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STUDY OF THE BIOLOGICAL CHARACTERISTICS OF THE TOMATO PLANT

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Abstract
This study investigates the main biological characteristics of the tomato (Solanum lycopersicum L.) plant under varying climatic and soil conditions. Key parameters examined include stem and root development, flower and seed formation, and the influence of temperature and soil factors on vegetative growth. Tomato fruits, which are multi-locular and multi-seeded fleshy berries, show wide variation in size and shape: fruit weight ranges from 20–50 g to 500–800 g, with fruits up to 70 g considered small, 70–100 g medium, and over 100 g large. Shapes include flat, round, oval, pear-shaped, and elongated cylindrical forms. The findings contribute to a clearer understanding of how environmental conditions affect tomato morphology and overall plant performance.

Keywords: Climatic conditions, plants, stem, flower, seed, vegetative propagation, seed weight, root system, temperature, soil conditions.

Introduction

The tomato belongs to the Solanaceae (nightshade) family and originates from the tropical regions of South and Central America. In tropical climates, the tomato is a perennial, evergreen plant. New stems form in the axils of each leaf, which easily take root and develop into a multi-stemmed bush. When the stems, unable to support the weight of the fruits, touch the moist soil, they form roots and produce new shoots.

Research Methology:

Under favorable conditions, tomato seeds germinate 4–5 days after sowing. The radicle (young root) appears first and grows into the soil, followed by the emergence of the cotyledon leaves above the soil surface. It has been determined that tomato seeds can retain their germination ability for up to 4–5 years.

The tomato belongs to the Solanaceae (nightshade) family and originates from the tropical regions of South and Central America. In tropical climates, the tomato is a perennial and evergreen plant. New stems develop from the axils of each leaf, easily taking root and forming a multi-stemmed bush. When the stems, unable to bear the weight of the fruits, come into contact with moist soil, they form roots and produce new shoots. These new shoots replace the aging parts of the plant that gradually wither and die.

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Along with vegetative propagation, tomatoes mainly reproduce sexually — through seeds. In northern regions, tomatoes grow as annual plants because in temperate climates they complete their growing season by autumn, when the first frosts occur.

According to V.I. Zuev and others (2009), tomatoes are naturally perennial plants, but when cultivated as crops, they are grown as annuals. If protected from cold, they can continue growing for more than one year. Depending on the variety, cultivation method, and growing conditions, tomato fruits begin to ripen 80–160 days after seedling emergence.

Tomato seeds are triangular-kidney-shaped, flat, hairy, and grayish-yellow in color. The weight of 1,000 seeds ranges from 2.5 to 4 grams. The seeds retain their germination ability for 4–6 years.

The tomato root system depends on the cultivation method and variety. When grown directly from seeds in open fields (without transplanting), the plant develops a taproot system that can penetrate the soil to a depth of 1.2–1.4 meters, with a spread diameter of 1.5–2 meters. When grown through seedlings (transplanting), the tomato forms a fibrous root system that extends only 0.3–0.5 meters deep into the soil. In protected conditions (such as greenhouses), the root system is located within a substrate layer not exceeding 30 cm in thickness.

In addition to the main and lateral roots, tomatoes have the ability to form adventitious roots when any part of the stem is covered with moist soil. This property allows for rapid vegetative propagation by rooting a part of the stem or a lateral shoot whenever necessary.

According to available data, mature tomato plants form a bush consisting of one or several stems. The leaves are arranged spirally along the stem and are odd-pinnate in shape. They may be attached to the stem vertically, horizontally, or in a drooping position toward the ground.

Tomato leaves consist of lobes, segments, and sub-segments. Depending on their number and degree of division, they may be entire, slightly or deeply divided, with large segments resembling those of the potato plant, or undivided with smooth edges. In standard (upright-growing) tomato varieties, the leaves are simple and potato-like, densely arranged, with short petioles and a heavily wrinkled surface (see Fig. 1).

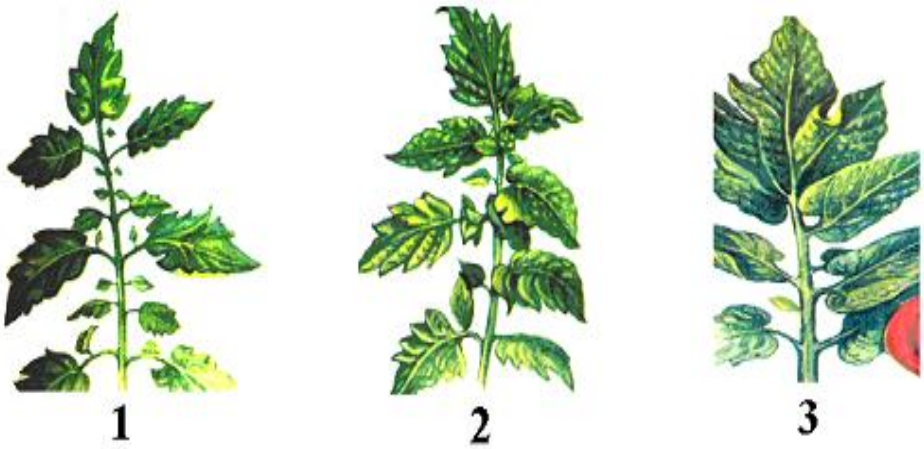

Figure 1. Tomato leaves:
1 – Simple leaf, 2 – Strandart (upright) leaf, 3 – Large-lobed leaf

The shape, size, and color of tomato leaves vary greatly depending on the plant's age, variety, and growing conditions. The leaves have a shorter lifespan (3–4 months) compared to the stem and

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roots.

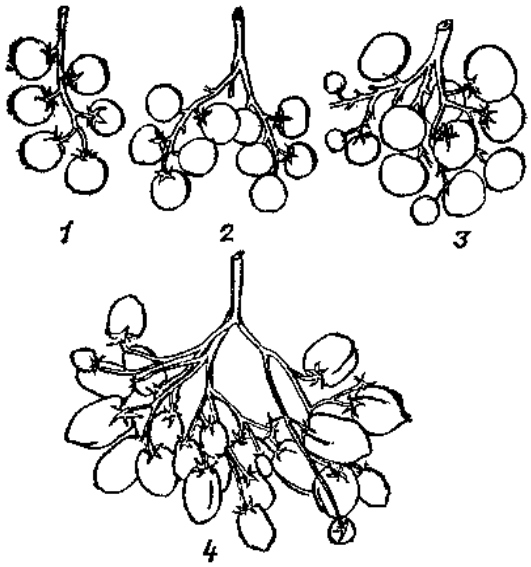
The tomato stem is round, succulent, covered with hairs, and bluish in color. Over time, the stem lignifies and may bend under its weight.

At the beginning of the growth period, tomato plants grow slowly, producing 3–4 leaves in the first month. Subsequently, growth accelerates, and after forming 6–12 leaves, the main stem ends with the first inflorescence. The apical shoot develops into the main stem, forming the first flower cluster, while lateral (axillary) shoots emerge. In monopodial growth, each lateral shoot produces 4–6 up to 12–15 leaves, from whose axils additional lateral branches emerge. After the first flower cluster forms, the plant continues growing through the development of buds below the inflorescence. This results in sympodial branching, producing secondary stems that complete growth after forming 3–4 leaves and a flower cluster. From the leaf axils below the inflorescence, tertiary stems may form, allowing the plant to continue prolonged growth. The stem in sympodial branching consists of successive lateral shoots.

The inflorescence is called a "cluster," and in most cases is referred to as a simple cluster. Inflorescences are classified as simple unbranched, simple branched, intermediate (once-branched), complex (multi-branched), and highly complex (Fig. 2).

The structure and development of the inflorescence are influenced by light intensity, temperature, mineral nutrition, and other environmental factors. Under normal conditions, it takes 50–60 days from seedling emergence for the first flower cluster to bloom. Flowering progresses from the bottom to the top of the plant. In indeterminate varieties, if lateral shoots are removed, 3–4 flower clusters can bloom simultaneously. In determinate varieties, flower clusters are more compact, so flowering occurs at the same time.

Flowering duration varies: for simple clusters, it lasts 10–20 days, while complex clusters may bloom for 30 days or more. In complex inflorescences, many flowers may drop, so varieties with complex clusters tend to have lower yield compared to simple or intermediate-clustered varieties.



2-Figure.Typles (Forms) of Tomato inflorescences (хиллари):
1 –Simple; 2 – Intermediate; 3 – Complex; 4 – Highly branched (very complex)

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The tomato flower is bisexual and consists of five or six petals. In large-fruited varieties, flowers often grow fused together (3–see Fig. 3).

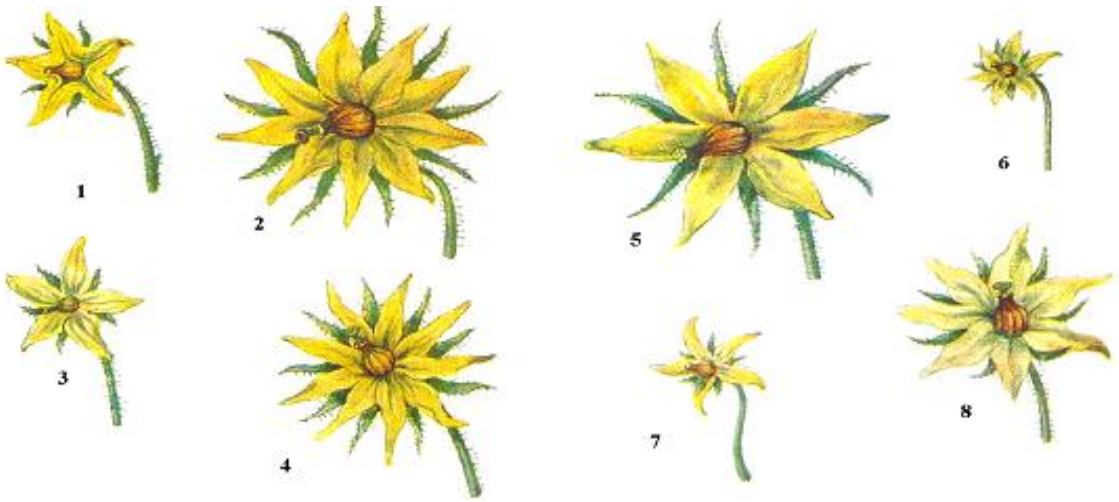

Figure 3. Tomato flowers:
Few-petaled – five petals (1, 3, 7), many-petaled – more than five petals (2, 4, 5, 6, 8), yellow (1, 2, 4, 5, 6, 7), dark yellow (3, 8), small (1, 3, 6, 7), large (2, 4, 5, 8), hairy (1, 2, 3, 4, 5, 8) and hairless (6, 7)

Tomato flowers remain open for 2–3 days. Experiments have shown that the most favorable conditions for flower pollination are a temperature of 24–32 °C and relative air humidity of 70–80%. Tomato is a self-pollinating plant. There are also varieties that produce seedless fruit. From flowering to fruit ripening takes 35–60 days.

Tomato fruit – multi-chambered, many-seeded, fleshy berry. The weight of the fruits varies: from 20–50 g up to 500–800 g. Fruits weighing up to 70 g are considered small, 70–100 g – medium, over 100 g – large. According to information, tomato fruits can be flat, flattened-round, round, oval, pear-shaped, cylindrical, or other shapes [Balashov N.N., Zeman G.O., 1981; Shuvaev Yu., 2001].

The size and shape of the fruit depend on the variety, and also on growing conditions. Fruits grown on fertile and moist soil are larger and firmer than those grown on less fertile and dry soils.

The fruit surface can be smooth or ribbed. Depending on the number of seed chambers and their division, fruits can have few (2–3) chambers, medium (4–5), or many (6 or more). Multi-chambered fruits are usually ribbed. If the fruit has fewer than 4–5 seed chambers, they are usually symmetrically arranged. Asymmetrical arrangement of chambers is characteristic of large, multi-chambered fruits.

The color of most cultivated varieties' fruits is red. Its redness ranges from bright red to dark red. For fresh consumption, varieties with pink, yellow, yellowish-white, or purple fruits are relatively rarely grown.

During the ripening period, each fruit passes through several stages, during which its color changes from green to brown, pink, and red.

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Conclusion

Tomato fruit ripening occurs in two distinct stages: biological and technical. Biological ripening ensures the fruit reaches its full size and the seed embryo develops characteristic growth traits, though the fruit remains green. The transition of color from green to red signals that the fruit is suitable for fresh consumption or processing, marking technical ripening. Technical ripening typically begins 5–15 days after biological ripening. This understanding underpins the common agricultural practice of harvesting green tomatoes for long-distance transport and allowing them to ripen off the plant, ensuring optimal quality and marketability.

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