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Analysis of Stem Anatomical Structure in Tomato (*Solanum lycopersicum*)

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Abstract

The tomato plant (*Solanum lycopersicum*) is native to the Americas, from the area around Mexico to Peru. Tomato stems, although not as hard as perennial plants, are quite strong. The color of the stem is green and is rectangular to round. This study aims to understand the structure and function of tomato stems in detail. The research method as well as analyzing the structure of tomato stems using descriptive methods. The research is descriptive analysis. Sampling was carried out at 16.00 WIB and only used one sample of tomato plant species and then made observations using a microscope with the help of section preparations. The data analysis technique used is a qualitative descriptive analysis model, where the model is included in the type of qualitative research described descriptively. The results showed that young tomato (*Solanum lycopersicum*) stems observed through a microscope with a magnification of 10x can be seen that only the epidermis, the cortex area (without being able to distinguish the tissue contained in the area), the transport tissue (without being able to know the location of xylem, phloem and other tissues) and the pith area where in this area the perenkim tissue is clearly visible.

Keywords: Stem Anatomy, *Solanum lycopersicum*, Plant Tissue

A. Introduction

The tomato plant (*Solanum lycopersycum*) is native to the Americas from the area around Mexico to Peru. Tomatoes spread throughout the tropics of America as weeds through seed-eating bird droppings. The spread in Indonesia itself was brought by the Dutch (Pracaya, 2012). Tomatoes are a type of vegetable that is widely used in cooking or consumed as fruit. Tomatoes contain many nutrients that are beneficial to the human body (Rugayah, Windadri, & A, 2004). Tomato stems, although not as hard as perennial plants, are quite strong. The stem is green in color and rectangular to round in shape. The surface of the stem is overgrown with many fine hairs, especially on the green part. Among these hairs there are usually glandular hairs. The books are thickened and sometimes there are short roots at the bottom of the books. If left untrimmed, medicinal plants will have many branches that spread evenly. Like other dicotyledonous plants, tomato plants have side roots that extend into the soil (Trisnawati & Setiawan, 2005).

Stems in dicotyledonous plants have some distinctive features that distinguish them from monocotyledonous plants. These characteristics include a generally round or cylindrical shape, diverse branching, varied surfaces, the presence of books and internodes, as well as structures that have cambium and concentric arrangement of xylem and phloem. Plant anatomy is a branch of biology that studies the physical structure of plants under a microscope. Anatomy itself is also called dissection, which is the study of the structure and function of parts of living things. a more detailed discussion of each plant structure through vertical or horizontal incisions observed with a microscope (Naisila, Kholimah, Chairunnisa, & Viratama, 2023).

Research on the anatomical parts of tomato stems aims to understand the structure and function of tomato stems in detail. Through this research, the internal structure of the tomato stem, including the epidermis, cortex, stele, and pith, can be studied, as well as understanding the function of each part. This study also observed the anatomical structure of tomato stems in young stems.

B. Literature Review

Tomato plants are classified as follows: Kingdom: Plantae, Subkingdom: Tracheobionta, Super Division: Spermatophyta, Division: Magnoliophyta, Class: Magnoliopsida, Sub Class: Asteridae, Order: Solanales, Family: Solanaceae, Genus: Solanum, Species: *Solanum lycopersicum* (Tugiono, 2005) in (Gultom, 2018). Tomatoes (*Solanum lycopersicum*) are members of the Solanaceae family with taproots, square to round stems with trichomes on the surface, compound leaves with oval-shaped leaf blades with serrated edges and trichomes on the surface and stalk, yellow star-shaped flowers, round fruits, flat round seeds (Nurmalasari & Ami, 2021).

One of the most important parts of a plant is the stem, which is positioned above ground level. Inside the seed is an institutional stem that will develop into a stem. The growing point of the stem comes from the apical meristem on the stem. The stem is above the ground as a support and support for other plant parts, such as leaves, flowers, and fruit. Stems can expand the field of photosynthesis by branching the stem (Rahman, 2022) in (Nurdiana, 2020). On several stems of *Solanum lycopersicum*, epidermal derivative in the form of trichomes were found. Trichomes or fine hairs derived from the epidermis appear and are found on the outer surface of almost all plant organs. Trichomes in epidermal tissue act as a protective force against various types of insects, which is determined by the presence of glands (glandula) or not (non-secretory), density, length, shape and firmness of the trichomes. The trichomes on Solanum lycopersicum stems are non-glandular, needle shaped trichomes (Mardhiyah & Ismail, 2024).

Roots that carry nutrients and minerals from the soil are directly connected to the stem organ which is responsible for transferring nutrients from the roots to the leaves to continue the photosynthesis process. In addition, the stem is attached to the leaves so that it plays a role in spreading and recycling the results of photosynthesis from the leaves to all parts of the plant body through the transport network, namely, Xylem and phloem which are also found in the roots and leaf bones in plants. In addition to transporting nutrients from roots to leaves and photosynthetic products from leaves to all parts of the plant, the stems of many types of plants also function as a storage area for food reserves such as sweet potatoes and ketang (Rahman, 2022).

As plants are differentiated into groups of dicots and monocots, then the stem is also in golongkan into groups of dicots and monocots. Stems that experience woody growth generally occurs in dicotyledonous plants while, in monocotyledonous plant stems do not experience woody growth. This is because in the stem of dicotyledonous plants there is part of the cambium. Meanwhile, monocotyledonous plants do not have cambium (Rahman, 2022) in (Riandari, 2007).

C. Methodology

1. Research Design

To determine the anatomical structure of the tomato stem (*Solanum lycopersicum*), the research method as well as analyzing the structure of the tomato stem using descriptive methods. The research is descriptive analysis. Sampling was carried out at 16.00 WIB and only used one sample of tomato plant species and then made observations using a microscope with the help of section preparations. The plant section method can be used on all plants that will be used as preparation objects.

At the time of the research, the data analysis technique used was a qualitative descriptive analysis model, where the model was included in the type of qualitative research described descriptively. Qualitative research methods emphasize the aspect of in-depth understanding of a problem or problem rather than seeing problems to be generalized. Descriptive research is a form of research aimed at describing existing phenomena, both natural and man-made phenomena. The phenomenon can be in the form, activity, characteristics, changes, relationships, similarities, and differences between one phenomenon and another (Rusandi & Rusli, 2022). In this case, it explains the parts of the anatomy of the tomato stem (*Solanum lycopersicum*) that have been observed descriptively.

2. Instruments

One of the plants that can be used as an object in plant section method preparations is the stem of the Tomato plant (*Solanum lycopersicum*). Tools and materials used in this study include glass rod, pipette, object glass (preparation), cover glass, distilled water, and microscope. The parameters observed were the structure of tomato stem tissue, vessel bundles, and the type of dicotyledonous or monocotyledonous stem.

3. Technique of Data Analysis

One technique in making preparations is using the section method on plants. Plant section preparation is a method of making microtechnical preparations intended for large and thick objects in plants, so that their tissues and cells can be seen under a microscope (Moebadi & Yudani, 2011). The quality of microtechnical preparations of the plant section method is the quality of microtechnical preparations that are adjusted or determined based on the purpose of making section preparations. The purpose of making plant section preparations is to be able to observe the structures of tissues and cells of plants/animals in the form of cross-sectional or longitudinal slices (Wahyuni, 2013).

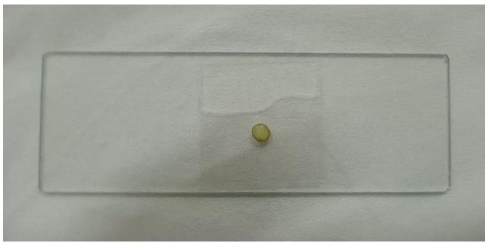

Figure 2. Longitudinal cross-sectional slices of tomato stems on a preparator.

This research procedure goes through several stages, namely: (1) Make thin longitudinal slices at both the base and tip of the tomato stem; (2) Place the results of the longitudinal slices of tomato stems on the object glass; (3) Give a little distilled water on the object glass that already has a sample using a pipette; (4) Cover the object glass with cover glass flatly; (5) Observation stage through a microscope under light until the cellular structure of the tissue can be seen.

D. Findings and Discussion

1. *Findings*

Based on the results of the research, young tomato stems have an anatomical structure of dicotyledonous stems. Where, in it there is an epidermis, cortex area, transport tissue and pith area as in (Figure 3.) which is magnified by 10x.

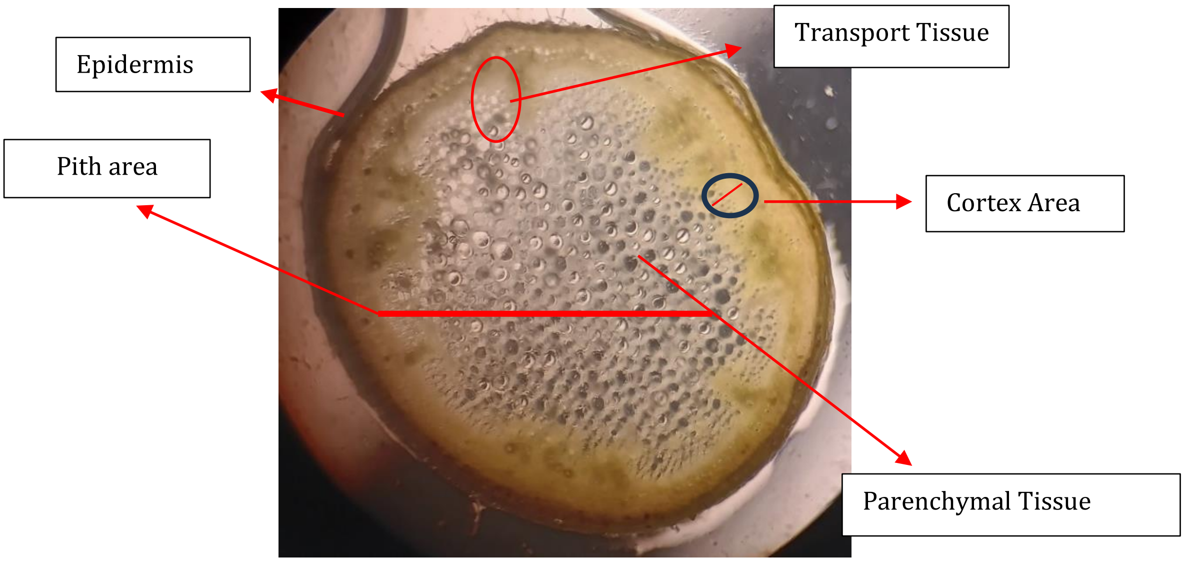

Figure 3. Young tomato stem at 10x magnificatio

2. *Discussion*

Based on the image of the research results, tissue networks such as xylem and phloem are not so visible at 10x magnification. The outermost tissue as a protector is the epidermis with its derivatives. In woody plants the epidermis is usually replaced with periderm. The next layer is the cortex, which generally consists of parenchyma, but often formed collenchyma. The core of the stem is a network of vessels in the form of cylinders in Gymnosperms and most dicots, or consisting of bundles of vessels separated from one another in monocots. Between the cortex and the vascular tissue there is often a starch shrimp or sclerenchyma shrimp found between the cortex and the part of the stem that contains the primary vascular tissue. The very center of the stem contains pith, which is parenchyma tissue in the middle of the stem (Saputri, Zakiah, & Turnip, 2022).

The epidermis is the outermost part of the stem in the anatomical structure of the stem. Epidermal tissue consists of a single layer of cells whose cell walls are thickened and protected by a cuticle (Rahman, 2022). The cells of the epidermis are composed of a single layer of cells, tight, non-split and on the wall facing the atmosphere, a thickening containing kutin is obtained (Bria, 2018). When the cells of the young stem including the epidermis are destroyed, the periderm (hypodermis) steps in to do its job. Young stems have trichomes (glandular or non-glandular), while photosynthetic stems have stomata that later grow into lenticels. Epidermal tissue in plant roots and stems that have undergone secondary growth will be replaced by cork tissue (periderm). Cork tissue has excellent protective capabilities for the underlying tissue and results in the surface of the roots or stems of plants becoming rough (Muttaqin, 2023) in (Britannica, 2014).

The cortex is a network of several cell layers that form a hollow structure with large vacuoles that function as a place to store food reserves (Rahman, 2022). The cortex is part of the parenchymal tissue that develops in plant stem organs. Stems are mostly composed of thin-walled parenchyma cells that make up the basic tissue and have cells that are unevenly. distributed. Sometimes there is collenchyma that is clustered or forms a closed circle in the peripheral area (edge). The fibers that make up the sclerenchymal tissue can be independent or in groups. The content in the cortex can include crystals, flour, or other materials, and sometimes idioblasts can also be found in the form of oil cells, mucus chambers, mucus cells, crystal cells, oil glands, hars cells, or gum ducts (Muttaqin, 2023).

Transport tissue is a tissue composed of two organs, namely xylem and phloem. Xylem tissue is the tissue involved in the transportation of nutrients and minerals from roots to leaves.

Phloem tissue, on the other hand, is the tissue involved in transporting the distribution of photosynthetic products from the leaves to all parts of the plant (Rahman, 2022) Water and minerals must be transferred from the roots to the stem and finally to the leaves through the xylem. most of the xylem tissue consists of specialized cells called vessels. Since transportation through xylem is a physical process, energy is not required for it. The structure of xylem in plants has the following functions: (1) Xylem forms a hollow tube whose structure is arranged continuously. As a result, water can flow freely in the xylem network; (2) Strengthened with the help of lignin substances. Cells that die will stop functioning. Then the hollow tube will be strengthened and supported by lignin (Muttaqin, 2023).

Translocation (transport system) refers to the up and down movement of the stem that occurs in the transportation system of phloem tissue. The phloem is made up of living cells. The cells that make up the phloem have been altered to perform the following tasks: (1) Specially designed filtration tubes without nuclei for transportation. In order for the cytoplasm to connect one cell to the next so that the end of each filter vessel is hollow; (2) Companion cells, the movement of materials through the phloem requires energy. This energy is provided by one or more companion cells attached to each filtration tube. Filtration tubes depend entirely on their companion cells (Muttaqin, 2023).

In dicots there is a vascular cambium between the xylem and phloem. It is called intravascular cambium because it is located between the two transport tissues. This intravascular cambium is the result of the development of parenchyma tissue between the transport vessel bundles. This cambium can create secondary growth to allow the stem diameter of dicotyledonous plants to increase (Rahman, 2022). However, in young tomato stems this intravascular cambium has not yet formed so that in young tomato stems there is only a transport network consisting of xylem, phloem and vascular cambium surrounded by sclerenchymal tissue.

The core of the basic tissue center, namely the pith, is also composed of large parenchyma cells and also has intercellular space (Bria, 2018) The pith itself means the center of the stem organ formed from parenchyma cells. While the radius of the pith is one part of the transport bundle which is located separately due to a row of radially arranged parenchyma cells (Muttaqin, 2023). Parenchyma is an important part of the basic tissue system and exists as a continuous tissue in different organs, including bark and stem pith, root cortex and stem mesophyll basic tissue.

Parenchyma is a very ordinary and undifferentiated plant tissue. Most of the nonstructural carbohydrates and water are reserved in this tissue by the plant. Parenchyma is generally the same size (isodiameter) in length and width, and active protoplasts are surrounded by thin cellulose primary cell walls. Intercellular voids are common in the parenchyma. This is a very common element of plants. The cells of the parenchyma tissue can therefore transform into different tissues. The cells of parenchyma tissue are also adaptable. This situation is caused by thin cell walls (Rahman, 2022). From the results of research on young tomato stems, it can be seen that in the pitharea there is only parenchymal tissue where parenchymal tissue is the basic tissue of plants that do not have special functions when the tissue has not changed into different tissues.

E. Conclusion

Based on the results of research on young tomato (*Solanum lycopersicum*) stems observed through a microscope with a magnification of 10x, we can know that only the epidermis, the cortex area (without being able to distinguish the tissues contained in the area), the transport tissue (without being able to know the location of xylem, phloem and other tissues) and the pith area where in this area the parenchyma tissue is clearly visible. The results of this study cannot be used to explain in detail the location of the tissues in the tomato stem. Therefore, more in-depth research is needed on stem anatomy in tomato plants, because to determine it, not only the young stem is needed, but also the adult stem.

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