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BRIEF COMMUNICATION

Endogenous indole-3-acetic acid during adventitious root formation in *Populus* × *canadensis* Moench.

T. DOLEŽELOVÁ, V. PSOTA and Z. FEIGLOVÁ

Institute of Landscape Ecology, Academy of Sciences of the Czech Republic, Květná 8, 603 65 Brno, Czech Republic

Abstract

Indole-3-butyric acid (IBA), phenylacetic acid (PAA) and naphthaleneacetic acid (NAA) were applied at a concentration of 10^{-4} mol dm^{-3} to stem cutting bases of *Populus* × *canadensis* Moench. During adventitious root formation, the content of indole-3-acetic acid (IAA) in cutting bases was estimated using the fluorimetric method. In the control variant, a rapid increase in endogenous IAA appeared after 24-h cultivation followed by gradual decrease during the following days. In contrast, the variants treated with IBA, PAA, and especially NAA exhibited firstly a decrease in endogenous IAA content and only afterwards an increase, reaching a maximum 48 h after excision. As root regeneration proceeded gradually, a decrease in the level of endogenous IAA occurred in all treatments. The first adventitious roots appeared in all treatments after 216-h cultivation.

Additional key words: indole-3-butyric acid, naphthaleneacetic acid, phenylacetic acid.

The response of cuttings to exogenous application of auxins is dependent on many internal and external factors. Both the concentration of the growth substance applied and, above all, the sensitivity of treated plant parts to this substance may be limiting factors (Trewavas and Cleland 1983). Exogenously applied auxin is one of the external factors influencing the phytohormonal balance in the cuttings and thus adventitious root formation.

In the present paper, the effect of three exogenously applied auxins on changes in the amount of endogenous IAA was investigated in cuttings of *Populus* × *canadensis* Moench. during adventitious root formation.

In October, approximately 10 cm long stem cuttings were taken from one-year-old shoots of *Populus* × *canadensis* Moench. The cuttings were trimmed at the apical part above a bud, and at the basal end below a bud. For IAA detection, 1 cm long

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segments free of buds were taken from the cutting bases. The cuttings were subjected to four treatments: 24-h dipping of the cutting bases in indole-3-butyric acid (IBA), phenylacetic acid (PAA) or naphthaleneacetic acid (NAA) at a concentration of 10^{-4} mol dm^{-3}. The control variant was dipped in distilled water only. Then the cuttings were rinsed in distilled water and cultivated in agroperlite under 12-h photoperiod, irradiance of 150 μmol (PAR) m^{-2} s^{-1} provided by fluorescent lamps. A high air humidity was secured using a method of water evaporation from moist substrate in boxes closed with transparent foil. The first determination of endogenous IAA was carried out immediately on taking cuttings, and in the tables this sampling is marked "0". The level of endogenous IAA in cutting bases was then determined in all treatments every day up to the time of first adventitious root formation. Endogenous IAA was determined using the fluorimetric method (Mousdale *et al.* 1978). The results were statistically evaluated by means of the *t*-test.

After the first 24 h, the level of endogenous IAA was nearly doubled in the control when compared to the initial level (Table 1). This maximum was followed by a gradual decrease with the minimum after 144 h of cultivation. A moderate increase in the level of endogenous IAA was observed in cutting bases of the control prior to adventitious root formation (*i.e.* 168 h after taking of cuttings).

Table 1. Changes in endogenous IAA in stem cuttings of *Populus* × *canadensis* untreated (control variant) or treated with PAA, NAA and IBA solutions (mean of 3 replications ± S.E.)

Time [h]	Endogenous IAA content [ng g^{-1} (f.m.)]			
	control	PAA	NAA	IBA
0	4.6 ± 0.10	4.6 ± 0.10	4.6 ± 0.10	4.6 ± 0.10
24	8.1 ± 0.10	4.0 ± 0.17**	2.3 ± 0.17**	3.7 ± 0.21**
48	4.1 ± 0.32	4.6 ± 0.26	5.6 ± 0.40**	4.1 ± 0.52
72	2.0 ± 0.00	3.3 ± 0.36**	3.2 ± 0.36**	2.7 ± 0.26 *
96	2.0 ± 0.20	2.3 ± 0.17	2.4 ± 0.20	3.0 ± 0.20**
120	2.0 ± 0.20	2.0 ± 0.26	1.8 ± 0.10	1.2 ± 0.00**
144	1.4 ± 0.20	1.4 ± 0.00	2.3 ± 0.20**	2.5 ± 0.26**
168	2.8 ± 0.30	3.6 ± 0.36 *	3.8 ± 0.20**	2.9 ± 0.26
196	2.8 ± 0.26	3.8 ± 0.15**	3.1 ± 0.26	2.4 ± 0.25
216	2.7 ± 0.15	1.8 ± 0.20**	1.6 ± 0.26**	1.6 ± 0.10**

**- statistically significant differences at $P = 0.01$,*- statistically significant differences at $P = 0.05$

In cuttings treated with IBA, PAA, and NAA, a decrease in endogenous IAA content was recorded after 24-h after application. This decrease was most pronounced in NAA-treated cuttings, in which the amount of endogenous IAA was reduced to one half of the initial value. After the next 24 h (*i.e.* 48 h after taking of cuttings), a slight increase in the level of endogenous IAA was recorded in cuttings treated with PAA and IBA while in NAA-treated variant the increase was conspicuous. After this time, all the cuttings treated with auxin-like substances exhibited a higher or approximately equal content of endogenous IAA as compared to the control. After 168- to 192-h cultivation, a gradual decrease followed by slight

increase was observed both in the treated variants and control.

An increase in auxin level in cutting bases during the initial phases of root induction was also reported in other herbs and tree species (Bláhová 1969, Bose *et al.* 1973, Brunner 1978, Michniewicz and Kriesel 1970). The initial phases of development of adventitious roots require highest levels of auxin, while the stage of primordium growth into the root has essentially lower demands for an auxin (Haissig 1972). The auxin level decreases gradually as roots are regenerated (Brunner 1978, Nakano *et al.* 1980).

Dunberg *et al.* (1981) found that IAA content in cutting bases of *Pinus sylvestris* treated with IBA was three times higher than in untreated cuttings. The authors suggested that the applied IBA was changed into IAA by the cuttings.

In *Populus* × *canadensis* Moench. cutting bases, the direct action of exogenously applied indole auxin IBA but also non-indole auxins PAA and NAA was responsible for an opposite effect, *i.e.* a decrease in endogenous IAA in the cutting bases. A reversion occurred only after removal of the direct action of the solutions of auxin-like substances by transferring the cuttings to perlite, when endogenous IAA content increased even above the level of the control variant.

The largest decrease and also subsequent increase in endogenous IAA content was recorded in the cuttings treated with a synthetic non-indole auxin NAA. The fluctuation was less conspicuous in those treated with IBA and PAA. The difference in the response of cuttings to the auxin-like substances used was probably caused by the ability of the enzymatic system of cuttings to degrade these substances.

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