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STUDY AND EVALUATION OF MORPHO-ANATOMICAL CHARACTERISTICS OF THE LEAVES OF TOMATO PLANT VARIETIES AND HYBRIDS

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ИЗУЧЕНИЕ И ОЦЕНКА МОРФО-АНАТОМИЧЕСКИХ ХАРАКТЕРИСТИК ЛИСТЬЕВ СОРТОВ И ГИБРИДОВ ТОМАТОВ

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Abstract. This article has been investigated and evaluated by studying the specification of anatomical structure of the sort samples of tomatoes. Studies have shown that anatomical indicators mainly have a great importance in learning of drought resistance, determining the origins of the different varieties, choosing of hybrid plants in selection work of the size and number of stomata, and total thickness of the leaves. Studying of anatomical characters of tomato sort samples and hybrids plants has shown that learning of the total thickness of the leaf and the size of number of stomata has a certain importance in selection of hybrid plants. It is defined that in sort samples which their cuticle layer is thick, water evaporation decreases, and they become resistible to illness. So, the sample of Volgograd 5/95, 82 and 90 in upper epidermis and the sample of 93 in lower epidermis were differed for the thickness of cuticle layer. As results of studies, it has been identified that chlorenchyma present in the sort samples predominant for differing according to the total thickness of the leaf. Moreover, studying of the leaf cells has shown that the evaporation of water is higher in the leaves which the number of stomatas is more, and the epidermis cells are few, for that reason, the leaves of *Solanum pimpinellifolium* L. (wild form) are in thin needle shaped in order to reduce the transpiration. Exactly for this reason, it's recommended to use the wild form as a donor in conducting the future selection work.

Аннотация. В статье изучена, выявлена и оценена специфика анатомического строения листьев сортов томата. Исследования показали, что анатомическими показателями являются главным образом общая толщина листа, количество листочков, размер и т. д. Это важно при выборе гибридных растений в селекционной работе, при определении происхождения сортов, изучении особенностей засухоустойчивости. Изучение анатомических особенностей сортов и гибридов томата показало, что общая толщина листа, величина числа устьиц и др. Исследование имеет определенное значение при выборе гибридных растений. Установлено, что сорта с толстым слоем кутикулы снижают испарение воды и устойчивы к болезням. Так, Волгоградские 5/95, 82 и 90 отличались толщиной слоя кутикулы в верхнем эпидермисе, а образец №93 отличался этим признаком в нижнем эпидермисе. В результате исследований установлено, что хлоренхима присутствовала и у сортообразцов, различающихся общей толщиной листа. Кроме того, исследование клеток листа показало, что клетки эпидермиса мелкие, листья с большим количеством устьиц обладают высоким испарением воды, поэтому листья *Solanum pimpinellifolium* L. (дикая форма) имеют тонкую игольчатую форму для уменьшения транспирации. Именно по этой причине данную дикую форму рекомендуется использовать в качестве донора в дальнейшей селекционной работе.

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Ключевые слова: томаты, сорта, гибриды, морфология, анатомия.

Tomato belongs to the (Solanaceae) chapter and is widespread plant type between the vegetable plants. Tomato is one of the valuable vegetable plants that have great importance as a food. Its planting area is more than 25,552 hectares in Azerbaijan. More than 408,782 thousand tons of tomatoes are produced every year, more than 50% of them have been processed, and the rest is used freshly. In order to meet fully demand of the population to tomato product, its production must be reached to 450000 million tons during a year.

The richness of tomato with biologically active substances increases its importance in nutrition. There are 4-8% of dried substance, 3-4% of glucose, to 1% of apple and lemon acids, 0,6-0,8% of protein, 0,13% of pectin substances, 92-96% of water, 4,2% of carbohydrates, 0,8% of cellulose, 0,4% of ash elements, and 0,6% of mineral substances in fully ripened fruits. Each 100 g of fruits contain on average of 4 mg sodium, 268 mg of potassium, 11 mg of calcium, 12 mg of magnesium, 0,6 mg of iron, 0,27 mg of phosphorus, 0,087 mg of copper and other substances. Fruits are also rich with biologically active substances like 1-2 mg % of A pro vitamin, 0,08 mg % of B_1, 0.045 mg % of B_2, 15-45 mg % of C, 0.53 mg % of P, 80 mg % of P vitamins [3, 6].

Tomato also contains vitamin D. It is also a good remedy to rachitic disease. It's known that when the body lacks vitamin D, the bone system lags behind normal development.

While producing tomatoes the number of vitamins go down on average of 25-30%. Therefore, eating fresh and raw tomatoes has a great importance.

Among the vegetable plants, tomato plants are almost the most commonly used vegetable plants, and all the nutrients contained in their fruits are essential for the normal development and ability of the human organism. In addition to comprehensive study of biological characteristics of these plants, learning the anatomical structure of their leaves has great importance, because these organs perform the transpiration and this process is regulated by the closing and opening of stomata on leaves compared to the evaporation on the opened surface [1, 4].

Common surface of stomata in the leaves of the plant contains only 1-2% of leaf's surface, transpiration in stomata depends on the value of the evaporation surface inside the leaves. Therefore, all the reasons that causes the opening of pores in the leaves: increased temperature of light, high water content in plants and so on reduces the diffusion resistance of water vapor and so, thus acceleration of transpiration [3, 6].

The main purpose of the research is to find out of studying the specificity of anatomical structure of tomato sorts and hybrids obtained from Scientific-Research Institute of Vegetable growing.

Material and methodology

The anatomical characteristics of leaves of sorts and hybrids of tomato plant and research work of stoma cells in lower epidermis of leaf is carried out and valued on the basis of generally accepted methodology of P. A. Baranov (1924) [1].

Selected 8 sorts and hybrids of tomato plant (Volgograd 5/95, Novichok, 58, 82, 87, 90, 93, *Solanum pimpinellifolium* L. (wild form)) obtained from SRI of Vegetable growing were used to carry out the research work.

For this purpose, taking 10-12 samples of fully formed leaves from the middle part (placing between 5-9 nodes) of annual branches and diametric cuts were made separately on each sort after fixing in the mixture of 70 % ethyl alcohol with glycerin in laboratory condition. Firstly, cuts were

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whitened in javelin water and then washed 3-4 times with distilled water. A drop of glycerin was added on the object glass, and as strung by range the thinnest 3-4 cuts over it and made a preparate by covering cover glass. And the drug was made by coating it with covering glass by arranging 3-4 thinner cuts [4, 5].

Histological elements of the leaf are measured by micrometer with MBI-3 marked in the microscope (upper and lower epidermis, cuticle layer, palisade parenchyma, spongy parenchyma, chlorenchyme, total thickness of a leaf).

Research analysis and discussion

It has been used as an auxiliary method to study the anatomical features of plants in accelerating the selection process in sort samples and hybrids of tomato plants. For this purpose, it is considered to carry out the following works.

Study of the parameters and brief description of sort samples and hybrids of the leaves tomato plant (Table 1).

Table 1

GENERAL CHARACTERISTICS
OF SORT SAMPLES AND HybRIDS OF LEAVES OF TOMATO PLANT

TETI Catalog number	*Name of the sort samples and hybrids*	*Leaf margin length, (cm)*	*Leaf margin length, (cm)*	*Leaf stalk length, (cm)*	*Leaf area, cm²*	*Leafing*	*Leaf type*	*Leaf surface*	*Leaf color*	*Leaf margin slicing*
control	Volgograd 5/95 sort	10.0	6.5	2.5	65.0	strong	Similar to potato's leaf	pleated	Dark green	medium
58	Utro × Marvi	12.3	5.1	1.6	62.7	medium	simple	pleated	light green	medium
87	VF-145 B	12.7	4.4	1.8	55.8	strong	simple	smooth	dark green	whole
90	WF-63 × j-2in	10.0	4.9	1.9	49.0	medium	simple	smooth	Dark green	medium
93	(Ottava-36 × 2in) × Ottava-30	11.5	6.2	2.0	71.3	medium	Similar to potato's leaf	smooth	Dark green	medium
control	Novichok sort	7.2	5.6	2.1	40.3	weak	simple	smooth	Dark green	whole
82	Cito × sort interval hybrid-5	13.3	6.4	1.9	85.1	medium	Similar to potato's leaf	smooth	Dark green	whole
110	*Solanum pimpinellifolium*	4.5	3.2	0.4	14.4	weak	simple	pleated	Dark green	strong

As it's seen in Table 1, Cito × sort interval hybrid-5 (82) was superior by differing (13.3 cm) more than Novichok control sort (7.2) and for the length of the leaf. Utro × Marvi (58) (12.3 cm), VF-145B (87) (12.7 cm) samples were differed for the length of the leaf compared to Control Volgograd 5/95 sort.

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Volgograd 5/95 (6.5 cm), (Ottava-36×2in) × Ottava-30 (93) (6.2 cm), Cito × Sort interval hybrid-5 (82) (6.4 cm) samples were selected for the width of the margin of leaf. (Ottava-36×2in) × Ottava-30 (93) (6.2 cm), Cito × Sort interval hybrid-5 (82) were differed for the area of the leaf (71.3–85.1 cm^2).

The type of the leaf was simple and similar form to the leaf of potato, the surface of the leaf was basically smooth, the color of the leaf was dark green, the margin of the leaf was whole and middle sliced.

Histological elements of the Leaf Research

Research has shown that there was a difference in the size of histological elements of the leaves of the sort and hybrids, so that when comparing sort samples with control and wild forms, the histological elements were different in size [2, 3].

Water evaporation decreases and becomes more resistant to the disease in sort samples with thick cuticle layer. It is advisable to take get tomato hybrids from these sort samples. So that the thickness of cuticle layer in upper epidermis is 2.51-2.65 mcm in 58 and 93 sort samples, 3.11-3.21 mcm in 87, 90, 82 sort samples, 2.81 mcm in wild form *S. pimpinellifolium* and 3.32 mcm in Volgograd 5/95 sort (Table 2).

The height of upper epidermis was 22.69-24.08 in 90 and 93 sort samples, Novichok sort, 27.08-29.20 mcm in 58, 87 and 82 sort samples, 21.06 mcm in *S. pimpinellifolium* (wild form), 19.04 mcm in control Volgograd 5/95 sort.

The width of upper epidermis was 24.16-29.43 in 58 and 93 sort samples, Novichok sort, 30.4-34.6 mcm in 87, 90 and 82 sort samples, 26,68 mcm in *S. pimpinellifolium* (wild form), 29.06 mcm in control Volgograd 5/95 sort.

According to the height of upper epidermis, 87, 90 and 92 sort samples were dominated. Sometimes large size cells were observed in upper epidermis of 87 sort sample.

The height of palisade parenchyma has changed to the limit of 58 95.2-104.1 mcm in Novichok and 82 sort samples, 110.9-129.2 mcm in 90 and 93 sort samples, 100.7 mcm in *S. pimpinellifolium* (wild form) [1, 4].

This indicator has been dominant (122.1 mcm) compared to other sort samples studied in control sort (except for 87 sort sample, the height was 129.2±4.49 in this sample and this is related to palisade parenchyma with two-floors).

The width of palisade parenchyma is 13.5±0.72 18.9±1.43 mcm in Novichok and 58, 87, 90, 93 sort samples. It is noted that the width of palisade parenchyma in 82 sort sample was higher (35.5±1.97 mcm) than control sort and other sort samples. The width of palisade parenchyma in wild form and control form was between 13.7±1.1 and 17.20±0.80 mcm.

The thickness of spongy parenchyma was 113.3±2.49 137.7±1.79 mcm in studied sort samples, 109.0±2.57 mcm in wild form and 130.14±3.60 mcm in control sort.

As can be seen general thickness of spongy parenchyma was higher in 90 and 93 sort samples (135.67±3.46 and 137.67±1.79 mcm).

As can be seen from Table 2 The thickness of cuticle layer in lower epidermis was 2.08-2.58 mcm in Novichok and 58, 87, 90 sort samples, and between 3.11-4.45 mcm in 93 and 82 sort samples. In this case the indicator is 2.7 mcm in *S. pimpinellifolium* (wild form) and 2.59 mcm in control sort [5].

The thickness of cuticle layer of lower epidermis was higher (4.45±0.13) in 93 sample as seen. The height of lower epidermis has changed between 11.31±0.72 17.9±0.88 mcm in sort samples. This height is the highest 25.47±1.14 micron in sort sample and 14.66±0.47 microns in *S. pimpinellifolium* (wild form) and 15.07±0.71 microns in control sort.

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The width of lower epidermis varied between13.71±1.11 31.13±2.47 mcm in studied sort samples and 82 sort sample has differed for this index and then this width was 31.13±2.47 mcm in sort sample.

The total chlorenchyma thickness varied between 202.3 and 252.4 micrometers in the sample. This thickness is 209.8 micrometers in *S. pimpinellifolium* (in the wild form), and 253.6 mcm in control Volgograd 5/95 sort. For the total chlorenchyma thickness, 93 sort sample was close (252.4 mcm) to the control sort sample.

As you can see the total thickness of the leaf varied between 253.6-299.7 mcm in sort samples. As can be seen graphic 1, the total thickness of the leaf was very high in 93, 87 sort samples and Volgograd 5/95 control sort. (292.2-299.7 mcm), this may also be explained by the fact that they contain a large number of chlorenchymes.

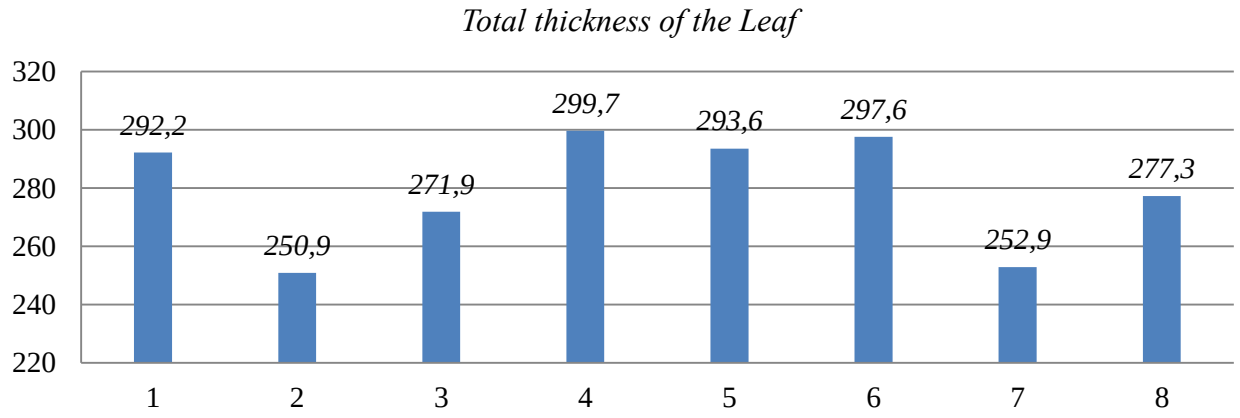

Figure 1. Graphic of histological elements of the leaf

1. Volgograd 5/95, 2. *S. pimpinellifolium* (wild form), 3.58; 4.87; 5.90; 6.93; 7. Novichok; 8.82. 3. Research on stoma cells of the Leaf.

The total surface of stoma in the leaves of the plant contains only 1.2% of the leaf surface.

It should be noted that the plant uses only 0.2% of its water to build its own organism, and the remaining 99.8 % is spent on evaporation.

To investigate the stomata cells, the lower epidermis of the leaf is peeled off and was whitewashed in javelin water and to prepare a drug selecting the thinner ones washing by distilled water at many times. The length, width and number of stomas were measured in 1 sq. mm.

Photos of the drugs obtained were taken under a microscope of MBI-6 (7×10 magnification).

Table 3

MEASUREMENT (MICRON) OF STOMA CELLS IN LOWER EPIDERMIS OF THE LEAF

Name of the sort and hybrids	*Stomata length*	*Stomata width*	*Number of stomatas in 1 sq. mm*
Volgograd 5/95 (control)	21.97	20.01	160
Wild form *S. pimpinellifolium*	21.82	15.98	298
Utro × Marvi (58)	39.09	22.51	121
VF-145 B (87)	28.71	17.58	172
WF-63 × j-2in (90)	27.19	16.71	167
Ottava-36 x 2in × Ottava-30 (93)	25.57	18.63	145
Novichok	28.35	20.41	140
Cito × Sort interval hybrid-5 (82)	29.35	26.0	198

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The Table 3 shows that as a result of measuring the size of stomata cells in lower epidermis of the leaf, the length of stoma was 25.57-39.09 mcm in 58, 87, 90, 93 sort samples, 21.97 mcm in Volgograd 5/95 control sort, 21.82 mcm in *S. pimpinellifolium* (wild form).

Due to the length of the stomata, number 58 sample was selected from the other sorts, and it was 39.99 mcm. This sample also differed for the width of the stoma (22.51 mcm). That's why the number of stomatas was little in the sample and the plant chose a means of self-defense from strong water evaporation. If not, then the plant could be destroyed due to high transpiration [2, 5].

The width of the stoma varied between 15.98–26.0 in the studied samples. The highest indication for the width of the stomata was recorded in 82 sort samples (26.0 mcm) and the lowest in the *S. pimpinellifolium* (wild form) (15.98 mcm).

Study of the stomata cells in lower epidermis has shown that stomata in sorts and hybrids is in anomaly type. The number of stomatas in a wild form *S. pimpinellifolium* is much (298 pcs) than other sorts in 1mm^2. The majority of this number is primarily due to the fact that the size of stomata in wild form is smaller than other samples.

Thanks to this the transpiration of water in the plant is normal and future development of the plant is ensured. In the remaining sort samples the number stomata has changed between 140-180. At that time the number of stomatas was 160 in Volgograd 5/95 sort. 93 and Novichok sort samples were close to each other due to the number of stomata (1 mm^2) (Figure 2). Number of stomatas in 1 mm^2.

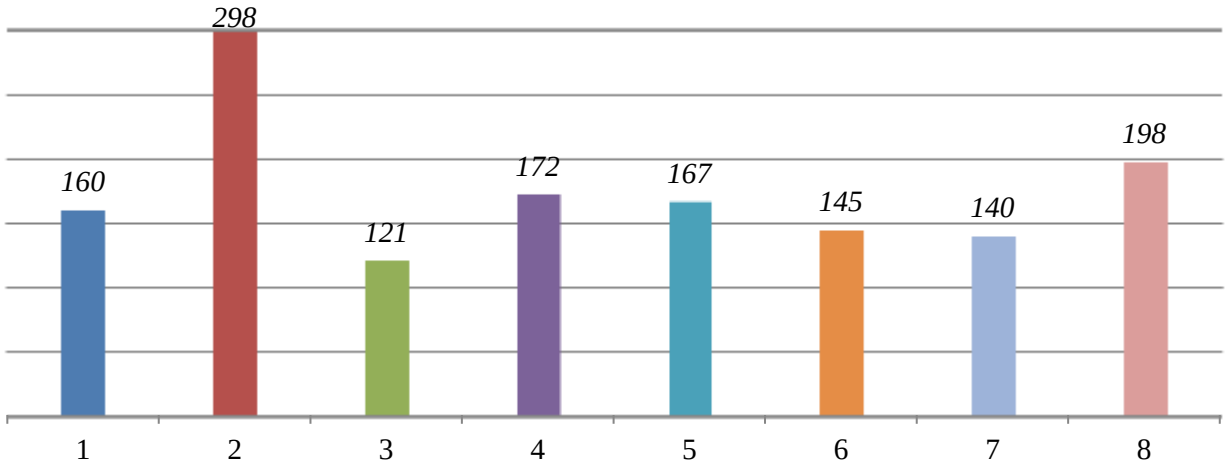

Figure 2. Measurement graphics of stoma cells in the lower epidermis of the leaf

2. Volgograd 5/95, 2. *S. pimpinellifolium* (wild form), 3.58; 4.87; 5.90; 6.93; 7. Novichok; 8.82

Result

Due to the research, we can make the following generalizations.

1. It has defined that the study of total thickness of leaves, the number, size of stomatas and etc. has some importance in choosing plants resistant to abiotic factors (heat, drought, etc.).

2. It is identified that wild forms *S. pimpinellifolium* is drought resistant. It is acceptable to use this samples as a donor in selection process.

3. In sort samples which the cuticle layer is thick, the water evaporation reduces, and they become more resistant to the disease. It is advisable to get new tomato hybrids from this sort samples. Thus, the thickness of cuticle layer on upper epidermis is 2.51-2.65 mcm in Utro × Marvi and (Ottava-36 × 2in) × Ottava-30 sort samples, 3.11-3.21 mcm in VF-145 B, WF-63 × j-2in

Novichok and Cito × Sort interval hybrid 5, 2,81 mcm in wild form *S. pimpinellifolium*, and 3.32 mcm in Volgograd 5/95 sort examples.

4. The height of the lower epidermis was observed in sample 82 (25.47 mcm).

5. It was found that the total thickness of leaves (292.2-299.7 mcm) in the 93 and 87 samples of the Volgograd 5/95 control variety is due to the high content of chlorenchyme in them.

6. The study of leaf cells has shown that in wild type *S. pimpinellifolium* epidermis cells are small, with a large number of pores (298). Due to the large number of stomata cells, the water evaporates from the leaves and leaves become needle shaped and thinner. Opposite of this was observed in number 58 sample.

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