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## Auxin Regulation of Branch Abscission by Aspen (*Populus tremuloides*, Michx.)

### Abstract

*Populus tremuloides*, Michx. abscises branches under natural conditions. Removing buds and/or leaves from a twig stimulates its abscission. The stimulation is increasingly inhibited by application of lanolin pastes containing respectively 0, 0.01, 0.1, or 1 percent indole-3-acetic acid to the cut end of a twig.

### Introduction

Almost any plant part may be abscised: leaves, fruits, flowers, flower parts, bark, buds, branches, roots, or prickles (Addicott, 1965). Millington and Chaney (1973) review the rather sparse literature on branch shedding; the phenomenon is widely distributed among both angiosperm and gymnosperm families, its anatomy is similar to that associated with abscission of leaves, it occurs most often in mature trees, and it is apparently stimulated by factors producing negative carbohydrate balances in the twig; i.e., by shading, insect attack, water stress, or fruiting. Recent reviews of the physiology of abscission ignore the subject of branch shedding.

This note reports the abscission of branches in aspen (*Populus tremuloides*, Michx.) and gives evidence for control of abscission by auxin.

### Methods

A set of six small twigs on one-year-old wood of an aspen branch were treated: the first four were cut back to about 1.5 cm, the fifth was defoliated and the sixth was half defoliated. The tips of the four clipped twigs were coated with lanolin enriched with 0, 0.01, 0.1, and 1 percent of auxin (indole-3-acetic acid), respectively. The twigs were observed at intervals to determine when they had dropped or would drop at a touch. Treatments five and six were omitted in experiments one, two, and four, described below.

### Results

*Experiment I.* Ten sets of twigs (i.e., the first seven lateral twigs on ten branches) were treated on 20 February 1971 and observed monthly. Most fell between 30 April (69 days) and 30 May (99 days) when the trees were just leafing out (20 May). Falling later (30 June to 1 October) were one treated with pure lanolin, one treated with 0.01 percent auxin, two treated with 0.1 percent auxin, and four treated with 1 percent auxin.

*Experiment II.* Ten sets of twigs were treated on 6 June 1971 and observed monthly. Six of the twigs treated with unenriched lanolin dropped before 29 June (23 days) as did one twig treated with 0.01 percent auxin. The remaining twigs, excepting one,

fell by 10 August (65 days). The final twig—one treated with 1 percent auxin—fell in September.

*Experiment III.* Fourteen sets of twigs were treated on 29 June 1971 and observed at two day intervals through 16 August. The results are shown in Table 1.

*Experiment IV.* Fourteen sets of twigs were treated on 1 October 1971 and observed at monthly intervals. None had been shed by 2 April 1972 (184 days). Two (pure lanolin and 0.01 percent IAA) were shed by 16 April (200 days). On 16 April, the tips of twigs on half the branches were clipped off and fresh IAA in lanolin was supplied. Twigs with applications of less than 1 percent IAA were all abscised by 4 June (247 days). Of the branches treated with 1 percent IAA—lanolin, those receiving only the initial treatment were shed before 4 June; half of those receiving the second treatment were shed after 4 June, and 25 percent were shed after 3 July (276 days): all were shed by 3 August (307 days).

TABLE 1. Results of experiment III: retention times (days) for twigs treated on 29 June 1971 (N=14).

Treatment	median (days)	range (days)	Percent retained <sup>1</sup>
0.0 percent auxin	15 A	13-21	0
0.01 percent auxin	16 A	13-27	0
0.1 percent auxin	27 AB	25-37	0
1.0 percent auxin	41 AB	27-115+	29
all leaves off	37 AB	29-115+	7
½ leaves off	79+ B	37-115+	29
control	115+ B	37-115+	71

<sup>1</sup>Percentage of twigs retained past 23 October or 115 days.

A—Significantly different from the untreated control at the 1 percent level, Rank T-Test (Moroney, 1951).

B—Significantly different from the 0 percent auxin treatment at the 1 percent level, Rank T-Test.

### Discussion

The third experiment (Table 1) shows that in summer (29 June) aspen twigs with buds removed will be abscised within 15 to 20 days and that abscission can be delayed by providing an auxin supply. That leaves may supply the auxin which naturally inhibits branch drop is suggested by the fact that defoliated and partially defoliated branches show a strong tendency to abscise.

The second experiment (6 June) shows that spring abscission rates are similar to those of mid-summer.

The first experiment (20 February) shows that the abscission rate is considerably slower in winter (70 days or more) and perhaps even nonexistent since treated twigs did not drop until spring. The fourth experiment (1 October) confirms that abscission rates are very slow in winter (200+ days). Perhaps the morphogenetic processes of abscission layer formation (cf. Eames and McDaniels, 1947) cannot occur at winter temperatures; more likely they are simply not initiated. Twigs which might have undergone abscission without treatment should have done so before 20 February or 1 October treatments; if they did not, their abscission was also prevented by winter.

The results presented above support the model that abscission occurs when auxin levels on the distal side of a prospective abscission layer are lower than those on the

proximal side (Addicott, 1961). Auxins are synthesized at and transported downward from leaves and buds. In summer, branches without leaves or buds are shed because their auxin levels are lower than trunk levels. Abscission may be inhibited by providing the branches with an auxin source: IAA rich lanolin. The absence of twig abscission in winter may be due to the weakness of auxin synthesis and auxin gradients or to low temperature inhibition of the abscission process. With the coming of spring and new auxin synthesis, budless or leafless branches are quickly shed unless they are well supplied with IAA.

Abscission of budless and leafless twigs could probably have been further postponed by continual reapplication of IAA. The poor success of such a reapplication (Experiment IV—spring, 1972) is likely due to its being made too late. The appearance of leaves soon after the reapplication suggests that buds were active at or before the reapplication time, that auxin synthesis processes were active, and that the abscission process had been initiated in most branches. Budless twigs of experiment IV which were not shed immediately (i.e., those in which abscission had probably not been initiated) were retained for over a month of "leaf time," as were summer-treated twigs of experiment III.

#### Literature Cited

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