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The Distribution and Type of Crystals in Woods of *Ginkgo biloba* L. *and Abies holophylla* Max.*1

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은행나무와 젓나무材에 있어서의 結晶 分布 및 形態*1

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要 約

은행나무의 異形細胞와 젓나무의 放射柔細胞에서 結晶이 確認되었는데 은행나무에서는 集晶만이 觀察된 반면 젓나무에서는 多面體形, 柱晶 및 針晶의 3종류가 觀察되었다. 이러한 結晶은 일반적으로 자주 觀察되었기에 樹種識別의 한 因子가 될 수 있는 것으로 여겨졌다.

INTRODUCTION

Crystals in softwoods were known to occur only in the Pinaceae in the form of exceedingly small cubes, octahedral, or rectangular prisms and were believed to be of no diagnostic significance due to their sporadic occurrence by Panshin and de Zeeuw(1980)[7] contrary to the earlier description by Core, Côté, and Day(1979)[2] that these crystals might be used as a diagnostic guide in wood identification.

In some *Abies* species indigenous to Canada and the United States, Kennedy, Sastry, Barton, and Ellis(1968)[5] found crystals of rhomboidal and elongated forms mainly in the marginal ray parenchyma cells. These crystals were also observed in ray parenchyma cells of *Picea sitchensis* by Sudo(1968),[8] and Core, Côté, and Day (1979)[2] reported that rhomboidal and rectangular crystals were rather common in some species of *Abies*. Panshin and de Zeeuw (1980)[7] also described that crystals were present only in ray parenchyma of North American softwoods, but found even in longitudinal tracheids of Eastern Asian, monotypic genus *Pseudolarix*. Recently, Wheeler, Pearson, LaPasha, Zack, and Hately (1986)[10] reported crystals in ray cells of *Abies, Cedrus, Keteleeria, Picea,* and *Pseudolarix*.

In Korean softwoods, Lee and Eom(1987)[6] have reported merely the presence of crystals in *Ginkgo biloba* L. and *Abies holophylla* Max. As a detailed research on the crystals in the above species, therefore, their type and distribution were investigated and discussed.

MATERIALS AND METHODS

The wood samples of *Ginkgo biloba* L. and *Abies holophylla* Max. were selected from collections in Wood Anatomy Laboratory, Department of Forest Products, College of Agriculture, Seoul National University, Suwon, Korea.

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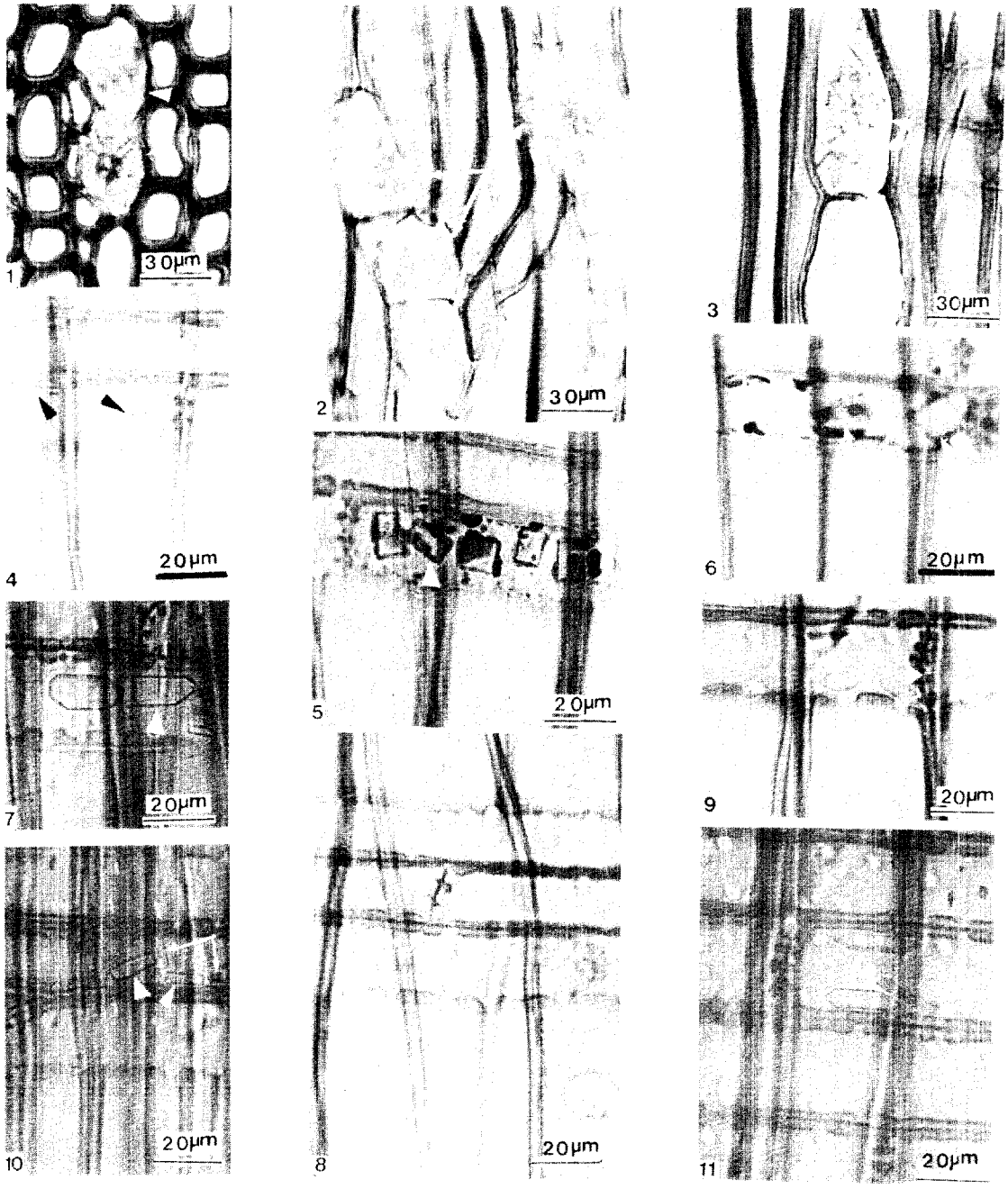

Fig. 1. Transverse section of *Ginkgo biloba* L. which shows druses in idioblasts (▲) formed by metamorphosis of strand of axial parenchyma. Fig. 2 and 3. Radial sections of *Ginkgo biloba* L. showing one (⬆) and two (▲) druses in idioblasts respectively. Fig. 4-9. Radial sections of *Abies holophylla* Max. showing aciculars (▲), polyhedral crystals of rectangular (▲) and square (⬆), polyhedral crystals of rhombic (▲) and hexahedral (⬆), polyhedral crystals of pentahedral (▲) and octahedral (⬆), polyhedral crystal of hexahedral (▲), and polyhedral crystals of hexahedral (▲) and heptahedral (⬆) in the marginal ray parenchyma cells respectively. Fig. 10 and 11. Radial sections of *Abies holophylla* Max. showing styloids with square ends (▲) and polyhedral crystals of rectangular (⬆), and styloids with pointed ends (▲) in the inner ray parenchyma cells respectively.

Wood blocks of ca. one cubic centimeter size were cut from the selected samples and soaked in water for one month, and thereafter softened in autoclave with water for 90 minutes and stored in the mixture of equal volumes of ethyl alcohol, glycerine, and water till sectioning (Berlyn and Miksche, 1976).[1] Cross, radial, and tangential sections, 15-20μm thick, were cut with sliding microtome and finally permanent slides were mounted with Canada balsam after staining with safranine and dehydration with ethyl alcohol and xylene (The Japan Wood Research Society, 1985).[9]

RESULTS AND DISCUSSION

In this study, the types of crystals of acicular, druse, and styloid followed the classification by International Association of Wood Anatomists (IAWA; 1964),[4] and the other types of crystals not exceeding about four times as long as broad were termed as polyhedral crystals by authors.

In *Ginkgo biloba* L., only druses were observed in idioblasts formed by metamorphosis of strand of axial parenchyma (Fig. 1), and each idioblast contained mostly one druse (Fig. 2) but occasionally two druses (Fig. 3). These druses in idioblasts of *Ginkgo biloba* L. were already reported by Hirai (1979)[3] and Lee and Eom(1987).[6]

Morphologically various types of crystals were observed in ray parenchyma of *Abies holophylla* Max. The polyhedral crystals were most commonly found and styloids were observed somewhat frequently. Aciculars (Fig. 4), however, were limited in some instances. In the type of polyhedral crystals, the most common shape was rectangular (Fig. 5 and 10) but square (Fig. 5), rnombic (Fig. 6), pentahedral (Fig. 7), hexahedral (Fig. 6, 8, and 9), heptahedral (Fig. 9), and octahedral (Fig. 7) shapes were also observed sometimes. On the other hand, the styloids were divided into two morphology groups with pointed (Fig. 11) or square ends (Fig. 10). These crystals in *Abies holophylla* Max. were observed mainly in the marginal ray parenchyma cells (Fig. 4-9) but their presence in the inner ray parenchyma cells (Fig. 10-11) were identified occasionally. In a ray parenchyma cell, more than two crystals were usually contained (Fig. 4-7 and 9-11) but there were instances where one crystal was included (Fig. 8).

In the investigation of crystals in genus *Abies* indigenous to Canada and the United States, Kennedy, Sastry, Barton, and Ellis (1968)[5] reported crystals of rhomboidal and elongated forms were regulary and mainly found in the marginal ray parenchyma cells of *Abies bracteata*, *Abies procera*, *Abies grandis*, *Abies magnifica*, and *Abies concola*. Core, Côté, and Day (1979)[2] also reported that crystals of rhomboidal and rectangular shapes were rather common in some species of *Abies*, and these crystals might be used as a diagnostic criterion in wood identification differently from the conclusion by Panshin and de Zeeuw(1980)[7] that crystals were of no diagnostic guide because of their sporadic occurrence. In reference manual for computer-aided wood identification, Wheeler, Pearson, LaPasha, Zack, and Hately (1986)[10] recommended these crystals in ray parenchyma of softwoods as a feature to be used positively (present) only. Based on our observation in this study, these crystals were believed to be of diagnostic significance due to their regular and frequent occurrence both in *Ginkgo biloba* L. and *Abies holophylla* Max.

CONCLUSIONS

In *Ginkgo biloba* L., only druses were observed in idioblasts and each idioblast usually contained one druse. However, three types of crystals of polyhedral, styloid, and acicular were encountered mainly in the marginal ray parenchyma cells of *Abies holophylla* Max., in which polyhedral crystals of rectangular shapes and styloids were common and each ray parenchyma cell generally contained more than two crystals.

Because of regular and frequent occurrence of crystals both in *Ginkgo biloba* L. and *Abies*

holophylla Max., these crystals were believed to be of diagnostic guide in wood identification.

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