Control of Aspen Poplar, Balsam Poplar, and Prickly Rose by Picloram Alone and in Mixtures with 2, 4-D

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Highlight: *Picloram alone and in combination with 2,4-D was evaluated for the control of aspen poplar (*Populus tremuloides* Michx.), balsam poplar (*Populus balsamifera* L.), and prickly rose (*Rosa acicularis* Lindl.) on rangeland in Saskatchewan which had alfalfa (*Medicago sativa* L.) as an important grazing component. The addition of picloram at 0.5 lb/acre to 2,4-D amine at 2 lb or less per acre did not improve the control of aspen poplar when compared to the presently recommended treatment in Saskatchewan of 2 lb/acre of 2,4-D ester. However, there was some evidence that the addition of 1 lb/acre of picloram to 2 lb/acre of 2,4-D amine may improve control. Picloram applied at 1 lb/acre alone or in combination with 2 lb/acre of 2,4-D amine provided effective control of balsam poplar. There was excellent control of prickly rose for 4 to 5 years following the application of 0.5 lb/acre of picloram with or without the addition of 2,4-D. The herbicide rates that were necessary for the control of any of the woody species, almost completely removed alfalfa from the rangeland. The significance of alfalfa on rangeland and the potential loss of grazing from using or not using herbicides is discussed.*

An important technique used for rangeland improvement in the aspen parkland of Saskatchewan is the removal of mature aspen poplar¹ (*Populus tremuloides* Michx.) and balsam poplar (*Populus balsamifera* L.) trees with bulldozers and the subsequent reseeding of rangeland improvement species. The main problem encountered with this improvement technique is the regrowth of aspen and balsam poplar, which compete with the desirable plant species established on the rangeland. Aerial applications of 2,4-D [(2,4-dichlorophenoxy)acetic acid] at 2.0 lb/acre are used for the control of young trees (Beck, 1968; Friesen et al., 1965). When the shrub prickly rose (*Rosa acicularis* Lindl.) is present, 2,4,5-T [(2,4,5-trichlorophenoxy)acetic acid] is substituted for a portion of the 2,4-D (i.e., 2 parts 2,4-D to 1 part 2,4,5-T). However, variable control is obtained and retreatment is often necessary.

Picloram (4-amino-3,5,6-trichloropicolinic acid) has shown promise for the control of aspen and balsam poplar (Corns and Dai, 1967). The need for more effective control of woody species in the aspen parkland provided the incentive for evaluating picloram.

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The objectives of this study were to determine (1) the effectiveness of picloram for the control of aspen poplar, balsam poplar, and prickly rose; (2) the control of all three species by combinations of picloram with other herbicides; and (3) the length of time that control can be expected.

Methods and Materials

The experimental site was located 120 miles northeast of Regina, Saskatchewan, on section 15, township 28, range 9 west of the 2nd meridian. The soil was classed as a Waitville loam (Mitchell et al., 1944). During the winter 1964-65 a solid stand of aspen poplar was bulldozed and piled. In the summer of 1965 the area was disced twice with a heavy duty serrated disc drawn by a crawler-tractor and was seeded with a double disc drill to a mixture of alfalfa (*Medicago sativa* L.) and brome grass (*Bromus inermis* Leyss.). This resulted in a satisfactory stand of forage; but disking did not kill all of the roots, so aspen poplar, balsam poplar, and prickly rose were rapidly re-establishing in the area at the time of herbicide application.

All experiments were designed as randomized complete blocks replicated four times. Size of plots for Experiment 1 was 6.4 × 9.1 m; for Experiment 2, 13.4 × 30.5 m. Untreated check plots were included in all tests. Evaluation of control was accomplished by counting the number of live shoots in the plots before herbicide treatment and the number surviving after chemical application. The assessment was obtained from three permanent quadrats each 1.5 × 4.0 m on each plot in Experiment 1 and 18 permanent quadrats each 1 × 1 m on each plot in Experiment 2. Results are expressed as percentage reduction in the number of live shoots recorded before herbicide treatment. The density of alfalfa was obtained from the permanent quadrats after herbicide treatment. Final evaluation for both experiments was made in 1972 by estimating the percentage canopy cover on each plot. Cover for each plot was estimated according to the classification system adapted by Trepp and quoted in Brown (1954). The cover scales were as follows: up to 1.0%, 1.0 to 9.9%, 10.0 to 24.9%, 25.0 to 49.9%, 50.0 to 74.9%, and 75.0 to 100.0%. The mid-points of the classes for the replicates were averaged for each treatment. Several extreme values in the data make the standard statistical procedures difficult to apply; and since meaningful conclusions are apparent from the results without resorting to specific tests, statistical procedures are not discussed.

Herbicides were applied as soon as possible after full leaf expansion on June 15, 1967, for Experiment 1 and June 26, 1968, for Experiment 2. In Experiment 1, all treatments were applied with a small back-pack sprayer using compressed air to propel the liquid spray solution to a four nozzle hand held boom. All treatments in Experiment 2 were applied with a sprayer mounted on a truck as described by Meyer et al. (1967).

Herbicides used were the dimethylamine salts of 2,4-D, the butoxy ethanol ester of 2,4-D, a mixture of the *iso*-octyl esters

¹The botanical nomenclature follows that by the Canada Weed Committee (1969).

of 2,4-D and 2,4,5-T, the potassium salt of picloram, and mixtures of the triisopropanolamine acid of 2,4-D and picloram. A surfactant containing polysorbate, mono- and diglycerides, butylated hydroxyanisole, butylated hydroxytoluene, and propylene glycol in a water-isopropanol medium (Atlox 210) was added to some treatments (Corns and Dai, 1967).

Results

Experiment 1

The density of aspen poplar in the experimental area varied from 1.0 to 2.2 live shoots/m² (Table 1). On the untreated

Table 1. Pretreatment densities (shoots/m²), reduction (%) of shoots, and canopy cover (%) of aspen poplar in Experiment 1 following application (lb/acre) of 2,4-D and picloram alone and in mixtures.

Treatment		Density 1967	Reduction of shoots			Cover 1972
Herbicide	Rate		1968	1969	1970	
Check		2.2	23	17	37	40
2,4-D amine	1.0	1.4	23	42	42	6
2,4-D amine	2.0	1.9	25	32	47	14
Picloram	0.5	1.0	26	23	57	9
Picloram	1.0	1.7	70	62	75	2
Picloram + 2,4-D	0.25 + 1.0	1.6	5	5	19	26
Picloram + 2,4-D	0.5 + 2.0	1.6	66	70	82	5
Picloram + 2,4-D	0.5 + 1.0	1.2	54	46	51	6
Picloram + 2,4-D	1.0 + 2.0	1.3	67	62	76	6

plots there was a natural reduction in the population of aspen poplar from 1968 to 1970. The amine formulation of 2,4-D was ineffective for the control of aspen poplar. When picloram was applied alone, at least 1 lb/acre was required to give a substantial reduction in the plant population. Picloram at 0.5 lb/acre gave good control provided 2.0 lb/acre of 2,4-D amine was added. Similar control was obtained when either 0.5 or 1.0 lb/acre of picloram was applied with 2.0 lb/acre of 2,4-D amine. Five years after any of the herbicide treatments, the cover of aspen poplar was still lower than on the untreated plots. The lowest canopy cover was present on the area treated with 1.0 lb/acre of picloram. However, the canopy cover 5 years after any of the other treatments that included at least 0.5 lb/acre of picloram alone or in a mixture with 2,4-D was similar to 1.0 lb/acre of 2,4-D amine.

The density of balsam poplar prior to the application of herbicides varied between 0.9 and 2.1 live shoots/m² on the experimental plots (Table 2). For 3 years after the start of the experiment there was a considerable and consistent reduction in the natural population of balsam poplar. The only herbicide treatments that effectively reduced the stand of balsam poplar were picloram at 1.0 lb/acre and a mixture of picloram plus

Table 2. Pretreatment densities (shoots/m²), reduction (%) of shoots, and canopy cover (%) of balsam poplar in Experiment 1 following application (lb/acre) of 2,4-D and picloram alone and in mixtures.

Treatment		Density 1967	Reduction of shoots			Cover 1972
Herbicide	Rate		1968	1969	1970	
Check		2.0	45	52	62	14
2,4-D amine	1.0	1.9	37	39	50	10
2,4-D amine	2.0	1.4	49	48	67	7
Picloram	0.5	2.1	66	63	72	4
Picloram	1.0	0.9	91	93	90	2
Picloram + 2,4-D	0.25 + 1.0	1.0	33	39	59	3
Picloram + 2,4-D	0.5 + 2.0	1.8	70	67	72	4
Picloram + 2,4-D	0.5 + 1.0	1.6	67	66	73	3
Picloram + 2,4-D	1.0 + 2.0	1.3	89	86	90	0.3

2,4-D at 1.0 plus 2.0 lb/acre, respectively. The amount of balsam poplar canopy cover 5 years following any of the herbicide treatments was less than on the untreated plots. The lowest canopy cover was recorded on the plots receiving the highest rate of picloram (1.0 lb/acre) and 2,4-D (2.0 lb/acre) applied as a mixture.

Prickly rose density varied between 2.9 and 6.4 shoots/m² prior to herbicide application (Table 3). There was a reduction in the population of prickly rose during a 3-year period after the start of the experiment. The control of prickly rose increased as the rate of picloram increased from 0.25 to 1.0 lb/acre. The addition of 2,4-D to picloram to form a mixture did not appear to have any effect on the control of prickly rose. Five years after the application of at least 0.5 lb/acre of picloram, the canopy cover of prickly rose was 1% or less of the ground surface.

Table 3. Pretreatment densities (shoots/m²), reduction (%) of shoots, and canopy cover (%) of prickly rose in Experiment 1 following application (lb/acre) of 2,4-D and picloram alone and in mixtures.

Treatment		Density 1967	Reduction of shoots			Cover 1972
Herbicide	Rate		1968	1969	1970	
Check		4.3	28	62	33	4
2,4-D amine	1.0	4.4	7	42	35	2
2,4-D amine	2.0	4.1	0	31	23	9
Picloram	0.5	3.7	97	93	90	0
Picloram	1.0	4.4	100	100	100	0
Picloram + 2,4-D	0.25 + 1.0	4.1	78	75	70	5
Picloram + 2,4-D	0.5 + 2.0	4.2	94	93	89	0
Picloram + 2,4-D	0.5 + 1.0	6.4	95	95	91	1
Picloram + 2,4-D	1.0 + 2.0	2.9	100	99	100	0

Experiment 2

Prior to treatment, the density of aspen poplar was relatively uniform and varied between 1.1 and 1.8 shoots/m² (Table 4). When picloram was applied alone, 1.0 lb/acre was required to give a high degree of control. The addition of the surfactant Atlox 210 to picloram did not improve the performance of the herbicide sufficiently to cause a satisfactory reduction in the population of aspen poplar. In all cases, the addition of 2,4-D to picloram resulted in a greater reduction in the population of aspen poplar than when picloram was applied alone at a similar rate. Increasing the rate of picloram from 0.5 to 1.0 lb/acre when each was applied with 2,4-D at 2.0 lb/acre improved the control of aspen poplar.

There was an effective reduction in the canopy cover of aspen poplar to less than 1% of the ground surface 4 years after the application of picloram plus 2,4-D at 1.0 plus 2.0 lb/acre; 2,4-D at 2.0 lb/acre; and 2,4-D plus 2,4,5-T at 0.7 plus 1.3 lb/acre (Table 4).

The density of prickly rose varied between 1.7 and 5.0 shoots/m² on the plots before treatment (Table 4). The number of prickly rose shoots was reduced as the rate of picloram was increased from 0.25 to 1.0 lb/acre. All treatments containing picloram were also more effective for the control of prickly rose than the presently recommended mixture in Saskatchewan of 2,4-D plus 2,4,5-T at 0.7 plus 1.3 lb/acre. The addition of the surfactant Atlox 210 to picloram did little to improve the performance of the herbicide. The canopy cover of prickly rose 4 years after any treatments that included at least 0.5 lb/acre of picloram was less than 1%.

The herbicide rate necessary to control any of the woody

Table 4. Pretreatment densities (shoots/m²), reduction (%) and canopy cover (%) of aspen poplar and prickly rose shoots in Experiment 2, following application (lb/acre) of 2,4-D and picloram alone and in mixtures.

Herbicide	Rate	Aspen poplar			Prickly rose		
		Density 1968	Shoot reduction 1969	Cover 1972	Density 1968	Shoot reduction 1969	Cover 1972
Check		1.4	21	39	2.3	(4) ¹	6
Picloram	0.25	1.2	21	14	3.0	82	2
Picloram	0.5	1.1	13	10	1.7	95	<1
Picloram	1.0	1.8	83	2	4.2	99	<1
Picloram + 2,4-D	0.25 + 1.0	1.6	31	10	2.7	81	1
Picloram + 2,4-D	0.5 + 2.0	1.2	77	2	2.4	98	<1
Picloram + 2,4-D	1.0 + 2.0	1.1	95	<1	4.6	100	0
Picloram + Atlox	0.25 + 1.0 ²	1.7	18	6	3.6	90	1
Picloram + Atlox	0.5 + 1.0 ²	1.1	32	6	2.5	95	<1
2,4-D ester	2.0	1.6	85	<1	5.0	(1) ¹	18
2,4-D + 2,4,5-T	0.7 + 1.3	1.4	65	<1	2.8	38	1

¹ This represents the increase in the rose population between 1968 and 1969.

² Atlox 210 was added at the rate of 1% of the spray volume.

species almost completely removed alfalfa from the rangeland (Table 5). Also, there was a natural reduction in the population of alfalfa in the untreated plots between 1968 and 1970.

Table 5. The density (plants/m²) of alfalfa following application (lb/acre) of 2,4-D and picloram alone and in mixtures.

Treatment		Experiment 1 1970	Experiment 2	
Herbicide	Rate		1968	1970
Check		1.15	0.72	0.28
2,4-D amine	1.0		0.49	0.24
2,4-D amine	2.0		0.11	0.12
2,4-D ester	2.0	0.01		
2,4-D + 2,4,5-T	0.7 + 1.3	0.02		
Picloram	0.25	0.05		
Picloram	0.5	0.0	0.0	0.0
Picloram	1.0	0.0	0.0	0.01
Picloram + 2,4-D	0.25 + 1.0	0.0	0.01	0.03
Picloram + 2,4-D	0.5 + 1.0		0.0	0.05
Picloram + 2,4-D	0.5 + 2.0		0.0	0.05
Picloram + 2,4-D	1.0 + 2.0	0.0	0.0	0.0
Picloram + Atlox	0.25 + 1.0 ¹	0.06		
Picloram + Atlox	0.5 + 1.0 ¹	0.0		

¹ Atlox 210 was added at the rate of 1% of the spray volume.

Discussion

Mixtures of amines of picloram and 2,4-D with the former component varying between 0.25 and 0.5 lb/acre and the latter component varying between 1.0 and 2.0 lb/acre, did not offer any advantage for the control of aspen poplar when compared to picloram at 1.0 lb/acre or an ester of 2,4-D at 2.0 lb/acre (Tables 1 and 4). However, there was some evidence that the addition of 1.0 lb/acre of picloram to 2.0 lb/acre of 2,4-D amine improved the control of aspen poplar when compared to 2,4-D ester at 2.0 lb/acre (Table 4). Picloram applied at 1.0 lb/acre alone or in a mixture with 2,4-D amine gave effective control of balsam poplar (Table 2). Unfortunately, the presently recommended treatment in Saskatchewan of 2,4-D at 2.0 lb/acre was not included in Experiment 1 so a comparison cannot be made with the treatments that gave effective control of balsam poplar. However, these picloram treatments reduced the balsam poplar population 90% which was the value arbitrarily selected as the acceptable level of control. Picloram at 0.5 lb/acre with or without the addition of 2,4-D gave excellent control of prickly rose (Tables 3 and 4). Therefore, where all three species are present, picloram can be added to 2,4-D for prickly rose control. Control should last 4 to 5 years.

While it has been demonstrated in field and greenhouse experiments that Atlox 210 improved the effectiveness of picloram for control of poplar, (Corns and Dai, 1966; 1967), the addition of the surfactant to picloram at 0.25 and 0.5 lb/acre did not provide satisfactory control of aspen poplar.

All herbicide treatments effective for the control of any of the woody species drastically reduced the population of alfalfa (Table 5). The density of alfalfa was reduced in the check plots on Experiment 2 between 1968 and 1970. During this time period aspen and balsam poplar continued to grow and increase their canopy cover. It was assumed that the increase in the growth of woody plants in the checks was associated with a decrease in the amount of alfalfa. While 1.0 and 2.0 lb/acre of 2,4-D amine did not control aspen and balsam poplar, it retarded the yearly growth of these species, which reduced the competitive effect on alfalfa between 1968 and 1970. The decrease in the density of alfalfa as 2,4-D amine increased from 0 to 2.0 lb/acre was caused by herbicidal injury (Table 5). The presence of alfalfa on any improved rangeland in Saskatchewan could be the deciding factor in determining if 2,4-D and/or picloram should be used to control woody plants. Additional research is needed on the relationship between the amount of alfalfa and the density of woody plants since the desirable species may be greatly reduced whether herbicides are used or not.

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