CHLOROPHYLL CONTENT AND PHOTOSYNTHETIC POTENTIAL OF WHEAT VARIETIES

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Abstract. *This study examines the interannual dynamics of photosynthetic pigments, particularly chlorophyll content measured by SPAD-500, in genetically diverse varieties of soft wheat (Triticum aestivum L.) cultivated under the specific soil and climatic conditions of the Khorezm region during 2023-2025. The three-year trends and their relationship with grain yield were evaluated. Based on averaged data, the varieties Nikifor/Kroshka (59.9±1.13) and Sila (58.5±0.92) demonstrated the highest photosynthetic potential and showed a positive association with yield parameters.*

Keywords: *soft wheat, chlorophyll, SPAD-500, photosynthesis, abiotic stress, yield, varietal differences, carotenoids.*

Chlorophyll content represents a complex genetically determined trait whose expression depends on both endogenous and environmental factors. Nitrogen fertilization plays a crucial role in maintaining high chlorophyll levels in plants [4]. The synthesis of photosynthetic pigments can be disrupted by various biotic [2,3] and abiotic [1] stresses. In addition to chlorophyll, plants contain carotenoids-pigments responsible for yellow, orange, and red coloration. Carotenoids assist in light absorption and protect plants from excessive radiation by preventing photodamage.

The assessment of chlorophyll content serves not only to quantify pigment concentration but also to evaluate the overall physiological status of plants and their adaptability to stress conditions. Such analysis fulfills several important functions. Chlorophyll is the primary pigment involved in photosynthesis [5]; therefore, higher chlorophyll levels indicate greater photosynthetic capacity and more efficient conversion of solar energy into organic compounds. This, in turn, promotes biomass accumulation and increased yield. Chlorophyll content also serves as a rapid indicator of plant health. Stress factors such as drought, high temperatures, salinity, nutrient deficiencies, or diseases often reduce chlorophyll concentration. Thus, chlorophyll measurements enable assessment of stress tolerance. In plant breeding, chlorophyll content is widely used to evaluate the photosynthetic potential of new varieties and to facilitate early selection for high productivity.

Table 1

Chlorophyll content of the varieties (SPAD-500).

№	Varieties	Years			Average indicator	Leaf area (cm^2)	Wheat yield (g/m^2)
		2023	2024	2025			
1	Durdona	54.1±1.29	55.2±0.68	54.8±1.75	54.7±0.35	378.7±62.6	389.5±5.50
2	Vostorg	56.6±0.93	57.0±1.55	55.9±0.86	56.5±0.32	345.2±88.7	441.0±8.0
3	Starshina	53.3±1.18	54.2±0.90	54.2±1.58	53.9±0.30	211.2±35.1	265.5±4.0

4	Kamol	57.2±0.80	59.7±0.77	56.6±0.94	57.8±0.95	292.9±18.6	420.0±26.0
5	Sila	57.7±0.96	60.3±1.36	57.4±1.86	58.5±0.92	267.5±29.1	572.5±5.5
6	Ayvina	53.8±1.53	54.3±1.61	54.6±1.77	54.2±0.23	323.8±34.6	370.0±4.0
7	Nikifor/Kroshka	57.9±1.28	61.8±0.65	60.0±1.78	59.9±1.13	309.8±51.0	543.6±6.0
8	Kasiet	54.8±1.41	55.7±1.38	55.1±2.14	55.2±0.26	373.8±49.6	349.0±52.0
9	Adyr	55.0±1.14	55.9±1.65	55.5±1.36	55.5±0.26	224.8±23.7	421.0±3.0
10	Vlada	55.4±0.52	56.9±0.71	55.9±0.39	56.1±0.44	224.4±13.4	335.0±6.0
11	Average indicator	55.2±1.10	57.1±1.10	56.0±1.44	56.2±0.51	295.2±40.6	410.5±3.46

The results revealed clear genetic differences among varieties in terms of chlorophyll content. In 2023, the overall mean SPAD value was 55.2±1.10.

Varieties exceeding this average included Vostorg (56.6±0.93), Kamol (57.2±0.80), Sila (57.7±0.96), and Nikifor/Kroshka (57.9±1.28). Elevated SPAD values indicate sufficient chlorophyll levels for effective light capture and energy conversion. Since chlorophyll contains nitrogen, reductions in SPAD values often reflect nitrogen deficiency, sometimes even before visible symptoms of chlorosis appear. During critical growth stages-such as active vegetative growth or reproductive organ formation-SPAD levels may predict subsequent yield quantity and quality.

In 2024, the average chlorophyll content increased to 57.1±1.10. This rise can be attributed to relatively cooler and wetter weather conditions compared to 2023. The mean annual temperature was 19.83°C, lower than in the previous year, and total precipitation reached 98 mm, including 50 mm in March. These favorable conditions supported photosynthetic activity and contributed to increased chlorophyll accumulation. The highest values were recorded for Nikifor/Kroshka (61.8±0.65) and Sila (60.3±1.36), followed by Kamol (59.7±0.77), Vostorg (57.0±1.55), and Vlada (56.9±0.71). The lowest values were observed in Starshina (54.2±0.90) and Ayvina (54.3±1.61).

In 2025, the overall mean chlorophyll content declined to 56.0±1.44, lower than in 2024. Although the annual mean temperature (19.67°C) and precipitation (147 mm) were generally favorable, early heat stress during April and May-when wheat was at heading and flowering stages-reached temperatures of up to 35°C. This early temperature increase negatively affected physiological development. Nevertheless, Nikifor/Kroshka (60.0±1.78) and Sila (57.4±1.86) maintained relatively high chlorophyll levels under these conditions. Kamol (56.6±0.94) and Vostorg (55.9±0.86) also performed above average, while the lowest values were again recorded in Starshina (54.2±1.58) and Ayvina (54.6±1.77).

The three-year average chlorophyll content across all varieties was 56.2±0.51. Varieties exceeding this mean were Nikifor/Kroshka (59.9±1.13) and Sila (58.5±0.92), demonstrating consistently superior performance. Kamol (57.8±0.95), Vostorg (56.5±0.32), and Vlada (56.1±0.44) also showed above-average results. The lowest three-year averages were observed in Starshina (53.9±0.30) and Ayvina (54.2±0.23).

Conclusion. The findings indicate that although chlorophyll content varied across years, certain varieties-particularly Nikifor/Kroshka and Sila-consistently exhibited higher pigment levels. Elevated chlorophyll content enhances photosynthetic efficiency, positively influencing growth and yield potential. These varieties demonstrate strong adaptability to varying environmental conditions and may serve as valuable genetic resources for breeding programs aimed at improving photosynthetic capacity and productivity.

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