# Control of Aspen Regrowth in Western Canada When There Is an Understory of Established Alfalfa

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Abstract

**The use of 2,4-D alone and in a mixture with 2,4,5-T was evaluated, when applied during the dormant season, for the control of aspen and balsam poplar regrowth in pastures previously seeded with a mixture of bromegrass and alfalfa. When 2,4-D was applied at 2.2 kg/ha for two consecutive years, sufficient control of aspen top growth was achieved to reduce the physical barrier presented by the trees and allowed uniform cattle grazing. An adequate kill of aspen was not obtained until the herbicide rate was increased to 4.4 kg/ha. Herbicide retreatments were required after 5 or 6 years. Balsam poplar canopy cover was not adequately reduced following the use of 2,4-D alone or in a mixture with 2,4,5-T. Grass, alfalfa, forb and woody plant yields were not affected by the herbicide treatments. The use of phenoxy herbicides during the dormant season for pasture improvement is discussed.**

Wood et al. (1948) observed in Manitoba that 2,4-D (2,4-dichloro-phenoxyacetic acid) controlled many of the woody plants growing in the aspen-oak vegetation zone (Rowe 1972). Thirty years ago the Manitoba Power commission was using air blast turbines to apply 2,4-D alone and in mixtures with 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) for the control of aspen *(Populus tremuloides* Michx.) and balsam poplar (*Populus balsamifera* L.) growing under electric transmission lines (Playfair 1952; Wood et al. 1951). Herbicides were applied in a solution of diesel oil after leaf fall when the trees were dormant. In general, brush control was satisfactory and there was an exceptionally good kill of aspen (Playfair 1952). During this time period the Western Section of the National Weed Committee recommended 2,4-D for the control of aspen during the dormant season (Anonymous 1953). During the 1960's, the Province of Saskatchewan started to use phenoxy herbicides to control the regrowth of brush which was invading areas with good stands of alfalfa (*Medicago sativa* L.) and bromegrass (*Bromus inermus* Leyss). Aspen was the dominant species with balsam poplar growing in the moister areas. Herbicides were applied when alfalfa, aspen, and balsam poplar were dormant. The advantage of applying herbicides during the late fall was to control the weeds without killing the alfalfa. Alfalfa will tolerate 2,4-D applied at 2.2 kg/ha provided the legume is in a dormant state of growth (Friesen 1964).

Between 1966 and 1968 I visited pastures which were sprayed during the dormant season to investigate reports of poor weed control. I observed that the control of aspen and balsam poplar was not satisfactory. This prompted the present research project, which was designed to evaluate the practice of applying phenoxy herbicides during the dormant season. The objectives of the experiments were to document (1) the degree of control of aspen and balsam poplar following the application of 2,4-D alone and in mixtures with 2,4,5-T during the dormant season and (2) the tolerance of alfalfa to the above mentioned herbicides.

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## Methods and Materials

All three experiments were located 190 km northeast of Regina, Saskatchewan, in an area classified by Rowe (1972) as the aspen grove vegetation zone. The soil was classed as a Waitville loam (Mitchell et al. 1944). The topography was undulating—rolling and rolling with sloughs and marshy depressions common. Surface drainage was impeded but profile drainage was adequate in most areas. Approximately 400 ha of trees were bulldozed and piled during the winter of 1964-65. The site was disced twice with a heavy duty serrated disc drawn by a crawler-tractor to prepare a seed before a mixture of alfalfa and bromegrass. This resulted in a stand of forage which was satisfactory. However, the cultivation treatments did not kill all of the roots of aspen and the species was rapidly re-establishing at the time of herbicide application.

In experiment 1, various rates of the butoxy ethanol ester of 2,4-D were compared for the control of aspen and balsam poplar and the tolerance of alfalfa. Rates of 2,4-D applied on November 3, 1967, were 1.1, 2.2, and 4.4 kg/ha. In experiment 2, the same formulation of 2,4-D was compared at four different application times during the dormant season. The herbicide was applied on November 3, 1967, March 27, 1968, April 29, 1968, and May 28, 1968. In experiment 3, several formulations of phenoxy herbicides were applied as a single application or as two consecutive yearly applications. The butoxy ethanol ester of 2,4-D, dodecyl and tetradecyl amine salt of 2,4-D and 2,4,5-T were applied on November 4, 1970 and 1971. All herbicides were applied with a small compressed air knapsack sprayer at 67 liters/ha in an emulsion with diesel oil. A randomized complete block designed experiment replicated four times was used with each individual plot 58 $m^2$.

Response of aspen and balsam poplar on experiment 1 and 2 was obtained by recording the number of living shoots in three fixed 9 $m^2$ quadrats, prior to herbicide treatment and at yearly intervals after treatment. The tolerance of alfalfa was determined by counting the number of plants at yearly intervals after the herbicide application. All counts in these experiments were made during September 1967 (trees only), and August of 1968 and 1969.

The effectiveness of the herbicides applied on experiment 3 was obtained by estimating the cover of each species after treatment according to the classfication system adopted by Trepp and quoted by Brown (1954). For each species on each plot, canopy cover was estimated within the following cover classes: 0 to 1.0%, 1.0 to 9.9%, 10.0 to 24.9%, 25.0 to 49.9%, 50.0 to 474.9%, and 75.0 to 100.0%. The midpoints of the classes were used to compute the averages. The standing crop was clipped at soil level on July 11, 1973, and June 21, 1976, from four randomly selected 0.5$m^2$ quadrats per plot. Samples were placed in plastic bags and frozen until they

**Table 1. The density of aspen, balsam poplar, and alfalfa before several rates of 2,4-D were applied during the dormant season and the percentage reduction following treatment.**

| Experiment 1. Treatment Herbicide | Rate kg/ha | Density/m² (1967) Aspen | Poplar | Alfalfa | Reduction (%) of Suckers Aspen 1968 | 1969 | Balsam poplar 1968 | 1969 | Alfalfa 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | | 0.8 | 0.6 | 3 | 7 | 37 | (1)[1] | 18 | 45 | 51 |
| 2,4-D | 1.1 | 1.1 | 0.4 | 4 | 47 | 49 | (12) | 3 | 47 | 60 |
| 2,4-D | 2.2 | 0.5 | 0.5 | 3 | 60 | 64 | 14 | 51 | 48 | 59 |
| 2,4-D | 4.4 | 0.7 | 0.3 | 4 | 81 | 63 | 59 | 32 | 56 | 61 |
| $S\bar{x}$ (N=4) | | 0.2 | 0.1 | 0.4 | 7 | 8 | 11 | 8 | 3 | 4 |

[1]Values in parenthesis represent an increase in the population.

could be sorted into four classes of vegetation which were grasses, alfalfa, forbs, and woody plants. All samples were oven-dried at 100° C for 48 hours before weighing.

While the area selected had a relatively uniform stand of alfalfa and either aspen or balsam poplar, the density of the tree species varied from plot to plot. This resulted in several extreme values which made statistical procedures impractical. However, standard errors ($S\bar{x}$) were calculated. Forage yield data were subjected to $F$ tests and were all found to be nonsignificant at $P$=0.05.

## Results

The experimental area contained a fairly uniform stand of aspen and balsam poplar, but the amount of aspen versus balsam poplar varied for any of the treatments (Table 1 and 2). However, the density of alfalfa was similar on the areas selected. The change in the percentage reduction of tree suckers and alfalfa plants on the control plots from 1968 to 1969 reflects the high degree of natural mortality which occurred in the area.

Generally, in experiment 1, the control of aspen and balsam poplar increased as the rate of 2,4-D increased from 1.1 to 4.4 kg/ha (Table 1). Application of 2,4-D when the trees were dormant was much more effective for the control of aspen than for balsam poplar. There was little or no reduction in the number of alfalfa plants following the application of the highest rate of 2,4-D.

In experiment 2, the reduction in the number of aspen suckers was higher on any of the herbicide treated than on the control (Table 2). The same herbicide treatments failed to control balsam poplar. There was a greater reduction of alfalfa plants, the closer the herbicides were applied to the spring growing season. The greatest alfalfa reduction occurred on May 28, which was after alfalfa had commenced spring growth.

The canopy cover of aspen on experiment 3 was lower or equivalent following the use of phenoxy herbicides during two consecutive years when compared to a single application (Table 3). There was no detectable difference between any of the formulations of 2,4-D and/or 2,4,5-T for the control of aspen. The canopy cover was remained at a low level for 4 years and a retreatment was not required until the sixth year. By this time (1976), there was a slightly lower canopy cover recorded on plots receiving two consecutive yearly treatments than a single application during 1971. None of the herbicides applied once or during consecutive years effectively reduced the canopy cover of balsam poplar.

The yields of grasses, alfalfa, forbs, woody plants, and total yield were similar on any of the plots receiving a herbicide treatment and the control (Table 3).

## Discussion

When 2,4-D was applied during the dormant season at the rate of 2.2 kg/ha, it failed to adequately kill aspen suckers but it gave satisfactory control of top growth (Table 1, 2, and 3). The treatments usually killed the top growth above the lowest branch on the stem, from which growth resumed. This type of herbicide damage was similar to that reported by Friesen (1964). However, the Manitoba Power Commission was able to control aspen successfully by using an air blast turbine to apply 2,4-D at 2.2 kg/ha (Playfair 1952; Wood et al. 1951). The lower volume of diluent (67 liters/ha) used in experiments 1 and 2 did not explain the poor plant kill, because Friesen (1962) only obtained top growth control when 2,4-D was applied in a solution of 224 liters/ha. It is possible that the Manitoba Power Commission only obtained top growth control, which could be interpreted as successful weed control, because the height of the tree canopy would have been greatly reduced under their electric transmission lines. The results of the three experiments suggest that the current recommended rate of 2.2 kg/ha or the lower part of the range of 2.2 to 4.4 kg/ha should be used when only top growth control is desired (Beck 1968; Friesen et al. 1965). In order to kill a large percentage of the suckers of aspen, 2,4-D should be applied at 4.4 kg/ha (Table 1).

There was little value in adding the more expensive herbicide, 2,4,5-T to 2,4-D because there was no improvement in the reduction of the canopy cover of aspen (Table 3).

It was reported that balsam poplar was less sensitive than aspen to an application of 2,4-D (Friesen et al. 1965). The results suggest that an application of 2,4-D applied at 2.2 kg/ha during the dormant season would not be adequate to control balsam poplar

**Table 2. The density of aspen, balsam poplar, and alfalfa before 2,4-D was applied at various times during the dormant season and the percentage reduction following treatment.**

| Experiment 2 Treatment Date applied | Rate kg/ha | Density/m² (1967) Aspen | Balsam poplar | Alfalfa | Reduction (%) of Suckers Aspen 1968 | 1969 | Balsam poplar 1968 | 1969 | Alfalfa 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | | 1.2 | 0.8 | 2 | 25 | 35 | 7 | 38 | 40 | 38 |
| Nov. 2, 1967 | 2.2 | 1.5 | 0.6 | 2 | 43 | 50 | (2)[1] | 8 | 41 | 40 |
| Mar. 27, 1968 | 2.2 | 1.9 | 0.4 | 3 | 57 | 49 | 30 | 65 | 48 | 54 |
| Apr. 29, 1968 | 2.2 | 0.9 | 1.2 | 3 | 58 | 59 | 13 | 44 | 60 | 56 |
| May 28, 1968 | 2.2 | 1.5 | 0.3 | 2 | 52 | 54 | 4 | 8 | 93 | 90 |
| $S\bar{x}$ (n=4) | | 0.3 | 0.1 | 0.3 | 10 | 7 | 12 | 18 | 7 | 7 |

[1]Values in parenthesis represent an increase in the population.

**Table 3. The percentage canopy cover of aspen and balsam poplar and yield of forage following single and double applications of different phenoxy herbicides at 2.2 kg/ha during the dormant season.**

| Experiment 3 | | Aspen | | | Balsam poplar | | | Forage yields ($g/m^2$) (1973) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Herbicides | Year sprayed | 1972 | 1974 | 1976 | 1972 | 1974 | 1976 | GR[1] | AL[1] | FO[1] | WO[1] | TO[1] |
| 2,4-D (BEE)[2] | 1970 | 4 | 6 | 33 | 1 | 1 | 3 | 70 | 22 | 35 | 42 | 169 |
| 2,4-D (BEE) | 1971 | 1 | 2 | 20 | 1 | 1 | 3 | 66 | 65 | 29 | 63 | 224 |
| 2,4-D (BEE) | 1970 and 1971 | 1 | 2 | 18 | 1 | 3 | 12 | 68 | 35 | 33 | 43 | 178 |
| 2,4-D (OSA)[3] | 1970 | 6 | 6 | 20 | 2 | 3 | 9 | 73 | 46 | 50 | 30 | 198 |
| 2,4-D (OSA) | 1971 | 2 | 4 | 34 | 1 | 2 | 7 | 53 | 18 | 41 | 34 | 146 |
| 2,4-D (OSA) | 1970 and 1971 | 1 | 1 | 15 | 1 | 1 | 7 | 57 | 34 | 37 | 50 | 178 |
| 2,4-D + 2,4,5-T (IOE)[4] | 1970 | 6 | 4 | 33 | 2 | 3 | 6 | 62 | 51 | 44 | 20 | 177 |
| 2,4,-D + 2,4,5-T (IOE) | 1971 | 1 | 3 | 25 | 1 | 1 | 15 | 64 | 53 | 40 | 40 | 197 |
| 2,4-D + 2,4,5-T (IOE) | 1970 and 1971 | 1 | 2 | 18 | 1 | 1 | 12 | 55 | 24 | 29 | 32 | 141 |
| Control | | 22 | 17 | 51 | 1 | 2 | 12 | 59 | 62 | 41 | 39 | 201 |
| $S\bar{x}$ (N =4) | | 3 | 3 | 9 | 1 | 1 | 4 | 8 | 17 | 7 | 9 | 24 |

[1]GR = grasses, AL = alfalfa, FO = forbs, WO = woody plants, TO = total
[2]BEE = butoxy ethanol ester
[3]OSA = tetradecyl and dodecylamine salt
[4]IOE = iso-octyl ester

(Table 1,2 and 3). If the herbicide rate is doubled to 4.4 kg/ha than only marginal control can be expected.

According to the results of the experiments, 2,4-D applied at 2.2 kg/ha can be safely used on areas which have an established stand of alfalfa, provided the herbicide is applied prior to the end of March which is approximately 6 to 7 weeks before the legume starts its seasons growth (Table 2). If the rate of the herbicide is increased to 4.4 kg/ha and applied during the safest time period (fall), then a slight reduction in the number of plants can be expected. This supports a previous report of a small reduction in the yield of alfalfa following the application of 3.3 kg/ha of 2,4-D during the dormant period (Friesen 1964).

The total yield recorded for any of the treatments was usually in the lower portion of the 135 to 336 $g/m^2$ range reported for the area (Anonymous 1974; Wiens and Lodge 1972). However, if the woody plants were not included in the total yield, then the 105 to 169 $g/m^2$ range recorded for the remaining herbaceous species was lower than the expected yield. It is not known if these lower than expected forage yields occurred because of a poorer than normal site or because of the competitive effect from the living trees in the herbicide treated areas. Weather conditions were not thought to have a great influence on the lower yields because during 1968 and 1969 the amount of precipitation at the nearest weather station 40 km away was equivalent and 5% above, respectively, the 1941-1970 Canadian normals during May to September (Anonymous 1972). However, yearly precipitation totals were 11 and 2% lower than the 1941-1970 Canadian normals for 1968 and 1969, respectively.

The advantage of using phenoxy herbicides during the dormant season is to reduce the top growth of aspen which reduces the physical barrier that trees have on cattle grazing. This was effectively accomplished following the use of two consecutive yearly treatments of phenoxy herbicides which should last about 4 years from the first application (Table 3). A single application was almost as effective when applied during 1971. However, because of the higher cover values recorded when single applications were applied during 1970 then 1971, ranchers should plan on using two consecutive herbicide treatments when developing a rangeland improvement program.

The justification for using phenoxy herbicides, which controlled the top growth rather than killing the trees, was the large contribution (approximately 30%) which alfalfa made to the total yield. By 1976 only 9% of the total yield was alfalfa, which was nearing a low enough level that it could be sacrificed when using effective weed control techniques. Herbicide treatments which will almost eliminate alfalfa but have proven to effectively kill a large percentage of tree shoots included mixtures of 2,4-D + 2,4,5-T, 2,4-D + dicamba (3,6-dichloro-o-anisic acid) and 2,4-D + picloram (4-amino-3,5,6-trichloropicobnic acid) applied during the spring (Bowes 1975).

## Conclusions

It was concluded that 2,4-D can be applied during the dormant season and will be effective in a long-term weed control program. In areas where aspen is invading forage stands in which alfalfa is an important component of yield, two consecutive treatments of 2,4-D applied at 2.2 kg/ha can be used to reduce the canopy cover, which acts as a physical barrier to grazing. Application must be made when alfalfa is dormant in the fall or in the spring, 6 to 7 weeks prior to growth. Aspen top growth control was satisfactory for 4 years, but a retreatment was needed on the sixth year. During this time, the amount of alfalfa in the stand had decreased and was no longer an important component of yield. Ranchers have the option of reapplying 2,4-D during the dormant season or using other herbicides which effectively kill aspen suckers as well as kill the alfalfa. Increasing the rate of 2,4-D from 2.2 to 4.4 kg/ha controlled the sucker growth of aspen, but injured alfalfa slightly. There was no advantage in using a mixture of 2,4-D + 2,4,5-T over 2,4-D alone. Dormant treatments of 2,4-D and/or 2,4,5-T failed to reduce the canopy cover of balsam poplar.

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