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SUCKER REGENERATION IN A UTAH ASPEN CLONE AFTER
CLEARCUTTING, PARTIAL CUTTING, SCARIFICATION, AND GIRDLING

George A. Schier and Arthur D. Smith¹

ABSTRACT

Clearcutting, partial cutting, scarification, and girdling were used to stimulate root suckering in a Utah aspen clone. Regeneration was inventoried yearly during the first 4 years after treatment and again after 12 years. Clearcutting resulted in the greatest number of suckers.

In most years, partial cuts (cuts that removed 67 percent of the basal area) had less than 50 percent as much regeneration as the clearcut plots. Girdling stimulated suckering to a lesser degree than cutting. Mortality was high on girdled plots and by the 12th year after treatment few suckers had survived. Scarification had no apparent effect on sucker production.

KEYWORDS: *Populus tremuloides*, aspen, root suckers, adventitious shoots, clearcutting, selection cutting, girdling

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Little information is available for the Rocky Mountains that pertains to methods of regenerating aspen (*Populus tremuloides* Michx.). Practically all aspen regeneration in the West is by root suckering. Methods to induce suckering are needed in areas where aspen clones are not regenerating and where it is desirable to maintain the species.

Baker (1969) and Smith and others (1972) reported the effect of cutting, girdling, and scarification on regeneration in a Utah aspen clone. They made yearly inventories of sucker numbers for 4 consecutive years after treatment. In the 12th year, we determined the condition of the aspen regeneration. Our findings are presented here.

ORIGINAL STUDY 1965-1969

Methods

The aspen clone used in this study is in the Twin Creek drainage of the Wasatch Mountains approximately 20 miles (32 km) northeast of Logan, Utah. Mean elevation of the site is 7,850 ft (2,390 m). The site has a southeast aspect and a deep sandy loam soil formed from Wasatch conglomerate.

The clone occupies approximately 21 acre (8.5 ha). When treatments were applied in 1965, the stand was approximately 55 years old and had a 130 ft²/acre (30 m²/ha) basal area. At that time, the average height and the diameter breast height (d.b.h.) of codominant trees was 58 ft (18 m) and 8 inches (20 cm), respectively.

Fifteen plots, 175 x 175 ft (53.3 x 53.3 m), were laid out in the clone and each of the five following treatments randomly assigned to three:

1. Clearcut--felled trees limbed, cut into logs, and logs piled along the plot boundary.
2. Partial cut--stems of large diameter removed leaving a basal area of 41.2 ft²/acre (9.46 m²/ha), 33 percent of the original basal area. Felled trees limbed and left where they lay.
3. Girdled--done with a hand ax.
4. Scarified--ripper blade drawn over plots at 6 to 10 ft (1.8 to 3.0 m) intervals and at depths varying from 3 to 8 inches (7.6 to 20.3 cm).
5. Control.

Treatments were started June 26, 1965, and were completed August 12, 1965.

Results

Clearcutting resulted in the greatest number of aspen suckers (table 1). The partially cut plots had 47 percent as much regeneration as the clearcut plots by the 4th year after treatment. The girdled aspen took 1 to 3 years to die. Girdling stimulated regeneration, but mortality was high, and by the fourth year only 6 percent of the initial numbers of suckers remained. The scarified plots did not produce significantly more suckers than the controls and therefore were not inventoried in 1977.

Table 1.--*Sucker regeneration in the Twin Creek alone during the first 4 years after treatment (Smith and others 1972)*

Treatment	Year after treatment			
	First	Second	Third	Fourth
	-----Suckers per acre (ha)-----			
Clearcut	52,352 (129,512)a ¹	24,040 (59,405)a	20,809 (51,419)	15,200 (32,617)
Partially cut	22,053 (54,493)ab	11,660 (28,812)a	12,252 (30,225)	6,173 (15,253)
Girdling	15,038 (32,217)b	4,047 (10,000)ab	2,808 (6,959)	773 (1,910)
Scarification	5,022 (12,409)b	1,880 (4,645)b	3,805 (9,402)	2,253 (5,567)
Control	3,447 (8,518)b	3,466 (8,564)b	4,140 (10,230)	2,400 (5,930)

¹Treatments with no common letters are significantly different at the 5 percent level.

1977 INVENTORY

Methods

Aspen regeneration on each clearcut, partially cut, girdled, and control plot was sampled using 25 107.6 ft² (10 m²) circular subplots with plot centers at a spacing of 25 x 25 ft (7.62 x 7.62 m). A uniform buffer zone, 30.2 ft (9.2 m) in width, around the area sampled in each plot reduced boundary effects. Suckers were divided into height classes, smaller than 3.28 ft (1 m), and 3.28 ft and larger. In each of the clearcut and partially cut plots, total heights of 20 randomly selected dominant and codominant saplings were measured.

Numbers and d.b.h. of mature stems on each partially cut and control plot were obtained from four randomly located 1,076.2 ft² (100 m²) circular plots. Five dominant and codominant trees were randomly selected on each control plot for height determination.

Results

Descriptions of the mature stems (mean age 67 years) on control and partial cut plots are given in table 2. Mean height of the dominant and codominant trees on the control plots was 69 ft (21.0 m).

Table 2.--*Description of mature stems (mean age, 67 years) on control and partially cut plots in the Twin Creek aspen alone in 1977, 12 years after treatment*

Treatment	d.b.h.	Stems per acre (ha)	Basal Area
	in (cm)		ft ² /acre (m ² /ha)
Control	8.2 (20.8)	367 (908)	140.1 (32.17)
Partial cut	8.9 (22.5)	121 (300)	51.6 (11.48)

The largest number and greatest frequency of suckers in the <3.28 ft (1 m) size class occurred on the control plots (table 3). Most of these were less than 4 inches (10.16 cm) in height, and many had arisen during the previous growing season. The mortality rate in this size class was high. The partially cut plots also had large numbers of smaller suckers, but the clearcut and girdled plots had relatively few.

Table 3.--Number and frequency of sucker regeneration in treated plots of the Twin Creek aspen clone in 1977, 12 years after treatment

Treatment	Regeneration						
	Number			Frequency			
	<1 m	:	>1 m	:	<1 m	:	>1 m
	-----Suckers per acre (ha)-----		-----Percent-----		-----Percent-----		
Clearcut	11 (27)c ¹	:	5,795 (14,320)a	:	3	:	100
Partially cut	831 (2,053)b	:	2,284 (5,643)b	:	39	:	97
Girdled	16 (40)c	:	124 (307)c	:	3	:	15
Control	2,272 (5,613)a	:	313 (773)c	:	73	:	27

¹Treatments with no common letters are significantly different at the 5 percent level.

The effect of treatment in 1965 on aspen regeneration was best shown by the number and frequency of suckers 3.28 ft (1 m) and larger (table 3). Sapling size suckers were most plentiful on the clearcut plots. When overstory trees were left in the partial cuttings, sucker numbers were reduced 60 percent. The girdled plots had even fewer suckers than the control plots (fig. 1).

Dominant and codominant suckers were significantly (1 percent level) taller on the clearcut than on the partially cut plots. Mean sucker heights were 19.3 ft (5.87 m) on the clearcut plots and 16.0 ft (4.89 m) on the partially cut plots.

DISCUSSION

The large numbers of small aspen suckers in the control plots indicate that it is normal for suckers to arise regularly in an aspen clone. Baker (1925) made a similar observation. While a clone is reasonably well stocked, the suckers are generally weak, inconspicuous, and do not live long. When the canopy opens because of natural mortality, additional light increases sucker survival and growth.

As in most studies on the effect of cutting methods on aspen regeneration (Brinkman and Roe 1975; Jones 1976; Sampson 1919; Sandberg 1951), the clearcut plots produced the largest number of suckers. Generally, after logging, sucker numbers are directly related to the number of stems removed; the greater the number of stems cut, the greater the proportion of root system that produces suckers. Suckers on partially cut plots

grow more slowly than suckers on clearcut plots because of competition and shade provided by remaining trees. If as little as 10 to 15 ft²/acre of (2.30 to 3.44 m²/ha) of basal area of residual overstory is left after cutting Eastern aspen, sucker growth will be substantially reduced (Perala 1977).

Girdling appears to be a good method for eliminating aspen from a site. Westveld (1939), apparently referring to unpublished data from the Lake States, reported that girdled aspen produce few suckers. Regeneration of girdled plots was unsuccessful because of a relatively poor initial response to treatment and high mortality in subsequent years. Suckers arose from roots of girdled aspen because the downward flow of auxin inhibitors in the phloem was stopped (Schier 1978); however, far fewer suckers were produced than from roots of decapitated trees because growth-promoting hormones that are synthesized in the roots do not accumulate but continue to move up the stem in the xylem. High sucker mortality was probably caused by the rapid deterioration of roots on girdled trees. Root dieback occurred because the tops, which remained alive for 1 to 3 years after treatment, drained the roots of food reserves and other growth factors. Of course, photosynthates, which are manufactured in the crowns, could not be translocated to the roots of girdled trees. Shade cast by girdled trees after treatment also contributed to sucker mortality by creating a microenvironment unsuitable for sucker development and growth.

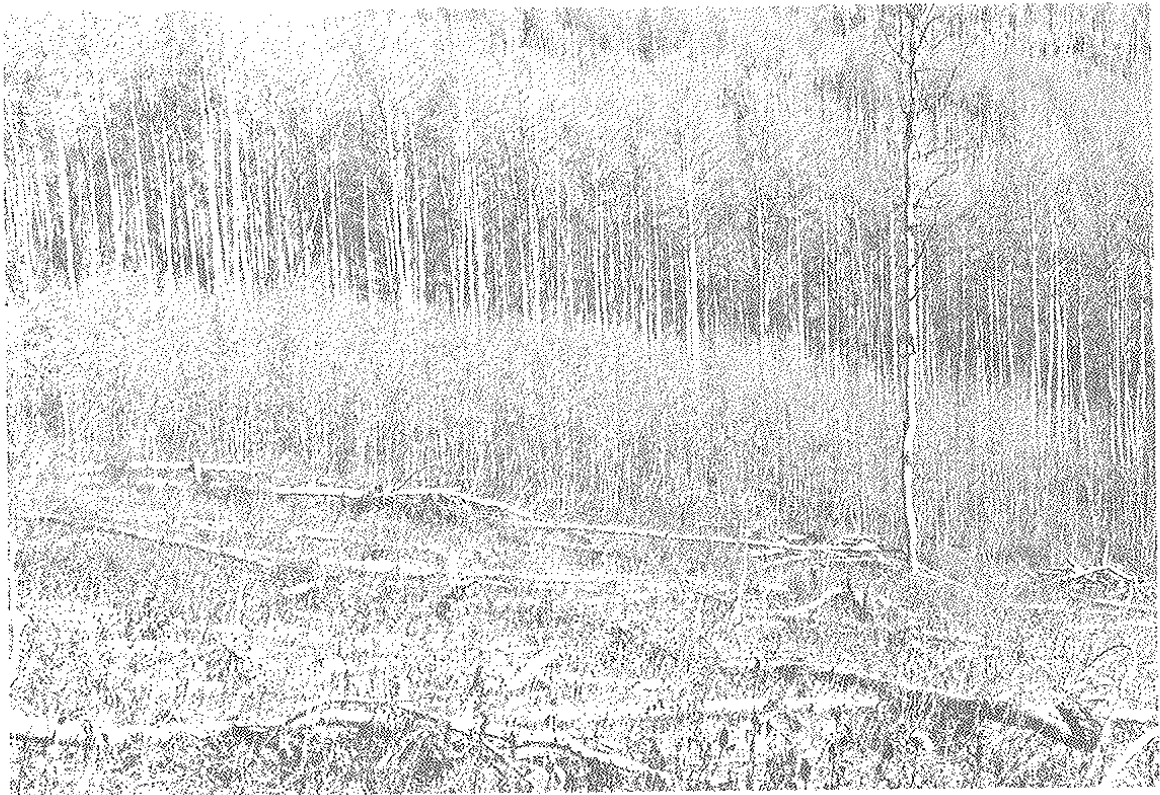


Figure 1.--One of the girdled plots in September 1977 with a clearcut plot in the background. A typical dead girdled stem is lying on the ground in the foreground. The tree fell because of basal root breakage. Widespread occurrence of root breakage indicated general decay of the root systems on girdled plots.

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