

Effects of Cutting Time and IBA Treatment on Rooting of Rhododendron Summer Cuttings Collected from Turkish Flora**B. Altun^{1*}, H. Celik², H. Gumus³, S. Saglam⁴, O. Eminagaoglu⁵, M. Turet⁶, T. Yucel⁷, I.T. Kaya⁸**¹Ahi Evran University Faculty of Agriculture Department of Horticulture, Kırşehir, Turkey²Ondokuz Mayıs University Faculty of Agriculture Department of Horticulture, Samsun, Turkey³T. C. General Directorate of Forestry Artvin Regional Directorate of Forestry, Artvin, Turkey^{4,7}Ahi Evran University Faculty of Agriculture Department of Plant Biotechnology, Kırşehir, Turkey⁵Artvin Coruh University Faculty of Forestry Department of Forest Engineering, Artvin, Turkey^{6,8}Boğaziçi University Faculty of Art and Sciences Depart. of Molecular Biology and Genetics İstanbul, Turkey***Corresponding author**
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Abstract: This study was carried out to determine the possibilities of vegetative propagation of the widespread 5 *Rhododendron* species (*R. ponticum* L, *R. luteum* Sweet, *R. smirnovii* Trautv, *R. ungerii* Trautv, and *R. caucasicum* Pallas) in Turkey. The plant material was obtained as shoot tip cuttings from Black Sea Region flora at three times (June, July and August). The respective cutting materials were subjected to 5 Indole-3-butyric acid (IBA) doses (0, 4000, 8000, 12000 and 16000 ppm) and planted in acidic peat and perlite mixture under mist propagation in greenhouse condition. Sixty cuttings (20 cuttings with 3 replicates) were used for each treatment. Totally, 300 cuttings were used. Results showed that three *Rhododendron* species (*R. ponticum*, *R. luteum* and *R. smirnovii*) were successfully rooted but the others (*R. ungerii* and *R. caucasicum*) were not. Only 16.000 ppm IBA gave the highest rooting rate (46.67%). The highest rooting rates were obtained in *R. ponticum* as 46.66 % from August cuttings, in *R. luteum* as 38.33 % from June cuttings and *R. smirnovii* as 13.33% from August cuttings. To conclude, when the cutting materials were obtained in summer season, their rooting rates were quite low in *Rhododendron* species, suggesting that when it is difficult to reach these plants in heavy winter conditions, it can be worked on summer cuttings even low rate of rooting.

Keywords: *Rhododendron*, propagation, cutting, summer season.

INTRODUCTION

Rhododendrons genera belonging to *Ericaceae* family, beside the natural hybrids with showing around 1100 natural species on earth, are defined as evergreen or deciduous shrub and rarely in the form of small tree shaped [1, 2]. The first study on cultivation of these genera had been done by Charles l'Ecluse in 16th century for ornamental purpose [3].

Since Turkey is under the influence of many different climates and geographies, she has a rich plant diversity including *Rhododendrons*. Due to their characteristic features, the species found in the *Rhododendron* genera are very popular plants in many countries due to their usage for outdoor and indoor ornamental plants purposes. With the colors of flowers, plant form and structure of leaves of *Rhododendrons* have become important ornamental plants in urban and rural landscape planning in many countries of the world [4].

Rhododendrons have never lost their attractiveness since the date they were first discovered and catch the attention of the researchers constantly. While the Most of *Rhododendrons* spread to the northern hemisphere, some of its species have spread to the southern hemisphere too. The spreading of *Rhododendrons* in Turkey starts from Artvin in the east and go along with the whole Black Sea coast, in the sea-facing directions of the mountains and ends on the northern slopes of the Istranca Mountains in the west. Eastern Black Sea Region is placed where species diversity is most concentrated and abundant. Except for the Black Sea Region, two species of *Rhododendrons* (*R. ponticum* L. and *R. luteum* Sweet.) naturally small populations in Bursa (Izmit), Yalova, Istanbul and Kırklareli provinces, and especially concentrated in Sakarya and Kocaeli provinces in the Marmara Region. It was also determined that *R. luteum* Sweet populations exist in two different locations in the southern hillside of the Ida Mountains in Canakkale province [3, 5, 6].

The beauty of *Rhododendrons* grown in natural flora has led to the widespread use of these plants for "aesthetic" and "functional" purposes in today's landscape arrangements. Besides *Rhododendron* species cultivated from nature, *Rhododendron* varieties were developed by breeding studies. Their recent usages in urban landscape planning have been widespread with thousands of new varieties [7, 8].

In landscaping applications, natural plants grown in natural flora besides standard ornamental plants have been becoming increasingly important nowadays. In this context, especially for *Rhododendrons*, the methods of propagation and growing have not been yet fully developed due to the genetics of the plant (rooting and germination problems etc.) and the difficulty in obtaining replicate materials all the times during year. This is why that the plants are under snow in winter in nature. In addition, there is a need quite long time for rooting of the cuttings of *Rhododendrons* Altun's [9] work with *R. ponticum*, *R. luteum*, *R. smirnovii*, *R. ungernei* and *R. caucasicum* cuttings, taken in autumn 2011, reporting that the cuttings remained in the rooting media for 220 days and their rooting rates varied between 21% and 95%. Therefore, in the present study, the effects of the cutting time i. e, the time of obtaining replicate materials and growth regulatory substance (IBA) on rooting rate were investigated in the regeneration of naturally summer cuttings of *Rhododendrons* of Turkey which have potential for ornamental plants like used in many other countries for this purpose.

MATERIALS AND METHODS

Cutting sampling and storing

In spring, when plants were in bloom, pure populations of species were identified with their locations by using GPS (Magellan, eXplorist 710). From these identified areas, the cuttings belonging to 5 *Rhododendrons* (*R. ponticum*, *R. luteum*, *R. caucasicum*, *R. smirnovii* and *R. ungernei*) were the shoots as tip cutting in three different periods, first week of June, first week of July and first week of August. The characteristics of locations where *Rhododendrons* cuttings were obtained are given in Table 1. In order to minimize the loss of water in the cuttings, all the other leaves were removed by leaving half of the top leaf. The prepared cuttings were connected to each other in the form of twenty buckets, then, put in the foam containers with wet newspaper and ice bags. These cutting materials were kept in this way until the time of planting. Acidic peat + perlite (3: 1) mixture was used as rooting medium in the present study as Altun [9] used.

Table-1: The characteristics of locations where *Rhododendrons* cuttings were obtained

Species	Coordinates	Altitude	Location
<i>R. ponticum</i> L.	41° 08'914 K 41° 46'205 D	1652 m	Artvin
<i>R. luteum</i> Sweet.	41° 10'424 K 42° 18'943 D	1671 m	Şavşat
<i>R. caucasicum</i> Pallas	41°43'450 K 42° 28'376 D	2289 m	Şavşat
<i>R. smirnovii</i> Trautv.	41° 07'904 K 41° 47'251 D	1982 m	Artvin
<i>R. ungernei</i> Trautv.	41°18'870 K 41° 53'495 D	1249 m	Borçka

Planting cuttings

Collected cuttings from determined locations (Table 1) were transferred to Horticulture Research Unit of Agriculture Faculty of Ahi Evran University in Kırşehir province within a foam container in cold chain condition. These cuttings and pruning shears were kept in fosetyl Al solution for a time against the possible contaminations or diseases. Then, to reach the living tissue, the lower part of each cutting was cut 0.5 cm straight from just under the bottom node. The bottoms of the prepared cuttings were kept in different doses of indole butyl acid (IBA) (0, 4000 ppm, 8000 ppm, 12000 ppm and 16000 ppm) for 5 seconds. The cuttings taken from IBA solutions were planted according to the experimental design of coincidence parcels in acidic peat + perlite mixture (3: 1) at temperature (under heating) and humidity control (under fogging). Trials were made in 3 replications, each contained 20 cuttings. To ensure homogeneity in the experiment, cuttings were planted on parcel by designing 4.5x3.0 cm space between and over in row, 5.5 cm space between replicates, and 10 cm space between species. The temperature of the rooting medium was kept constant at 24 °C (± 1). The rooting environment humidity is will be set to by manually so that the leaves will always be damp.

Collecting data

After the cuttings were planted in the rooting environment, the regular controls were made frequently (daily) to see if there was a problem with the fogging unit and the heating greenhouse. When necessary, ventilation was activated

and the duration of fogging was reduced or increased. The cuttings were removed from the rooting medium after 210 days of planting and calculated rooting rate as percentage.

Statistical analysis

Rooting rates obtained from each cycle were calculated as percentages. After applying Log10 transformation to the obtained figures, ANOVA was subjected to analysis of variance by using SPSS statistical software (Windows version of SPSS, release 16.00) and differences were revealed by Duncan Multiple Range Test in the same software.

RESULTS AND DISCUSSIONS

In this work, it was aimed to propagate the *Rhododendrons* with summer cuttings. Experiment was set up on the species and cuttings were taken from tip of shoots at different times (the first week of June, the first week of July and the first week of August). Cuttings were subjected to different IBA doses (0, 2000 ppm, 4000 ppm, 8000 ppm and 16000 ppm) in rooting benches with supplied bottom heating (fixed) and misting. Rooting results showed that there were rooting three species (*R. ponticum*, *R. luteum* and *R. smirnovii*) while the cuttings of other species (*R. ungeri* and *R. caucasicum*) were not rooted in the level of expected rates.

The rooting rates of *R. ponticum* L (%)

The effects of the interactions on the rooting rates of the top cuttings taken in the summer months of *R. ponticum* species were statistically important (p <0.01). In this context, the best rooting rate (46.67%) was obtained from the cuttings taken in August of the second year (Table 2).

Table-2: The rooting rates of *R. ponticum* L. cuttings by year, collection time and IBA doses (ppm)

Year	Month /IBA treatments	Rooting rates (%)				
		0	2000	4000	8000	16000
2014	June	0.0 ± 0.00 g	0.0 ± 0.00 g	10.0 ± 10.01 efg	3.0 ± 3.34 gf	0.0 ± 0.00 g
	July	25.0 ± 0.00 abc	31.0 ± 3.34 ab	21.6 ± 8.83 a-e	25.0 ± 0.00 abc	41.6 ± 6.02 a
	August	6.7 ± 3.34 efg	10.0 ± 2.89 c-g	6.6 ± 3.34 efg	5.0 ± 2.89 efg	3.33 ± 1.67 gf
2015	June	1.7 ± 1.67 gf	0 ± 0.00 g	5.0 ± 2.89 efg	6.6 ± 1.67 d-g	5.0 ± 2.89 efg
	July	11.7 ± 3.34 b-f	3.0 ± 1.67 gf	6.6 ± 4.42 efg	23.3 ± 4.42 a-d	23.3 ± 7.27 a-d
	August	13.3 ± 6.02 b-f	36.0 ± 9.29 a	36.6 ± 7.27 a	31.6 ± 13.03 abc	46.6 ± 13.66 a

The rooting rates in *R. luteum* Sweet. (%)

The effect of interaction of the effect of Year x Period x Dose on the rooting rates of cuttings of *R. luteum* species was found statistically significant (p <0.01). The highest rooting rate (38.33%) was obtained in the first year of the study, obtained in June with 16000 ppm IBA treatment (Table 3).

Table-3: The rooting rates in *R. luteum* Sweet. cuttings by year, collection time and IBA doses (ppm)

Year	Month /IBA treatments	Rooting rates (%)				
		0	2000	4000	8000	16000
2014	June	5.0 ± 5.01 d-g	1.7 ± 1.67 fg	3.3 ± 3.34 efg	15.0 ± 2.89 abc	38.3 ± 1.67 a
	July	16.7 ± 4.42 abc	5.0 ± 0.00 c-g	18.3 ± 3.34 abc	13.3 ± 4.42 bcd	13.3 ± 1.67 fg
	August	1.7 ± 5.01 d-g	11.7 ± 1.67 b-e	11.7 ± 4.42 b-e	23.3 ± 16.43 bc	15.0 ± 2.89 abc
2015	June	1.7 ± 1.67 fg	0.0 ± 0.00 g	0.0 ± 0.00 g	0.0 ± 0.00 g	0.0 ± 0.00 g
	July	0.0 0.00 g	0.0 0.00 g	0.0 0.00 g	0.0 ± 0.00 g	0.0 ± 0.00 g
	August	35.0 ± 16.09 ab	31.7 ± 3.37 ab	11.7 ± 6.02 c-f	11.7 ± 1.67b-e	3.3 ± 3.34 efg

The rooting rates in *R. smirnovii* Trautv. (%)

It was determined that the effect of Year x Period x Dose interaction was statistically significant (p <0.01) in the present study on the reproduction of cuttings of *R. mirnovii* species. The best rooting rate was obtained from the second year cuttings, which was treated with 4000 ppm and 16000 ppm IBA.

Many studies had been working on propagation of cutting on *Rhododendrons*. According to these studies, the success in the rooting in *Rhododendron* cuttings varied by species to species due to their genetical difference, the time of taking cutting, the shape of the cutting preparation, the rooting environment, the type and amount of growth regulators used [9-12].

In this study, the rooting rates of cuttings of 5 different *Rhododendron* species treated with different IBA doses (0, 4000 ppm, 8000 ppm, 12000 ppm and 16000 ppm) taken at different periods (the first week of June, the first week of the July and first week of August). It was determined that the rooting rates of summer cuttings were lower than that of autumn cuttings when compared with the previous studies. The species of *R. ponticum* had the highest rooting rate as 46.67% in the current study. A rooting rate of 38.33% in *R. luteum* and 13.33% in *R. smirnovii*. Any rooting activity was not observed in *R. ungeronii* and *R. caucasicum* species. These results showed that these species are more suitable for with autumn cuttings according to the study of Altun [9]. It was also observed that summer cuttings were more susceptible to disease than autumn cuttings. This situation can be considered to be a factor restricting success in rooting.

Wang et al. [10] studied on the cutting propagation of *R. kiangsiense* and *R. liliiflorum* species. They showed that IBA concentration and cutting time had significant effects on rooting rate. The best roots were obtained with 100 ppm IBA dosing in April and October cuttings. They, also, found out that the summer cuttings which received June 21st and August 16th had the worst rooting rate, concluding that propagation with summer cuttings was not appropriate for propagation. Yamashita & Okamoto [13] reported in their work on Kurume azalea (*Rhododendron* Kurume group) that the rooting potential of these plants had quite low during the months of June and August due to the fact that carbohydrates in xylem tissues are almost lost or limited. The lower rooting rates in the current study are agreed with their findings, most likely, for the similar reason of carbohydrate shortage during summer season.

To conclude, although the rooting rates in the summer cuttings of the studied species were quite low in *R. ponticum* L., this species could be propagated with its summer cuttings, if necessary, as evidenced with the highest rooting rate obtained.

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