

**Effect of nutrition on growth  
and flower bud formation of *Rhododendron* cultivated  
on ebb and flow benches**

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Key words: recirculation system, nutrient solution, fertilization

ABSTRACT

Growth and flower bud formation of *Rhododendron* 'Blurettia', 'Percy Wiseman', and 'Bengal' on ebb and flow benches flooded with nutrient solution containing 60, 120, and 180 mg N dm<sup>-3</sup>; 20, 40, or 60 mg P dm<sup>-3</sup> and 60 or 120 mg K dm<sup>-3</sup> were evaluated. The best growth of all cultivars was obtained at 180 mg N dm<sup>-3</sup> while increasing P and K levels did not stimulate growth of plants. 'Bengal' did not form flower buds at all but flowering of 'Blurettia' was stimulated by high N level while for 'Percy Wiseman' N level 120 mg dm<sup>-3</sup> and increased K to 120 mg dm<sup>-3</sup> ensured the best flower bud set. P level did not affect flowering.

## INTRODUCTION

Fertigation, i.e. fertilization with each plant watering, and nutrient solution recirculation, become more and more popular in *Rhododendron* production all around the world. The main advantages of this fertilization method are lower fertilizer use and possibility of adjusting nutrient solution concentration and composition following changes in weather conditions and plant requirements during vegetation period. Unfortunately, recommendations for nutrient solution composition for fertigation of rhododendrons are not consistent. Various authors suggest using nutrient solutions with N : P : K ratios (in mg dm<sup>-3</sup>) as different as 90 : 15 : 30 (Wright 1992) or 200 : 22 : 83 (Chaanin and Preil 1992).

It is well known that by changing the nutrient solution composition one can affect the growth and flowering of plants. Evergreen rhododendrons are believed to be nitrogen-loving plants (Aendekerk 1997). In contrast, their requirements for phosphorus and potassium are not high. However, literature data show that low availability of phosphorus results in reduced flowering of rhododendrons, while increased potassium levels at the end of the growing season stimulate plant tolerance to frost. Also, it is generally accepted that generous nitrogen fertilization, at the same time, decreases the winterhardiness of plants. This is especially important for cultivars belonging to the Forrestii Group and Yakushmanum Group, whose coldhardiness is relatively low.

The research aimed at evaluation of growth and flowering of three rhododendron cultivars cultivated using different fertigation solutions.

## MATERIAL AND METHODS

The experiments were carried out for two consecutive years at the Research Institute of Pomology and Floriculture in Skierniewice on three rhododendron cultivars, i.e. 'Blurettia' and 'Percy Wiseman' (both belonging to the Yakushmanum Group) in 2001, as well as 'Blurettia' and 'Bengal' (a cultivar from the Forrestii Group) in the year 2002.

One-year-old plants, propagated *in vitro* and cultivated in 9 × 9 × 10 cm pots, were transplanted at the end of April into 2 dm<sup>3</sup> containers. Potting medium consisted of white peat (pH 3.8) and composted pine bark in the ratio 3 : 1 (v / v). The plants were placed outdoors on the ebb and flow benches with a recirculation system of nutrient solution (Matysiak et al. 2001). Three nitrogen levels in the nutrient solution (60, 120, and 180 mg dm<sup>-3</sup>) as well as three levels of phosphorus

(20, 40, 60 mg dm<sup>-3</sup>) and two levels of potassium (60 and 120 mg dm<sup>-3</sup>) were evaluated in the experiment. The magnesium content was 20 mg dm<sup>-3</sup> for all nutrient solutions tested. Measurements of plant height (from the medium to the tip of the most distal bud), total length of new shoots (the first and the second growth flush), total leaf number formed on new shoots, the number of plants with flower buds and the number of flower buds per plant were recorded in both years, at the beginning of October. For all experimental treatments there were 4 replicates with 5 plants in each replicate.

The results were statistically analysed by ANOVA and Duncan's Multiple Range test at 5% level of significance.

## RESULTS AND DISCUSSION

Nutrient solution composition significantly affected plant growth rate and to a smaller extent also flower bud formation (Table 1). Irrespective of cultivar, the best vegetative growth was observed in plants fertigated with nutrient solution containing 180 mg N in dm<sup>3</sup>, which supports the information on high requirements of rhododendrons for this nutrient element. Plants fertigated with the lowest N doses not only grew worse but also their leaves were poorly coloured and exhibited reduced frost hardiness (data not presented). In contrast, phosphorus and potassium fertilization level did not affect the vegetative growth of tested cultivars, except for 'Blurettia' in the second experimental year where the high phosphorus level significantly increased shoot length and number of leaves per plant.

Due to the young age of plants and the fact that no chemical plant growth regulators were used, flower bud setting was relatively poor and strongly varied between individual plants. These made it difficult to prove significant differences between treatments. However, it may be stated that in 'Blurettia' high N levels in the nutrient solution stimulated flower bud formation, whereas for 'Percy Wiseman' the highest number of flower buds initiated plants fertigated with nutrient solution with raised potassium content (120 mg dm<sup>-3</sup>). Interestingly, in contrast to literature information, phosphorus availability had no effect on flower bud formation in either of the above cultivars. *Rhododendron* 'Bengal' plants set almost no flowers at all, which suggests that to obtain marketable, flowering plants from cultivars belonging to this group, either the production cycle must be extended to at least 3 years or treatments with chemical plant growth regulators have to be applied.

Table 1. Effect of N, P, and K content in a nutrient solution on growth and flowering of rhododendrons

Years	N P K content in nutrient solution (mg dm <sup>-3</sup> )	Plant height (cm)	Total length of new shoots per plant (cm)	Total leaf number on new shoots per plant	Number of plants with flower buds (n** = 5)	Number of flower buds per plant
2001	'Blurettia'					
	60, 20, 60	17.6 a*	56 a	86 a	1.3 a	0.6 a
	120, 20, 60	18.2 a	67 ab	99 a	4.3 a	2.1 bc
	180, 20, 60	21.5 b	87 c	99 a	4.2 a	3.3 c
	120, 40, 60	19.6 ab	73 bc	103 a	3.0 a	1.3 ab
	120, 60, 60	19.5 ab	62 ab	94 a	4.3 a	1.8 ab
	120, 20, 120	17.3 a	68 ab	100 a	3.7 a	1.6 ab
	'Percy Wiseman'					
	60, 20, 60	19.1 a	80 a	86 a	3.9 a	1.6 a
	120, 20, 60	22.0 b	115 b	113 b	4.7 a	2.3 ab
	180, 20, 60	22.0 b	133 c	122 b	3.8 a	2.3 ab
	120, 40, 60	22.3 b	115 b	113 b	4.4 a	2.7 b
	120, 60, 60	22.2 b	107 b	102 ab	4.4 a	2.6 b
	120, 20, 120	22.5 b	114 b	112 b	5.0 a	3.2 b
2002	'Bengal'					
	60, 20, 60	13.2 a	79 a	164 a	0.0 a	0.0 a
	120, 20, 60	14.8 a	101 ab	221 bc	0.0 a	0.0 a
	180, 20, 60	15.8 a	130 c	242 c	0.0 a	0.0 a
	120, 40, 60	14.9 a	124 bc	234 bc	0.0 a	0.0 a
	120, 60, 60	14.1 a	115 bc	225 bc	0.0 a	0.0 a
	120, 20, 120	15.1 a	108 bc	201 b	1.0 a	0.1 a
	'Blurettia'					
	60, 20, 60	9.0 a	20 a	68 a	0.0 a	0.0 a
	120, 20, 60	10.9 ab	30 b	92 bc	0.3 a	0.3 a
	180, 20, 60	14.3 c	38 bc	89 abc	1.5 a	0.6 a
	120, 40, 60	12.0 b	37 bc	106 c	2.2 a	0.8 a
	120, 60, 60	11.7 b	41 c	104 c	0.8 a	0.4 a
	120, 20, 120	11.7 b	31 b	79 ab	1.1 a	0.5 a

\* Means designated within each column, year, and cultivar with the same letter do not differ significantly according to Duncan's Multiple Range Test at  $p = 0.05$

\*\* number of plants in a replicate

## CONCLUSIONS

- Increasing N content in a nutrient solution (from 60 to 180 mg dm<sup>3</sup>) stimulated vegetative growth of rhododendrons in closed recirculation system. P and K levels had little or no effect on vegetative growth.
- Flower bud initiation in 'Blurettia' was favoured by a high N level while in 'Percy Wiseman' by raising potassium content in solution. Phosphorus level did not affect flower bud formation in either cultivar when N content in solution was 120 mg dm<sup>3</sup>.

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## WPŁYW NAWOŻENIA NA WZROST I ZAWIĄZYWANIE PĄKÓW KWIATOWYCH U RÓŻANECZNIKÓW UPRAWIANYCH NA STOŁACH ZALEWOWYCH

Streszczenie: W latach 2001 i 2002 badano wzrost i zawiązywanie pąków kwiatowych u różaneczników 'Blurettia', 'Percy Wiseman' (grupa Yakushimanum) i 'Bengal' (grupa Forrestii) uprawianych na stołach zalewowych z wykorzystaniem pożywki zawierającej 60, 120 lub 180 mg N dm<sup>-3</sup>, 20, 40 lub 60 mg P dm<sup>-3</sup> i 60 lub 120 mg K dm<sup>-3</sup>. Najlepszy wzrost wegetatywny wszystkich trzech odmian uzyskano przy zastosowaniu pożywki zawierającej 180 mg N dm<sup>-3</sup>, natomiast zwiększenie zawartości P i K nie stymulowało wzrostu roślin. Rośliny odmiany 'Bengal' nie zawiązały pąków kwiatowych, lecz kwitnienie odmiany 'Blurettia' było stymulowane przez wysoki poziom azotu, zaś odmiana 'Percy Wiseman' najlepiej zawiązała pąki kwiatowe, gdy rośliny były uprawiane na pożywce zawierającej 120 mg N dm<sup>-3</sup> i 120 mg K dm<sup>-3</sup>. Zawartość P w pożywce nie wpływała na kwitnienie badanych roślin.

Received September 15, 2003; accepted May 13, 2004