



Urszula Nawrocka-Grześkowiak

## Rooting of softwood and partly semi-hardwood shoot cuttings of *Kalmia angustifolia*

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**Abstract:** Rhizogenesis was stimulated in *Kalmia angustifolia* cuttings by auxins and fungicides in dust preparations. Satisfactory results were obtained for the combination of 0,5% indolebutyric acid (IBA) and Captan in talcum powder. The optimum time for taking the cuttings was the peak of the flowering period of mother plants. The best rooting medium was mixture of pine bark compost and peat (1:2).

**Additional key words:** auxins, cutting date, fungicides, vegetative propagation

**Address:** U. Nawrocka-Grześkowiak, Department of Dendrology and Landscape Architecture, Agricultural University, Janosika 8, 71-424 Szczecin, Poland, e-mail: ung@man.poznan.pl

### Introduction

The genus *Kalmia* belongs to the family *Ericaceae*, subfamily *Rhododendroideae*. Its name derives from the Swedish botanist Peter Kalm, who travelled across North America in 1748–1751 and was the first to describe the vegetation of that continent (Rehder 1967). *Kalmia*, according to Ebinger (1974), includes 8 taxa: *K. ericoides* from Cuba and 7 taxa from eastern North America: *K. angustifolia*, *K. carolina*, *K. latifolia*, *K. latifolia* var. *laevipes*, *K. latifolia* var. *rosmarinifolia*, *K. microphylla*, and *K. polifolia*.

*Kalmias* are poisonous (Grimm 1952; Olson and Barnes 1974), and the toxic substances are contained in leaves and nectar. Among many *Kalmia* spp., only the two most popular are planted in Poland: *Kalmia angustifolia* (sheep laurel) and *K. latifolia* (mountain laurel). They are characterized by shiny, evergreen leaves and plate- or cup-shaped corolla, pink in different tints, gathered in axillary or terminal corymbs (Bugala 1991).

*Kalmias* can be propagated from cuttings, by layering, and sowing of seeds (Lamb et al. 1975; Jaynes

1988). Reproduction from seeds, particularly of *Kalmia longifolia*, will probably remain important for a long time (Czekalski 1996). *Kalmias* can also be propagated by grafting and tissue culture *in vitro* (Dirr and Heuser 1987). Reproduction by shoot cuttings is a method useful for popularization of these plants (Nawrocka-Grześkowiak 2001a).

Shrubs of this genus show a weak ability to regenerate roots (*Kalmia latifolia* in particular), and the rooting of cuttings depends to a large degree on cutting date, the applied medium and substances stimulating the process of rooting. The plants propagated from shoot cuttings grow quicker and can be sold after a short time, but this way of reproduction still poses many difficulties. That was the reason why this study was conducted to facilitate the rooting of *Kalmia angustifolia*.

### Material and method

Cuttings were collected from old shrubs of *Kalmia angustifolia* growing in the “Zwierzyniec” Experimental Forest of the Kórnik Arboretum. The top parts (5–7 cm

long) of one-year-old shoots were used as cuttings. They were cut just below a node, and only leaves of that node were removed. Tests were carried out to analyse the influence of cutting date, medium composition and stimulating substances on the percentage of rooted cuttings and size of their root systems.

The cuttings were collected at three developmental stages of the mother plants: I – peak of flowering (full bloom – 7 June); II – end of flowering (16 June); III – partly lignified shoots (25 June).

The cuttings were rooted in open-work containers in a greenhouse, in a propagating case covered with glass, where temperature was maintained at around 20–26°C. The bottom of each container was covered with a 3-cm layer of compost, overlaid with a 4-cm layer of the rooting medium. The usefulness of 7 kinds of media was tested: sand and peat mixture (1:2), perlite and peat (1:2), pine bark compost and peat (1:2), sawdust and peat 1:2, and separately pine bark compost, sawdust and peat. Auxins were applied as stimulating substances: 0.5% or 1% IBA (indolebutyric acid) or 0.4% NAA (naphthaleneacetic acid) in dust preparations containing only talc or talc with Captan powder (2:1). As a control, talc alone and Captan with talc (1:2) were also applied. Additionally, rooting preparations were tested: B<sub>2</sub> composed of NAA 0.4% + rutin 0.2% + salicylic acid 0.2% + vit. B<sub>1</sub> 0.2% + vit. B<sub>2</sub> 0.1% + boric acid 0.1% + Benlate 5% + Captan 4%; and B<sub>10</sub> composed of IBA 0.5% + rutin 0.2% + salicylic acid 0.2% + vit. B<sub>1</sub> 0.1% + vit. B<sub>2</sub> 0.1% + boric acid 0.1% + Benlate 5% + Captan 4%. During rooting, the cuttings were sprayed (preventively) with Captan 0.2% and Benlate 0.2% alternatively every 14 days.

At the end of each experiment, the percentage of rooted cuttings was assessed and root system size was classified on a scale of 0 to 6: 0 = unrooted cuttings producing callus, 1 = few small roots, 2 = root-ball volume: 1–8 cm<sup>3</sup>, 3 = root-ball volume: 8.1–27 cm<sup>3</sup>, 4 = root-ball volume: 27.1–64 cm<sup>3</sup>, 5 = root-ball volume: 64.1–180 cm<sup>3</sup>, 6 = root-ball volume: >180.1 cm<sup>3</sup>. Diseased and rotten cuttings were regarded as dead.

The experiments were conducted in randomized block designs with 3 replicates, and each combination was represented by 24 cuttings. The results of each experiment were subjected to analysis of variance. The significance of differences between individual combinations was assessed by Duncan's multiple range test for threshold values 1% and 5%.

## Results and discussion

The percentage of rooted cuttings and root system size depended on the cutting date, the stimulating substance, and the kind of rooting medium. Significant differences in the percentage of rooted cuttings were recorded between cutting dates. The highest percentage of rooted cuttings was recorded when cuttings were collected in full bloom and were treated with 0.5% IBA combined with Captan (87.5%) or only IBA (79.16%) (Table 1). Lignification of cuttings generally had a restraining effect on the rooting process, as the percentage of rooted cuttings reached then only up to 8.33% (best results for 0.5% IBA + Captan). Nawrocka-Grzeškowiak (2001) drew similar conclusions on rooting of azalea cuttings, where lignification markedly inhibited the rooting of cuttings. IBA at a concentration of 0.5% and in connection with Captan proved to be the most suitable stimulating substance for rooting of cuttings of *Kalmia angustifolia*, irrespective of cutting date.

Interesting results were obtained when various media were used for rooting of kalmia cuttings treated with 0.5% IBA combined with Captan (Table 2). No significant differences in the percentage of rooted cuttings were found between the tested kinds of media. Anyway, the highest percentage of rooted cuttings (79.16%) and strongest root systems were observed in a mixture of pine bark compost with peat (1:2), while the worst results were recorded for peat alone (33.33%). Bark and sawdust were applied also for rooting of rhododendron cuttings by Eichelser (1981), who got very good results. For kalmia, Eichelser (1978) recommends, a mixture of sawdust of *Pseudotsuga* and *Cedrus* (40% each) with peat (10%)

Table 1. Effect of cutting date and stimulating substances on the rooting of *Kalmia angustifolia* cuttings

Stimulating substances	Rooted cuttings (%) (depending on cutting date)		
	I (7 June)	II (16 June)	III (25 June)
Control	8.33	0.00	0.00
IBA 0.5%	79.16	25.00	0.00
IBA 0.5% + Captan	87.50	54.16	8.33
NAA 0.4%	4.16	4.16	0.00
NAA 0.4% + Captan	33.33	16.66	4.16
Captan	33.33	8.33	4.16

Stimulating substances (IBA 0.5% + Captan) given in dust preparation (number of cuttings per replicate: 8). I (7 June) – full bloom; II (16 June) – end of flowering; III (25 June) – cutting lignification.

and perlite (10%). Wiśniewska-Grzeszkiewicz (1980) reports that bark contains not only chlorogenic acid – which influences the resistance of plants to diseases – but also small quantities of ascorbic acid, vitamins B<sub>2</sub> and B<sub>1</sub> and nicotinic acid, which can have a positive effect on the rotting of cuttings. Peat, in turn, has the worst aerial proprieties (Hetman and Martha 1980), which could explain why it gave the worst results in the rooting of the cuttings. This medium did not ensure the penetration of suitable quantities of oxygen, necessary for respiration in the cuttings. In such conditions, the insufficient access to oxygen and high moisture content lead to fermentation and decay of cells.

When investigating the influence of the most often applied media for rooting the cuttings, namely sand with peat (1:2) or perlite with peat (1:2), better results for all applied stimulating substances were recorded in perlite with peat, although the highest percentage of rooted cuttings (87.5%) was noted in sand with peat (1:2), when 0.5% IBA was combined with Captan (Table 3). Also Dirr and Heuser (1987) recommend a mixture of peat and perlite. This medium is distinguished by a large quantity of accessible water, and also suitable aerial proprieties.

No significant differences in the percentage of rooted cuttings were detected between the applied stimulating substances. However, the percentage of rooted cuttings (83.33%) was the highest for 0.5% IBA with Captan or NAA 0.4% with Captan (Table 4). According to Bärtels (1982), *Kalmia angustifolia* cuttings collected in June rooted very easily, even without using stimulating substances in this process. The present study shows that the percentage of rooted cuttings and root system size in the control variant was smaller than in other variants, where stimulating substances were applied. Also the positive influence of Captan on rooting of *kalmia* cuttings was confirmed. Captan in connection with an auxin acted always positively, in comparison with cuttings treated only with the auxin. However, Captan itself also gave good results in comparison with the control, especially in the case of cuttings collected in full bloom (Tables 1, 2, 3). It can be concluded that at that developmental stage, Captan has not only a passive function, protecting cuttings against pathogens, but also stimulates the process of rooting. The stimulating influence of mixtures of various substances (rooting preparations B<sub>2</sub> and B<sub>10</sub>) was not stronger than that of an auxin alone or an auxin with Captan (Table 4).

The results of this study show that good rooting is determined by a simultaneous influence of suitable stimulating substances, medium, and cutting date. Similar conclusions were drawn by Czekalski (1996a), who studied the rooting of *Rhododendron maximum* cuttings, where interactions between individual factors were essential for the ability of cuttings to take root and produce new shoots.

Table 2. Effect of medium on the rooting of *Kalmia angustifolia* cuttings

Medium	Rooted cuttings (%)	Root system size (scale 0–6)
Sand + peat (1:2)	50.00	1.08
Perlite + peat (1:2)	58.33	3.62
Pine bark compost + peat (1:2)	79.16	4.04
Sawdust + peat (1:2)	58.53	3.24
Pine bark compost	54.16	2.53
Sawdust	58.53	2.16
Peat	33.33	1.32

Stimulating substances (IBA 0.5% + Captan) given in dust preparation (number of cuttings per replicate: 8)

Table 3. Effect of medium and stimulating substances on the rooting of *Kalmia angustifolia* cuttings

Stimulating substance	Rooted cuttings (%) depending on medium	
	sand + peat (1:2)	perlite + peat (1:2)
Control	8.33 a	25.00 a
IBA 0.5	79.16 c	58.33 b
IBA 0.5 + Captan	87.50 c	75.00 b
NAA 0.4	4.16 a	20.83 a
NAA 0.4 + Captan	33.33 b	62.50 b
Captan	70.83 c	50.00 b

Stimulating substances given in dust preparations (number of cuttings per replicate: 8). Values marked with the same letter do not differ significantly from each other

Table 4. Rooting of *Kalmia angustifolia* cuttings as affected by stimulating substances

Stimulating substances	Rooted cuttings (%)	Root system size (scale 0–6)
Control	41.66	1.24
IBA 0.5	62.50	3.62
IBA 0.5 + Captan	83.33	4.53
IBA 1	54.16	2.62
IBA 1 + Captan	62.50	3.24
NAA 0.4	70.83	2.92
NAA 0.4 + Captan	79.16	4.04
Rooting preparation B <sub>2</sub>	70.83	4.77
Rooting preparation B <sub>10</sub>	62.50	2.33
Captan	58.33	1.77

Medium: mixture of perlite and peat (1:2). Cutting date – full bloom. Stimulating substances given in dust preparations (number of cuttings per replicate: 8)

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