ANALYSIS OF RESISTANCE TO DROUGHT AND HEAT AMONG INTRODUCED FLORIBUNDA ROSE VARIETIES IN ABSHERON CONDITIONS

Ofeliya Gafarova
Central Botanical Garden

Abstract: The article presents data from a study on ten varieties of floribunda roses (*'Anabell', 'Bella Rosa', 'Charleston', 'Eutin', 'Frisko', 'Krasnij Mak', 'Masquerade', 'Mecta, 'Regensberg', 'Rosemary Rose'*) that were observed in the conditions of the Absheron Peninsula. The study showed that the flowering of roses in these conditions stops with the onset of intense heat (from 39°C to 41°C and above) in the second half of July and until mid-August. The varieties differed in the level of water deficiency in the presence of regular watering. It was found that different varieties of roses have different water regimes in their leaves. The lack of watering causes a decrease in the length and width of the leaves in the studied varieties of roses, and the changes in width are more significant. The '*Charleston*' variety was found to have a relatively low water deficit and a smaller amplitude of changes, which may be due to the relatively high water-holding capacity of leaf tissues. The research revealed that high temperatures cause the greatest damage to young plants' leaves since actively growing tissue is less resilient than older tissue. This suggests that water-holding capacity indicators depend on varietal characteristics. The study also revealed that the following varieties are characterized by the highest water-holding capacity and minimal daily water loss: *'Masquerade'*, *'Bella Rosa'*, *'Eutin'*, *'Mesta'*, *'Regensberg'*. Furthermore, the most promising varieties in heat resistance are: *'Anabell'*, *'Bella Rosa'*, *'Eutin'*, *'Masquerade'*, *'Mecta'* and *'Regensberg'*, which are recommended for use in landscaping the region, as well as in breeding work.

Keywords: floribunda rose, drought resistance, heat resistance, water regime, Absheron.

***Corresponding Author:** ofeliya.qafarova@gmail.com

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Introduction:

The Central Botanical Garden houses many introduced varieties of roses belonging to different garden groups, including roses of the floribunda group (Kafarova, 2014). Studying the biological and economically valuable traits of roses is important because it helps to identify their potential in new soil and climatic conditions.

The goal of the study was to identify highly decorative varieties of floribunda roses that are most suited to the conditions of Absheron, especially in years with abnormal weather conditions. This will help to create a crop assortment and select the best varieties for breeding, as well as their use in green construction.

The soils of Absheron are mainly "arid" semi-desert soils, with predominantly sandy and carbonate soils along the Caspian coast. The Botanical Garden's main soil type is brown loam and grey soil, where the research was conducted.

The climate of Absheron is characterized by very hot and dry weather in spring and summer, with January-February as the coldest months and July and August as the hottest months. The average air temperature is 27.3°C, with maximum temperatures reaching up to 35.8°C and sometimes even up to 40°C or higher. High maximum temperatures and prolonged drought make July and August the most unfavourable months for plant growth and development. (Isaeva, 2012), (Ruzaeva, 2008)

Drought is one of the most important factors affecting plants, and it is crucial to understand its negative effects to recognize the importance of plant adaptation to unfavourable environmental conditions. Therefore, several morphophysiological parameters characterizing the drought resistance of some varieties of floribunda roses were analyzed from 2014 to 2016 in the dry subtropical conditions of Absheron. Additionally, it is necessary to evaluate the breeding material's heat resistance when developing new rose varieties.

Research methods:

Ten varieties of roses from the floribunda group were introduced in the research material, including *'Anabell', 'Bella Rosa', 'Charleston', 'Eutin', 'Frisko', 'Krasnij Mak', 'Masquerade', 'Mecta, 'Regensberg', and 'Rosemary Rose'*. The studies were carried out between 2012 and 2016 at the experimental site of the Central Botanical Garden. The variety study of floribunda roses was conducted using the methodology of variety assessment and variety testing of ornamental crops (Bylov, 1971). The heat resistance of rose varieties was determined using the method of V.P. Tarabrin (Tarabrin, 1969). The water regime of plants was assessed according to the method of N.A. Gusev, taking into account the degree of damage to the leaf blades of experimental plants (Gusev, 1960). The study of water-holding capacity was carried out at different phases of plant development. The method used is based on the reaction of replacing hydrogen ions from the cells of the chloroplast membrane with magnesium ions in the chlorophyll molecule under the influence of high temperatures, which subsequently turn into brown pheophytin.

During the experiment, the leaves were submerged in a water bath at a temperature of 40°C and left there for 30 minutes. Afterwards, they were removed and temporarily placed in a crystallizer filled with water at room temperature. This process was repeated five times, with the temperature increased by 5°C each time.

Following this, the leaves were taken out of the crystallizer and filled with a solution of 0.2 M HCl, which turned them brown. After 10-20 minutes, the leaves were thoroughly washed with water and placed on plates. The extent of damage to the leaf blade was noted as a percentage.

To determine the water regime of the plants, 10 leaf blades were selected, counted, weighed, and kept in a drying oven at a temperature of 100°C to 105°C for two hours.

Water content (W), water holding capacity (R), and moisture content (L) in leaf samples were determined using the following equation:

$$W= 100 \cdot (M-M_2)/MR=100\cdot ((M-M_2) -(M-M_1)/M = 100\cdot(M_1-M_2)/M$$

$$L = W-R$$

M – mass of fresh sample; M_1 – sample weight after 24 hours;

Results and discussion:

Research has shown that with the onset of extreme heat (from 39°C to 41°C and above) on Absheron, roses stop blooming from the second half of July until mid-August. During this period, we analyzed a number of morphophysiological parameters characterizing the drought resistance of roses.

When studying the dynamics of soil moisture, it was revealed that in January and February, due to low air temperatures and low evaporation rates, moisture along the soil profile changes within small limits (Table 2).

In January, the soil moisture level in the 0-25 cm layer ranges from 19.2-20.5% for irrigated plots and 19.0-17.2% for rain-fed plots. However, in the 1-meter layer, these indicators are 21.4% and 16.1% for irrigated and rain-fed areas respectively. In February, the soil moisture level is slightly lower, with 17.5% in the upper layer and 19.4% in the lower layers.

Table 2. Dynamics of soil moisture by phases of rose development for 2016 (%).

Sites	Depth, cm	Phases of development				
		Beginning of the growing season (I-II stages)		III-IV stages of organogenesis	V-VII stages of organogenesis	budding and flowering (stages VIII-IX)
		January	February	March	April	May
		Substrate humidity, %				
irrigation	0-25	19,2	17,8	23,2	22,1	21,7
	25-50	20,5	18,2	22,8	22,0	19,4
	50-75	20,2	18,0	20,7	17,4	16,1
	75-100	21,4	19,4	17,1	16,0	14,2
rainfed	0-25	19,0	17,4	16,7	15,3	14,6
	25-50	17,2	16,8	15,2	14,3	13,3
	50-75	16,4	15,9	13,8	12,4	12,1
	75-100	16,1	13,5	12,9	11,9	11,7

In March, the air temperature increases and 4 times of watering of 10 litres per bush is carried out, resulting in an increase in the humidity of the top layer of soil to 23.2% and 17.1% in the bottom layer. In April, irrigation is carried out in the same way as in March, but the soil moisture level in the 0-100 cm layer varies from 22.1% to 16.0% due to rising temperatures and increased evaporation.

In May, during the full flowering phase, the moisture level in the soil profile ranges from 21.7% to 14.2%. With the onset of the hot period, watering is increased to 8-9 times per month with 10-12 litres per bush (Bylov, 1971).

It is observed from Table 2 that the humidity of the substrate changes in irrigated and rainfed areas because of an increase in air temperature and irrigation rates. To assess the impact of drought and the resistance of roses to it, the following basic parameters need to be studied primarily: the total water content of the leaves, the water-holding capacity of leaves, and the rate of water loss from leaves during transpiration.

It has been discovered that different varieties of roses have different water regimes for their leaves, which implies that water-holding capacity indicators are dependent on varietal characteristics. Under the influence of drought, the water-holding capacity of leaves increases in numerous varieties of roses, and the variety 'Frisko' is characterized by the highest daily water loss, demonstrating its vulnerability to droughts (Fig. 1). The total water content of the studied varieties was found to be quite high.

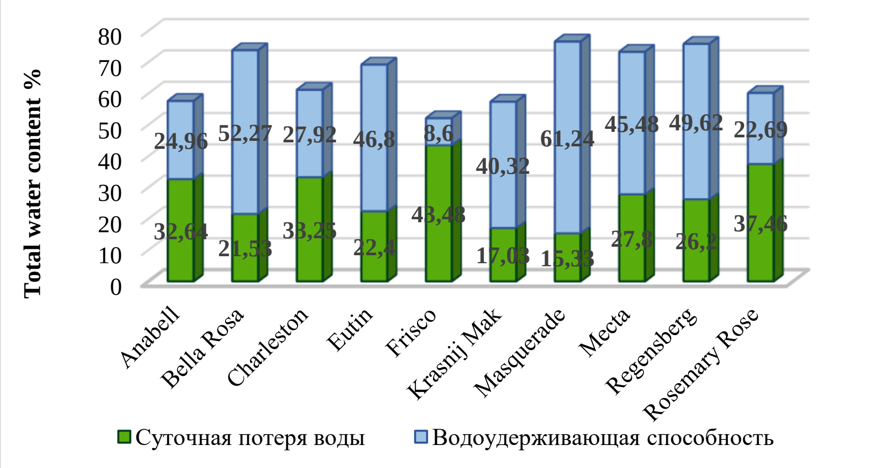


Fig. 1. Water regime of leaves of some varieties of floribunda roses.

It has been established that the rose varieties with the highest water-holding capacity and minimal daily water loss in Absheron are *'Masquerade', 'Bella Rosa', 'Eutin', 'Mecta', and 'Regensberg'*. In the irrigated area, the surface of the leaves of these roses appears smooth, glossy, and dark green with varying degrees of a waxy coating. However, roses grown on a rain-fed plot exhibit weak-leaved shoots and small leaves. Varietal differences were found in these varieties based on the response to growing conditions, as observed by measuring the length and width of the leaf blade. The water regime of leaves of some floribunda rose varieties is presented in Figure 1.

The conclusions drawn from the data obtained from Tables 1 and 2 are as follows: In the conditions of Absheron, the lack of watering causes a reduction in the length and width of the leaves of the studied varieties of roses. The changes in width are more significant. In the absence of watering, the leaves of some floribunda rose varieties fall off completely, while in regularly watered conditions, some varieties partially lose their leaves in autumn.

The study found that the varieties differed in the level of water deficiency, even with regular watering. The *'Charleston'* variety has a relatively low water deficit and a smaller amplitude of changes - 33.25%. This may be due to the relatively high water-holding capacity of leaf tissues, which is 27.92%. The results obtained when determining water deficiency in the leaves of the studied varieties of roses grown on a rain-fed plot are similar.

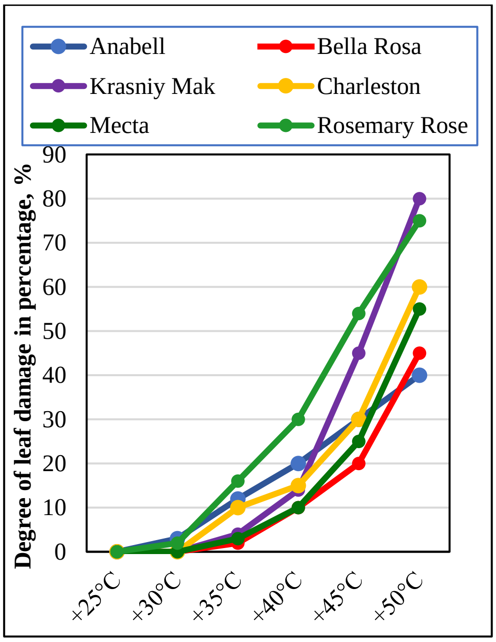
Table 1. Morphometric parameters of leaf blades for floribunda roses in irrigated and rainfed areas.

Sort	Sites	
	irrigation	rainfed
	Sheet length(cm)	
Anabell	5,4 ±0,1	3,0±0,1
Charleston	4,5±0,1	3,2±0,2
Frisko	5,6±0,2	3,1±0,4
Krasnij Mak	6,1±0,2	4,6±0,3
Rosemary Rose	5,7±0,15	3,6±0,2
	Sheet width (cm)	
Anabell	3,6±0,1	2,0±0,4
Charleston	3,1±0,1	2,2±0,3
Frisko	3,8±0,3	2,2±0,2
Krasnij Mak	4,2±0,4	3,4±0,4
Rosemary Rose	3,4±0,2	2,1±0,1

Based on the observations of water deficiency in the leaves of floribunda roses, it was found that the differences between the control and experimental variants are most prominent during the peak period of meteorological factors, particularly heat in July and August. Therefore, it is recommended to increase the number of waterings during this time by 8-9 times a month, which would require 86-98 litres of water per bush.

Additionally, a study was conducted to determine the heat resistance of some varieties of roses from the floribunda garden group. The results showed that the degree of leaf damage due to high temperatures varies widely among different varieties. Please refer to Figure 2 for further details.

Tests conducted on different varieties of roses have shown that the leaf blades of *‘Frisco’* and *‘Rosemary Rose’* are most susceptible to damage in hot weather when the air temperature ranges between +35°C to +40°C. At temperatures above +50°C, the leaves of these varieties completely die. However, other varieties like *'Krasnij Mak'*, *'Masquerade'*, *'Mecta'*, *'Regensberg'* do not exhibit any burns on their leaves even during the hottest periods of summer, and their leaves remain intact even at a high temperature of +45°C, which is the maximum temperature for tissue death.



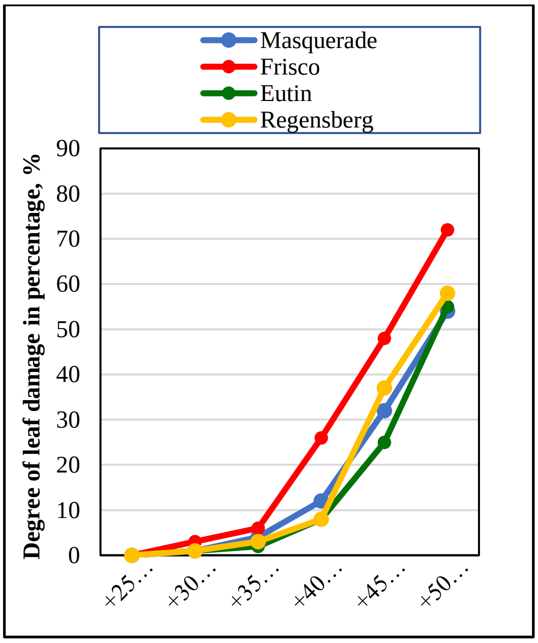


Fig. 2. Heat resistance of some varieties of floribunda roses.

The study shows that high temperatures cause more damage to young plant leaves, as they are less stable than old tissues.

Conclusıon:

A study was conducted on 10 different varieties of floribunda roses including *'Anabell'*, *'Bella Rosa'*, *'Charleston'*, *'Eutin'*, *'Frisko'*, *'Krasnij Mak'*, *'Masquerade'*, *'Mecta'*, *'Regensberg'*, *and 'Rosemary Rose'*. The study found that in Absheron, the roses with the highest water-holding capacity and minimal daily water loss were *'Masquerade*' at 61.24%, *'Bella Rosa'* at 52.3%, *'Eutin'* at 46.8%, '*Mesta*' at 45.5%, and *'Regensberg*' at 49.62%. If these roses are not watered enough, their leaves will become smaller in both length and width, with the changes in width being more significant. On the other hand, *'Frisko'*, *'Krasnij Mak'*, and *'Rosemary Rose'* are highly productive and have great decorative properties when regularly watered.

In conclusion, it was discovered for the first time that six varieties of roses introduced in the Central Botanical Garden (*'Bella Rosa'*, *'Charleston'*, *'Eutin'*, *'Masquerade'*, *'Mecta'*, *and 'Regensberg'*) have adapted well to the hot and dry conditions of Absheron. These roses are recommended for use in landscaping the region and in selection work.

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