Assessment of the pigment complex of some woody introducers of the family Rosaceae Juss. in a culture condition

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Abstract. The article presents the results of a study of the adaptation mechanisms of wood introducers of the family Rosaceae Juss. It was shown that a high content of photosynthetic pigments Nbi, Chl, Flv falls on the period of flowering and fruit ripening in plants. Pigment composition of leaves Padus maackii and Sorbaria sorbifolia indicates their high physiological status and adaptability in culture conditions.

1. Introduction
The family Rosaceae Juss. is the most representative in the number of species of woody plants in Asian Russia and includes 97 species from 25 genera [1]. The economic importance of the representatives of Rosaceae is extremely high. Among them are pharmacopoeia, food, essential oil, dye, honey and valuable fodder plants [2]. All species are decorative, grow relatively quickly, are easily formed, therefore they are used everywhere in landscaping.

The study of the pigment composition of plant leaves in culture conditions is an urgent task to identify adaptive responses of the plant organism to the variation of environmental factors of the environment. In connection with the adaptive lability of the photosynthetic apparatus and its significance in the processes of plant growth and development, this work aimed to study the adaptation mechanisms of some tree introducers to culture conditions [3, 4].

2. Materials and methods
The research was conducted on the territory of the Surgut Botanical garden, which is located almost in the Central part of the city, bordered by the city Park "Za Saima" and busy highways. The area of the Botanical Garden is about 15.5 hectares; objects of research (two types) are located in an open, exposed to recreational load part of the garden. These are species that, according to the results of many years of observation, belong to the category of the most stable tree introducers in the soil and climatic conditions of Surgut.

Padus maackii, or Far Eastern (Padus maackii (Rupr.) Kom. & Aliss.) - a tree up to 15-17 m tall, an inhabitant of the floodplain forests of the Amur and the Ussuri rivers basin. It is distinguished by a brown or golden brown, shiny bark, exfoliating by transverse films. Leaves are ovoid-elliptic, with a drawn-out lancet top, osteo-dentate along the edge. The flowers are white in leafy racemes, blooming after frondescence. Mesophyte, drought-resistant. Mesotroph. Gas resistant. Winter hardiness, valued in landscaping [1, 5].

(Sorbaria sorbifolia (L.) A. Braun) - shrub up to 2-3 m tall; leaves are unpaired and decompound with numerous leaves. The flowers are white, small, collected in loose end panicles. It naturally grows...
in floodplain forests and shrubs in the east of Western Siberia, in Eastern Siberia and the Far East. One of the earliest growing shrubs. The dissolving leaves are reddish-brown, grown - green, with a drawn-out lancet top, yellow in autumn. Very hardy and shade-tolerant species. Mesohygrophyte, drought-resistant. Eutroph, but can grow on poor soils. Gas resistant. It is used in landscaping, including the tundra and forest-tundra regions [1, 5].

We studied the content of pigments in the leaves of 1658 model woody plants growing in group plantings in an open space, illuminated throughout the daylight hours, twice a season - June, August. The studies were carried out in the morning (period 11-13 hours), in dry weather at air temperature on June 19 (+11°C), on August 6 (+19°C).

Determination of biochemical parameters (flavonol content - Flv, mg/cm², chlorophyll - Chl, mg/cm², nitrogen balance index - Nbi, anthocyanins - Anth, mg/cm²) was performed using the innovative DUALEX apparatus (France). Nitrogen balance index of plants Nbi (Nitrogen Balance Index) is the ratio of the number of chlorophyll and flavonols. The leaves were sampled from several closely growing plants, at the level of a raised hand, with the maximum number of available branches, conditionally directed north, west, east and south.

Mathematical data processing was carried out using the statistical software package Statistica 10. The correspondence of the data structure to the law of normal distribution was estimated based on the calculation of Shapiro-Wilk's W-test (for samples n <30). The indicators Nbi, Chl, Flv were identified for compliance with the Gauss law. Further studies of the dependencies were carried out using nonparametric statistics methods - Wilcoxon matched pair test and analysis of variance Kruskal-Wallis ANOVA. The results of the calculation of indicators are presented: □ Median – median; □ Percentile - percentiles 25–75%; □ min– minimum indicator values; max - maximum indicator values.

3. Results and discussion
An analysis of the data showed that the content of Nbi, Chl is 1.5 times higher in August compared with the beginning of the studies, which is associated with the development of generative organs in both species - fruit ripening in Padus maackii and flowering Sorbaria sorbifolia (table 1).

| Table 1. Data analysis result performed using Descriptive Statistics module*. |
|---------------------------------------------------------------|
| Indicator      | Mean  | Std.Dev. | W     | p       |
| Padus maackii  |       |         |       |         |
| Nbi            | 12.90 | 3.53    | 0.88  | 0.02    |
|                | 19.81 | 5.91    | 0.85  | 0.01    |
| Chl            | 19.99 | 3.73    | 0.94  | 0.35    |
|                | 24.58 | 3.99    | 0.89  | 0.03    |
| Flv            | 1.59  | 0.16    | 0.90  | 0.04    |
|                | 1.35  | 0.43    | 0.86  | 0.01    |
| Anth           | 0.18  | 0.03    | 0.90  | 0.04    |
|                | 0.11  | 0.01    | 0.74  | 0.001   |
| Sorbaria sorbifolia |      |         |       |         |
| Nbi            | 14.27 | 7.24    | 0.77  | 0.0003  |
|                | 17.41 | 4.98    | 0.78  | 0.001   |
| Chl            | 15.30 | 2.68    | 0.93  | 0.16    |
|                | 26.27 | 3.73    | 0.93  | 0.17    |
| Flv            | 1.16  | 0.34    | 0.87  | 0.01    |
|                | 1.57  | 0.29    | 0.87  | 0.01    |
| Anth           | 0.18  | 0.04    | 0.89  | 0.03    |
|                | 0.11  | 0.01    | 0.78  | 0.01    |

* In the numerator - values for June; in the denominator - for August. Mean - average values for each group; Std. dev. - standard deviations for each group; W – criterion Shapiro-Wilk’s W-test; p - the probability of error (p <0.05).
Throughout the study period, the chlorophyll content ranged from 15.30 to 26.27 mg/cm², with peaks in the reproductive period of plants, which indicates a high physiological status of introducers and rather favourable environmental (lighting) growth conditions. The flavonoid content was practically at the same level, with a slight increase to 1.57-1.59 mg/cm² during flowering periods for both species. No sharp fluctuations were found for anthocyanins, and their content was noted in the range from 0.11 to 0.18 mg/cm².

In the obtained results, differences were statistically significant when comparing dependent samples of Nbi, Chl, Flv, Anth indicators in leaves Padus maackii and Nbi, Flv, Ant in leaves Sorbaria sorbifolia for the summer months (June, August) at the value of the criterion Wilcoxon p <0.05 (figures 1, 2).

**Figure 1.** Comparative analysis of indicators in leaves Padus maackii: (a) – Nbi; (b) is Chl; (c) – Flv; (d) – Anth.
**Figure 2.** Comparative analysis of indicators in leaves *Sorbaria sorbifolia*: (a) – Nbi; (b) is Flv; (c) – Anth.

When comparing two independent groups *Padus maackii* and *Sorbaria sorbifolia* in terms of Flv, revealed a statistically significant difference between the compared samples with a value of $p < 0.05$ (figure 3).

**Figure 3.** Comparative analysis of Flv in leaves I - *Padus maackii*, II– *Sorbaria sorbifolia*.

4. **Conclusion**

The maximum values of biochemical parameters in the leaves of two species introduced under the conditions of Surgut, *Padus maackii* and *Sorbaria sorbifolia*, were noted in the phase of development of generative shoots (flowering and ripening of fruits). Thus, biochemical studies of the photosynthetic apparatus confirmed the high adaptability of these plants previously established by phenological methods.

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