INSTITUTE of DIGITAL ECONOMICS and LAW

PART 1, PART 2

WFSDI 2023

PART 1,2

INTERNATIONAL SCIENTIFIC FORUM
ON SUSTAINABLE DEVELOPMENT
AND INNOVATION

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The II International Scientific Forum on Sustainable Development and Innovation (WFSDI 2023) recently concluded, bringing together a diverse group of scientists, researchers, business leaders, and policymakers from around the world. The forum served as a vital platform for the exchange of knowledge and experiences across various disciplines related to sustainable development and innovation. The forum covered the following thematic areas:

1. Sustainable Regional Development: Economic Aspect: Discussions focused on economic strategies and policies aimed at supporting sustainable regional development. The sessions highlighted methods to enhance economic resilience and welfare.
2. Sustainable Energy Development: This track explored innovative technologies and practices for sustainable energy sector development, emphasizing energy efficiency and reducing environmental impact.
3. Sustainable Development and Ecology: Research on the interplay between sustainable development and ecology was presented. Discussions included methods for preserving biodiversity and preventing ecological disasters.
4. Education for Sustainable Development: The role of education in achieving sustainable development goals was examined. Participants discussed innovative educational programs and methods aimed at fostering environmentally and socially responsible citizens.
5. Energy and Earth Sciences: Topics included studies in energy and earth sciences, with a focus on renewable energy sources and their impact on climate and the environment.
6. Renewable Energy Sources: Exploration of various types of renewable energy sources, their advantages and disadvantages, and technologies that promote their efficient use.
7. Smart Cities and Robotics: The concept of smart cities and the use of robotics and automation to improve quality of life and promote sustainable urban development were key topics.
8. Natural Resource Management: Issues related to the management of natural resources, including water, forest, and mineral resources, in the context of sustainable development.
9. Applied Mathematics and Statistics: The application of mathematical and statistical methods to solve problems in sustainable development and innovation was a focus area.
10. Big Data and Intelligent Data Analysis: Methods for collecting, storing, and analyzing big data and their application across various industries to achieve sustainable development were discussed.
11. Engineering and Environmental Protection: Engineering solutions and technologies aimed at environmental protection and reducing the negative impact of industrial activities were presented.
12. Engineering Project Management: Best practices and methods for managing engineering projects with a focus on sustainable development and innovation.
13. Fuzzy Systems, Intelligent Networks, Machine Learning: Studies on fuzzy systems, intelligent networks, and machine learning methods for solving complex problems in various fields of science and technology.
14. Digital Economy: The impact of digital technologies on the economy, the development of new business models, and the transformation of traditional industries were explored.
15. Digital Education: Current trends and technologies in digital education and their impact on accessibility and quality of learning were key topics.
16. Digital Transformation: The forum examined the digital transformation of various industries, including manufacturing, healthcare, education, and public administration.
17. Digital Technologies in Jurisprudence: The application of digital technologies in legal practice and their impact on the legal system and processes were discussed.
18. Interdisciplinary Research: Encouragement of interdisciplinary approaches to solving complex problems related to sustainable development and innovation.

The forum provided participants with a unique opportunity to share their experiences and knowledge, establish new business contacts, and discuss the future prospects of their research. WFSDI 2023 was a significant event that contributed to the advancement of sustainable development and innovation on a global scale.

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O.A. Ardasheva, A.V. Fedorov, N.V. Kholmogorova, G.R. Platunova and N.G. Zykina The Content of Photosynthetic Pigments in the Leaves of Rose Varieties in the Process of Adaptation to the Conditions of the Middle Urals 1940
A.P. Mazurenko, V.N. Orobinskaya and V.V. Mishin The Moderns Digital Technologies In Lawmaking 1944
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The Content of Photosynthetic Pigments in the Leaves of Rose Varieties in the Process of Adaptation to the Conditions of the Middle Urals

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Keywords: Rose varieties, Functional groups, Diagnostics, Chlorophyll, Resistance.

Abstract: Diagnostics of the pigment complex in the leaves of garden roses from various functional groups during 2021-2022 allowed us to establish changes in the content of green pigments and to note significant differences in a number of indicators depending on the varietal affiliation and functional group at the early stages of introduction in the conditions of the Middle Urals. We studied 25 varieties of roses from 5 garden groups - climbing (R.); hybrid-tea (HT.); shrub (S.); floribunda (F.); hybrids of Musk rose (HMsk.). As a result of the analysis, it was found that the most photosynthetic activity is shown by rose varieties of the Musk rose hybrids group, which is confirmed by the high content of chlorophylls in the leaves of 8.3 mg/g. Varieties of roses from the climbing, hybrid-tea and floribunda groups have average chlorophyll content of 1.8-1.9 mg/g of dry matter, which indicates moderate photosynthetic activity. Weak adaptation to the conditions of the Middle Urals is demonstrated by rose varieties from the group of shrub 1.5 mg/g of dry matter. For landscaping settlements of the Middle Urals, we recommend using the most hardy varieties from the group of hybrids of Musk rose. At the same time, the maximum decorative effect of the variety can be achieved by taking into account the ecological needs of the culture when placed in the landscape. It is of great importance to take into account the requirements of plants for temperature and humidity conditions, illumination conditions, the influx of solar radiation to their surface, in particular, to the leaf apparatus. In this regard, it is relevant to study physiological indicators, in particular, the dynamics of the content of photosynthetic pigments of varieties of garden roses, depending on the growing conditions.

1 INTRODUCTION

For a long time before our era, roses were cultivated in China and India, in the countries of the Middle East and Asia Minor. From there they penetrated into Ancient Greece and Rome. Roses are the leading crop among ornamental plants (Izhevskij, 1958).

Currently, there are several thousand garden varieties and hybrids of roses, the origin of which is often difficult to trace. Therefore, the modern classification of roses is based on the division into classes and conditional groups based on stable garden characteristics, and not their apparent origin. However, these classifications are difficult to apply in the practice of garden and park construction, because they do not contain information about the possibility of using a particular variety in various types of plantings. Based on the results of many years of

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research (2019-2022), we proposed to combine varieties of garden roses into groups according to their functional characteristics. In total, 5 functional groups were identified for the region – climbing, hybrid-tea, scars, floribunda and Musk rose hybrids. In the practice of landscape gardening, each group occupies a specific niche and performs a specific function, such an association allows to fully reveal the economic and biological qualities of the variety.

At the same time, the maximum decorative effect of the variety can be achieved by taking into account the ecological needs of the culture when placed in the landscape. It is of great importance to take into account the requirements of plants for temperature and humidity conditions, illumination conditions, the influx of solar radiation to their surface, in particular, to the leaf apparatus. In this regard, it is relevant to study physiological indicators, in particular, the dynamics of the content of photosynthetic pigments of garden rose varieties, depending on the growing conditions (Klemeshova, Budarin, 2019).

In general, to date, floriculture has accumulated some experience in variety studies, breeding, morphology, anatomy, cytoembryology, which can be used as a methodological basis for the construction of introduction studies on the culture of roses in various ecological and geographical conditions.

The purpose of this work is to study the features of the content of photosynthetic pigments in the leaves and shoots of various varieties of garden roses in the conditions of the Middle Urals to develop a methodology for a comprehensive assessment of culture in the region.

2 OBJECTS AND METHODS OF RESEARCH

In 2018, a collection site of various varieties of garden roses (in the amount of 316 pcs.) was created on the territory of the Udmurt Federal Research Center of the Ural Branch of the Russian Academy of Sciences. The objects of research were 25 varieties of roses belonging to 5 functional groups – climbing (R.); hybrid-tea (HT.); shrub (S.); floribunda (F.); hybrids of Musk rose (HMsk.), propagated by microclonal propagation and green cuttings.

The studies were conducted in 2021-2022, the content of photosynthetic pigments in the leaves and shoots of plants was determined. The collection of raw materials was carried out in dry weather, in 2021 - in the second half of June (the phase of active flowering), in 2022 – in the second half of August (after flowering).

The grade *Flammentanz* (K) was taken for control. The most popular and sought-after variety from the group of climbing. This variety has excellent decorative qualities, is considered hardy, and is also resistant to diseases and pests (Artamonov, 2005).

To study the physiological characteristics of roses, the method of G.V. Napolov, V.T. Lobkov was used: determination of chlorophyll in buckwheat plants (patent for invention RU 2244916. 2003) (Napolova, Lobkova, 2003).

Ethyl alcohol, acetone and other solvents were used to isolate pigments from rose leaves. Extraction must be carried out with a pre-cooled solvent in a dark place. Quantitative determination of pigments was carried out according to the following method. An exact weight (about 100 mg) of crushed raw materials was placed in a mortar and ground with a small amount of calcium or magnesium carbonate, quartz sand was added at the tip of the spatula, 2-3 ml of 96% ethyl alcohol and thoroughly rubbed for 2-3 minutes. The resulting extract was drained by a glass rod onto a glass filter No. 3 (covered with a circle of filter paper), and the filtrate was collected into a glass tube suspended by a thread in a Bunsen flask attached to a water jet pump. The extraction of pigments from raw materials with new portions of the extractant was carried out until the filtrate was discolored. The extract from the test tube was quantitatively transferred to a 25 ml volumetric flask and brought to the required volume with pure 96% ethyl alcohol. The resulting extract contains a sum of green and yellow pigments (SHlyk, 1971).

The determination of chlorophyll pigments was carried out by spectrophotometry on a PEVI 5300 device with the extraction of vegetable carotenoids in 90% ethanol.

The content of individual substances was determined using a two-wave method, determining the optical density (*D*) of extracts at 665 and 645 nm (absorption maxima, respectively, for chlorophyll *a*, chlorophyll *b* in ethyl alcohol).

The concentration (*C*), mg/l of chlorophylls *a* and *b* was calculated according to the equations (Wintermans, De Mots, 1965) for ethyl alcohol:

$$C_a = 13.7*D_{665} - 5.76*D_{649}$$

where C_a is the concentration of chlorophyll *a* (mg/l), D_{665} and D_{649} are the optical densities at wavelengths of 665 and 649 nm, respectively.

$$C_b = 13.7*D_{665} - 5.76*D_{649}$$

where C_b is the concentration of chlorophyll *b* (mg/l), D_{649} and D_{665} are the optical densities at wavelengths of 649 and 665 nm, respectively.

The sample for assessing the concentration of chlorophyll *a* and *b* was 100 samples. Each sample was tested three times, the results were averaged.

The data are statistically processed using the Microsoft Excel software package.

3 STUDY RESULTS

The main life process of plants is photosynthesis, the course of which is associated with photosynthetic pigments formed in leaf cells. The higher the content of these pigments in the plastids of assimilating cells and tissues, the more efficient photosynthesis is, the higher the viability of the plant and the more resistant it is to adverse abiotic and biotic environmental factors (Barskaya, 1967; Zelepuhin, Zelepuhin, 1967; Semkina, SHavnin, Efimova, 1998). The accumulation of chlorophyll is one of the main mechanisms of plant adaptation to growing conditions (Godnev, Lempickaya, 1965; Konovalov, 1977). Therefore, it is important to investigate the features of the pigment complex of plants in different natural and geographical regions. The quantitative determination of pigments is based on their ability to absorb rays of different wavelengths (Hapugin, Rosa glabrifolia, 2011).

Literature data indicate that chlorophyll is sensitive to insufficient water supply. There is also a certain relationship between the chlorophyll content in leaves during drought and the drought resistance of the plant (Lebedev, 1988). The content of chlorophylls and carotenoids in plant leaves is closely related to specific growing conditions (air temperature, precipitation, illumination) (Tyshchenko, 2005).

The varieties of roses studied by us from different garden groups differ significantly in the quantitative ratio of pigments accumulated in leaf cells (table). The limits of changes in the concentration of chlorophyll, *a* in the studied varieties of roses ranged from 3.5 to 5.2 mg/g. The content of chlorophyll *b* varied from 2.0 to 3.0 mg/l. Thus, the content of chlorophyll *a* in the leaves significantly exceeds the content of chlorophyll *b*.

Table 1: Chlorophyll content in the leaves of rose varieties 2021-2022, (mg/g of raw weight).

Garden Group	Chlorophyll			
	a	*b*	*a+b*	*a/b*
Climbing (R.)	4.6	2.4	7.0	1.9
Hybrid-tea (HT.)	4.3	2.4	6.9	1.8
Shrub (S.)	3.7	2.4	6.1	1.5
Floribunda (F.)	3.5	2.0	5.5	1.8
Hybrids of Musk rose (HMsk.)	5.2	3.0	8.3	1.7

The content of chlorophylls *a* and *b* in leaves, their ratio and the ratio of their sum are reliable indicators of the physiological state of plants and indicators of stress. A high concentration of chlorophyll is characteristic of healthy plants. According to the ratio of chlorophyll forms, rose varieties from the group climbing, hybrid-tea and floribunda (1.8-1.9 mg/g of raw weight), because the higher the *a/b* ratio, the more shade-tolerant the plant is. For varieties of these groups, the requirements for light intensity may be lower than for others. Therefore, they can be grown in shaded areas.

If we summarize the above results of our research on the study of chlorophylls in rose leaves in the process of their adaptation to the conditions of the Middle Urals, then the maximum content of chlorophyll is characterized by rose varieties from the group of hybrids of Musk rose, that is, this group has an increased potential for photosynthesis, which provides them with high viability in the conditions of the Middle Urals. It can be noted that the earliest and longest flowering is observed in the group of Musk rose hybrids (Ardasheva, Cheremnykh, Lekontseva, Zorin, 2023) (Figure).

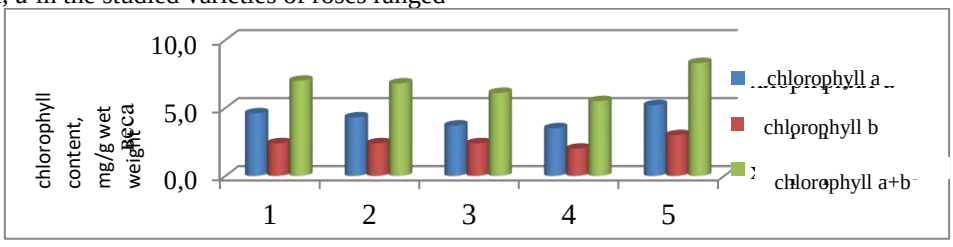

Figure 1: The content of chlorophyll *a*, *b* and their amounts in rose leaves within garden groups Note: 1 - climbing (R.); 2 - hybrid-tea (HT.); 3 - shrub (S.); 4 - floribunda (F.); 5 - hybrids of Musk rose (HMsk).

4 CONCLUSION

Thus, in the conditions of the Middle Urals, the most photosynthetic activity is shown by rose varieties of the Musk rose hybrids group, which is confirmed by the high content of chlorophylls in the leaves of 8.3 mg/g. Varieties of roses from the climbing, hybrid-tea and floribunda groups have average chlorophyll content of 1.8-1.9 mg/g of dry matter, which indicates moderate photosynthetic activity. Weak adaptation to the conditions of the Middle Urals is demonstrated by rose varieties from the group of shrub 1.5 mg/g of dry matter.

As a recommendation, for landscaping settlements of the Middle Urals, we recommend using the most hardy varieties from the group of hybrids of Musk rose.

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