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CHARACTERIZATION OF NEWLY INTRODUCED POMEGRANATE VARIETIES

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Abstract. The paper is focused on examining and selecting morphometric indicators of leaves and flowers from genotypes within the collection of the pomegranate varieties. The research was carried out on 6 varieties of pomegranate plants, collected and introduced from diverse ecological and geographical regions. The objective was to collect, cultivate and assess the technological features of pomegranate varieties and forms. The morphometric characteristics of generative and vegetative organs from the "Malas" and "Kirmizi Gazyan" varieties were studied for the first time. Observation of pomegranate flower petals revealed that different sizes could be found in both long toothed (LT), middle toothed (MT) and short-toothed (ShT) flowers, suggesting petal size is not determined by flower type. The difference between the leaves of these two varieties was found to be insignificant. Flower diameter showed variability across all three types of flowers. The biological and economic significance of the newly developed form F-6-8 and the varieties "Malta", "Oleg" and "Devachi" was also assessed. "F-6-8" and "Malta" are sweet varieties, while "Oleg" and "Devachi" are sweet and sour varieties. "Malta" was distinguished by its fruit weight (380.4 g), thin skin (2.5 g) and high juice yield (50.4%).

Keywords: *Pomegranate, Punica granatum, genotype, morphometric parameters.*

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1. Introduction

Genetic resources provide people with a variety of products and the global economy, livelihoods and health of individuals significantly rely on these resources. The natural soil and climatic conditions of Azerbaijan indicate substantial agroclimatic potential for cultivating pomegranates, which are considered one of the strategically important plants. However, a key challenge is correctly and effectively utilizing the agroclimatic conditions of each economic and administrative region, along with collecting genetic resources to place agricultural plants according to their agrobiological characteristics, conducting comprehensive assessments and studies. Studying the gene pool of the pomegranate plant, determining its potential and ensuring correct and effective use are crucial for safeguarding it from the risk of extinction and laying the foundation for future breeding efforts.

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Pomegranate belongs to the family Punicaceae, consisting of one genus (Punica) and two species (*P. Protopunuca* Bolf. and *P. Granatum* L.). According to Smith, P. *granatum* L. has 2n=18 chromosomes. The basic number of chromosomes in the genus Punica is 2n= 14, with seven bivalent chromosomes. However, *P. granatum* evolved with 2n = 16 or 2n = 18 chromosomes with eight or nine bivalent chromosomes (Shilkina, 1973; Sheidai & Noormohammadi, 2005; Levin, 2006; Akparov, 2023). Pomegranate is one of the oldest cultivated plants among fruit plants. Despite its economic importance and high morphological diversity, it is underutilized in breeding programs. Since the pomegranate plant is drought tolerant, it can be planted in dry areas. In recent years, this fruit has been grown over large areas in a number of countries, especially on the Mediterranean coast (Morocco, Spain, Turkey, Tunisia, Egypt and Algeria) (Parashar, 2010).

Pomegranate is an ancient fruit plant and widely used in the food industry and medicine. It stands out as one of the few zero-waste plants. Currently, the possibilities for expanding pomegranate plantations are limited due to unfavorable environmental conditions, the impact of anthropogenic factors, pests, and diseases, which do not allow the full realization of plant varieties and forms. At the same time, a comprehensive integrated assessment of biodiversity creates opportunities for developing new plant varieties with important characteristics, scientifically selecting parental forms, and applying appropriate hybridization methods. Therefore, studying the biological and ecological characteristics of pomegranates is crucial for conservation the genetic biodiversity of this critically endangered plant.

Hajiyeva (2020b) studied various pomological and biochemical characteristics of fruits of 60 pomegranate genotypes collected from 4 different regions of Azerbaijan. The results showed a high level of diversity in the studied traits. Fruit weight, juice yield, juice content and seed hardness had a fairly wide range of variation and therefore their diversity was assessed as high (Hajiyeva, 2020b).

Several research papers have recently been published on the biological and economic properties and importance of the pomegranate plant (Hajiyeva, 2020a, 2020b; Akparov, 2023). Considering its significance as an important and valuable fruit and medicinal plant, leading fruit scientists worldwide continue scientific research on it across various directions.

2. Materials and methods

In the research, 6 varieties and forms of pomegranate plants were used. The research focused on examining and selecting morphometric indicators of leaves and flowers from the 6 varieties and forms included in the collection, following the methodological instructions in “Descriptors for Pomegranate” (Messaud, 1997). The objective of the study was to collect, cultivate and technologically assess pomegranate varieties and forms.

For leaf analysis, 25 well-developed leaves were selected in 2 variants. The parameters measured included the total leaf length L (mm), the length of the leaf axil L1, the length of the petiole L2 and the leaf width W.

Fruit weight was measured using an electronic scale and then the percentage of juice was calculated by separating the seeds and peel.

To analyze fruit shape, a dynamometer with a rod was utilized. Fruit length and diameter were measured and the ratio of length to diameter was calculated.

3. Results and discussion

The study investigated the morphometric indicators of the vegetative (leaves) and generative (flowers) organs of the pomegranate plant. Pomegranate varieties “Kirmizi Gazyan” and “Malas” were selected for this analysis. The comparison of total leaf length between the two varieties in variant 1 showed an average difference. Specifically, the leaves of the “Malas” variety were 5 mm longer than those of the “Kirmizi Gazyan” variety, although in the second variant, there was nearly no difference, as they were almost the same size. Regarding the length of the leaf blade, the difference between the varieties in both variants was very insignificant, with the leaves of the “Malas” variety being 1 mm longer than those of the “Kirmizi Gazyan” variety. The results obtained are presented in Table 1.

Table 1. Leaf parameters in the studied varieties

Varieties	Repeats	Total length of leaf L (mm)	Leaf blade length L_1 (mm)	The width of the leaf W_l(mm)	The length of the petiole L_1 (mm)
"Kirmizi Gazyan"	1st repetition	53.88 ±15.5	50,46 ± 15,0	16,08 ± 4,0	5,46 ± 1,5
	2nd repetition	56.66 ±11.2	51,58± 12,0	15,64 ± 2,5	5,20 ± 1,5
“Malas”	1st repetition	58.72 ±10,0	52,98 ±13,5	14,88 ± 3,5	5,58 ± 2,75
	2nd repetition	56,80 ± 12	52,52 ± 9,5	16,0 ± 4,0	4,88 ± 3,50

Table 2. Flower parameters in the studied pomegranate varieties

Flower parameters	KIRMIZI GAZYAN			MALAS		
Flower type	LT	ShT	MT	LT	ShT	MT
L_f (mm)	41,5± 7,5	34,5± 9,5	38,5 ±8,5	41,4 ±7,0	33,1± 6,5	37,7± 7,5
D_f (mm)	13,16±2,5	12,4± 11	14,8±2,5	12,9 ±1,0	10,9± 3,0	12,1± 1,5
NCL	5,56 ± 1,0	5,5± 1,5	5,8± 1,0	5,4± 1,0	5,4 ± 1,0	5,4± 1,0
NP	5,56 ± 1,0	5,5± 1,5	5,8 ±1,0	5,4± 1,0	5,4 ± 1,0	5,4±1,0
L_p	24,0± 2,5	21,1± 4,9	22,9± 5,2	24,6±5,0	22,2± 5,9	26,8± 1,7
W_p (mm)	17,4± 3,2	14,8± 3,4	15,9± 2,7	16,3± 2,8	15,5± 5,6	19,9± 1,9
P_p $P_L = W_p/L_p$ (mm)	0,73	4,35	0,69	0,66	0,69	0,74
Ps_l (mm)	17,8± 2,0	8,2± 5,0	13,5± 1,5	17,0± 2,0	6,4±3,8	13,0± 2,0

NOTE: L_f - The length of the flower, D_f - Flower diameter, NCL- Number of calyx leaves, NP-Number of petals, L_p - Petal length, W_p - Petal width, P_L - Petal pointer, Ps_l -The length of the pistil, LT-long toothed, MT-middle toothed, ShT- short-toothed

As mentioned earlier, along with the leaves, the sizes of the flowers from the two mentioned varieties were also studied, including their length, diameter, number of calyx leaves, length and width of petals, petal index and length of stamens. The results obtained are presented in Table 2.

During the examination of pomegranate flower petals, it was observed that in, long toothed, middle toothed or short-toothed flowers, petals of varying sizes were present. This indicates that petal size does not depend on the type of flower. The number of leaves in the calyx and petals remains consistent. Typically, both varieties have 6 petals, but occasionally there can be 4, 5 or 7 petals.

There is no difference in flower length between the two varieties. However, regarding diameter, the "Kirmizi Gazyan" variety shows a small difference, being 1-2 mm larger. Our research demonstrates that even though the studied parameters are secondary, the results we obtain serve as auxiliary tools for identifying the variety.

Additionally, the biological and economic indicators of newly introduced varieties and forms (P1-8-6 and "Malta", "Oleg", "Devachi") were studied.

Table 3. Main biological and economic indicators of the studied forms and varieties

Forms and varieties	Form P1-8-6	Malta	Oleg	Devachi
Fruit weight (g)	226,1	380,4	265,7	255,8
Thickness of the shell (mm)	5	2,5	5,6	5,5
The mass of 100 separate seeds of pomegranate (g)	47,1	49,1	47,3	58,1
Weight of 100 seeds (g)	4,4	10,1	5,1	5,2
Juice yield (%)	29,4	50,4	41,0	40,8
The ratio of the peel to the mass of the fruit (%)	55,4	29,7	44,8	41,8
Sugar percentage (%)	16,6	14,3	16,1	16,1
Acidity (%)	0,3	0,45	1,3	1,2
Glucoacidometric coefficient	55,3	31,7	12,4	13,4

The Form P1-8-6 can be classified in the large-fruited group due to its mass (226.1 g). The degree of attachment of the individual pomegranate seeds to the endocarp is average, with a shell thickness of 5 mm. The weight of 100 separate seeds was 47.1 g and the weight of 100 seeds (considering wet seeds) was 4.4 g. The ratio of shell to fruit weight is 55.4% and the sugar content is 16.6%. It belongs to the category of sweet varieties. Harvest time is mid-October.

Malta is a variety of Spanish origin with an average fruit weight of 380.4 g. The degree of attachment of the separate pomegranate seeds to the endocarp is very poor, with a thin shell (2.5 mm). The weight of 100 separate grains was 49.1 g and the weight of 100 wet seeds was 10.1 g. The juice yield of this variety is also high at 50.4% and the ratio of peel to fruit weight is 29.7%. High juice content is directly related to the thin crust. The sugar content of the variety is 14.3%. Harvest time is mid-October.

The average fruit weight of the Devachi variety is 255.8 g, placing it in the large-fruited category. The degree of attachment of the separate pomegranate seeds to the endocarp is average, with a shell thickness of 5.5 mm. The weight of 100 separate grains was 58.1 g and the weight of 100 wet seeds was 5.2 g. The juice yield was 40.8% and the ratio of peel to fruit weight was 41.8%, with a sugar content of 16.1%. Its taste is sweet and sour, leaning towards sweetness. This is due to the relatively high acidity content (1.2%). "Devachi" fruits ripen in the third ten days of September.

As shown in Table 3, all the samples studied fall into the large-fruited category, with “Malta” fruits being larger than the others. Malta's average fruit weight is 380.4 g, compared to 226.1 g for form P1-8-6, 265.7 g for “Oleg” and 255.8 g for “Devachi”. In terms of peel thickness and the ratio of peel to fruit weight, again “Malta” is superior to the other studied forms and varieties. Malta's shell thickness is 2.5 mm, with a ratio of 29.7%, while P1-8-6, “Oleg” and “Devachi” have shell thicknesses of 5, 5.6 and 5.5 mm respectively, with ratios of 55.4%, 44.8% and 41.8% respectively.

For the abovementioned forms and varieties, the mass of 100 separate pomegranate seeds is 47.1 g for P1-8-6, 47.3 g for “Oleg”, 49.1 g for “Malta” and slightly higher for “Devachi” at 58.1 g. Although “Malta” has a higher weight of 100 seeds at 10.1 g compared to 4.4 g for form P1-8-6, 5.1 g for “Oleg” and 5.2 g for “Devachi”, its juice yield was higher. This is attributed to Malta's thin skin (2.5 mm) (Table 3).

According to Kulkov (1983), the average mass of 100 grains for the studied varieties was 29.4 g and the average mass of 100 seeds was 2.7 g. Our research indicates that in those years, these figures were lower compared to current years. Over time, pomegranate berries and seeds have increased in size, with berry weights ranging from 47.1 to 58.1 g and seed weights from 4.4 to 10.1 g. As individual pomegranate seeds have grown, the overall seed size has increased. Hajiyeva (2020b) evaluated samples of fruit from native and introduced pomegranate genotypes and averaged them out. They noted that the fruit weight is 107-606 g, the fruit height is from 50 to 98 mm, the fruit diameter is 55-105 mm, the juice volume is 63-320 ml. the weight of 100 gills ranges from 23-59 g (Hajiyeva, 2020b).

The sugar content in the two local varieties studied (“Oleg”, “Devachi”) was the same at 16.1%, placing them in the sweet and sour group. This sugar percentage is typical for this group. The sugar content for form P1-8-6 was 16.6%, while for “Malta” it was 14.3%. These two varieties differ in taste and belong to the sweet varieties. Comparatively, their acidity should be very low, around 0.3% and 0.45%, respectively (Table 3).

In summary, the “Malta” variety stands out for its fruit mass, thin peel and high juice yield.

4. Conclusion

The morphometric parameters of generative and vegetative organs of the varieties “Malas” and “Kirmizi Gazyan” were studied for the first time. When studying the petals of pomegranate flowers, it was noticed that petals of different sizes can be found in both long toothed, middle toothed and short-toothed flowers, meaning the size of the petals does not depend on the type of flower. The difference between the leaves of the two varieties was insignificant. The diameter of the flowers may vary for all three types of flowers. For the first time, the biological and economic significance of form F-6-8 and the varieties “Malta,” “Oleg” and “Devachi” was studied. Varieties “F-6-8” and “Malta” are sweet varieties, while “Oleg” and “Devachi” are sweet and sour varieties. The “Malta” variety was distinguished by its fruit weight (380.4 g), thin skin (2.5 g) and high juice yield (50.4 g).

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