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The Effects of Some Ecological Factors on the Pre-Adaptation Activities for the Purple-Flowered Rhododendron (Rhododendron ponticum L.) reproduced by Seeds

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Abstract

This study was carried out to identify the effects of temperature, light, and humidity factors on the pre-adaptation of the seedlings, which were reproduced using the seeds of *Rhododendron ponticum* L., which is among the indigenous species of Turkey. Two environments namely full-sun and partial-shade were selected; the temperature, light, and humidity levels in these environments were measured, the survival and development rates of the seedlings planted on both sites were documented, and the obtained results and the relations of these results to each other have been provided along with related statistical results. This study has found that *Rhododendron ponticum* L. adapts better in soils that are acidic in terms of pH (4.5-5.5) and rich in organic materials (60-70%) and in moisture (60%-70%) and semi-shaded areas (areas that receive 50% or more of solar radiation indirectly). Additionally, the adapted seedlings have produced blooms and reproduced seeds only within three years from their first production, although there are findings in literature that seedlings reproduced by seeds bloom in 6, 7 and up to 12 years.

Keywords: Forest Rose, *Rhododendron ponticum* L., reproduction by seeds, adaptation

INTRODUCTION

Rhododendrons are included in the Rhododendron Genera of shrubs in the Ericaceae family of seed plants super-division of the kingdom of Plantae. They are deciduous or evergreen bushes, or occasionally ligneous plants in the form of trees. They have evergreen, leathery, entire-sided and wide striped or elepidote leaves (Ansin and Terzioğlu 1994; Abbot 1972)

Rhododendron ponticum L growing naturally in Turkey is a decorative ornamental plant due to its flowers and leaves. Although the purple-flowered rhododendron (*Rhododendron ponticum*) is mainly spread over the United Kingdom (UK), Ireland, Bulgaria, Turkey, Caucasus, and Lebanon, some areas in Southeast Spain, Middle and Southern parts of Portugal as well as Belgium and France. Among these areas, the plant is mostly spread over the UK, Ireland, and the Black Sea Region in North of Turkey (Robinson 1980; Clay et al. 1992; Colak and Aksoy 1997). It exists over the entire Black Sea Coast in Turkey to Zonguldak, Bolu, Duzce, Bilecik, Demirkoy, and the Istranca Mountains in the west. It is most heavily distributed on the North West Anatolia Mountains (Ansin and Terzioglu 1994).

The *Rhododendron ponticum* is generally a round or irregular-formed bush with a height of 3 to 5 meters, and occasionally a small tree that can extend its length up to 10 meters (Yaltirik 1997;

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Var 1992; Ferguson 1984). The flowers bloom starting from mid April (some sub-species in August) are in the form of joint bunches and in purple and varying shades of purple in terms of colour (Var 1992; Ansin and Terzioglu 1994; Abbot 1972).

The plant likes shady areas and even soils with high moisture content (Kucuk and Topcu 1993). It generally prefers cool and protected northerly mountainsides and riverbeds (where high illumination, wind, and draught are not predominant factors) (Esen 2000; Libb and Nilsen 1997; Thomson et al. 1993). In addition, *Rhododendron ponticum* does not prefer soils with low moisture content (Cross 1981; Colak and Aksoy 1997).The plant likes acidic soils and is resistant to salty soils, including those on the seaside (Marlowe 1977).

Although rhododendron groups are considered harmful in terms of forestry as they block the development of the primary tree distribution within forest populations and there are efforts to eliminate them via mechanical and chemical means, they can aesthetically as well as functionally (as bordering elements, flood barriers, and in fence making) be utilized in landscape planning. In addition, they can be used in road bevel stabilisation, particularly in traffic island planting to create stimulating effects thanks to their colourisations and flower colours (Reiley 1995; Clarke 1982).

Rhododendrons cover the soil surface partly or completely in the middle and lower parts of the highly steep and sloped forests or in areas without forest in Northern Anatolia as a live cover and protect the soil against erosion and landslide, and constitute a hiding and protection are for many animals (Kücük and Var 1995).

Due to its characteristics outlined above, *Rhododendron* is one of the most important plants in Landscape Architecture. However, this plant has remained only in the countryside landscapes of Turkey and has not been brought into urban landscape.

Our main objectives in this study include the identification of the conditions for the adaptation of *Rhododendron ponticum* L. to increase its widespread use in urban landscape planning and lead the way to ensure that other rhododendron taxa in Turkey are utilised.

MATERIALS AND METHODS

MATERIAL

The r*hododendron ponticum* seeds were collected at the Çamburnu Location in the Surmene Sub-province of Trabzon Province at an altitude of 300 – 500 meters. The thousand-piece-weight of rhododendron seeds was 0.0081 g (Var and Dinçer 2005). The seedlings obtained from these seeds were used in the adaptation study. Peat, forest soil, and clay-mud (control soil)[1] were selected as planting mixtures for adaptation.

The light intensity, air temperature, air humidity, and soil temperature were measured with MX4 brand luxmeter, a Thermohydrograph, and an Ondotori TR-71 brand automatic temperature recorder.

METHODS

Preparation of Adaptation Mediums

Two separate clay-mud-soil working sites, one partial-shade, and one full-sun were selected for the pre-adaptation work on the *Rhododendron ponticum* seedlings. Peat, forest soil, and mud-clay (control) soil mixtures were filled as planting soil in the holes dug on these sites.

Preparation of Trial Patterns for the Seedlings Used for Adaptation

Of the 240 *Rhododendron ponticum* seedlings, 120 were planted in the full-sun environment and 120 in the partial-shade one. Into each one of the three types of planting mixtures used, 10 seedlings were planted on each of the four rows to make up 40 seedlings for each type of soil on both planting sites (Fig.1).

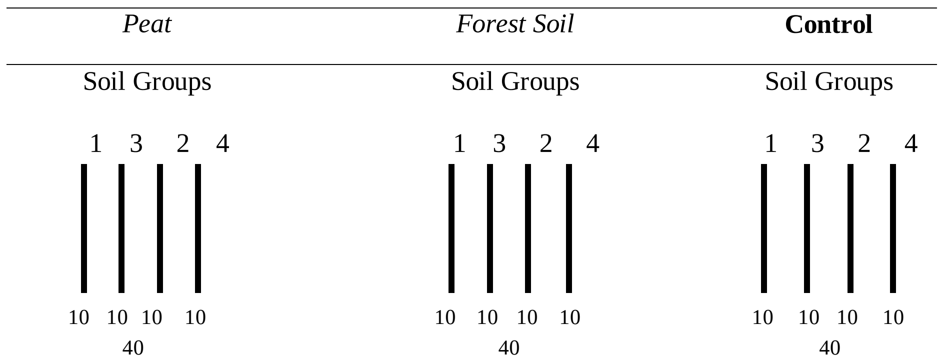

Figure 1. Trial patterns used on each of the two environments used in the adaptation work

The Planting of *Rhododendron ponticum* Seedlings in an Outer Spot

The *Rhododendron ponticum* seedlings obtained by the second replanting were a year later planted in the full-sun and partial-shade working environments (using peat forest soil, and clay-mud planting mixtures) prepared for adaptation. Watering was administered once a day every morning on hot days. At cloudy weather, watering was administered once every three days to maintain the moisture level of the soil.

The development of the seedlings was observed on both fields and when the seedling deaths started, light intensity, air temperature and humidity were measured and recorded between 08:00 am and 5:00 pm. Similarly, when the air temperature started to drop, soil temperature and air temperature for both fields every hour 24 hours a day and for two months were measured and recorded and the data of two months was transferred to the computer medium via the Ondotori TR-71 software program.

RESULT

Throughout the present study on the identification of the suitable conditions of temperature, light, humidity, and moisture for the adaptation of forest roses, it has been observed that survival percentages, as well as diameter and height developments varied in full-sun and partial-shade sites (Table 1). The evaluation of the obtained results was done utilising graphics, variance analysis, and Duncan's test.

Table 1 The diameter-height development of the *Rhododendron ponticum* seedlings at the two working sites in different soils and survival rates and the soil Ph

	Survival Ratio	Average Root Neck Diameter (cm)	Average Height (cm)	Soil pH
Partial-shade Site				
Peat	90	0,7	11,9	4,91
Forest Soil	88	0,7	14,4	4,44
Control	85	0,6	12,7	6,35
Full-sun site				
Peat	73	0,5	5,4	4,91
Forest Soil	75	0,5	7,8	4,44

Control	35	0,3	6,7	6,35

According to the results of the variance analysis, through which an evaluation of the developments of the diameters-heights of the *Rhododendron ponticum* seedlings on both sites were carried out with regards to soil types, the temperature and the intensity of light on both sites and in the same type of soil in different sites and in different types of soil in the same site (Table 2), the relation between the diameter-height development differences and the differences in the intensity of light and temperature has been found to be strongly significant with a significance level of 0.000. The diameter development difference in different types of soils used was found to be strongly significant with a significance level of 0.000 as well as the height development, of which the significance level was 0.001. The diameter-height difference was found to be significant with a significance level of 0.059 in the same type of soil in different sites and in different types of soil in the same site.

The average values for the height and diameter development as well as the survival percentages of the *Rhododendron ponticum* seedlings on both sides are provided in Table 1. Accordingly, *Rhododendron ponticum* seedlings developed 90% better in the partial-shade site in terms of diameter-height as compared to the full-sun site. The result of the variance analysis showed that there are also differences in terms of diameter and height development in different types of soils on the same site. In addition, the diameter-height developments in the same type of soils on different sites were observed to be quite different from each other (Fig. 2).

A B

Figure 2. The diameter-height development of *Rhododendron ponticum* seedlings in peat soil (A, in partial-shade site; B, in full-sun site)

The measurements showed that the highest diameter-height development of the *Rhododendron ponticum* seedlings in partial-shade and full-sun sites occurred in the forest soil. The lowest diameter-height development occurred in the control soil in the full-sun site, whereas in the partial-shade site, the lowest height development occurred in peat and the lowest diameter development took place in the control soil.

Table 2 The results of the variance analysis showing differences in diameter-height development based on the growing site and soil type

Feature	Variation Source	Type III Total Squares	S. D.	Mean Squares	F-Rate	Significance
Medium Properties	Diameter	2,153	1	2,153	117,189	0,000
	Height	1337,237	1	1337,237	78,659	0,000
Soil Type	Diameter	0,362	2	0,181	9,840	0,000
	Height	261,951	2	130,967	7,704	0,001

Medium x Soil Type	Diameter	0,106	2	5,278E-02	2,872	0,059
	Height	95,343	2	47,672	2,804	0,063
Fault	Diameter	3,344	182	1,838E-02		
	Height	3094,093	182	17,001		
Total	Diameter	59,730	188			
	Height	24696,250	188			
Corrected Total	Diameter	6,005	187			
	Height	4769,866	187			

When the data on the survival percentages of the seedlings in both sites were evaluated, it has been found that 89% of the seedlings survived in the partial-shade site and 71% of them survived in the full-sun site. The survival percentage in the same site on different types of soils was also found to be different from each other. While the survival percentage in peat and control soil in the partial-shade area was 90%, this was measured as 88% in the forest soil. In the full-sun site, this value was found to be 75% in the forest soil, 73% in peat, and 35% in the control soil (Figure 3).

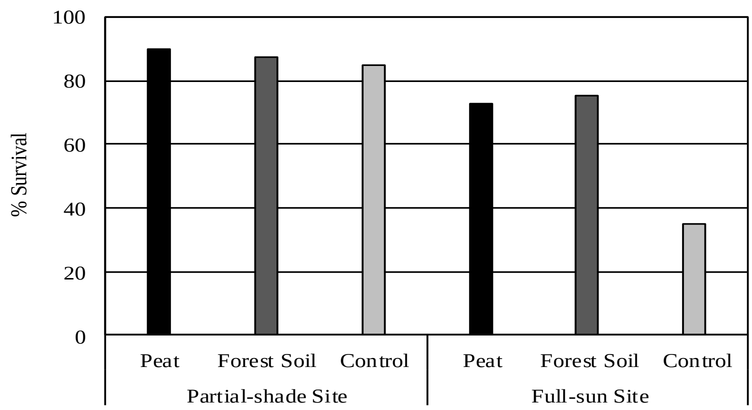

Figure 3. The comparison of the survival percentages of the *Rhododendron ponticum* seedlings in different soils on both sites

In the observations carried out in September, it was found that seedling deaths started on both sites and that of the deaths in the full-sun area, 71% occurred in the month of September and of the deaths in the partial-shade site, 53% of the deaths occurred in the same month. It has been observed that the death rate in October considerably reduced as compared to that in September.

The intensities of light, temperatures, and humidity on both sites were measured every hour and everyday starting from the month of September, during which the deaths started. Accordingly, it was found that light intensity was considerably higher in the full-sun site as compared to that of the partial-shade site (70% more). The light intensity was measured to drop by 50% in the full-sun site in October. In the partial-shade area, however, it was found that the difference between the intensities of light in two months was not big (Figure 4).

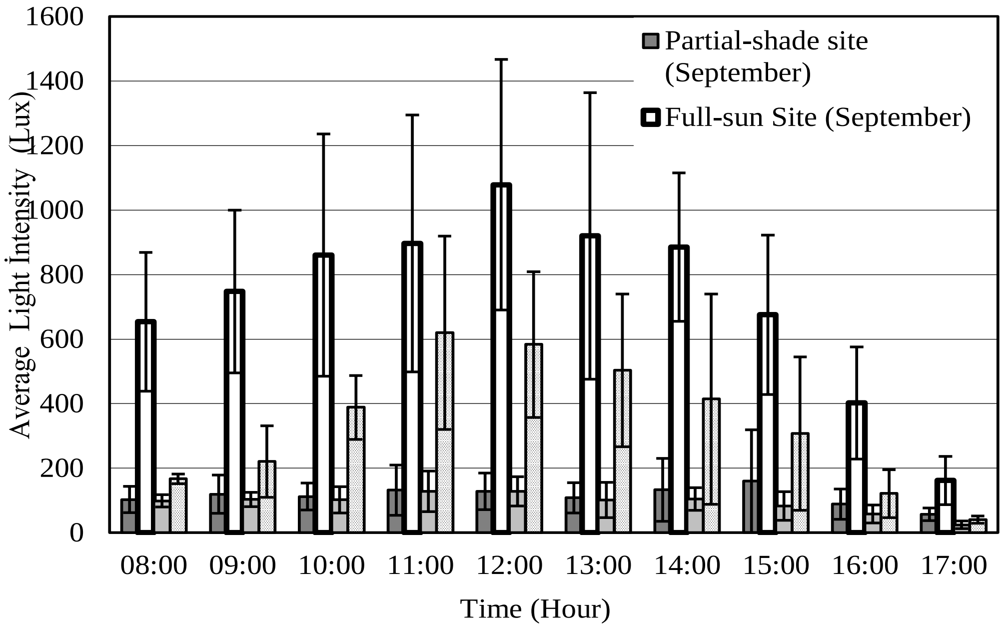

Figure 4. The comparison of the light intensity in both sites in September and October

The results of the air temperature measurements carried out every hour and everyday during the months of September and October showed that the air temperature in October was 7% lower on average than the air temperature in September. According to the results of the air humidity measurements carried out similarly in September and October, it was found that the average air humidity increased 18% in October (Figure 5).

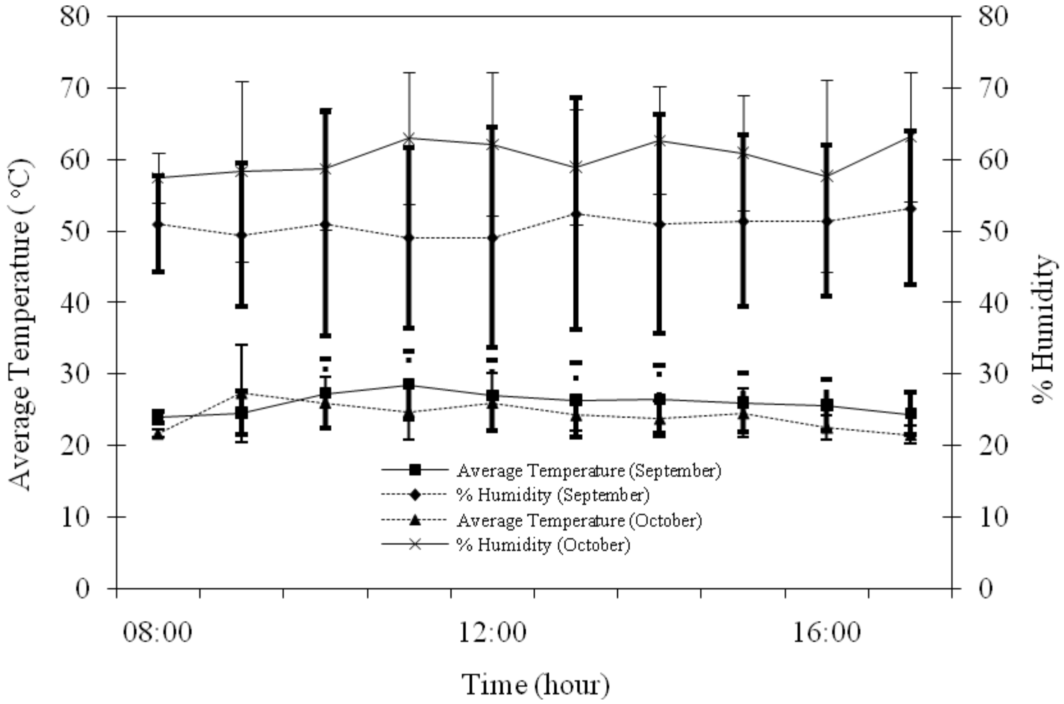

Figure 5. The results of average air temperature and humidity measurements in the months of September and October.

No deaths were detected between the months of October and December. The soil and air temperatures for these months were recorded 24 hours a day. The measurements showed that there was a gradual degrease in soil temperatures on both sites (Figure 6).

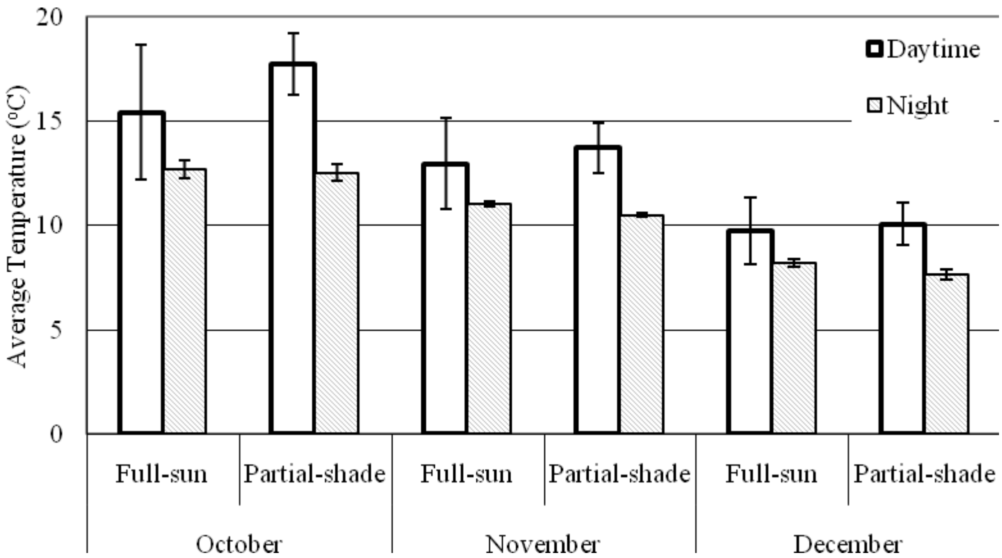

Figure 6. Average soil temperature changes during the months of October and December

It has been observed that the *Rhododendron ponticum* seedlings produced by seeds yielded flowers and seeds in the partial-shade area three years after their reproduction (Fig. 7).

Fig. 7 Seeding and flowering condition of *Rhododendron ponticum* in partial-shade area

DISCUSSION

The findings related to the identification of the effects of temperature, humidity, and light intensity on the adaptation of *Rhododendron ponticum* showed that the seedling survival percentage and diameter-height development in the full-sun site was considerably lower as compared to the partial-shade site.

Deaths were observed in both sites during periods when the light intensity and air temperature increased, however, this ratio was considerably higher in the full-sun site as compared to the partial-shade site. In relation to this, Beckett (1985), Reiley (1995), and Clarke (1982) stated that nearly all forest rose species prefer partial-shade areas, which do not get direct sunlight, and that this is of vital importance particularly in areas where the temperature is considerably high, the solar rays are vertical, and humidity is low. The measurements carried out during the periods when the seedlings deaths increased showed that although the intensity of light and air temperature increased, air humidity was considerably low.

The counts of the numbers of forest rose seedlings planted on both sites at the end of the first winter season they encountered showed that around 90% remained in the full-sun area whereas these measurements resulted only around 8% percent. This is in parallel to the study of Clarke (1982), in which it is stated that these vulnerable taxa can continue their development in their natural habitat, which areas are protected and covered with snows, and that there are barriers that protect them throughout the whole winter, and these natural barriers consisting of snows and other plants protect forest roses from high winds and cold.

Robinson (1980) stated that Purple Flowered *Rhododendron* blooms flowers after the age of 12. Similarly, Davis (1978) as well as Tabbush and Williamson (1987) stated that *Rhododendron ponticum* does not bloom flowers before the ages of 10-12 and that they do not yield seeds. However, in our present study, these forest-rose seedlings reproduced from the seeds that continued development in the partial-shade site produced both flowers and seeds after 3 full years from their first reproduction.

In summary, this study has found that *rhododendron ponticum* adapts better in soils rich in organic material and moist, where the pH is between 4.5 and 5.5 and in semi-shade sites where the humidity is high and the climate is mild, and that of the 120 seedlings planted, 55% bloomed within 3 years.

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