

A Study on Turkish *Rhododendron* L. (*Ericaceae*)

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Abstract: Some of the Turkish *Rhododendron* L. taxa need wood anatomical and palynological studies for their certain determination together with morphological studies. Therefore, some of them were studied and a revised list of them is given. New distribution areas of a newly recorded endemic variety of *Rhododendron ponticum* L. (*Rhododendron ponticum* L. subsp. *ponticum* var. *heterophyllum* Anşin) were determined: A7 Trabzon: Maçka, A8 Rize: Çamlıhemşin and A8 Artvin: Murgul, in addition to the already known A8 Trabzon: Of region. Morphological, wood anatomical and palynological features of very rare white-flowered specimens of *Rhododendron ponticum* L. were compared to the main taxa of *Rhododendron ponticum* L., with purplish-pink flowers, and *Rhododendron x sochadzeae* Charadze & Davlianidze, which has nearly the same colored flowers and a hairy ovary. The specimens of *Rhododendron ponticum* L. with white flower and a naked ovary, collected from Turkey, were studied for the first time from anatomical and palynological points of view and were determined to be a natural form of *Rhododendron ponticum* L. (*Rhododendron ponticum* L. subsp. *ponticum* forma album (Sweet.) Zab.).

Key Words: Wood Anatomy, Morphology, Palinology, Turkish *Rhododendron*, *Ericaceae*.

Türkiye Orman Gülleri (*Rhododendron* L.), (*Ericaceae*) Üzerine Bir Araştırma

Özet: Türkiye Orman Gülü taksonlarının kimileri kesin teşhislerinin yapılabilmesi için morfolojik özelliklerinin yanında odun anatomisi ve palinolojik yönden de araştırılmalıdır. Bu bakımdan, sorunlu taksonlar araştırılmış ve revize edilmiş listesi verilmiştir. Bu taksonlardan endemik olup, yakın geçmişte saptanan *Rhododendron ponticum* L. subsp. *ponticum* var. *heterophyllum* Anşin' un A8 Trabzon: Of yöresinden başka, A7 Trabzon: Maçka, A8 Rize: Çamlıhemşin ve A8 Artvin: Murgul yörelerinde de yayıldığı saptanmıştır. *Rhododendron ponticum* L.' un ender, beyaz çiçekli ve çıplak ovaryumlu bireyleri toplanmış, morfolojik, anatomik ve palinolojik yönden araştırılmıştır. Bu bireylere ait özellikler aynı türün mor çiçekli bireyleri ile kendisine yakın çiçek rengine ve tüylü ovaryuma sahip olan *Rhododendron x sochadzeae* Charadze & Davlianidze bireyleri karşılaştırılmıştır. Beyaz çiçekli ve çıplak ovaryumlu bu örnekler Türkiye' den toplanmış olup, bu bireylerin anatomik ve palinolojik özellikleri ilk kez çalışılmış; bireylerin *Rhododendron ponticum* L.' un doğal bir formu (*Rhododendron ponticum* L. subsp. *ponticum* forma album (Sweet.) Zab.) olduğu sonucuna varılmıştır.

Anahtar Sözcükler: Odun Anatomisi, Morfoloji, Palinoloji, Türkiye Ormangülleri, *Ericaceae*.

Introduction

Rhododendron L. of the *Ericaceae* is one of the largest genera of dicotyledons. According to Heywood (Heywood, 1978), there are about 700 species in the area of China, Tibet, Burma, Assam and Nepal; almost 300 species in New Guinea; many in Japan, tropical Asia from Indochina to Indonesia and the Philippines; while a small number occur in Europe and North America. The habitats of *Rhododendron* species also show a wide range, from low-mountain forests to alpine regions more than 4000 m high. The species are usually shrubs of low to medium height, sometimes dwarfed with creeping fine stems in alpine regions, while certain members in low-

mountain regions grow into fairly tall trees of about 30 m in height and 100 cm in diameter (Suzuki and Ohba, 1988; Noshiro and Suzuki, 1989).

Turkish *Rhododendron* species grow naturally from sea level to altitudes of 2500 (3100) m. They take the form of shrubs (*R. luteum* Sweet), dwarf shrubs (*R. caucasicum* Pallas) and large shrubs (*R. ponticum* L., *R. ungeronii* Trautv., *R. smirnovii* Trautv.). Leaves evergreen or deciduous, entire or serrate. Flowers in terminal racemes, usually 5, occasionally 6-10 merous. Corolla campanulate and slightly zygomorphic. Ovary 6-8 (5-9)-locular, stigma capitate. Fruit is a septicial capsule, seeds winged (Çolak, 1997; Davis, 1978; Anşin and Özkan, 1993).

In the latest studies, all Turkish *Rhododendron* plants consist of 5 species and 12 taxa, four of which are hybrids (Anşın and Terzioğlu, 1994; Milne et al., 1999).

Materials and Methods

All herbarium, wood and pollen samples were collected from the Black Sea region in Turkey. Plant samples were stored in KATO Herbarium (Karadeniz Technical University, Faculty of Forestry Herbarium). Wood and pollen samples were collected from Artvin: Kafkasör, 1359 m above sea level and Trabzon: Maçka, Sümela area, 900 m above sea level.

Stems from older parts of the plants were cut into pieces of ca. 1.5x1.5x1.5 cm, and immediately boiled in water to soften the tissues sufficiently for sectioning. Transverse, radial and tangential sections (20-25 micrometers) were obtained by using a sliding microtome and then the sections were stained in 1% aqueous safranin. Measurements of cell length were carried out on macerated materials (Schultze's method) with a calibrated ocular micrometer. Pollens of the purplish-pink and white flowered *R. ponticum* were collected on 1st June 1995. Pollen slides were prepared according to Wodehouse's method.

Results

In this study, the presence of the *Rhododendron ponticum* subsp. *ponticum* form album was established in Turkey. All the Turkish *Rhododendron* taxa were listed by taking in to account other studies.

Newly distribution areas of *R. ponticum* subsp. *ponticum* var. *heterophyllum* were found in A7 Trabzon: Maçka, A8 Rize: Çamlıhemşin and A8 Artvin: Murgul, in addition to A8 Trabzon: Of region.

According to morphological studies, it was found that *R. ponticum* has flowers of different colors. Spots of corolla changing from deep purplish-pink to pure white are arranged regularly. The colors of these spots vary from pink to orange. Some individuals have pure white and purplish-white flowers. However, pure white corollas and filaments have conspicuous purplish bases. White-flowered *R. ponticum* were collected from A8 Trabzon: Of, Kumludere village, 25 m above sea level (Terzioğlu, 16 May 1993, KATO: 10206). This locality is outside the natural distribution areas of *Rhododendron x sochadzeae*,

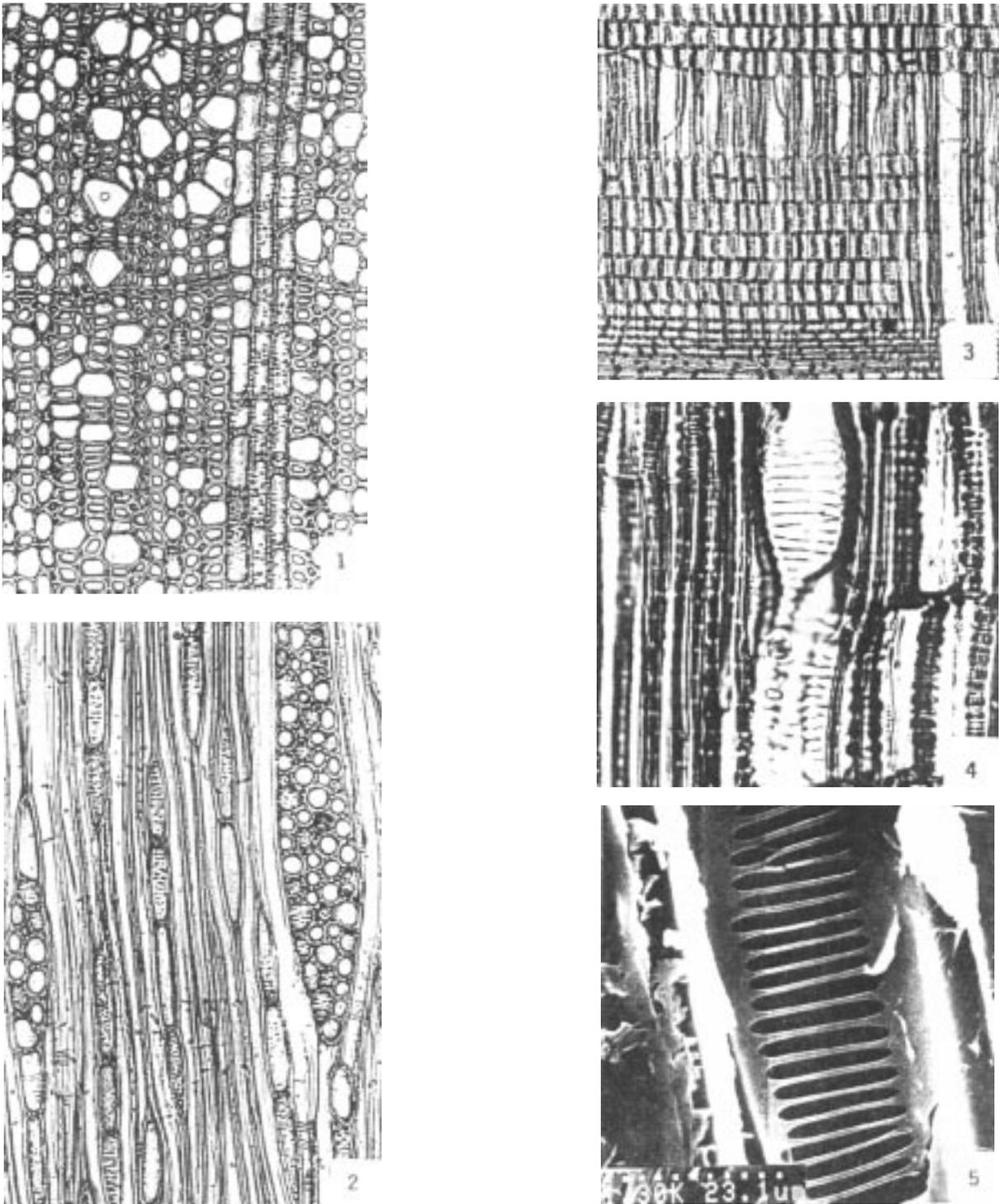
which also has white flowers. It is possible to see white-flowered *R. ponticum* 500-700 m above sea level, together with mixed-deciduous forest trees and other shrubs, especially with *R. luteum*.

Wood anatomical characters: Tangential vessel diameter, vessel element length, bar number per perforation plate, fiber length, width and wall thickness, multiseriate ray height and width, multiseriate ray in mm decrease with altitude (positive correlation), while pore density (pore number/1mm² in cross section) increases (negative correlation) with altitude (Merev and Yavuz, 2000). In this study, wood anatomical and palynological traits were studied in samples obtained from the same altitude, 900 m above sea level.

Generic description of wood: Wood diffuse-porous, growth ring boundaries distinct or indistinct. Pores evenly distributed without any tendency to a specific pattern, numerous (pores/sq. mm), very small to small (tangential diameters), outline angular, solitary and sometimes radial and tangential multiples (2-5 pore) in cross section. Vessel elements short with thin walls (1-1.25 microns), perforation plates mostly scalariform and sometimes both simple and scalariform (only *R. luteum*). Helical thickening present on the wall of the vessel elements but inconspicuous, usually restricted to ligulate ends. Imperforate tracheary elements intermediate or libriform fibers (few), fiber-tracheids (abundant) and tracheids. Libriform fibers with simple pits (sometimes extremely minute vestige of border observed on pits, sometimes inpitted).

Fiber-tracheids with distinctly bordered pits on the radial and tangential walls. Tracheids, here defined as tracheary elements, resemble narrow vessel elements but lack perforation plates or only have a single perforation plate or very reduced perforation. Parenchyma (axial) apotracheal-diffuse, very sparse, fusiform and strands of 2-4 cells. Rays heterogeneous I, II or I uniseriate and multiseriate. Crystals not observed in ray cells or parenchyma cells (Merev and Yavuz, 2000).

Some wood anatomical features: White-flowered *R. ponticum*: tangential diameter of vessels is 26.80 microns, vessel element length is 550.85 microns and fiber-tracheid length is 702.84 microns; purplish-pink flowered *R. ponticum*: Tangential diameter of vessels is 25.96 microns, vessel element length is 553.14 microns, fiber-tracheid length is 693.63 microns (Figures 1-5).

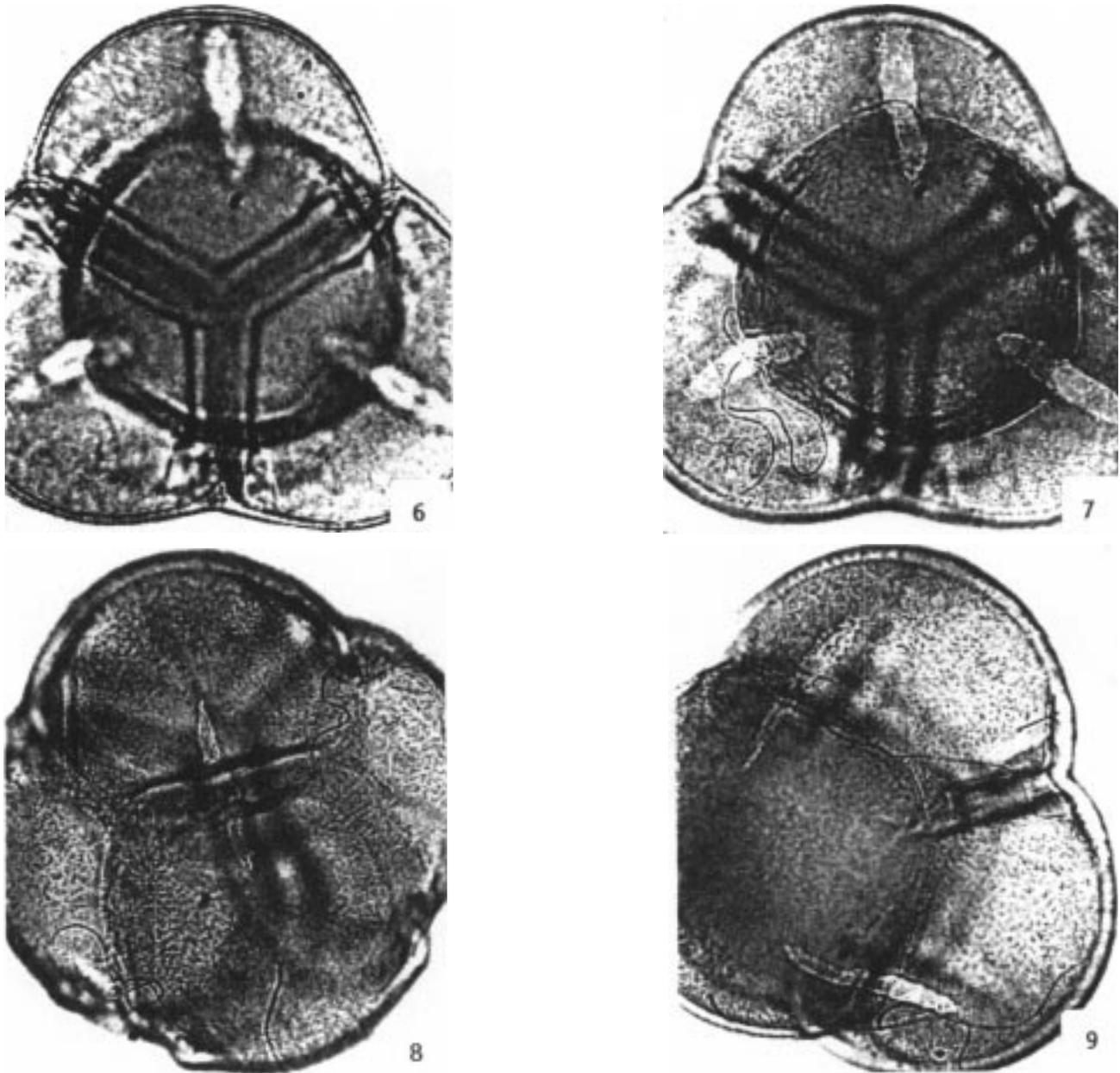


Figures 1-5. Wood of *Rhododendron ponticum* L. - 1: Cross section; wood diffuse porous, big cells = vessels, small cells = fibers, multiseriate ray on the right (x 200). -2: Tangential section; multiseriate ray on the right and left, procumbent cells on the core of multiseriate rays, upright or square cells on the uniseriate wing of multiseriate rays and uniseriate ray with upright cells (in center), and fiber cells in vertical direction (x 300). -3: Radial section; procumbent, square and upright cells in the ray (x 80). - 4: Radial section; scalariform perforation plate (above), upright cells with simple pits (on the right) (x 500). - 5: Radial section; scalariform perforation plates (SEM, 11 square = 23.1 microns).

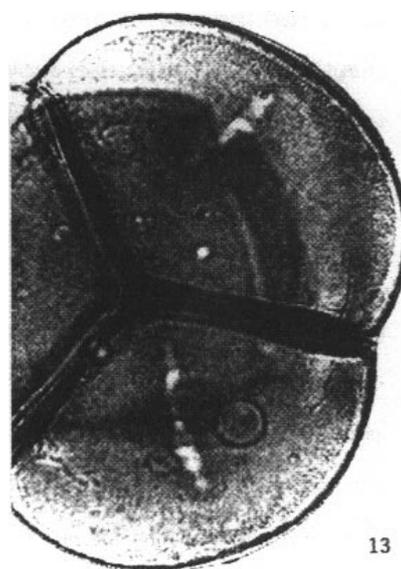
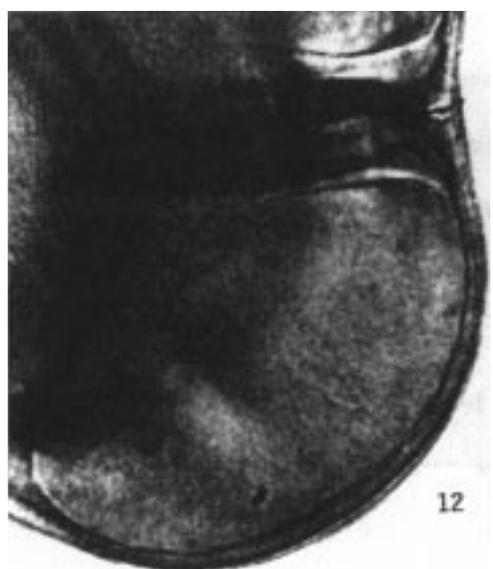
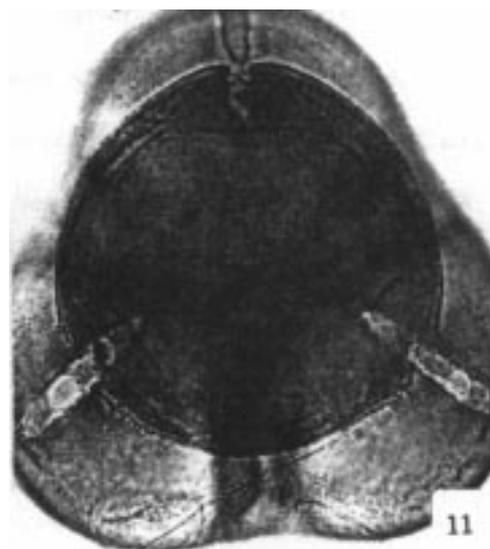
Pollens of *Rhododendron* are tetrad calymmate, and each of the tetrads is tricolporate. Type of tetrad pollen is spheroid and each one is subprolate. Texture of the pollen is tectate and the ectexine and endexine have two layers. Sculpture is fossulate in purplish-pink-flowered *R. ponticum* (Figures 6-9), and fossulate and lisse in white-flowered *R. ponticum* (Merev, 1995), (Figures 10-13). All the pollen dimensions of purplish-pink and white-flowered *R. ponticum* were measured (Table 1).

Discussion and Conclusion

According to morphological investigations, *Rhododendron ponticum* specimens with white flowers differ from *Rhododendron x sochadzeae* with their naked ovary and pure white flowers. Furthermore, these specimens have some other morphological features, such as height, leaves, fruits, and seeds in common with *R. ponticum* with purplish-pink flowers. Although it is mentioned that *R. ungerii*, *R. x sochadzeae* has white



Figures 6-9. Pollen grains of purplish-pink-flowered *Rhododendron ponticum* L. (Wodehouse). – 6: Optic section of tetrad, 7-9: - porus, colpus and exine ornamentation in surface view (x 1300).



Figures 10-13. Pollen grains of pure white-flowered *Rhododendron ponticum* L. forma *album* (Sweet) Zab. (Wodehouse). – 10: Optic section of tetrad, - 11: Surface view of pollen tetrad, - 12-13: Players of exine in optic section (Figs. 10-11 = x1300, 12-14 = x2300).

flowers, *R. ponticum* with white flowers is not mentioned in “Flora of Turkey and the East Aegean Islands” (Davis, 1978).

In terms of wood anatomy, there are no distinctly different traits between purplish-pink and white-flowered specimens of *R. ponticum* because of the homogeneous wood structure of *Rhododendron* species (Merev, 1995). Moreover, there are no extreme dimensions between the wood elements which characterized the wood of hybrid taxa. These characteristics make the white-flowered

taxon of *R. ponticum* different from *R. x sochadzeae*, which is a hybrid taxon and has extreme dimensions between its own wood elements.

The morphological features of these specimens of *R. ponticum* with flowers of two different colors have some differences. In particular, total length of tetrad pollen (M+), (lt), (lg), (clt) and (plg) have a 1% degree of significance according to the t test. Moreover, the sculpture of purplish-pink flowered ones is more conspicuous than that of white-flowered ones, but cracks

| Properties | Purplish-pink-flowered | | | White-flowered | | |
|------------|------------------------|------|-----|----------------------|------|-----|
| | x | S | n | x | S | n |
| M+ | 56.02-(48.75-61.50) | 2.75 | 100 | 62.40-(52.50-73.50) | 4.24 | 100 |
| lt | 39.20-(33.75-45.00) | 2.38 | 100 | 43.99-(37.50-52.50) | 3.16 | 100 |
| lg | 30.24-(26.25-34.50) | 1.42 | 100 | 32.81-(27.00-39.00) | 2.30 | 100 |
| f | 10.27-(6.75 -13.50) | 1.50 | 40 | 10.27-(7.50-13.50) | 1.19 | 40 |
| ct | 3.67-(1.50 - 5.25) | 0.86 | 30 | 2.75-(1.50 - 3.75) | 0.63 | 30 |
| plg | 4.27-(2.25 - 6.75) | 1.02 | 40 | 2.72-(1.50 - 3.75) | 0.50 | 30 |
| plt | 3.42-(1.50 - 5.25) | 0.87 | 30 | 2.72-(1.50 - 3.75) | 0.66 | 30 |
| pt | 28.85-(21.00-28.50) | 1.70 | 30 | 25.57-(20.25 -30.00) | 2.41 | 30 |
| Ex | 2.15 | - | 10 | 1.88 | - | 10 |

Table 1. Pollen dimensions (microns) of purplish-pink and white-flowered *Rhododendron ponticum* L. (*R. ponticum* L. forma album (Sweet.) Zab.) according to Wodehouse's method.

Legend for Table 1: M+: total length pollen tetrad, lt: width of a pollen in tetrad, lg: height of a pollen in tetrad, f: semi-length of colpus on a pollen in tetrad, ct: colpus width, plg: porus length, plt: porus width, pt: one side of triangle polar on a pollen in tetrad, Ex: exine.

in the endexine of purplish-pink flowered ones are less conspicuous than in the white flowered ones. White-flowered *R. ponticum* specimens do not have the abnormal pollens that characterize hybrid taxa. Consequently, the white-flowered *R. ponticum* distributed at lower altitudes differs from *R. x sochadzeae*, because of the features mentioned above and it is the natural form of *R. ponticum* (*R. ponticum* L. subsp. *ponticum* forma album (Sweet) Zab.) indicated by Merev (Merev, 1995) according to Davidian (Davidian,

1989). Other Turkish *Rhododendron* species distributed from sea level to 3100 m in the Black Sea region in Turkey include *R. luteum* from 110 to 2230 m, *R. ungeronii* from 900 to 2020 m, *R. smirnovii* from 1600 to 2230 m, *R. caucasicum* from 1900 to 3100 m, and *R. ponticum* from 5 to 2230 m (Merev and Yavuz, 2000).

Consequently, determining some of the Turkish *Rhododendron* taxa by their morphological features may be insufficient; their wood anatomical and palynological traits also need to be studied.

All Turkish *Rhododendron* taxa:

1. *Rhododendron luteum* Sweet
2. *Rhododendron ungeronii* Trautv.
3. *Rhododendron smirnovii* Trautv.
4. *Rhododendron caucasicum* Pallas
5. *Rhododendron ponticum* L. subsp. *ponticum* var. *ponticum*
6. *Rhododendron ponticum* L. subsp. *ponticum* var. *heterophyllum* Anşin
7. *Rhododendron ponticum* L. subsp. *ponticum* forma album (Sweet) Zab.
8. *Rhododendron ponticum* L. subsp. *baeticum* (Boiss. & Reut.) Hand.-Mazz. (suspicious record (Davis, 1978))
9. *Rhododendron x sochadzeae* Charadze & Davlianidze
(*Rhododendron ponticum* L. x *Rhododendron caucasicum* Pallas)
10. *Rhododendron x rosifaciens* R. Milne
(*Rhododendron smirnovii* Trautv. x *Rhododendron ungeronii* Trautv.)
11. *Rhododendron x davisianum* R. Milne
(*Rhododendron smirnovii* Trautv. x *Rhododendron caucasicum* Pallas)
12. *Rhododendron x filidactylis* R. Milne
(*Rhododendron ponticum* L. x *Rhododendron ungeronii* Trautv.)

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