Forbs	Grass & alfalfa	Total
1) Check		139	28	26	167	193
2) Picloram	0.6	174	0	4	174	178
3) Picloram	1.1	153	1	1	154	155
4) 2,4-D amine	1.1	125	26	24	151	175
5) 2,4-D amine	2.2	135	4	21	139	161
6) Picloram + 2,4-D	0.3 + 1.1	154	1	8	155	162
7) Picloram + 2,4-D	0.6 + 2.2	150	1	4	151	155
8) Picloram + 2,4-D	0.6 + 1.1	180	1	3	181	184
9) Picloram + 2,4-D	1.1 + 2.2	174	0	1	174	175
Sx (N = 36)		8	4	2	8	9
F test ¹		*2	*	**2	ns ²	ns

¹Orthogonal comparisons used were as follows:

a. Check vs. herbicide treated plots (Treatment 1 vs. 2,3,4,5,6,7,8 and 9).

b. Picloram treatments vs. 2,4-D treatments (Treatments 2 and 3 vs. 4 and 5).

c. Single 2,4-D or picloram treatments vs. treatments with combinations of 2,4-D and picloram (Treatments 2,3,4 and 5 vs. 6,7,8 and 9).

* = statistically significant, P = .05, and ** = statistically significant, P = .01, and ns = non-significant.

Table 3. The amount of forage growing directly under aspen poplar and prickly rose and in the openings between woody plants.

	Aspen poplar		Prickly rose		Open spaces	
	1973	1974	1973	1974	1973	1974
Height (cm)	160 ± 10 ¹		47 ± 3			
Cover (cm ²)	5649 ± 6.5		582 ± 74			
Density (no./625 cm ²)	1	3.4 ± .2				
Grass weight (g/625 cm ²)	4.9 ± .3	3.2 ± .3	6.1 ± .5	3.9 ± .4	5.8 ± .5	4.4 ± .6
Alfalfa weight (g/625 cm ²)	0.9 ± .5	.2 ± .1	0.7 ± .5	3.9 ± 2.8	2.8 ± 1.0	
Forb weight (g/625 cm ²)	3.0 ± .4	2.3 ± .2	3.5 ± .5	2.3 ± .2	3.0 ± .4	2.2 ± .1

¹Values are means ± Sx

be questioned. Herbicides used to control the two woody species almost eliminated alfalfa (Table 1 and 2) and the legume was a poor competitor under clumps of prickly rose and small aspen poplar (Table 3). Also, it is reasonable to assume that alfalfa losses increase as the amount of woody regrowth increases. The decision on using alfalfa depends on which herbicides are used for regrowth control. If cattle producers plan on controlling prickly rose and aspen poplar regrowth with phenoxy herbicides, then alfalfa should not be seeded in pastures because successful control depends on spraying during the first 2 years of regrowth when the new root system is not well developed (Bowes 1975). If a picloram + 2,4-D mixture is used to control regrowth, 5 to 10 years after tame forage species are seeded, then alfalfa can be included in the forage mixture. In this case, the contribution of alfalfa to the total yield decreases as woody regrowth increases and terminates when herbicides are applied (Bowes 1976). A mixture of picloram + 2,4-D applied at 0.5 + 2.2 kg/ha effectively controlled aspen poplar 9 years after the area was seeded to a mixture of alfalfa and brome grass (Bowes, unpublished data).

Several conclusions were derived from the research project. Controlling woody regrowth helps to maintain a high yielding grass stand. This prevents succession ending in the aspen poplar vegetation type, which has a lower amount of forage available to cattle. Most producers realize that alfalfa is lost following the application of picloram and/or phenoxy herbicides, but they must also realize that alfalfa was unable to compete with invading aspen

poplar and prickly rose. There appeared to be little value in including alfalfa in forage stands, when foliage applications of 2,4-D and/or 2,4-D + 2,4,5-T are used to control 1- and 2-year-old aspen poplar regrowth. It may be advantageous to include alfalfa in a forage stand when a mixture of 2,4-D and picloram is used for regrowth control and is applied 5 to 10 years after the forage species were seeded.

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