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Perforated Ray Cells in Some Species of Korean Hydrangeaceae[1]

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韓國産 수국科 一部 樹種의 穿孔을 지니는 放射組織 構成細胞[1]

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ABSTRACT

Perforated ray cells are identified for the first time in the Korean species of *Deutzia glabrata*, *Deutzia sieboldiana*, *Hydrangea paniculata*, and *Philadelphus schrenckii* that belong to Hydrangeaceae but not observed in *Deutzia gracilis*. These ray cells have simple to scalarifrom perfora-tions in *Deutzia glabrata* which have vessel elements with scalariform perforations, and have scalariform to reticulate perforations in *Deutzia sieboldiana*, *Hydrangea paniculata*, and *Philadelphus schrenckii* which have vessel elements with scalariform perforations. Thus, the perforations of ray cells in Korean Hydrangeaceae appeared not to be exactly the same as the types of scalariform perforation plates in the vessel elements of same wood.

Key words : *perforated ray cells*, Deutzia, Hydrangea, Philadelphus, *Hydrangeaceae*.

要 約

本 硏究는 수국科의 물참대(댕강말발도리), 둥근잎말발도리(꽃말발도리), 나무수국 및 고광나무에 있어서 木部 放射組織내에 穿孔을 지니는 放射組織 構成細胞가 存在함을 처음으로 報告하는 것으로써 穿孔을 지니는 이들 放射組織 細胞는 導管要素에 發達하는 階段狀 穿孔과는 달리 물참대는 單一 내지 階段狀 穿孔을 그리고 나무수국, 둥근잎말발도리 및 고광나무는 階段狀 내지 網狀 穿孔을 지니는 것으로 밝혀졌다. 그러나 조사 수종 가운데 애기말발도리에서는 穿孔을 지니는 放射組織 構成細胞가 관찰되지 않았다.

INTRODUCTION

Perforated ray cells in the secondary xylem are derived from ray initials and are of the same dimensions or larger than the adjacent ray cells, but have perforation plates and lateral wall pitting like vessel elements (Carlquist, 1988; IAWA Committee, 1989). These ray cells with perforations connect a vessel on one side of a ray with a vessel on the opposite side of that ray (Bottoso & Gomes, 1982; Otegui, 1994), and were referred to as perforated ray cells by Chalk & Chattaway (1933) or as vascular ray cells by McLean & Richardson (1973). They may occur either individually or in radial or tangential rows, and radial rows of perforated ray cells with perforations in tangential walls have been described as radial vessels (van Vliet, 1976; IAWA Committee, 1989). The type of perforation in a perforated ray cell

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may be simple, scalariform, reticulate, or foraminate, and does not necessarily coincide with the type of perforation plate occurring in the vessel elements of the same woods (Rao *et al.*, 1984; IAWA Committee, 1989).

Since Chalk and Chattaway (1933) reported for the first time the occurrence of perforated ray cells in a number of families, this cell type has been commonly found in hardwoods : Carlquist (1960, 1982, 1983, 1989), Stern (1967), Koek-Noorman (1970, 1972), McLean & Richardson (1973), Koek-Noorman & Hogeweg (1974), Miller (1975), Nazma *et al.* (1981), Bottoso & Gomes (1982), Carlquist *et al.* (1983), Teixeira (1983), Dayal *et al.* (1984), Rao *et al.* (1984), Rudall (1985), Baas *et al.* (1988), Zhang & Baas (1992), Norverto (1993), Eom & Chung (1993, 1995, 1996), Eom (1994), Otegui (1994), and Nagai *et al.* (1994). Until recently, however, there have been no previous records of perforated ray cells in the Korean Hydrangeaceae.

This paper aims to report on the occurrence and type of perforated ray cells in Korean Hydrangeaceae.

MATERIALS AND METHODS

Five Korean hardwood species from genus *Deutzia*, *Hydrangea*, and *Philadelphus* belonging to Hydrangeaceae were investigated in the present study (Table 1). All are deciduous shrubs and the scientific names are based on Kim (1994).

Wood samples were obtained from the collections in Wood Anatomy and Physics Laboratory, Department of Forest Products, Kookmin University, Seoul and in Mt. Chiri located in the southern part of the Korean Peninsula.

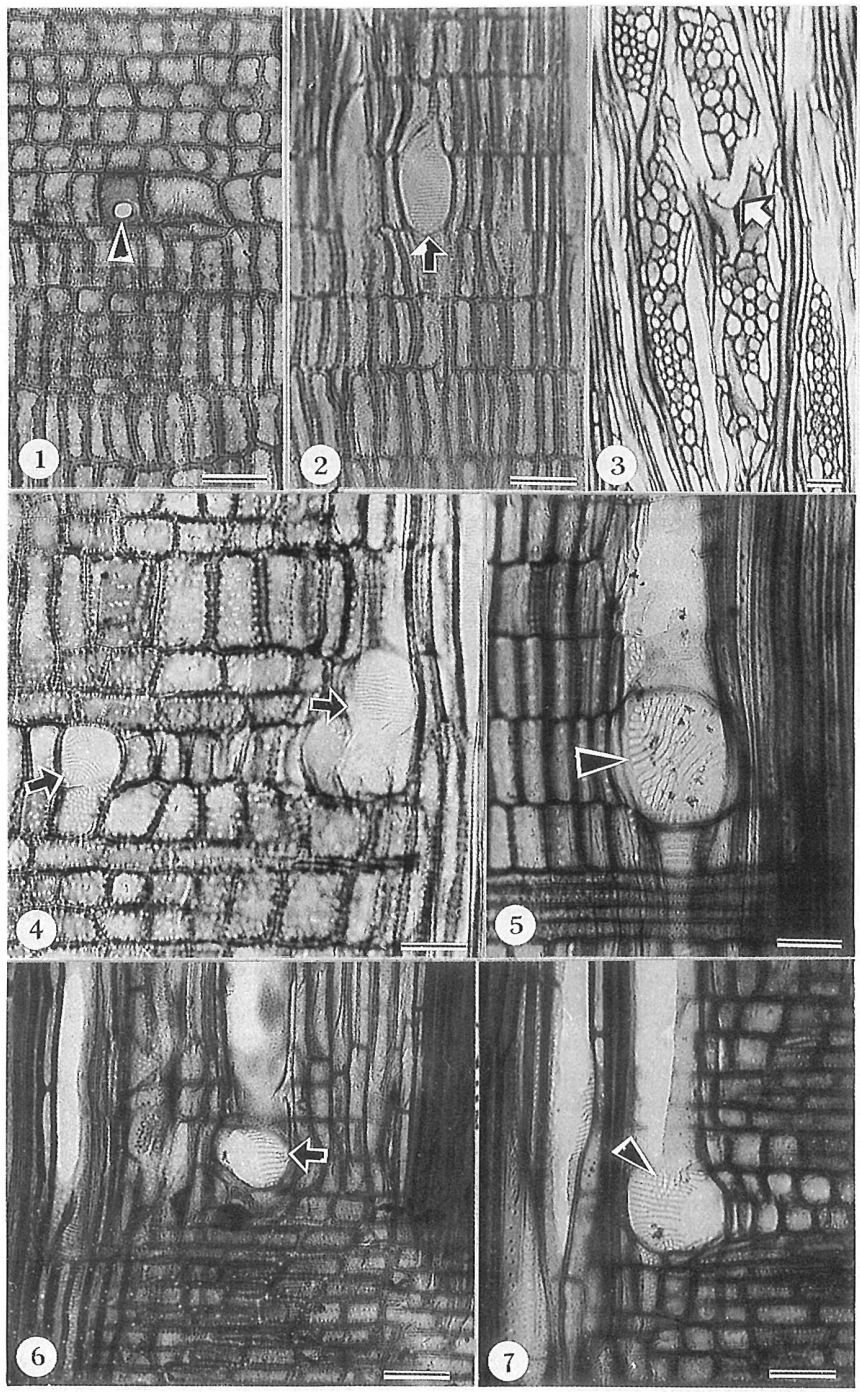
Their subdivided blocks of *ca.* 1cm^3 size were softened in water in an autoclave and immediately stored in a mixture of equal volumes of glycerine, ethyl alcohol, and water till sectioning (Berlyn & Miksche, 1976). From these blocks, transverse, radial, and tangential sections of 20 to 30 μm thickness were cut with a sliding microtome. Permanent slides were prepared after staining with safranine, dehydration in ethyl alcohol and xylene series, and mounting with Canada balsam (Japan Wood Research Society, 1985). The observation and photomicrography of perforated ray cells were made in the radial and tangential sections by the aid of Axioskop routine microscope with attachment camera, Carl Zeiss, Germany.

RESULTS AND DISCUSSION

Ray cells with perforation plates are identified for the first time in Korean Hydrangeaceae (Table 1). The perforated ray cells have perforation plates of simple to scalariform in *Deutzia glabrata* (Figs. 1 & 2) and scalariform to reticulate perforation in *Deutzia sieboldiana*, *Hydrangea paniculata*, and *Philadelphus schrenckii* (Figs. 4-7), and thus appeared not to be exactly the same as the types of scalariform perforation plates in the vessel elements of same woods. This is in agreement with the description that the perforation type in a perforated ray cell does not necessarily coincide with the type of perforation occurring in the vessel element of the same wood (Teixeira, 1983; Rao *et al.*, 1984; IAWA Committee, 1989; Otegui, 1994). However, the perforation plates in perforated ray cells may be identical with the types of perforation in the vessel elements of the same woods (Nazma *et al.*, 1981; Dayal *et al.*, 1984; Rudall, 1985; Eom and Chung, 1993, 1995; Eom, 1994). Recently, Nagai *et al.* (1994) suggest that the perforation plates are mostly dimorphic with the total area of the openings in the perforated

Table 1. Types of perforations in vessel elements and perforated ray cells in the xylems of Korean Hydrangeaceae.

Species	Vessel element	Perforated ray cell
Deutzia glabrata Kom.	scalariform	simple to scalariform
Deutzia gracilis Sieb. *et* Zucc.	scalariform	none
Deutzia sieboldiana Max.	scalariform	scalariform to reticulate
Hydrangea paniculata Sieb.	scalariform	scalariform to reticulate
Philadelphus schrenckii Rupr.	scalariform	scalariform to reticulate



Figs. 1 & 2. Perforated ray cells with simple (arrowhead) to scalariform (arrow) perforation.-**Fig. 3.** Perforated ray cells (arrow) in multiseriate ray.-1-3 : *Deutzia glabrata* Kom.-**Figs. 4-7** : Perforated ray cells with scalariform (arrow) to reticulate (arrowhead) perforation.-4 : *Deutzia sieboldiana* Max.-5 : *Hydrangea paniculata* Sieb.-6-7 : *Philadelphus schrenckii* Rupr.-1, 2 & 4-7 : radial surface.-3 : tangential surface.-Scale bars = 50 μm.

ray cells smaller than the perforation plates in vessel element ends.

Perforated ray cells in Korean Hydrangeaceae usually have perforation plates in their radial walls (Figs. 1-2 & 4-7), and ray splitting is correlated with the development of perforated ray cells (Fig. 3). The ray cells with perforations in their radial walls are considered to connect two longitudinal vessel elements in tangential direction (Teixeira, 1983; Eom & Chung, 1993, 1996), and sometimes are found in woods in which breakup of large rays into smaller segments is occurring actively (Carlquist, 1988; Otegui, 1994; Eom and Chung, 1995). These perforated ray cells are believed to connect a vessel element on one side of a ray with a vessel element on the opposite side of that ray (Botosso & Gomes, 1982; IAWA Committee, 1989).

Ray cells with perforations in Korean Hydrangeaceae are generally much larger than the surrounding ray cells (Figs. 1, 2 & 4-7) as reported by Eom (1994) and Eom and Chung (1995, 1996), although in other species they usually are the same dimensions or larger than the adjacent cells (IAWA Committee, 1989; Eom and Chung, 1993; Nagai *et al.*, 1994).

The diagnostic value of these perforated ray cells has been discussed by several researchers. Dayal *et al.* (1984), Rudall (1985), IAWA Committee (1989), and Eom and Chung (1996) describe that the presence or absence of perforated ray cells is not useful in wood identification due to their sporadic occurrence. However, Otegui (1994) insists that perforated ray cells in *Rapanea laetevirens* and *Rapanea lorentziana* of Myrsinaceae have a diagnostic value due to their regular occurrence. Absence of perforated ray cells may be due to chance because they are of irregular occurrence. To our knowledge, there have been no previous records of perforated ray cells in Korean Hydrangeaceae, so the occurrence of this feature may be variable and of minor diagnostic significance in this family.

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