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Effect of stock and grafting method on successful graft union in rhododendrons

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Abstract: Grafting plays an important role in rhododendron propagation. Successful graft union depends on selection of a suitable stock, grafting season, and method. In this study, three methods (whip, cleft, and side grafting) were compared in two seasons. The stocks were mainly cuttings of *R. catawbiense-Hybridum*, *R.* 'Cunningham's White', but also *R. pachytrichum* and *R. brachycarpum*. Scions were taken from several cultivars deriving from *R. catawbiense*. To shorten the production period, scions were grafted on unrooted stocks, and the results are encouraging. The best stock was *R.* 'Cunningham's White', especially when side grafting was applied in spring.

Additional key words: propagation, whip graft, cleft graft, side graft

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Introduction

Grafting is the operation of uniting two plant organisms into a single plant. For many species, selection of a suitable stock and grafting method is very important. This applies also to rhododendrons. A good rootstock is physiologically compatible and capable of uniting properly with the scion, but additionally must be able to adapt to difficult climatic and site conditions – resistant to frost and drought. Rhododendron cultivars are more and more often propagated from shoot cuttings (Hicke 1978; Kondratowiès 1981; Guire 1981), but grafting (Burhards 1966; Bärtels 1982; Dirr and Heuser 1987) is still the most effective method. It enables popularization of all cultivars, even of those whose propagation from cuttings is very difficult.

The major aims of this study were: (1) to determine which grafting method is the most suitable for rhododendrons; (2) to select the stocks that are the most suitable for rhododendron propagation and enable shortening the production period of those beautiful plants; and (3) to check which grafting season is the best.

Material and methods

Scions were taken from 8 cultivars evergreen rhododendrons: *R*. 'Caractacus', *R*. 'Dr H.C. Dresselhuys', *R*. 'Everestianum', *R*. 'Kate Waterer', *R*. 'Nowa Zembla', *R*. 'Mrs. P. den Ouden', *R*. 'Parsons Gloriosum', and *R*. 'Van der Hoop'.

Stocks of two kinds were used: (1) cuttings rooted in the preceding year; and (2) unrooted cuttings, which were rooted after grafting (Fig. 1). Cuttings were collected mainly from *R. catawbiense-Hybridum* and *R.* 'Cunningham's White'. Two other species – *R. brachycarpum* and *R. pachytrichum* – were included only in the first two years of the study (1987 and 1988), as it was difficult to produce a sufficient amount of rooted cuttings. The cuttings were apical fragments (10–12 cm long) of one-year shoots the terminal veg-



Fig. 1. Unrooted stock after grafting

etative bud. In the lower part of the cutting, a bark belt (ca 1 cm wide) was removed to encourage rooting (Wagner 1978, Lange 1980). After grafting, unrooted stocks were treated with a dust preparation of talcum powder and the fungicide Captan (2:1) with an auxin (4% indolebutyric acid, IBA). Cuttings prepared in such a way were planted in pots, in a substrate composed of peat, bark compost and leaf mould (1:1:1). The same substrate was used for planting the stocks that had been rooted in the preceding year. Rooting and graft union took place in a greenhouse at 15°C. Under such conditions, the highest percentage of stocks rooted and developed strong root systems. The pots were placed on tables, under an air-tight polyethylene cover, and were surrounded with sawdust. According to Dostálkova (1981), the grafted plants should be kept for 2 weeks under windows or polyethylene covers. In this study, the grafts were covered for 3 weeks, and only water was replenished. After this period, they were sprayed with fungicides every 2 weeks (alternately with Captan, Topsin or Benlate).

Whip, cleft and side grafts were applied, and the union was bound with a plastic band. The operation was carried out in a greenhouse, in two seasons: autumn (early October) and spring (early March), from a 1987 year to 1994. Only well-lignified shoots were selected, as this is important for a successful graft union. In spring, special care was taken to avoid frost-damaged shoots.

Three months after grafting (in early January and early June), the plastic band was removed and the union was controlled. In the group of side grafts, the upper part of the stock was then cut off if the graft was successfully united.

The experiments were conducted for eight years, in a randomized block design with three replicates of 8 stocks each, so that each combination was represented by 24 plants. The results were subjected to analysis of variance. Significance of differences between the means was assessed with the use of Duncan's multiple range test for threshold values 1% and 5%. In tables, statistically different values were marked with different letters.

Results and discussion

Numbers of united grafts depended on the applied stock, its rooting level, grafting method and season, and the grafted cultivar.

Irrespective of the grafted cultivar, the best stock was *Rhododendron* 'Cunningham's White' (Tables 1 and 2). The worst results were recorded for stocks of *R*.

Table 1. Effect of stock on numbers of united grafts of selected rhododendron cultivars (based on 3 replicates of 8 plants each). Mean years 1987 and 1988

Stock	Mean number of united grafts
R. catawbiense-Hybridum	5.16 b
R. 'Cunningham's White'	6.16 b
R. brachycarpum	0.83 a
R. pachytrichum (green shoots)	0.83 a
R. pachytrichum (red shoots)	2.83 ab
Cultivar	
'Nowa Zembla'	3.20 b
'Kate Waterer'	3.13 b

Values marked with the same letter do not differ significantly $(p\!<\!0.05)$

brachycarpum and the form of *R. pachytrichum* with green shoots. This may be due to incompatibility of those stocks with the grafted cultivars. However, this hypothesis needs to be verified, as those species are rarely used as stocks and the true reason for the low numbers of united grafts on those species may be completely different. In the available literature, there is little information on incompatibility between stock and

Table 2. Effect of grafted cultivar and stock on numbers of united grafts of selected rhododendron cultivars (based on 3 replicates of 8 plants each). Mean years 1989–1992

Cultivar	Mean number of united grafts	
'Nowa Zembla'	6.50 bc	
'Kate Waterer'	4.83 a	
'Van der Hoop'	7.66 d	
'Mrs. P. den Ouden'	7.33 cd	
'Everestianum'	7.50 cd	
'Dr H.C. Dresselhuys'	6.16 b	
'Caractacus'	7.16 cd	
Stock		
R.'Cunningham's White'	7.23 b	
R. catawbiense-Hybridum	6.23 a	
Interaction		
Cultivar' stock	+ +	

++ interaction significant at p < 0.01

Values marked with same letters do not differ significantly (p < 0.05)

scion in rhododendrons. Dirr and Heuser (1987) suggest that evergreen rhododendrons should be grafted on *R. catawbiense* or *R. ponticum*. Also Lamb et al. (1975) regard the latter species as the best stock for grafting.



Fig. 2. 1. A – R. 'Van der Hoop' two years after grafting on: 1 – R. Catawbiense-Hybridum; 2 – R. 'Cunningham's White' D – R. 'Van der Hoop' first year after grafting on: 1 – R. Catawbiense-Hybridum; 2 – R. 'Cunningham's White'

Table 3. Effect of grafting method and stock on numb	ers of
united grafts of selected rhododendron cultivars (l	oased
on 3 replicates of 8 plants each). Mean years 1989–1	994

Cultinum	Mean number of united grafts			
Cultivar	R.'Cunningham's White'	R. catawbiense		
'Parsons Gloriosum'	7.50 bc	8.00 d		
'Nowa Zembla'	8.00 c	8.00 d		
'Everestianum'	4.66 a	5.83 a		
'Van der Hoop'	6.83 b	6.83 c		
'Dr H.C. Dresselhuys'	8.00 c	6.66 bc		
'Mrs. P. den Ouden'	7.66 bc	6.16 ab		
Method				
Side graft	7.33 b	7.33 b		
Whip graft	7.11 a	6.50 a		
Cleft graft	6.50 a	6.50 a		

Values marked in columns with same letters do not differ significantly (p < 0.05)

Table 4. Effect of grafting season and stock on numbers of united grafts of selected rhododendron cultivars (based on 3 replicates of 8 plants each). Mean years 1989–1994

	Mean number of united grafts			
Cultivar	Autumn		Spring	
	Stock A	Stock B	Stock A	Stock B
'Nowa Zembla'	6.50 b	7.33 b	8.00 b	8.00 b
'Dr H.C. Dresselhuys'	5.83 a	7.00 b	8.00 b	8.00 b
'Van der Hoop'	5.16 a	5.33 a	6.83 a	6.83 a

Stock A = *Rhododendron catawbiense-Hybridum*

Stock B = Rhododendron 'Cunningham's White'

Values marked in columns with same letters do not differ significantly (p < 0.05)

Table 5. Effect of stock species and rooting level on numbers of united grafts of selected rhododendron cultivars (based on 3 replicates of 8 plants each). Mean years 1989–1994

	Mean number of united grafts			
Stock rooting level	R. catawbiense- -Hybridum	<i>R</i> . 'Cunningham's White'		
Rooted	5.88 b	6.77 b		
Unrooted	5.00 a	5.88 a		
Cultivar				
'Nowa Zembla'	6.33 b	6.16 ab		
'Dr H.C. Dresselhuys'	5.33 a	7.00 b		
'Van der Hoop'	4.66 a	5.83 a		
Interaction				
Rooting level ´ cultivar	+ +	+ +		

++ interaction significant at p<0.01

Values marked in columns with same letters do not differ significantly (p < 0.05)

Observations of further growth of rhododendrons grafted on *R. catawbiense-Hybridum* or *R.* 'Cunning-ham's White' show that irrespective of the applied stock, their growth was quite uniform (Fig. 2).

A comparison of different grafting methods revealed that the most effective are side grafts without removal of the upper part of the stock (Table 3). Statistical analysis proved that this method is the best for both *R. catawbiense-Hybridum* and *R.* 'Cunningham's White'. The other two methods (whip and cleft grafts) are also good, but in case of unsuccessful graft union, they must regenerate much longer before they can be used as stocks again. According to Bärtels (1982), the most popular and the best were whip grafts, which were good also in my study.

Irrespective of the applied stock and grafting method, some cultivars united very well (e.g. 'Nowa Zembla' or 'Dr H.C. Dresselhuys'), while others gave worse results (e.g. 'Everestianum'). The same conclusion can be drawn when only the most often used stocks are considered – *R. catawbiense-Hybridum* and *R.* 'Cunningham's White'. During the control, the number of united grafts on those stocks was the lowest in cultivar 'Kate Waterer' (Table 2).

The best results were recorded when the grafting was performed in spring, regardless of the stock and grafted cultivar, but the differences between spring and autumn grafting were not statistically significant. In most nurseries, grafting is usually carried out in spring. However, the scions can be then frost-damaged, so it is recommended that they should be collected in autumn and stored in a refrigerator. In this study, grafts performed in autumn were more successful on *R*. 'Cunningham's White' (Table 4). Lamb et al. (1975) suggested that grafting should be started in December and finished in late April. Results of the present study show that also October is a good period for grafting.

When unrooted stocks are used (Fig. 1), the rooting substrate is very important. It should be airy, easily permeable to water, but at the same time sufficiently moist (Miller 1985). The substrate applied in this study enabled effective rooting of the stocks, which was crucial for the experiment. The presented results (Table 5) are encouraging. Admittedly, slightly more grafts united on the stocks that rooted earlier, as they were stronger, better prepared for grafting. Nevertheless, grafting on unrooted stocks enabled shortening the production period by one year. Unrooted stocks of R. 'Cunningham's White' proved to be significantly better than those of R. catawbiense-Hybridum (Tables 6 and 7). R. 'Cunningham's White' generally roots very well, irrespective of the stimulating substance (Nawrocka-Grześkowiak 2003), which probably had a strong impact on results of this study.

Cultivar	Mean number of united grafts	
'Nowa Zembla'	5.83 b	
'Dr H.C. Dresselhuys'	5.33 b	
'Van der Hoop'	4.33 a	
Stock		
R. catawbiense-Hybridum	4.33 a	
R. 'Cunningham's White'	6.00 b	
Interaction		
Cultivar ´ stock	+ +	

++ interaction significant at p<0.01

Values marked in columns with same letters do not differ significantly (p<0.05)

Table 7. Percentage of united grafts of rhododendrons, depending on grafted cultivar and stock rooting level (based on 3 replicates of 8 plants each). Mean years 1989–1992

	Mean percentage of united grafts			
Cultivar R. 'Cunning White		ningham's 'hite'	R. catawbiense- -Hybridum	
	rooted	unrooted	rooted	unrooted
'Nowa Zembla'	79.1	75.0	87.5	70.8
'Dr H.C. Dresselhuys'	95.8	79.1	66.6	66.6
'Caractacus'	83.3	79.1	83.3	70.8
'Van der Hoop'	79.1	66.6	66.6	62.5

Conclusions

- 1. *R. catawbiense-Hybridum* and *R.* 'Cunningham's White' are good stocks for grafting of rhododendrons of the *R. catawbiense-Hybridum* group.
- 2. The highest number of successfully united grafts was recorded for side grafting.
- 3. Irrespective of the applied stock, grafting was more effective when performed in spring.

- 4. The number of successfully united grafts was slightly higher on rooted stocks than on unrooted stocks.
- 5. The grafting of rhododendrons on unrooted stocks shortens the production period by one year.

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