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## COMPARATIVE ANALYSIS OF THE MORPHOLOGICAL TRAITS, BIOCHEMICAL COMPOSITION, AND FUNGAL DISEASES OF THE CORNELIAN CHERRY (*CORNUS MAS L.*)

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### SUMMARY

Currently, significant attention centers on cultivating rare fruit crops with unique properties worldwide. The cornelian cherry (*Cornus mas* L.) is also popular for its abundant and stable yield. Industrial plantation of cultivated cornelian cherry remains limited globally, which restricts the ability to meet the growing demands of this valuable fruit. Therefore, studying the morphological and biochemical composition of its cultivated cultivars can be an important research task. The following research analyzes the morphological and biochemical traits of fruits of five cornelian cherry cultivars grown in the Tashkent Region, Uzbekistan, as well as the content of photosynthetic pigments in their leaves. The study recorded the cornelian cherry fruit mass up to 2.88 g, length (22.47 mm), and width (13.80 mm). In cornelian cherry fruits, the dry matter content reached 20.2%, pH is 3.18, and sugar level is 10.88%. Leaf chlorophyll content ranged from 8.55 to 9.34 mg/kg. The study also identified *D. destructiva* as the primary fungal pathogen affecting cornelian cherry under the growing conditions of Uzbekistan. Infection by *D. destructiva* resulted in losses of dry matter (6.27%), sugars (7.18%), macroelements (34.37–755.78 mg/kg), microelements (0.05–3.22 mg/kg), and reduction in chlorophyll a and b (0.9–1.4 and 1.0–1.81 mg/g, respectively).

**Keywords:** Cornelian cherry (*C. mas* L.), morphological traits, biochemical analysis, macro- and microelements, chlorophylls (Chl-a and Chl-b), *D. destructiva*

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**Key findings:** The morphological and biochemical traits and chlorophyll content determination were successful in the cornelian cherry (*C. mas* L.). The results revealed that anthracnose disease caused by *D. destructiva* leads to a considerable reduction in biochemical traits of fruits and leaf pigments.

## INTRODUCTION

The cornelian cherry (*Cornus mas* L.) is a perennial shrub and a small tree belonging to the family Cornaceae. The said species distribution mainly spreads across Central and Southern Europe, the Caucasus, Central Asia, and the Mediterranean region. It is also widespread in the foothill and mountainous areas of Uzbekistan. The plant typically reaches a height of 2–6 meters. Its trunk is woody with sparse, intricately branched shoots. Mature trees have brown to dark-brown bark. The leaves are elliptic, oppositely arranged, with a green upper surface and a pale underside. The small, yellow flowers appear in March–April, blooming before leaf emergence. The fruits are ovoid and elongated, bright to dark red, each containing a single seed, and ripen in August–September.

The cornelian cherry is native to Southern Europe, Southwestern Asia, and the Caucasus Region (Dinda et al., 2016), with cultivations in countries such as Romania, Bulgaria, Italy, and Turkey. Its fruits can be eaten fresh and processed into products like jam, marmalade, juice, wine, and liqueur (Brindza et al., 2007). *Cornus sanguinea*, widespread in Europe and the Caucasus, is mainly ornamental due to its red foliage (Tenuta et al., 2022). Although its fruits are non-toxic, their acidic taste limits fresh consumption; hence, their main uses are for jams and juices (Kollmann and Grubb, 2001). *Cornus officinalis*, native to China, Korea, and Japan (Tenuta et al., 2022; Ma et al., 2024), produces edible red fruits harvested in autumn and has been part of traditional Chinese medicine for over 2,000 years (Dong et al., 2018). *Cornus kousa* is also native to East Asia and bears the largest and sweetest fruits among *Cornus* species, with its traditional use in therapeutic preparations and occasionally in winemaking (Vareed et al., 2006).

Cornelian cherry fruits showed characteristics of the highest levels of

nutritional and bioactive compounds. Their fruits contain 8%–12% sugars (glucose and fructose), citric, malic, and succinic acids, vitamins C, A, E, and PP, as well as minerals such as potassium, calcium, phosphorus, iron, and magnesium. The fruit color depends on the contents of anthocyanins and tannins. Traditionally, the cornelian cherry plant has been effective in folk medicines for its antipyretic, antimicrobial, antihypertensive, and digestive-enhancing properties, contributing to immune support system and vitamins intake. The fruits mostly undergo process into juices, jams, compotes, syrups, dried products, and liqueurs. The cornelian cherry plant is drought-tolerant and grows well in foothill and mountainous regions, preferring fertile, slightly alkaline, and neutral soils.

Seed-propagated plants typically enter the fruiting stage after 6–8 years, whereas grafted plants reach reproductive maturity earlier, usually within 3–4 years. Economically, *C. mas* provides valuable raw material to the food and pharmaceutical industries. It is hard, with its dense wood mostly used for crafting tools, handles, and various artisanal products, and the said species cultivation serving as an ornamental plant in landscapes and gardens. The genus *Cornus* L. (*Cornaceae*) comprises approximately 65 species distributed across Central and Southern Europe, Eastern Africa, Southwest Asia, the Mediterranean Region, and the Americas (Dinda et al., 2016). Among edible species of the genus *Cornus*, several have wide consumption across Europe and Asia (Seeram et al., 2002).

Research on *Cornus mas* L. in Uzbekistan has started by Gulnaz Matkarimova, Nodira Nurullayeva, and Khislat Khaydarov. The researchers examined the composition of fruits from different *C. mas* cultivars, including glucose, fructose, organic acids (particularly lactic acid), nitrogen and coloring substances. They also checked essential oils, vitamin C, and minerals such as Ca, Fe, K, Mg, P, as well as other vitamins,

mineral salts, and bioactive compounds. Among the main findings, the carbohydrate and amino acid contents of the fruits of the "Elegant" and "Svetlyachok" cultivars attained analysis. They determined that the amino acid content in the fruits of *C. mas* grown in Uzbekistan was 2.643235 mg/g in the "Svetlyachok" cultivar and 1.794235 mg/g in the "Elegant" cultivar (Matkarimova *et al.*, 2023).

Several studies have taken place to investigate the biochemical composition of *C. mas* in Uzbekistan. Research on the amino acid composition, flavonoid content, and other biochemical traits of *C. mas* fruits has also progressed, contributing to understanding more of their nutritional and functional value. Furthermore, studies have looked into fungal and viral diseases affecting the country's agricultural crops (Makhmudov *et al.*, 2024).

However, despite the growing interest in cornelian cherry cultivation in Uzbekistan, comprehensive comparative evaluations of morphological and biochemical traits among locally grown cultivars remain limited. In particular, insufficient information prevails regarding the relationship between fruit biochemical composition and photosynthetic pigment content in leaves under the agroclimatic conditions of the Tashkent Region. Therefore, the ensuing study aimed to analyze the morphological and biochemical characteristics of five cornelian cherry cultivars grown in the Tashkent Region of Uzbekistan, as well as to determine the content of photosynthetic pigments in their leaves.

## MATERIALS AND METHODS

### Study object and local conditions

The study focused on the selection and differentiation of red-fruited cornelian cherry (*C. mas* L.) cultivars. The collected study samples came from the Academic Horticulture, Viticulture, and Winemaking Research Institute named after M. Mirzaev, located in Tashkent Region (41°25'23.5"N, 69°19'30.3"E). The region has a continental climate, with cold winters and warm summers, at an average

altitude of 450–500 m above sea level. Annual precipitation ranges from 370 to 390 mm, and the growing season lasts approximately 235 days. The cornelian cherry cultivars Elegantly, Vydubitsky, Vladimirsky, Elena, and Evgenia were specimens selected for this study. Fully ripened fruits underwent harvesting for each cultivar before their transport to the laboratory for morphological and biochemical analyses.

### Morphological analysis

Biometric analyses of red fruits at the ripening stage started in the Plant Protection and Quarantine laboratory of the Institute. Parameters, such as fruit weight, length, and width, attained measurements. Fruit weight determination used an analytical electronic balance (MS303TS, Mettler-Toledo Instruments). Thirty fruits per variety underwent weighing individually to calculate the mean value. Fruit length and width estimation used a digital caliper (Stainless Hardened 0.01–150 mm, Russia).

### Biochemical analysis

The analyses of cornelian cherry cultivar fruits included moisture, dry matter, ash content, acidity, total sugars, macro- and microelements, vitamin C, and pH. All the laboratory analyses were in four replicates. Moisture content determination employed the quartz sand drying method, which allows indirect measurement by weighing residual material after drying. Determining dry matter took place in a muffle furnace at 600 °C. Total sugar content analysis used the standard Luff-Schoorl method (Vračar *et al.*, 2001), with the pH measured using a pH meter (HI981030, Hanna Instruments) by immersing prepared solutions (Skender *et al.*, 2022).

### Leaf pigment analysis

The pigment content detection in red plant leaves engaged a spectrophotometer (Shimadzu UV-1900i) following the methodology described by Lichtenthaler and Wellburn (1985). Analysis proceeded in three variants with three replicates. Considering that

photosynthesis and pigment activity peak in the morning, samples of healthy and diseased leaves succeeded in their collection between 09:00 and 10:00 am. In the laboratory, weighing 50 mg of each leaf type bore fine grinding before extracting chlorophyll a and b pigments using 5 ml of 95% ethanol solution.

### Macro- and microelement analysis

Macro- and microelement contents in red fruits entailed determination after drying in a thermostat at 70 °C and incineration in a furnace at 500 °C–550 °C. The resulting ash gained dissolving in 1 N nitric acid for one day, followed by filtering and adjusting the solution to 50 ml with 1 N nitric acid. The macro- and microelement contents' analysis used an Avio 200 ICP-OES atomic emission spectrophotometer (PerkinElmer®).

### Fungal phytopathogen identification

Fungal phytopathogens in cornelian cherry cultivar plants underwent isolation using morphological methods. Assessing samples of leaves, shoots, and fruits under laboratory conditions determined the occurrence of phytopathogens in the studied cultivars of *C. mas*. The collected samples reached incubation in a moist chamber, after which the isolated phytopathogens sustained culturing on artificial nutrient media, with their biological characteristics systematically investigated. Colonies grown on artificial nutrient media succeeded in their identification based on macroscopic characteristics, such as color, shape, hyphal structure, and spores. The potato dextrose agar (PDA, Micro-Lab, Russia) was the medium used to cultivate the pathogens, adding antibiotics, such as tetracycline and streptomycin, to inhibit

bacterial growth. Phytopathogens' culturing in 100 mm Petri dishes and their incubation used a Memmert incubator (Memmert AtmoControl, Germany). The morphological structures of the phytopathogens obtained examination under a microscope (BDS400-FL, China).

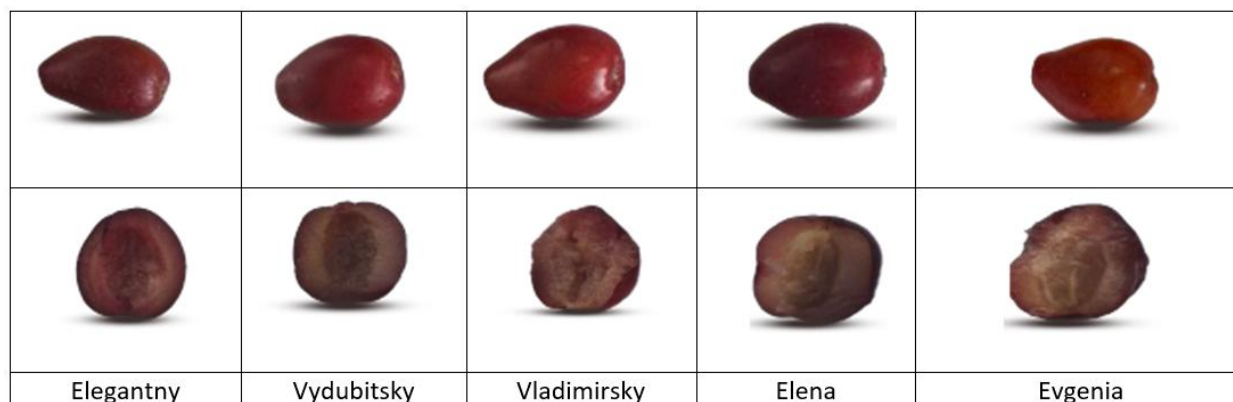
### RESULTS

Based on the morphological traits of cornelian cherry (*C. mas*) fruits, the cultivars revealed significant differences for fruit weight, length, and width (Table 1). The observations showed the fruit weight ranged from 1.66±0.28 g (Elena) to 2.88±0.17 g, and the heaviest fruits belonged to the cultivar Elegantny. Fruit length recorded at 17.57±0.61 mm resulted in the cultivar Vydubitsky; 20.37±0.75 mm occurred for the cultivar Vladimirsky, and 21.13±0.21 mm appeared for the cultivar Elena, with the longest fruits again found in the cultivar Elegantny. Fruit width varied from 12.07±0.67 mm (Evgenia) to 13.80±0.50 mm (Elegantny). The fruit widths of the cultivars Vydubitsky, Vladimirsky, and Elena were 12.83±0.58, 12.77±0.51, and 13.33±0.59 mm, respectively (Figure 1).

Biochemical analysis of the cornelian cherry fruits revealed the cultivar Elegantny fruits contained 18.43% dry matter, 81.57% water, a pH of 2.97, and a total sugar content of 10.7% (Table 2). For cultivar Vydubitsky, the respective values were for dry matter (19.50%), water (80.5%), pH(3.18), and sugar content (11.28%). The cultivar Vladimirsky fruits exhibited 20.2% dry matter, 79.8% water, pH2.83, and 9.81% sugar content, while the cultivars Elena and Evgenia fruits had their dry matter at 17.87%–16.43%, water at 82.13%–83.57%, pH of 2.76–3.07, and sugar content at 10.02%–10.88%.

**Table 1.** Morphological traits of cornelian cherry (*Cornus mas* L.) fruits.

| Cultivars   | Fruit weight (g) | Fruit length (mm) | Fruit width (mm) |
|-------------|------------------|-------------------|------------------|
| Elegantny   | 2.88±0.17        | 22.47±0.86        | 13.80±0.50       |
| Vydubitsky  | 1.83±0.09        | 17.57±0.61        | 12.83±0.58       |
| Vladimirsky | 2.12±0.11        | 20.37±0.75        | 12.77±0.51       |
| Elena       | 2.29±0.03        | 21.13±0.21        | 13.33±0.59       |
| Evgenia     | 1.66±0.28        | 16.37±1.75        | 12.07±0.67       |



**Figure 1.** Morphological structure of cornelian cherry (*Cornus mas* L.) fruits.

**Table 2.** Biochemical traits of cornelian cherry (*Cornus mas* L.) fruits.

| Cultivars   | Dry matter (%) | Water (%)  | pH        | Sugar content (%) |
|-------------|----------------|------------|-----------|-------------------|
| Elegantny   | 18.43±0.8      | 81.57±2.53 | 2.97±0.13 | 10.27±0.36        |
| Vyubitsky   | 19.50±1.7      | 80.5±2.0   | 3.18±0.2  | 11.28±0.33        |
| Vladimirsky | 20.2±0.56      | 79.8±1.38  | 2.83±0.09 | 9.81±0.2          |
| Elena       | 17.87±1.46     | 82.13±3.47 | 2.76±0.27 | 10.02±0.07        |
| Evgenia     | 16.43±0.83     | 83.57±2.55 | 3.07±0.05 | 10.88±0.37        |

**Table 3.** Macroelement content in cornelian cherry (*Cornus mas* L.) fruits.

| Cultivars   | K (mg/kg)     | Ca (mg/kg)  | Na (mg/kg) | P (mg/kg)  | Mg (mg/kg) |
|-------------|---------------|-------------|------------|------------|------------|
| Elegantny   | 2348.7±129.66 | 449.7±26.03 | 51.7±7.36  | 294.7±4.85 | 99.83±3.45 |
| Vyubitsky   | 2091.0±125.97 | 424.3±34.21 | 64.87±6.79 | 284.8±6.45 | 106.0±4.38 |
| Vladimirsky | 2169.3±242.23 | 337.3±42.25 | 45.43±5.90 | 235.4±10.6 | 93.53±2.46 |
| Elena       | 2087.7±55.54  | 513.0±22.72 | 60.73±3.01 | 244.5±15.5 | 88.7±8.8   |
| Evgenia     | 2346.0±122.87 | 317.3±30.50 | 35.33±2.71 | 264.0±4.3  | 114.0±3.76 |

The detection of mineral composition (macro- and microelements) of the cornelian cherry fresh fruits was successful. Among macroelements, cultivar Elegantny fruits contained K (2348.7±129.66 mg/kg), Ca (449.7±26.03 mg/kg), Na (51.7±7.36 mg/kg), P (294.7±4.85 mg/kg), and Mg (99.83±3.45 mg/kg) (Table 3). For the cultivar Vyubitsky, these values were 2091.0±125.97, 424.3±34.21, 64.87±6.79, 284.8±6.45, and 106.0±4.38 mg/kg, respectively. The cultivar Vladimirsky contained K (2169.3±242.23 mg/kg), Ca (337.3±42.25 mg/kg), Na (45.43±5.90 mg/kg), P (235.4±10.6 mg/kg),

and Mg (93.53±2.46 mg/kg). Meanwhile, cultivars Elena and Evgenia had the contents of K (2346.0±122.87 mg/kg), Ca (513.0±22.72 mg/kg), Na (60.73±3.01 mg/kg), P (264.0±4.3 mg/kg), and Mg (114.0±3.76 mg/kg).

In cornelian cherry cultivars, the microelement contents in fresh fruits also reached their evaluation (Table 4). The cultivar Elegantny contained Fe (3.45±0.43 mg/kg), Zn (0.91±0.08 mg/kg), Cu (0.39±0.03 mg/kg), Mn (0.11±0.02 mg/kg), and Ni (0.05±0.02 mg/kg). The cultivar Vyubitsky contained 2.88±0.08 mg/kg Fe, 0.64±0.09 mg/kg Zn, 0.35±0.07 mg/kg Cu,

**Table 4.** Microelement content in cornelian cherry (*Cornus mas* L.) fruits.

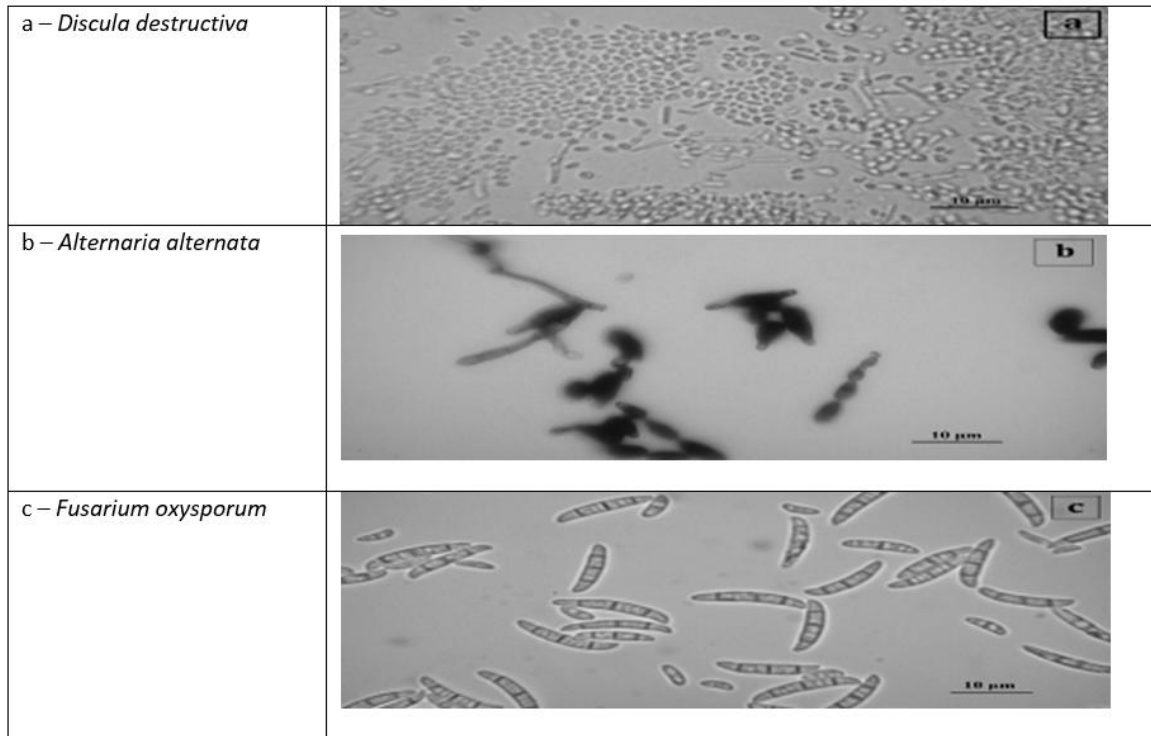
| Cultivars   | Fe (mg/kg) | Zn (mg/kg) | Cu (mg/kg) | Mn (mg/kg) | Ni (mg/kg) |
|-------------|------------|------------|------------|------------|------------|
| Elegantny   | 3.45±0.43  | 0.91±0.08  | 0.39±0.03  | 0.11±0.02  | 0.05±0.02  |
| Vydubitsky  | 2.88±0.08  | 0.64±0.09  | 0.35±0.07  | 0.19±0.03  | 0.07±0.02  |
| Vladimirsky | 2.55±0.08  | 0.77±0.05  | 0.32±0.04  | 0.21±0.03  | 0.03±0.01  |
| Elena       | 3.17±0.14  | 0.56±0.11  | 0.42±0.06  | 0.08±0.01  | 0.06±0.04  |
| Evgenia     | 4.04±0.06  | 0.68±0.05  | 0.36±0.04  | 0.16±0.02  | 0.04±0.03  |

0.19±0.03 mg/kg Mn, and 0.07±0.02 mg/kg Ni. For cultivars Vladimirsky and Elena, the highest levels of microelement were Fe → 3.17±0.14 mg/kg, Zn → 0.77±0.05 mg/kg, Cu → 0.42±0.06 mg/kg, Mn → 0.21±0.03 mg/kg, and Ni → 0.06±0.04 mg/kg. In the cultivar Evgenia, the corresponding microelements were Fe → 4.04±0.06 mg/kg, Zn → 0.68±0.05 mg/kg, Cu → 0.36±0.04 mg/kg, Mn → 0.16±0.02 mg/kg, and Ni → 0.04±0.03 mg/kg.

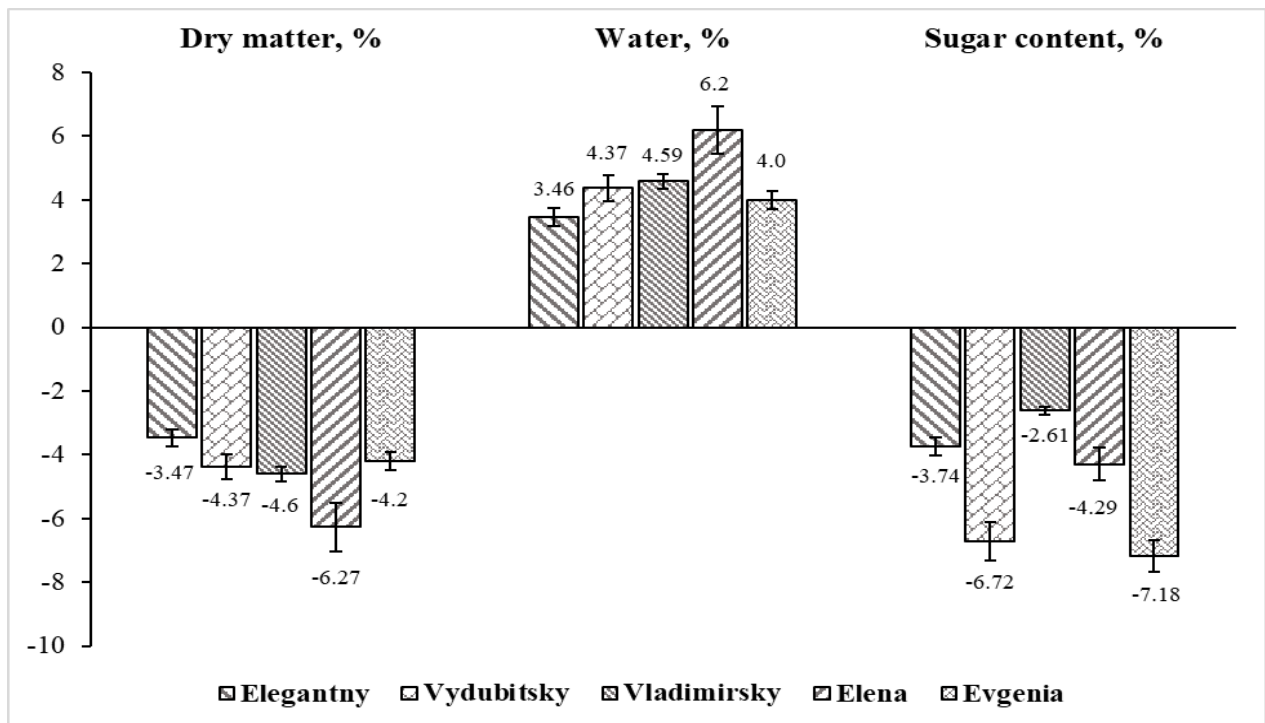
In cornelian cherry cultivar leaves, the study of photosynthetic pigments ensued. In this study, leaves of cultivars Elegantny contained chlorophyll-a (2.99±0.15 mg/g) and chlorophyll-b (6.31±0.53 mg/g), Vydubitsky (3.22±0.22 and 5.33±0.25 mg/g), and Vladimirsky (3.06±0.64 and 6.12±0.21 mg/g). The cultivars Elena and Evgenia contained chlorophyll-a (3.17–3.55 mg/g) and chlorophyll-b (5.79–6.10 mg/g). However, the total chlorophyll content ranged from 8.55 to 9.34 mg/g. Plants contain two types of pigments capable of functioning as photosynthetic antennae, which absorb visible light quanta and facilitate the accumulation of radiant energy as a proton electrochemical gradient across the biological membranes. Chlorophylls predominantly serve as antenna pigments, while retinals with vitamin A function play a minor role. Both chlorophyllous and non-chlorophyllous photosynthetic processes occur in plants (Tyutereva et al., 2017; www.agrobiology.ru). Chlorophylls are key components of photosynthetic membranes, with chlorophyll-b acting as the primary light-harvesting regulator, dissipating excess light energy potentially harmful to crop plants (Lichtenthaler et al., 1985; Pogson et al., 2005).

The effects of the pathogen *D. destructiva* on cornelian cherry fruits' biochemical parameters, macro- and microelement contents, and leaf photosynthetic pigments (Chl-a and Chl-b) also received assessments. Using a humidity chamber helped isolate pure cultures of the pathogen-inducing anthracnose. Sterilized filter paper in Petri dishes, moistened with sterile water, had samples surface-sterilized with 96% ethanol before cutting them into 3–5 mm fragments and evenly placing them on the filter paper. Petri dishes reached incubation at 18 °C–26 °C, with slow-growing isolates transferred to 2% malt extract agar for enhanced growth. Fungal growth monitoring began on day three, with mycelium aseptically transferred to the PDA medium. Morphological identification involved observing hyphal structures and spores under a 400× light microscope, recording measurements from three replicates per isolate, and comparing with reference fungal guides.

Major pathogens isolated from the cornelian cherry leaves, shoots, and fruits included *Alternaria alternata*, *Fusarium oxysporum*, and *D. destructiva* (Figure 2). However, *D. destructiva* emerged as the dominant phytopathogen belonging to class Sordariomycetes, order Diaporthales, family Gnomoniaceae, and genus *Discula*. Laboratory analyses revealed the pathogen *D. destructiva* significantly affected the cornelian cherry fruit's biochemical composition. Infected fruits of the cultivar Elegantny showed a 3.47% decrease in dry matter, a 3.74% decrease in sugar content, and a 3.46% increase in water content compared with healthy fruits (Figure 3). Similar trends were evident for cultivars Vydubitsky, Vladimirsky, Elena, and Evgenia, and water content increased up to 6.2%.



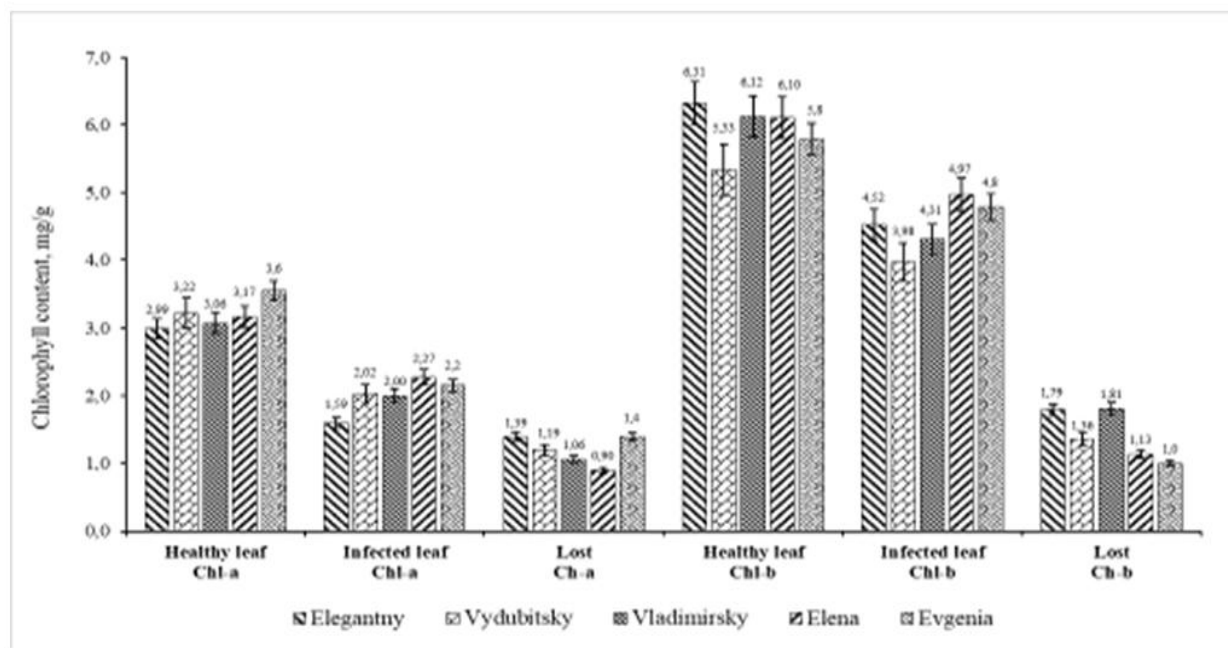
**Figure 2.** Microscopic view of fungal diseases.



**Figure 3.** Decrease level of biochemical traits of cornelian cherry (*Cornus mas* L.) fruits caused by the fungus *D. destructiva*.

**Table 5.** Macroelements' loss in cornelian cherry (*Cornus mas* L.) fruits as affected by the fungus *D. destructiva*.

| Cultivars   | K (mg/kg)     | Ca (mg/kg)  | Na (mg/kg) | P (mg/kg)    | Mg (mg/kg) |
|-------------|---------------|-------------|------------|--------------|------------|
| Elegantny   | 1832.33±129.6 | 179.67±22.6 | 14.67±3.5  | 164.67±11.59 | 55.6±9.85  |
| Vydubitsky  | 1197.43±292.8 | 157.33±24.5 | 12.33±1.5  | 185.33±7.02  | 59.63±12.6 |
| Vladimirsky | 1571.0±208.9  | 193.33±15.3 | 20.67±4.1  | 115.03±5.62  | 79.8±15.34 |
| Elena       | 1398.0±46.1   | 110.77±15.0 | 22.7±4.56  | 142.60±8.32  | 44.8±7.26  |
| Evgenia     | 1265.0±224.3  | 143.67±8.5  | 11.9±2.17  | 164.93±27.15 | 90.4±2.63  |

**Figure 4.** Reduction of photosynthetic pigments (mg/g) in cornelian cherry (*Cornus mas* L.) leaves as a result of the fungus *D. destructiva* infection.

Macro- and microelement contents also incurred adverse effects from the pathogen *D. destructiva*. In the cultivar Elegantny, K decreased to 1832.33±129.6 mg/kg, Ca to 179.67±22.6 mg/kg, Na to 14.67±3.5 mg/kg, P to 164.67±11.59 mg/kg, and Mg to 55.6±9.85 mg/kg (Table 5). On average, the reductions across infected fruits compared to healthy fruits were K→755.78 mg/kg, Ca→251.38 mg/kg, Na→35.16 mg/kg, P→110.18 mg/kg, and Mg→34.37 mg/kg. Microelements in infected cultivar Elegantny fruits decreased to Fe→2.28±0.27 mg/kg, Zn→0.40±0.03 mg/kg, Cu→0.15±0.06 mg/kg, Mn→0.05±0.02 mg/kg, and Ni→0.02±0.01 mg/kg. Finally, photosynthetic

pigment content in leaves entailed quantification, showing chlorophyll-a decreased to 1.59±0.16 mg/g and chlorophyll-b to 4.52±0.39 mg/g in the cultivar Elegantny; 2.02±0.09 mg/g and 3.98±0.11 mg/g in the cultivar Vydubitsky; 2.0±0.13 mg/g and 4.31±0.21 mg/g in the cultivar Vladimirsky; and 2.15–2.27 mg/g and 4.79–4.97 mg/g in the cultivars Elena and Evgenia, respectively (Figure 4). Total chlorophyll content ranged from 6.01 to 7.24 mg/g. Losses in chlorophyll-a and chlorophyll-b were significant in infected cornelian cherry plant leaves compared with healthy ones, with the carotenoid content also reduced.

The research findings demonstrated that *Discula destructiva* exhibits a high adaptive capacity and intensive development under the soil and climatic conditions of Uzbekistan. Under the influence of this phytopathogen, significant alterations were evident in the biochemical composition of *C. mas* fruits. In particular, the dry matter content decreased by 6.27%, while the total sugar content declined by 7.18%. Moreover, a reduction in macroelement concentrations (34.37–755.78 mg/kg) and microelement concentrations (0.05–3.22 mg/kg) was notable. The pathogen also exerted a negative effect on photosynthetic pigments in the leaves: chlorophyll-a content decreased to 0.9–1.4 mg/g, and chlorophyll-b content declined to 1.0–1.81 mg/g. These results scientifically substantiate the substantial impact of the pathogen on plant physiological processes and on key quality parameters of the fruit.

## DISCUSSION

The cornelian cherry (*C. mas*) belongs to the family Cornaceae that includes over 60 species worldwide. It naturally occurs in Southern Europe, the Caucasus, Central Asia, Turkey, Iran, and East Asia, with some species also found in North America. *Cornus* fruits provide the valuable raw materials for the food industry. According to a past study, bioactive components of *Cornus mas* gave the highest content of organic acids and phenolic compounds in the fruit, enhancing its sensory properties in the cornelian cherry (Bayram and Ozturkcan, 2020). Other sources have also highlighted that *Cornus* species have significant medicinal, nutritional, pharmaceutical, and ecological values, with the species *C. mas* and *C. officinalis* being the most studied and commercially valuable worldwide. Fruits and plant organs have appeared to exhibit antioxidant, antidiabetic, and anti-inflammatory activities, playing an important role in human health (Dinda *et al.*, 2016; Deng *et al.*, 2024).

The estimated global production of *C. mas* amounts to 722,684 tons. The leading

producer is the United States (404,880 tons), followed by Canada (195,196 tons), Chile (106,180 tons), Turkey (11,481 tons), Azerbaijan (2,874 tons), and Romania (581 tons). Among the most widely cultivated and commercially significant cultivars of this species are Elegantny, Vydubetsky, Yevgeniya, Lukyanivskyy, and Dublany. These cultivars are distinctive with their high productivity, large fruit size, and favorable technological and quality characteristics (Ercisli, 2004).

Recently, *Cornus* species have attracted particular attention due to massive contents of bioactive compounds. These have potential as a natural source against various diseases, suitability for functional food production, and morphological and genetic diversity, which make them promising candidates for breeding programs (Dinda *et al.*, 2016; Klymenko *et al.*, 2019; Yilmaz and Yilmaz, 2020; Deng *et al.*, 2024). Previous research revealed six cornelian cherry genotype fruits revealed significant differences among the morphological (weight, fruit size) and biochemical (sugar, water, organic matter) traits grown under diverse ecological conditions, indicating the genetic and ecological diversity of *C. mas* (Cornescu and Cosmulescu, 2017).

Similarly, the analysis of 13 *C. mas* genotypes cultivated in Antalya, Turkey, showed morpho-biochemical and mineral variability in fruit structure and composition, with recommendations provided for breeding based on genotypic traits (Ercisli *et al.*, 2011). In this present study, morphological and biochemical characterization of fruits of *C. mas* cultivars Elena, Vladimirsky, Evgenia, Elegantny, and Vydubetsky underwent comparative analysis. Additionally, the harmful effects of the fungus *D. destructiva* on *Cornus* leaves and fruits entailed investigation, with the results compared with previously published findings. The analyzed fruit weight ranged from 1.66±0.28 g (Elena) to 2.88±0.17 g (Elegantny). The comparison showed that the cultivar Elena exhibited fruit weight values similar to those of genotypes BK4 and BK5, whereas other cultivars differed, indicating a close genetic relationship among the cultivar Elena and BK4 and BK5 progenies (Skender *et*

al., 2022). Fruit length ranged from  $16.37 \pm 1.75$  mm (Evgenia) to  $22.47 \pm 0.86$  mm (Elegantny), disclosing the cultivar Evgenia as similar to genotypes CA1 and BU3 (Skender et al., 2022).

The biochemical analysis of *Cornus* fruits cultivated in the Tashkent Region showed the cultivar Elena had a dry matter of 17.87%, water of 82.13%, and sugar content of 10.02%, which proved similar to the genotypes C8–C9 (Skender et al., 2022). Macro- and microelement contents in the fruits of cultivars Elegantny and Elena were comparable to the four other genotypes—Cm-01, Cm-02, Koralyovi, and Nizhnyi (Lidiková et al., 2024). Evaluation of the photosynthetic pigment content in *Cornus* leaves also transpired. Previous studies reported the chlorophyll content ranged from 0.073 to 6.281 mg/g, while the dry weight had the highest value recorded in the cultivar Wydubiecki and the lowest occurring in the cultivar Florianka (Szczepaniak et al., 2019). In this study, total chlorophyll (Chl-a + Chl-b) was 6.12 mg/g (for cultivar Elegantny), 6.01 mg/g (Vydubysky), 6.31 mg/g (Vladimirsky), 7.24 mg/g (Elena), and 6.94 mg/g (Evgenia).

*Cornus* species appeared to be susceptible to various fungal pathogens. These pathogens cause leaf spotting, leaf fall, anthracnose, powdery mildew, and rust. Present observations identified anthracnose as the most widespread and damaging disease in *Cornus*, caused by *D. destructiva* (*Gloeosporium* sp.), with the same first reported in the species *C. nuttallii* in Washington and Vancouver in 1976. Later, its description as anthracnose arose in 1979 (Byther and Davidson, 1979). The pathogen *D. destructiva* infects the leaves, causing lesions on twigs and fruits. Hibben and Daughtrey (1988) reported that infected twigs and fallen leaves over winter harbor small acervuli (30–135  $\mu$ m) typical of this pathogen. In spring, spores spread via rain and wind, infecting new tissues. The fungus thrives under high humidity and rainfall, further increasing its spread and damage (Holzmueller et al., 2006; Borcean and Imbrea, 2020).

Anthracnose symptoms appear in early spring as small, purple-bordered brown spots

on young leaves and flowers. These spots enlarge and coalesce over the season, particularly under wet conditions, often leading to perforations in leaf tissues (Daughtrey and Hagan, 2001). Infected twigs do not shed leaves in autumn; the pathogen survives the winter and later spreads to new shoots and causes dieback. This facilitates infection of soft and succulent shoots in the following spring, ultimately leading to canker formation (Hibben and Daughtrey, 1988). Fungal infections negatively affect the fruit's biochemical composition and the leaf's photosynthetic pigments. Previous studies demonstrated that pathogens *Venturia pyrina* and *Monilinia fructigena* infections reduced the chlorophyll content in pear leaves by up to 1.024 mg/g (Chl-a) and 2.65 mg/g (Chl-b) compared with healthy plant leaves (Pulatov and Umarov, 2023).

In the presented study, pathogen *D. destructiva* infection resulted in significant reductions in dry matter (6.27%), sugar content (7.18%), macroelements (34.37–755.78 mg/kg), and microelements (0.05–3.22 mg/kg) in fruits, and Chl-a (0.9–1.4 mg/g) and Chl-b (1.0–1.81 mg/g) in leaves of the cornelian cherry. Research in the United States has also confirmed that the pathogen *D. destructiva* negatively affects *C. mas* fruit yield and quality, requiring integrated control measures, including agronomic, chemical, and biological methods (Oswalt et al., 2012).

## CONCLUSIONS

The study on cornelian cherry (*C. mas* L.) cultivar fruits demonstrated significant differences for morphological and biochemical traits, including fruit weight of up to 2.88 g, dry matter up to 20.2%, and sugar content up to 10.88%. Leaf chlorophyll content ranged from 8.55 to 9.34 mg/kg. The fungal pathogen *D. destructiva* caused notable reductions in fruit dry matter (6.27%), sugar content (7.18%), macroelements (34.37–755.78 mg/kg), microelements (0.05–3.22 mg/kg), and leaf chlorophyll-a and chlorophyll-b contents (0.9–1.4 and 1.0–1.81 mg/g, respectively). Without timely management,

pathogen *D. destructiva* significantly compromises both the biochemical quality of *Cornus* fruits and leaf pigments, emphasizing the need for effective phytopathogen control measures. From a strategic research perspective, future work should prioritize molecular confirmation of *D. destructiva* through ITS sequencing and phylogenetic analysis, as well as assessment of intra-species genetic diversity among local isolates. In parallel, comprehensive phytopathological surveillance integrating molecular diagnostics is an immediate action to characterize the diversity of fungal, bacterial, and viral pathogens associated with *Cornus mas* cultivation in Uzbekistan. These directions will strengthen scientific understanding and contribute to sustainable disease control programs.

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