



Original Article

Anatomical Features of *Scutellaria tonkinensis* Doan in Vietnam

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Abstract: *Scutellaria* L. is a genus of flowering plant in the Lamiaceae. The genus includes about 350 species commonly known as skullcaps. *Scutellaria* is widespread in temperate regions and tropical mountains, including Europe, North America, and East Asia. 15 species belonging to *Scutellaria* genus were recorded in Vietnam. The perennial herb *Scutellaria tonkinensis* Doan is an endemic species of Vietnam and was recorded in Lao Cai and Vinh Phuc provinces. In this study, anatomical characteristics of this species using double-staining method have been investigated. The anatomical characteristics indicate that *S. tonkinensis* Doan adapts to a habitat with high moisture and intensive insolation.

Keywords: *Scutellaria*, *Scutellaria tonkinensis* Doan, Lamiaceae, Vietnam, anatomy.

1. Introduction

Scutellaria L. is a genus of flowering plant in the Lamiaceae. *Scutellaria* is called Thuan or Hoang cam in Vietnamese. The genus includes about 350 species commonly known as skullcaps. *Scutellaria* is widespread in temperate regions and tropical mountains, including Europe, North America, and East Asia [1]. 15 species belonging to *Scutellaria* genus were recorded in Vietnam [2, 3]. Two species of *Scutellaria* are endemic in Vietnam [2]. Some *Scutellaria* species have been used in traditional medicine in many cultures [4]. Although *Scutellaria* species are potential

sources for biologically active substances, researches on them are not many. One of the endemic species in Vietnam as *S. tonkinensis* Doan, which is distributed in Lao Cai (Sa Pa) and Vinh Phuc (Tam Dao). They have been recorded to grow in sunny and moist areas, such as forest edge or roadside, at altitude more than 1,000 meters. The study was conducted with aim to understand the anatomical delimitation of *Scutellaria tonkinensis* Doan in a better way.

2. Material and Methods

The specimens of *S. tonkinensis* Doan were collected in Tam Dao National Park, Vinh Phuc province in the North of Vietnam in the year of 2017, 2018, and 2019. Efforts were made to collect both flowering and fruiting specimens for studying morphological characteristics. Collecting samples was performed according to

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Nguyen Nghia Thin [5]. No. of specimens studied as TX361 that have been keeping in Herbaria of Hanoi University.

The double-staining method was used to study root, stem, and leave structures, according to F. David Cutler, Ted Botha, Wm. Dennis Stevenson [6] and Nguyen Khoa Lan [7].

3. Results

3.1. Root

The cross section is circular. The outermost is epidermis with long hirsute that possess efficient in absorption (Figure 1, 3, 4). More root absorbent hairs were observed, which increases the contact area between the roots and soil, leading increases the ability to absorb water and nutrients. Radial vascular bundle has polyarch protoxylem and is located in the middle of the root (Figure 1: 1, 2). Xylem

develops from the outside inwards towards the center (exarch). Parenchyma consists of polygonal cells with large intercellular space, allowing water to be absorbed efficiently. Casparian strip was observed to expand ???, which plays the role in regulatory of water absorption Figure 1: 6).

Comparing secondary root to primary root revealed that transport system has developed completely. From outside to inside, there are epidermis, parenchyma, sclerenchyma, endodermis, phloem, and xylem (Figure 1: 5, 6). Parenchyma consists of multi-layer of diverse cells with large intercellular space. Vascular bundle is concentric, and periphloematic. Endodermis is impregnated with casparian strip to restrict apoplastic flow of water to the inside. Sclerenchyma, gathering perpendicularly to some spots outside the phloem, plays the role of mechanical support.

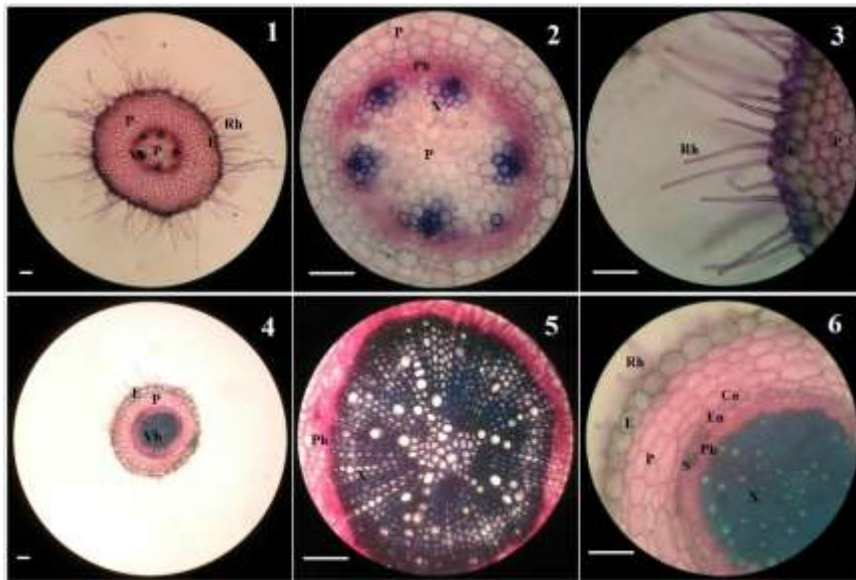


Figure 1. The transverse section of the root of *S. tonkinensis*.

Ca: Casparian strip; E: epidermis; En: endodermis; P: parenchyma; Ph: phloem; Rh: root hirsute; S: sclerenchyma; Vb: Vascular bundle; X: xylem. Bar = 100 μ m.L

3.2. Stem

The cross section of primary stem is square with a parallel convex side pair (Figure 2: 1, 5). This is the most recognizable feature of

Lamiaceae species. Epidermis contains needle-shaped multicellular trichomes and glandular trichomes and is covered by a thin layer of cuticle (Figure 2: 3, 4, 8). The epidermis includes uniseriate small polygonal cells arranged

regularly in a single layer (Figure 2: 7). Collenchyma cells concentrate in 4 corners, contributing to the rigidity of stem (Figure 2: 5). It's relatively similar to the stem structure of *S. barbata* (Do Thi Lan Huong) [8]. Vascular bundles are collateral open and located at 4 corners. Parenchyma in the center consists of big polygonal cells (Figure: 2, 6).

Secondary stem with xylem is arranged around the stem. Vascular cambium is located between xylem and phloem. Cortex parenchyma has relatively large intercellular space. That allows the plant to adapt to wet

environment (Figure 2: 7, 8) (Nguyen Khoa Lan; Nguyen Ba) [7, 9]. Besides, sclerenchyma has been formed and arranged exteriorly along phloem at 4 corners and in convex sides, contributes to rigidity of the stem.

In many cases, parenchyma matures very early and stops growing. In contrast, the surrounding has the properties of nascent tissue, which further expands horizontally and vertically. Therefore, the middle part of the plant may expand gradually and form a hollow plant (Figure 2).

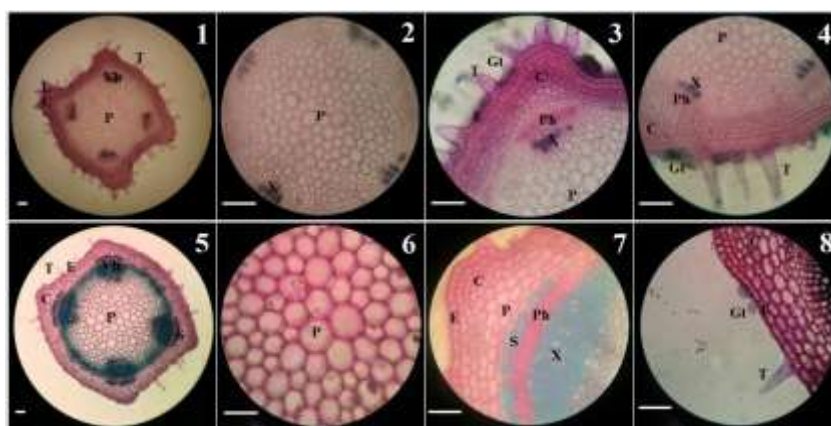


Figure 2. The transverse section of the stem of *S. tonkinensis*.

C: collenchyma; E: epidermis; Gt: glandular trichome; P: parenchyma; Ph: phloem; S: sclerenchyma;

Vb: Vascular bundle; T: trichome; X: xylem. Bar = 100 μ m.

3.3. Leaf

- Leaf blade: Leaf surface is covered by a multicellular needle-shape trichomes and glandular trichomes (Figure 3: 2, 4). Leaf trichomes are similar to stem trichomes. Cuticle is thick, restricting the evaporation in order to adapt to extensive insolation (Nguyen Khoa Lan, 1996; Nguyen Ba; C. William Dickson; T. William Penfound) [7, 9, 10, 11]. Upper epidermis consists of large cells arranged regularly (Figure 3: 1, 3). Mesophyll region is composed of 2 layers of elongated rectangular palisade cells and 3-6 layers of irregular spongy cells with large intercellular space (Figure 3: 3).

That indicates that the plant is a heliophyte (William C. Dickson; William T. Penfound) [10, 11]. Lower epidermis consists of small cells (Figure 3: 1, 3, 4)

- Leaf vein: Leaf vein is convex in the lower side and slightly convex or straight in the upper side. Outermost layer is epidermis covered by trichomes. Below epidermis in lower side, there are 1-2 layers of collenchyma, contributing the rigidity. Next is parenchyma with polygonal cells and large intercellular space. There is an open vascular bundle in the center of the vein that plays the role of transportation (Figure 3: 1, 2).

- *S. tonkinensis* have anatomical characteristics that allow them to adapt to a habitat with intensive insolation. Trichomes cover all surface of stem and leaf along with thick cuticle in leaf that prevents evaporation of water from the epidermal surface under the sunlight. In addition, relatively developed intercellular space system provides them ability to grow in a habitat with abundance of watersources .

The humid and heliophyte plants usually grow in moist grasslands, amongst them mostly are herb species (Nguyen Khoa Lan) [7]. When investigating the distribution of *S. tonkinensis* in nature, individuals of *S. tonkinensis* were recorded often along the forest path, where there is a lot of light, and near water sources.

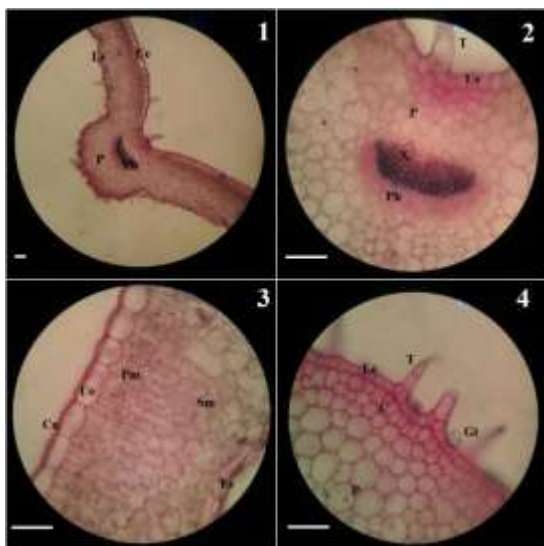


Figure 3. The transverse section of the leaf of *S. tonkinensis*.

Cu: Cuticle; Gt: glandular trichome; Le: lower epidermis; P: parenchyma; Ph: phloem; Pm: palisade mesophyll; Sm: spongy mesophyll; T: trichome; Ue: Upper epidermis; V: Vascular bundle; X: xylem.
Bar = 100 μ m.

4. Conclusion

- *S. tonkinensis* Doan has squarred stem cross-section. Stem vascular bundles are

collateral open and locate at 4 corners. Secondary root cross-section is radial and has a radial vascular bundle locates in the center. Xylem in root develops from the outside inwards towards the center (exarch). Leaf has 2 layers of elongated rectangular palisade cells and 3-6 layers of irregular spongy cells with large intercellular space. Collateral open vascular bundle is located in the center of the leaf vein.

- *S. tonkinensis* Doan adapts to a habitat with high moisture and intensive insolation.

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