Analysis of chlorophyll "a", "b", and carotenoids in leaves of oriental maple, biota, common oak, and chestnut trees resistant to harmful substances emitted by motor vehicles in Tashkent city

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Abstract. The work is devoted to the composition of the atmospheric air on the main streets, the level of traffic on these streets, the selection of resistant species of phenol trees for growing ornamental trees, and the laws of changing the number of pigments in these trees depending on the streets and season in the Republic of Uzbekistan. At the same time, the types of ornamental trees and their resistance to pollution from the pollution of carbon dioxide, nitrogen oxides, and sulfur dioxide are mainly represented by atmospheric air pollution.

1 Introduction

Nowadays, the growth rate of large cities depends on the growth of industrial enterprises and motor transport, which requires many environmental issues. Air pollution is mainly caused by large-scale enterprises and motor vehicle emissions, especially on roads along major highways, with motor vehicle emissions. In this case, pollutants are mainly exposed to tree leaves. This is because photosynthesis and many other processes that allow the growth of the leaves to take place in these leaves. Therefore, it is important to study the degree of contamination of tree leaves with various contaminants and to evaluate the resistance of these toxic compounds to the green and yellow pigments involved in the photosynthesis process in the leaves and their resistance to heavy metals. The volumes of carbon dioxide absorption and oxygen production in different species of trees and leaves vary. The air purification efficiency of ordinary juniper trees is 100 %, pine – 164%, large deciduous – 254 %, oak – 450 %, and Berlin poplar – 691 % [1]. Decorative trees play an aesthetic and social role in the environment and affect the quality of atmospheric air [2]. Trees in urban areas were planted to create favorable environmental conditions close to optimal parameters corresponding to the so-called comfort zone. When the wind speed in

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the comfort zone is 2-6 m/s, and the relative speed is 30-70%, then the average temperature is about 18-28°C. Under favorable conditions, the noise should not exceed 45 dB (in the evening) and 65 dB (in the afternoon). Remember that some factors determine comfort conditions and depend on the degree of air pollution with gases and other particles [3]. In nature, there are also artificial forests, parks, and even single trees, which significantly improve the climate, creating a high level of comfort and hygiene. The green massif has its own microclimate [4]. According to Roberta Baroni Fornasiero, fluoride and many fluorides are vital to humans and plants. Fluoride flora is found in highly industrial areas: characteristic leaves are present on the leaves, the tip separating them from burns and healthy, undamaged tissues. As a result of pollution, it is observed that the leaves of the trees fall, the ends and edges of the leaves change, and they turn red and brown [5]. Air pollutants are any gases or solid particles that can harm human health and the environment at a sufficiently high concentration. It is known that air pollution occurs mainly from two sources: natural factors and a human product – from anthropogenic sources or both. Pollutants are found in most parts of the troposphere; nevertheless, surface pollution in the boundary layer is the most alarming since the concentrations caused by surface sources are relatively high [6]. An increase in population, a reduction in natural resources, and an increase in pollutants enhances climate change. It was previously believed that the climate does not affect the surface of the Earth or living organisms in the Earth's crust. It plays an important role in determining climate change on Earth [7]. Global warming associated with climate change is one of the most discussed topics. There are also natural causes and the various anthropogenic effects of air pollution worldwide. Many factors play a decisive role in climate change and global warming, leading to changes in global temperatures and the nature of precipitation [8]. Anthropogenic pollution occurs mainly due to pollutants entering the air from industrial enterprises, automobiles, air, rail, and water transport, and the use of various types of fuel. In the era of science and technology, air pollution is becoming more intense [9]. Currently, there are more than 40,000 sources of air pollution in Uzbekistan, and almost half of them are not equipped with filters, which leads to more than 2 million pollutants in the country with more than 150 pollutants per year, tons of waste are released into the atmosphere [10]. As a result of the effect of polluted air on the environment, many health problems arise both for the environment and for humans and cause diseases such as asthma, bronchitis, cardiovascular diseases, heart attack, and hypertension [11]. The largest industrial cities of the country are Tashkent, Andijan, Fergana, Navoi, and others, which are among the largest cities in Europe in terms of air pollution [12]. Atmospheric air is mainly contaminated with carbon monoxide, nitrogen oxides, and sulfur oxides. From a scientific point of view, the choice of decorative trees and their durability is important for cleaning and protecting the air from pollution. In this situation, it is necessary to conduct phenological observations of growing trees under these conditions and study the quantity and quality of substances in their various organs. It is also known that most of the toxins are primarily affected by the leaves of the trees due to photosynthesis and many processes that occur in them. From this, we can conclude that the amount of photosynthetic pigments in trees is a measure of resistance to harmful gases in trees. Given the above, we plan to study the formation of green and yellow dyes on the leaves in the example of the city of Tashkent. Purpose of the study. Study of drought tolerance of decorative trees, determination of atmospheric air pollution, seasonal studies of dyes in tree leaves along the main highways of the city of Tashkent.

2 Methods

Each leaf was diluted to 50 milligrams to determine the amount of chlorophyll "a", chlorophyll "b" and carotenoids in plant leaves. Each leaf specimen was homogenized in 5

to 100% acetone solution. The homogenate was centrifuged at 10,000 mph at a rate of 5,000. Chlorophyll "a", chlorophyll "b", and carotenoid light absorption values were determined at 662, 645, and 470 nm (Agilent Cary 60 UV-Vis spectrophotometer). Based on this index, chlorophyll "a", chlorophyll "b" and carotenoid content in leaves of ornamental trees were calculated using the equation Lichtentaler and Wellburn (1985): Statistical analysis of experimentally obtained plant chlorophyll a and chlorophyll b and carotenoid levels was performed in EXCEL 2016, Stat View 5.0 by anova.

One of the main environmental problems of Tashkent city is the negative impact on the environment of various harmful gases emitted by vehicles. More than 70 percent of air pollution in Tashkent is caused by various gases emitted by motor vehicles. As a result of the growth of the population in Tashkent and the expansion of the city territory, the number of motor vehicles in the city is also increasing. As of January 1, 2022, motor vehicles belonging to individuals in our Republic totaled 3.6 million units, which are 10.6% more than last year's figures. Of these, the number of motor vehicles belonging to the residents of Tashkent city is more than 450 thousand, and on average, more than 23 thousand motor transport vehicles from the region enter the city and move on the city streets. 60% of motor vehicles in the capital run on gasoline and diesel, and 40% run on gas.

Table 1. Classification of motor vehicles moving in Tashkent by types of fuel (2022 year)

Total number of vehicles	Gasoline	Diesel	Compressed gas	Liquefied gas
3.6 mln. piece	911.0 thousand piece	135.3 thousand piece	2.3 mln. piece	294.2 thousand piece

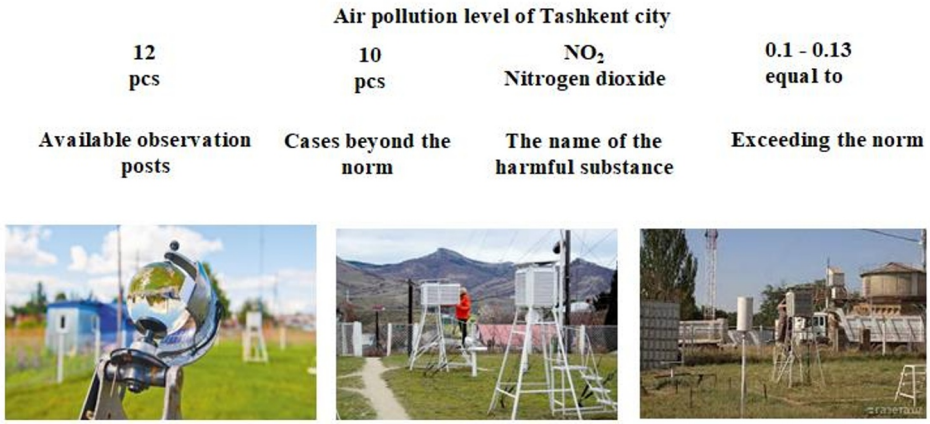


Fig. 1. Process of nitrogen dioxide production during high-temperature combustion of various fuels (natural gas, gasoline) in car engines

Effect on a person - reduces the normal function of the lungs and has an adverse effect on the respiratory system. As a solution to this problem, it is necessary to increase the number of green spaces in the city; that is, as a result of scientific principles, it is necessary to study the city's climatic and soil conditions. It is desirable to selectively plant and maintain tree species that are resistant to various gases emitted by motor vehicles in urban areas [13-18].

Planting and cultivating landscape trees can achieve enormous economic and social benefits. Because plants are designed to meet the natural and vital needs of the population, which plays an important role in human health, trees prevent various infectious diseases. Ionization of the air under the influence of needles and broad-leaved trees and shrubs from

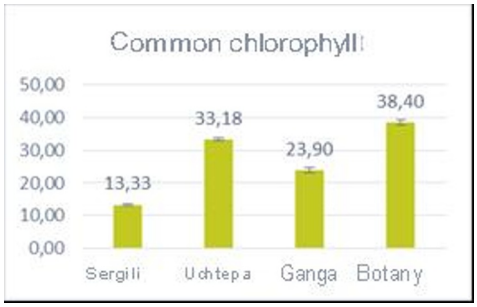
the types of decorative trees recommended based on scientific principles is of great importance for the health of the natural environment in cities. The level of air pollution is determined due to the effect of atmospheric air quality on the positive charge of light and heavy ions. For example, the number of light ions present in 1 cm3 of atmospheric air: - up to 2000-3000 in forests - up to 800 in urban parks - up to 200-400 in industrial zones - up to 25-100 in densely populated buildings by influencing, it ensures the harmony of cardiovascular, respiratory and circulatory systems, strengthens brain activity, lowers the amount of sugar and phosphorus in the blood, improves mood, reduces headaches and fatigue, and ensures people live longer. This, in turn, increases the economic efficiency of citizens living and working in the area. The better a person's physiological and psychological condition is, the more effective he will be in his work [15-18]. Currently, satellite imagery monitoring of tree stands is also being conducted to study emissions and reduce damage.

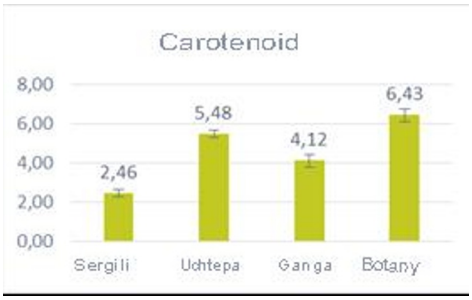
3 streets and 1 park with ornamental trees were selected as the research object of Tashkent city. These objects are Sergeli district along Nyi Sergeli Street, Ukhtapa district along Farkhod Street, Sheikhontohur district along Abdulla Qadiri (Ganga) Street, and Yunusabad district along the botanical garden. Experiments were conducted to determine the amount of pigment in the leaves of eastern sycamore, eastern biota, common oak, and chestnut trees planted on these objects.

Fig. 2. Process of conducting experiments on samples taken from landscape tree leaves in laboratory conditions

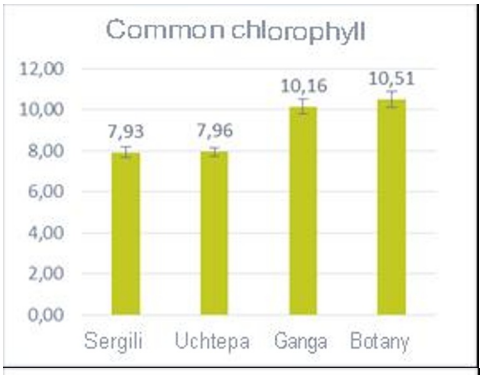
3 Results and Discussion

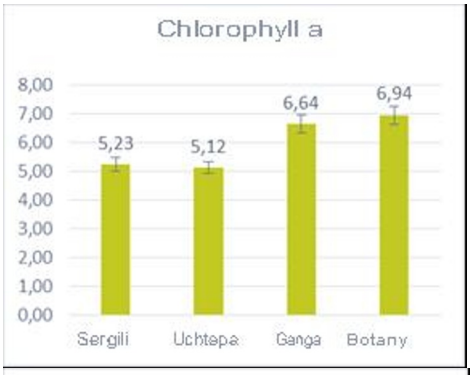
Results of the analysis of leaf pigments of the oriental sycamore tree (Table 2).

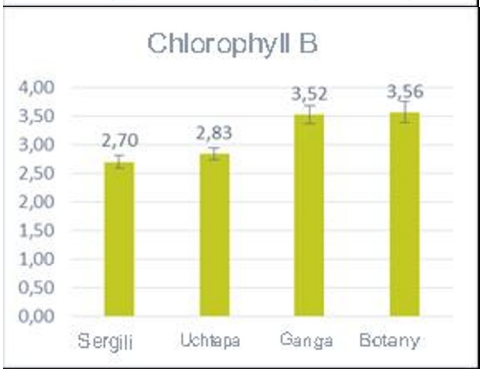


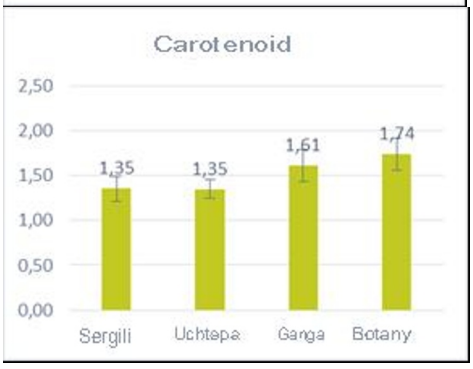


Results of pigment analysis of leaves of oriental biota (Table 3).

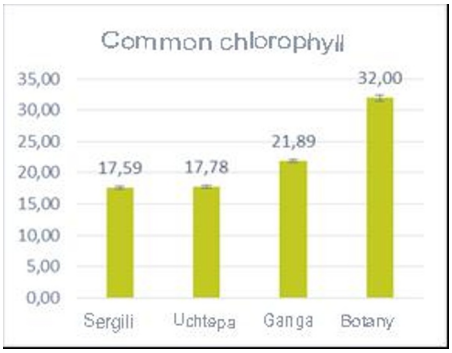


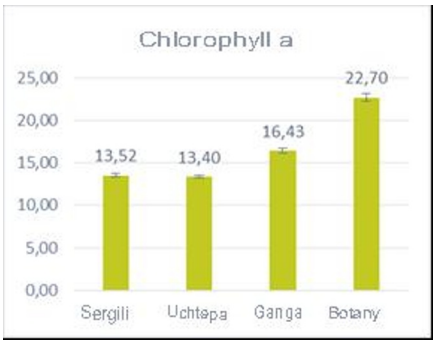


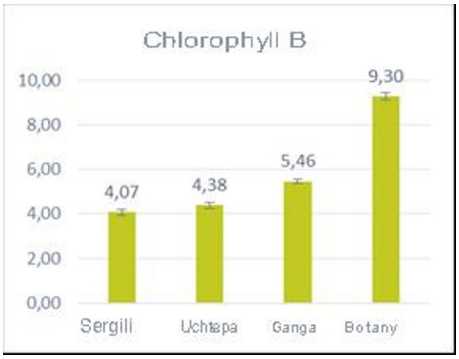


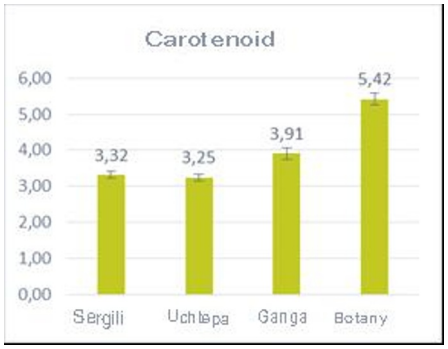


Results of pigment analysis of common oak leaves (Table 4).

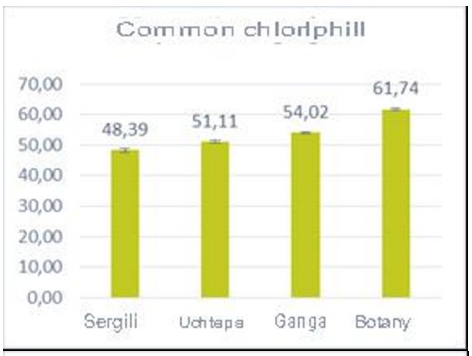


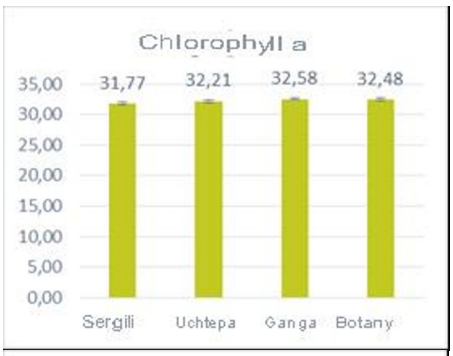


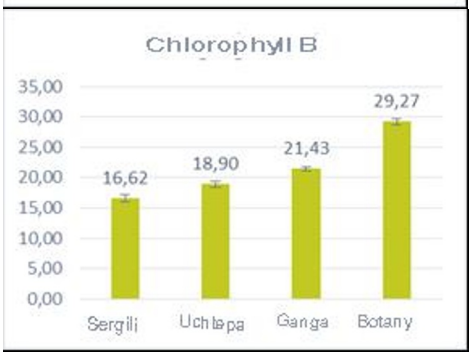


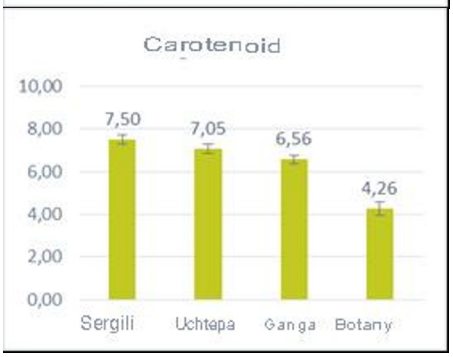


Results of pigment analysis of chestnut tree leaves (Table 5).









Compared to the general results, it was found that the amount of pigments of all trees are different, and the varieties of ornamental trees depend on the environment of the growing regions. Tree leaves in areas with less vehicular traffic also have higher amounts of pigments. For example, the number of pigments in the leaves of ornamental trees growing along Nyi Sergeli Street in the Sergeli district is lower because the level of traffic in this area is high. These indicators indicate that harmful substances emitted by motor vehicles hurt the leaves of ornamental trees. On the contrary, the number of pigments in the leaves of ornamental trees growing in the Botanical Garden of Yunusabad district is slightly higher. This is because the trees grow in natural conditions, the impact of substances emitted by motor vehicles is almost absent, and the abundance of other types of ornamental trees shows its positive effect.

4 Conclusions

It was found that the number of pigments in the leaves of ornamental tree species growing on city streets and then planted differed, and their amount changed depending on the season.

The results of the phenological observation of ornamental trees growing on the streets selected for the study showed that various spots appeared on the leaves of the trees on the streets of Nyi Sergeli, Farkhod, and they began to dry up. From the end of the summer months, it was found that the leaves fell early. The reverse was observed in the leaves of trees growing in Ganga Street and Botanic Garden, and these changes were explained as directly proportional to the number of harmful substances in the streets.

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