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Rooting of azalea shoot cuttings depending on the degree of lignification

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Abstract: Relationship between the degree of cutting lignification and rooting ability was studied. Anatomical changes in cuttings were observed, too. The study involved azalea hybrids from groups: Gent, Rustica Flore Pleno, Occidentale and Knap Hill, which can be propagated vegetatively by shoot cuttings. The cuttings were apical parts of shoots, 7–10 cm long. They were collected at various stages of lignification. Rooting was performed in a greenhouse with controlled temperature of the rooting bed. Only the penetrating observation of mother plants allows to determine the best period of taking the cuttings. The cuttings were treated with a growth regulator, 0.5% IBA (indolebutyric acid), combined with Captan in talcum powder. Sand and peat (1:2) were used as a medium for rooting.

Additional key words: cutting date, lignified cuttings, propagation shoot anatomy, *Rhododendron*

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Introduction

The beginning of cultivation of *Rhododendron* spp. (*Ericaceae*) as ornamental shrubs dates back from 1656, when the alpine species *R. hirsutum* was introduced into England (Leach 1962). The cultivation and breeding of open-ground azaleas have developed in the countries where climatic conditions are suitable, mainly in the Netherlands, England and Belgium. Because of the extreme variability of flowers (size, shape and colour), these shrubs have become popular not only in Western Europe and the United States but also in some Central European countries, recently in Poland, too.

The botanical genus *Rhododendron* is divided into two subgenera (Czekalski 1991; Bugała 2000): *Anthodendron*, including partly evergreen species and deciduous species (azaleas), and *Eurhododendron*, comprising only evergreen species. Rhododendrons are normally reproduced from seeds, cuttings, layering, by grafting and tissue culture. More and more people are interested in their cultivation. The Exbury, Ghent, Knap Hill and similar deciduous azaleas can be rooted, but there is extreme variability among species and clones. There are two problems with the propagation of deciduous azaleas by shoot cuttings: (1) rooting the cuttings, and (2) inducing new growth after rooting.

Species and cultivars of this genus vary in rooting ability. Moreover, formation of roots depends to a large extent on rooting medium, cutting date and application of appropriate growth substances (Lee 1958; Bärtels 1982; Albrecht and Sommer 1991; Nawrocka-Grześkowiak 2001). Investigations presented in this paper concerned mainly the effect of the date of taking the cuttings on their rooting.

Material and methods

The examined cultivars belong to groups: Gent, Mollis, Rustica Flore Pleno, Occidentale and Knap Hill. Apical parts (7–10 cm long) of one-year-old shoots from mother shrubs growing in the collection of the Kórnik Arboretum were used in the experiment. The cut was made directly under a node, because the growth substances accumulated there are necessary for root initiation. The lowest leaves of each cutting were removed and only short petioles were left. Other leaves were not removed. The cuttings were rooted in a propagating case covered with glass in flat, open-work containers. At the bottom of each container, a 3-cm layer of steamed compost was placed and – on top of the compost – a 4-cm layer of peat and sand mixture (2:1). Rooting was performed in a greenhouse, with controlled temperature of the rooting bed. Its temperature was maintained at around 20–25°C.

The cuttings showed various degrees of lignification depending on the date of their taking. They were collected at five developmental stages of the mother plants: (I) beginning of flowering, (II) full bloom, (III) end of flowering; (IV) beginning of lignification; and (V) advanced lignification (Fig 1). Intervals between the successive stages of development lasted 7–9 days, depending on weather. All cuttings were treated with an auxin, 0.5% IBA (indolebutyric acid), combined with Captan in talcum powder. In order to prevent a *Botrytis* infection, the cuttings were treated with a suitable fungicide (Captan or Topsin) every 10–14 days.

Each experiment was carried out in 3 replicates in a randomized block design, with 8 cuttings per replicate. Thus each combination was represented by 24 cuttings.

The rooting degree was evaluated after 11 months, when the rooted plants were transplanted to a cold frame in May. The following parameters were assessed: (a) number of diseased or dead cuttings, (b) number of healthy, non-rooted cuttings, (c) number of healthy, rooted cuttings, (d) root system size. The size of the root system was classified as follows: 0 = non-rooted, healthy cuttings, 1 = few small roots; 2 = root-ball volume 1–8 cm^3; 3 = root-ball volume 8.1–27 cm^3; 4 = root-ball volume 27.1–64 cm^3; 5 = root-ball volume 64.1–180 cm^3; 6 = root-ball volume > 180.1 cm^3.

Table 1. Effect of cutting term on the rooting of azalea cuttings; (0.5% IBA + 20% Captan in dust preparations). Number of cuttings per replicate: 8. Medium: sand + peat (1:2)

Cultivar	Cutting term					
	full bloom		end of flowering		lignification	
	rooted cuttings (%)	rooting intensity	rooted cuttings (%)	rooting intensity	rooted cuttings (%)	rooting intensity
Berry Rose	58.33	2.2	50.00	2.2	33.33	0.7
Aida	58.33	2.5	58.33	1.8	20.83	0.4
Fanny	87.50	3.8	95.83	4.4	33.33	0.7
Dr M. Oosthoek	58.33	1.9	50.00	2.3	8.33	0.1
Glowing Embers	70.83	2.9	45.83	1.3	4.16	0.2

Rooting intensity = numberof rooted cuttings in a given class number x class number/number of cuttings per replicate.

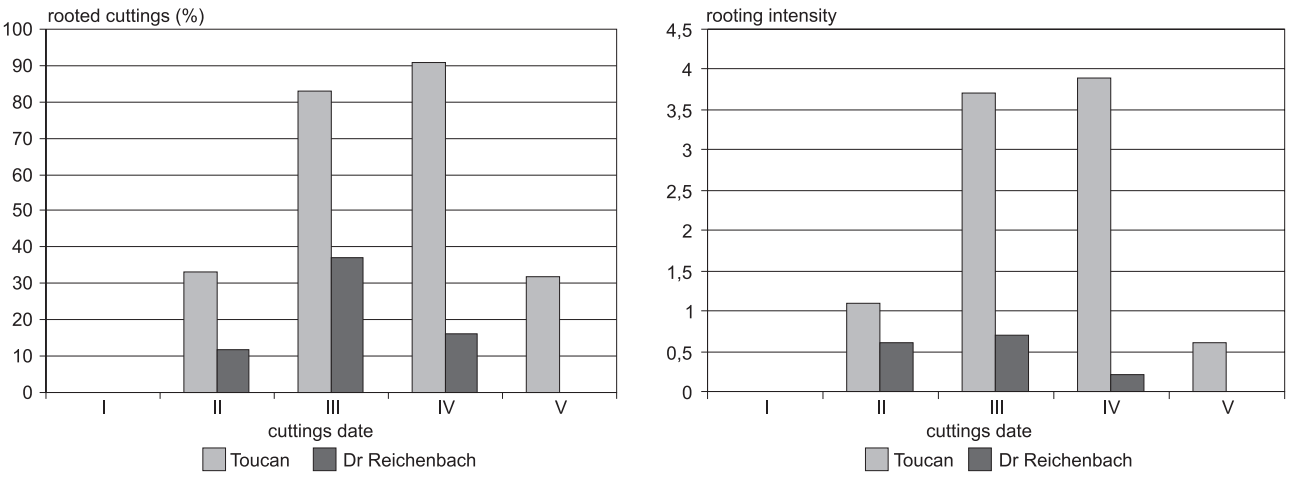

Fig. 1. Effect of cutting date on the rooting of azalea cuttings (cvs. Toucan and Dr Reichenbach)
Cutting dates: (I) 29 May – beginning of flowering; (II) 4 June – full bloom; (III) 10 June – end of flowering; (IV) 16 June – beginning of lignification; (V) 22 June – advanced lignification.

Table 2. Effect of cutting date and cultivar on the rooting of azalea cuttings (0.5% IBA + 20% Captan in dust preparation). Number of cuttings per replicate: 8. Medium: sand + peat (1:2)

Cutting date	Non-rooted	Rooting intensity
4 June (full bloom)	2.25 a	0.67 a
10 June (end of flowering)	5.41 b	2.70 c
16 June (lignification)	3.08 a	1.30 b
Cultivars		
Berry Rose (Knap Hill)	4.11 b	1.87 c
Toucan (Knap Hill)	4.77 b	2.92 d
Grandeur Triomphate (Ghent)	3.66 b	1.09 b
Dr. Reihenbach (Mollis)	1.77 a	0.35 a
Interaction: Dates × Cultivars	-	++

- – interaction not significant; + – interaction significant at 0.02. Values marked with the same letter do not differ significantly from each other.
Rooting intensity = number of rooted cuttings in a given class number × class number/number of cuttings per replicate.

The data from each experiment were subjected to analysis of variance. In multifactorial experiments, the orthogonal design was applied, which allowed to calculate an interaction between particular factors. Duncan's multiple range test was used to estimate the differences between the means at 1% and 5% levels of significance. Within a table, values marked with the same letter are not significantly different from each other.

Results and discussion

The purpose of the conducted investigations was to determine the most suitable date of taking azalea cuttings for rooting. The cuttings showed different degrees of lignification depending on the date of their collection.

The cuttings taken in full bloom and at the end of flowering of mother plants had the highest percentage of rooting (50–90%) and the largest root systems. The cuttings taken after flowering, rooted much worse (4–33%) or did not root at all, except cv. Fanny, which forms roots very easily. In the presented experiments the cuttings were treated with 0.5% IBA with Captan. This substance caused a substantial increase in the number of rooted cuttings and root system size.

In the experiments, cultivars from various groups but having the same time of flowering and a similar degree of cutting lignification were compared. It was found that irrespective of the group (Tables 1 and 2), the cuttings rooted much worse if taken after flowering of mother plants, when the degree of lignification was high, and also if the cuttings were taken relatively early, at the beginning of flowering (Fig. 1). Anatomical examinations confirmed the relationship between

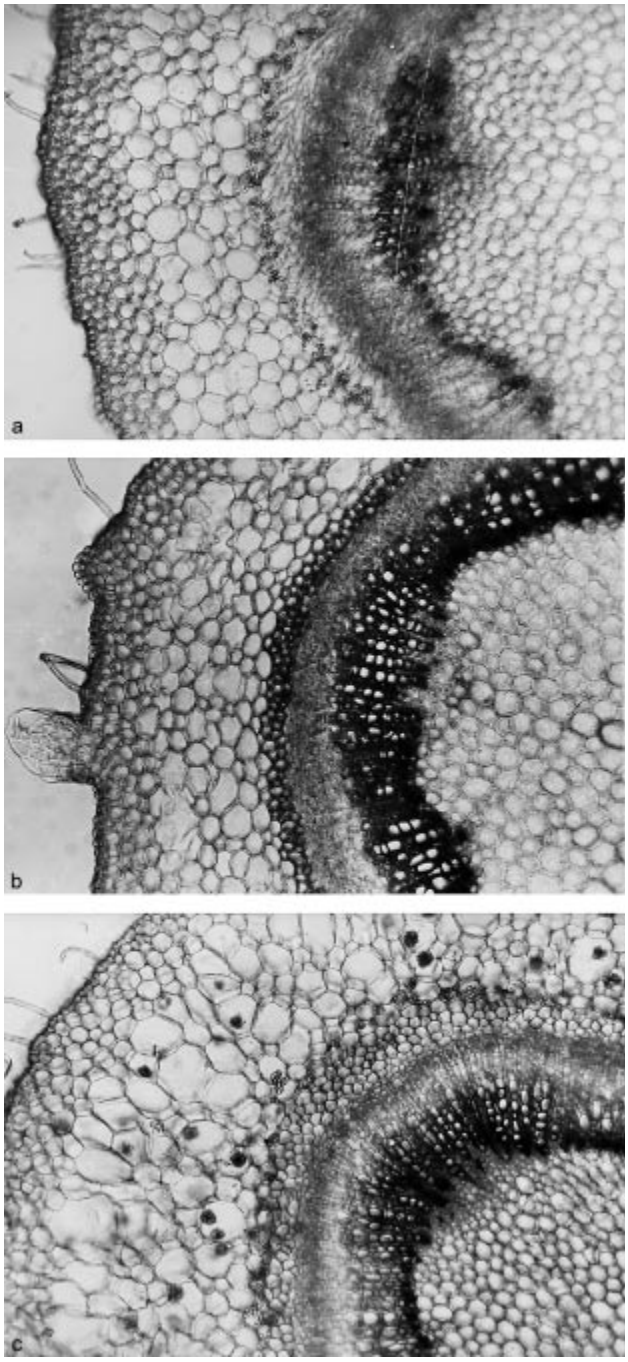

Fig. 2. Anatomical changes associated with progressing lignification of azalea cuttings (cv. Grandeur Triomphante)
Cutting dates: (a) 9 June – full bloom; (b) 15 June – end of flowering; (c) 21 June – beginning of lignification.

the lignification degree of the cuttings and their rooting ability. The cuttings that did not have secondary xylem or its layer was minimal, rooted the best (Fig. 2).

Consequently, there seems to be a strong relationship between the date of taking the cuttings and the degree of their rooting. Grampp (1976) asserted that the best time of taking the cuttings from azaleas was the end of flowering of mother plants. This was confirmed in the performed experiment. The cuttings that were lignified to a large extent, rooted in a low

percentage or did not root at all. Markham (1976) and Smith (1978) obtained similar results for azalea. According to those authors, more lignified cuttings formed fewer roots and rooting lasted longer. By contrast, Burton and Webster (1971) proposed that cuttings should be taken when they are more lignified and their growth is over. Leach (1962) showed that it is very important to select the cutting date properly for azalea and rhododendron propagation. He found that missing the optimum time by two weeks could decrease rooting to a large extent. The results of the present experiment confirm this important conclusion. Komarow (1995) showed for some trees the dependence of the rooting degree on the developmental stage of the mother plant. In his opinion, the most suitable moment for taking the cuttings is the time of flowering of mother plants. This is confirmed by physiological research on azalea cuttings, which revealed that cuttings taken from mother plants in full bloom or at the end of flowering contain much more rooting stimulators (Nawrocka-Grześkowiak 2001). Thus only continuous observation of mother plants makes it possible to determine the proper time for collection of azalea cuttings.

Conclusions

Observations permit to formulate the following conclusions about the rooting process of azalea cuttings:

– Cuttings of azaleas, irrespective of which group they belong to, root much worse when their degree of lignification is high or when they are taken too early.
– The best time of taking cuttings for vegetative propagation is from full bloom till the end of flowering of the mother plants.
– Six-day intervals between dates of taking the cuttings are sufficient to cause a substantial decreased or increase in the degree of their rooting.

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