THE EFFECT OF ROOT LENGTH UPON THE SUCKERING OF TREMBLING ASPEN

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TABLE OF CONTENTS

ABSTRACT

Under a controlled environment, the total number of suckers and buds produced per unit length of 3-foot and 6-inch root cuttings was independent of the root lengths. Sucker height growth, however, was slower on the shorter root cuttings. It is suggested that increases in the total number of suckers after field discing is the result of better exposure of the roots to heat rather than of cutting of roots.

Polarity in suckering on 6-inch and 3-foot root lengths was observed. Sectioning of 3-foot root lengths 0, 2, 4, and 6 days after field collection did not result in an increase in such polarity along the 3-foot lengths with an increase in period before sectioning, which suggests that factors other than the simple polar movement of auxins may be involved in controlling polarity in aspen roots.

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INTRODUCTION

In the last two decades, an increase in the use of trembling aspen (Populus tremuloides Michx.) as lumber and fibre has necessitated the development of better techniques for its regeneration.

There is ample evidence (Zehngraff, 1947 and 1959; Sandberg, 1951; Strothmann and Zasada, 1957; Maini and Horton, 1966) that clear-cutting aspen usually promotes abundant suckering. Additonal cultural treatments such as light burning (Shirley, 1931 and 1932; Rowe, 1955; Lutz, 1956; Maini and Horton, 1966b), or scarification, or both, which expose more fully the soil surface to direct sunlight thus increasing soil temperatures, further enhance suckering.

It has been demonstrated that discing promotes aspen suckering (Sandberg, 1951; Zillgitt, 1951; Zehngraff, 1957; Jankowski, personal communication). It has been suggested (Zehngraff, 1957) that this increased suckering is partly caused by the roots being cut by the disc. If this idea is correct, then one would expect that, for the same total length of root, short root-cuttings would produce more suckers than longer ones.

Roots of different lengths were collected from aspen clones and

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allowed to sucker under controlled environmental conditions. This provided data on the effect of root length on sucker production and growth.

The influence of root orientation upon sucker location along the root was also examined. Work by Sandberg (1951) provided evidence that suckering in aspen is closely related to apical dominance and that it is controlled by auxin levels in the root. Sandberg suggested that any cutting of the roots would result in lower auxin levels in that part of the root away from the auxin source. Maini (1968) demonstrated the existence of polarity in aspen roots and suggested that this feature is apparently related to movement of growth-regulatory substances towards the root tip. An attempt was made in this study to demonstrate such polar movement. By sectioning roots at increasing time intervals after placing them in a propagation chamber but before the commencement of suckering, it was hypothesized that a gradual increase with time in polarity of suckering, along the original lengths of the roots could be demonstrated.

METHODS

In the spring of 1968, two 3-foot root cuttings were collected from each of 15 dormant trees in the vicinity of Winnipeg, Manitoba. All 15 trees belonged to different clones. Only lateral roots with little or no taper and with a diameter of about 1 inch were selected. One root-cutting from each tree was left uncut, while the other was immediately sectioned into six 6-inch lengths. The material was then placed in a propagation chamber. Temperature in the chamber which consisted of a greenhouse bench enclosed with polyethylene, varied between 70 and 80 F, while humidity was kept

close to 100% by means of a humidifier. Daylight was the only light source. For each root-cutting, the proximal and distal ends (i.e., ends respectively closest and farthest away from the tree from which the root was cut) were marked, and the 6-inch pieces were placed in the sequence in which they had been cut.

A second root-collection was made after leaf fall in the autumn of 1968 in the Agassiz Forest Reserve, about 70 miles east of Winnipeg. Again, 15 trees, each from a different clone, were selected. Five 3-foot lateral roots were collected from each tree. These roots were used for periodic sectioning as follows: one root was left intact and one was sectioned into 6-inch pieces when placed in the chamber. The remaining three roots were sectioned at 2, 4, and 6 days after placement in the chamber. Orientation of all root-sections was recorded.

A third collection was made in the spring of 1970 in the Agassiz Forest Reserve. Roots were collected and handled in the same manner as in the spring of 1968.

After about 1 week in the chamber, the first sucker-buds appeared on roots from the spring collections. Sucker numbers were counted and heights were measured 30 days after the roots had been placed in the chamber. Corresponding periods for the fall collection were $2\frac{1}{2}$ weeks and 50 days. For the total number of suckers on each root, both developed suckers and sucker-buds were counted.

RESULTS

Number and Height of Suckers in Relation to Root Length

Table 1 shows the number and height of suckers on the 3-foot and the

6-inch root sections. Although for the 1968 spring collection significantly more ($P \leq .05$) suckers were produced per six 6-inch sections than per one 3-foot section, no significant differences in sucker production were observed between the different root lengths when data for all collections were combined.

Average height of suckers on the 3-foot roots was considerably greater than on the 6-inch sections. For all collections combined, height differences were highly significant ($P \leq .01$).

Polarity and Suckering

A comparison of the number of suckers on the proximal and distal halves of the 3-foot roots showed a highly significant ($P \leq .01$) polarity in suckering (Table 2), with 65% of the suckers occurring on the proximal halves and 35% occurring on the distal halves. Although weaker, a polarity was still detected on the sectioned root-cuttings, with 55% of the suckers occurring on the proximal and 45% of the suckers occurring on the distal three 6-inch sections.

The number of suckers along the 3-foot entire and sectioned lengths is shown in Figure 1. For the 1968 collections, the number of suckers on the entire root-lengths tended, in contrast to that on the sectioned root lengths, to increase sharply towards the proximal end. Polarity along the 3-foot root lengths in the 1970 collections was apparently not affected by sectioning.

The number of suckers on the proximal and distal halves of each 6-inch cutting indicated that even on these short sections, a highly significant ($P \leq .01$) polarity was observed (Table 3).

In Figure 2, the distribution of suckers is shown, subsequent to the

periodic sectioning of the 3-foot root lengths from the 1968 fall collection. Although polarity tended to be higher on the entire root lengths than on the roots sectioned immediately after collection (See also Table 2), an analysis of variance and range test, using the number of suckers on the proximal 12 inches of each root as a percentage of the total number of suckers per root to assess polarity, showed no significant increase in polarity with an increasing number of days in the propagation chamber before sectioning.

DISCUSSION AND CONCLUSIONS

The results obtained from the 45 clones suggest that root length does not influence the number of suckers produced per unit length of root. There is evidence (Maini, 1965) that if roots become too short (e.g., less than 3 inches), sucker production per unit length of root would decline. The increased suckering, observed after discing, is thus probably the result of better exposure of the aspen roots to heat because of root upheaval and reduction in brush competition, rather than root cutting. The favourable effect of discing on sucker production may be offset by the slower growth of the suckers. Sandberg (1951) drew a similar conclusion when he observed that a decrease in height growth could be noted up to 10 years after discing. Young suckers depend for some time on the original root-system (Zahner and DeByle, 1965). If this root system is broken up through discing, individual suckers will initially have a smaller root system from which to draw nutrients and moisture. This could explain the detrimental effect of discing on height growth.

The greater polarity of the 3-foot roots as compared to the equivalent halves of the 6-inch sections (Table 2) may have been caused by the polar

movement of auxins. However, no clear trend of increasing polarity was detected after periodic sectioning of the roots. This suggests that factors other than the simple polar movement of auxins may be involved in controlling polarity in aspen roots. The maximum period in the propagation chamber before sectioning was 6 days. Considering that the first sucker-buds on the periodically sectioned roots appeared after about 14 days, periods longer than 6 days may have been required to demonstrate any trend in polarity. Further work is required for better understanding of the mechanism of polarity in aspen roots.

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Figure 1. Number of suckers along uncut and sectioned 3-foot lengths for three collections. (Basis: 15 roots per treatment).

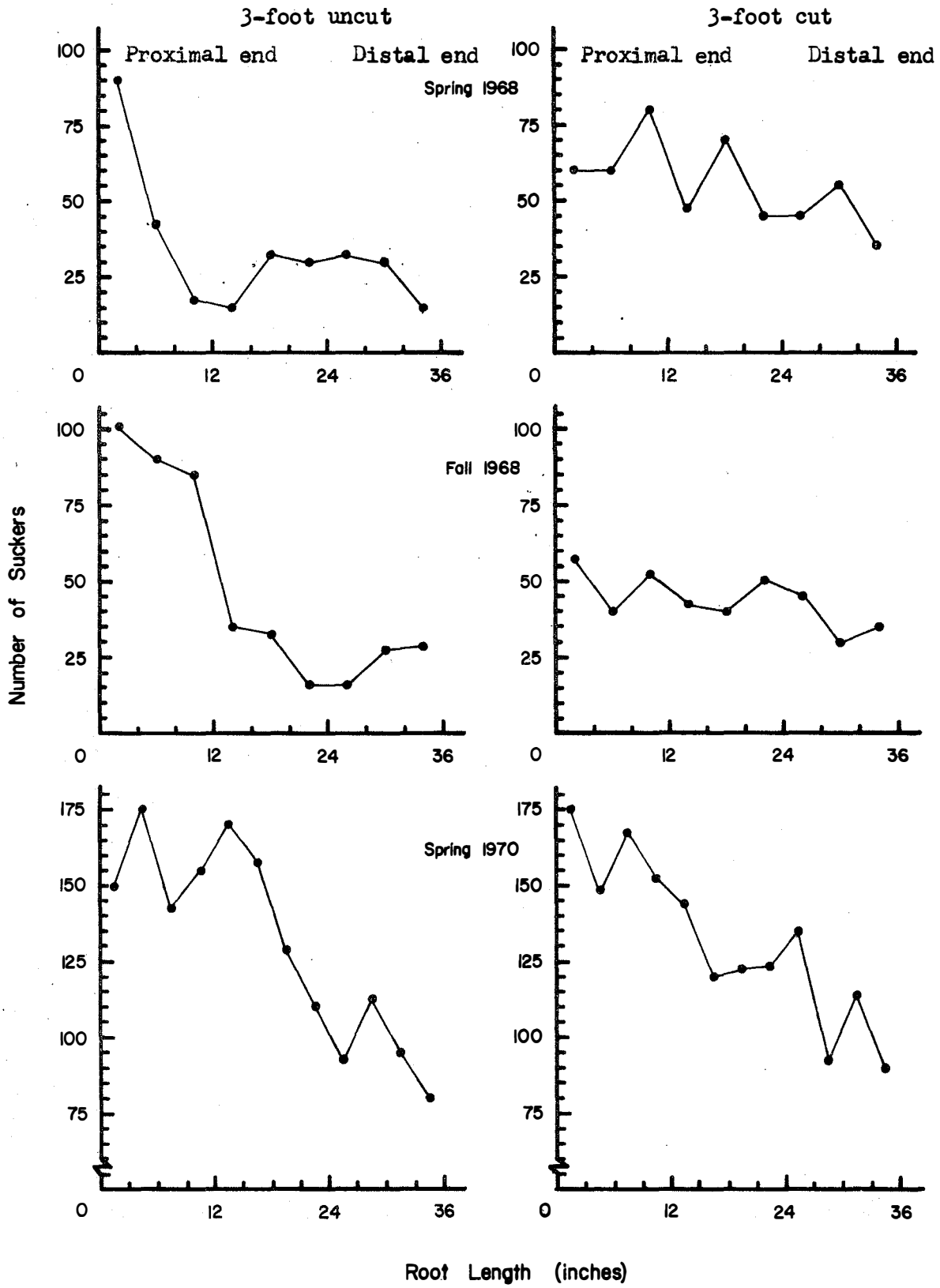

Figure 2. Total number of suckers along the 3-foot periodically sectioned and entire roots of the fall collection in 1968. (Basis: .15 roots per treatment).

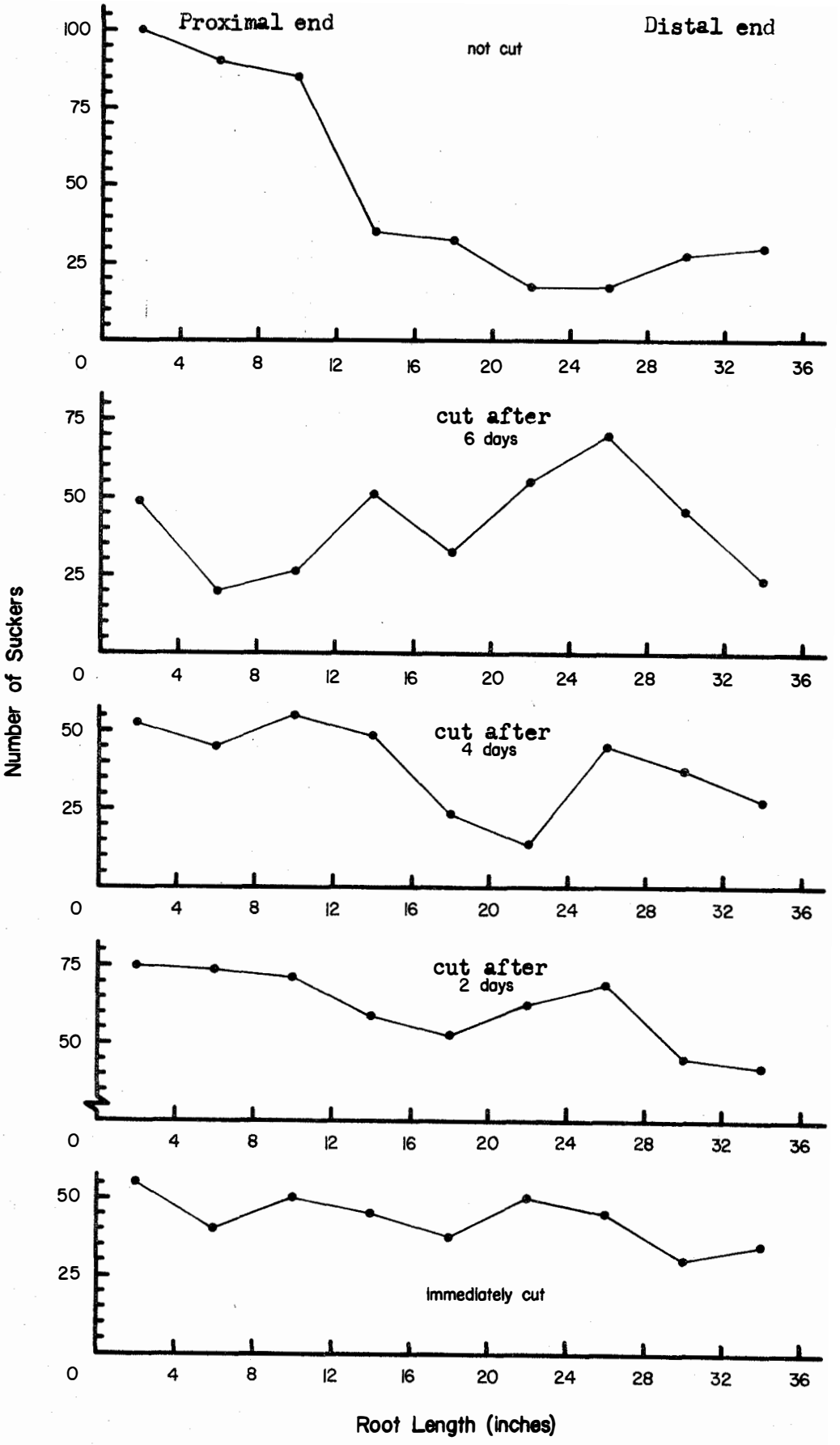

Table 1. Number and height of suckers on 3-foot roots and the equivalent length of six 6-inch root sections. (Basis: 15 pair of roots per collection)

Collection date	Total number of suckers		Average sucker height (inches)	
	1 x 3-foot root section	6 x 6-inch root sections	1 x 3-foot root section	6 x 6-inch root sections
Spring 1968	313	502*	1.39	1.16
Fall 1968	436	393	0.75	0.52
Spring 1970	1553	1576	0.40	0.25
MEAN	51.2	54.9	0.85	0.64**

* - Significant difference $P \leqslant .05$
** - Significant difference $P \leqslant .01$

Table 2. Percentages of the total number of suckers on the proximal and distal halves of entire and sectioned 3-foot roots. (Basis: 15 pair of roots per collection)

Collection date	Uncut 3-foot root		Sectioned 3-foot root	
	Proximal half ($1\frac{1}{2}$-foot length)	Distal half ($1\frac{1}{2}$-foot length)	Proximal half ($1\frac{1}{2}$-foot length)	Distal half ($1\frac{1}{2}$-foot length)
Spring 1968	61	39	55	45
Fall 1968	76	24	52	48
Spring 1970	59	41	58	42
MEAN	65	35**	55	45*

* Significant difference $P \leqslant .05$
** Significant difference $P \leqslant .01$

Table 3. Percentage of the total number of suckers on the proximal and distal halves of 6-inch root sections. (Basis: 90 root sections per collection)

Collection date	Proximal half (1 x 3-inch length)	Distal half (1 x 3-inch length)
Spring 1968	56	44
Fall 1968	58	42
Spring 1970	54	46
MEAN	56	44**

** Significant difference $P < .01$