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Influence of different nitrogen fertilization on photosynthetic pigments in winter wheat

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INTRODUCTION & AIM

Nitrogen uptake in wheat crops can vary greatly, as the variability of fertilizer uptake depends on the interaction of complex abiotic and biotic environmental factors, including edaphic and climatic conditions and agricultural management practices. Higher nitrogen fertilizer levels typically result in increased photosynthetic pigments and can have a significant impact not only on plant vegetative biomass but also on photosynthetic pigment concentrations, which are key determinants of plant productivity. The distribution and arrangement of these pigments in the leaves may vary depending on the plant species and variety, environmental conditions, cultivation techniques, and various stress factors. Therefore, the amount of pigments in plants can be considered an important biochemical indicator reflecting the optimal functioning of the photosynthetic process. To investigate these relationships, a three-factor field experiment was conducted in 2025 at the experimental sites of the AgroITC Innovation and Research Center of the JSC Agrokoncernas Group.

The aim of this study was to investigate the influence of different nitrogen fertilization rates on the content of photosynthetic pigments in three winter wheat varieties.

METHOD

Experimental design. Factor A – three winter wheat varieties: 1)'Chevignon', 2) 'LG Keramik', 3) 'Euforia'; Factor B – nitrogen fertilization rates: 1) 150 kg ha-1, 2) 180 kg ha-1; Factor C – nitrogen application time: 1) three times; 2) four times. Ammonium nitrate (N34) and ammonium sulfate (N21 S24) was used for fertilization.

Treatment	Fertilization time				
	BBCH 27–29	BBCH 29–30	BBCH 32–33	BBCH 37–39	Total N rate, kg ha^{-1}
$N_{60}+N_{60}+N_{30}$	N_{60}	N_{60}	N_{30}	-	150
$N_{70}+N_{70}+N_{40}$	N_{70}	N_{70}	N_{40}	-	180
$N_{50}+N_{50}+N_{20}+N_{30}$	N_{50}	N_{50}	N_{20}	N_{30}	150
$N_{60}+N_{60}+N_{30}+N_{30}$	N_{60}	N_{60}	N_{30}	N_{30}	180

Analysis of photosynthetic pigments content. It was determined at growth stages of BBCH 32-33 and BBCH 37-39 of winter wheat. Five plants were randomly selected from each winter wheat field of different varieties, which were used for analysis of photosynthetic pigments (chlorophylls a, b and carotenoids). The content of photosynthetic pigments in fresh leaf mass was determined using 96% ethyl alcohol according to the Holm–Wettstein spectrophotometric method. A Jenway 7300 Spectrophotometer was used in the corresponding wave spectrum: 441 nm for carotenoids; 662 nm for chlorophyll a; 644 nm for chlorophyll b (von Wettstein, 1957). The content of pigments was determined according to the following equations:

$$\text{Chl a} = 9{,}784\times D662 - 0{,}990\times D664\ (C\times V)/(P\times 1000);\ (1)$$
$$\text{Chl b} = 21{,}426\times D644 - 4{,}650\times D662\ (C\times V)/(P\times 1000);\ (2)$$
$$\text{Carotenoid} = 4{,}695\times D440{,}5 - 0{,}268\ (\text{Chl a+b})\ (C\times V)/(P\times 1000);\ (3)$$

where C – pigment content (mg g-1); V – extracts volume (ml); P – fresh mass of plants (g).

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RESULTS & DISCUSSION

Fertilization with nitrogen inhibits the breakdown of photosynthetic pigments, extends the period of active photosynthesis, and ensures more efficient transport of assimilates, which further affects the yield (Vagusevicienė et al., 2021). The results of this studies showed that the total amount of photosynthetic pigments and the mass of the aboveground part of plants depended on the winter wheat variety and the level of nitrogen rates. The highest total amount of photosynthetic pigments was determined in the BBCH 32-33 stage in the winter wheat 'Chevignon', when the plants were fertilized with N180, applied three times (Fig. a). However, the total amount of photosynthetic pigments in the BBCH 37-39 stage was the highest in 'Chevignon', when the plants were fertilized with N150, applied three times (Fig. b). The variation in chlorophyll content in leaves was also studied using different nitrogen rates in different crop species, with the aim of quantitatively assessing the effects of different nitrogen sources (Gherban, Florin, 2023). .

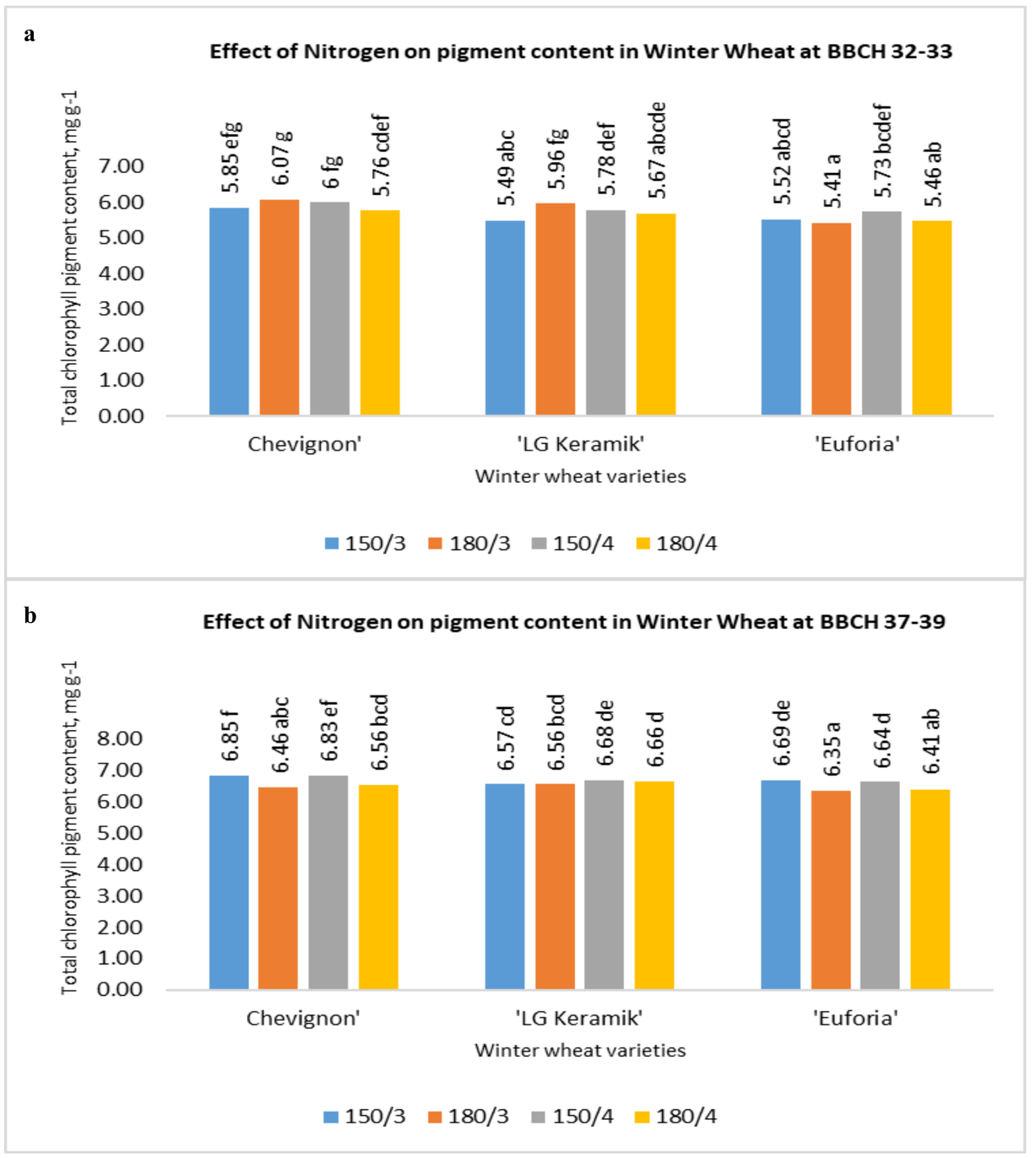

Figure. Total chlorophyll pigment content in winter wheat at different fertilization rate

CONCLUSION

The total chlorophyll content varied among different winter wheat varieties. All varieties accumulated high levels of pigments, but 'Chevignon' showed the highest photosynthetic pigment content during growth stages BBCH 32–33 and BBCH 37–39.

FUTURE WORK

Further research is in progress to learn how to improve nitrogen use efficiency and how plants respond to split fertilization under different environmental conditions and over different years.