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STIMULATION OF SPRING WHEAT GROWTH BY VARIOUS COMBINATIONS OF SPECTRAL COMPOSITION OF LED-LIGHT

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INTRODUCTION & AIM

Additional lighting is required to cultivate crops in northern latitudes and in greenhouse conditions. Light can be used not only for plant illumination, but also as a physical factor influencing the growth and yield of agricultural crops. The light intensity, spectral composition and illumination duration are important factors influencing the optimization of plant growth in a controlled environment. The use of LED light sources ensures faster growth compared to fluorescent ones. Research aimed at accelerating growth processes and increasing productivity using optimal light sources is especially relevant.

In the present study the effect of two light-emitting diode sources on the growth and yield of the spring bread wheat cv. Zlata was studied.

METHOD

Wheat plants were cultivated under complete isolation from sunlight in the controlled growth chamber. Plants were grown in 5 L pots containing universal soil. The growth conditions, including the temperature, humidity, watering, fertilization and the length of the photoperiod were the same for all plants. Fertilizer I (N 18%, P2O5 18%, K_2O 18%, MgO 2%, S 1.5%, Fe 0.054%; Zn 0.014%; Cu 0.01%; Mn 0.042%; Mo 0.004%; B 0.02%) was applied every week starting from the 14th day of vegetation. At the earing stage, plants were the fertilizer weekly with Fertilizer II (N 14%, P_2O_5 10%, K_2O 28%, MgO 2.5%, S 1.5%, Fe 0.054%; Zn 0.014%; Cu 0.01%; Mn 0.042%; Mo 0.004%; B 0.02%). The study used two light spectra established by commercially available LED lamps, provided by UnieL, China (prevalence of red light) and Agroaspect, Russia (prevalence of blue light) (Fig. 1).

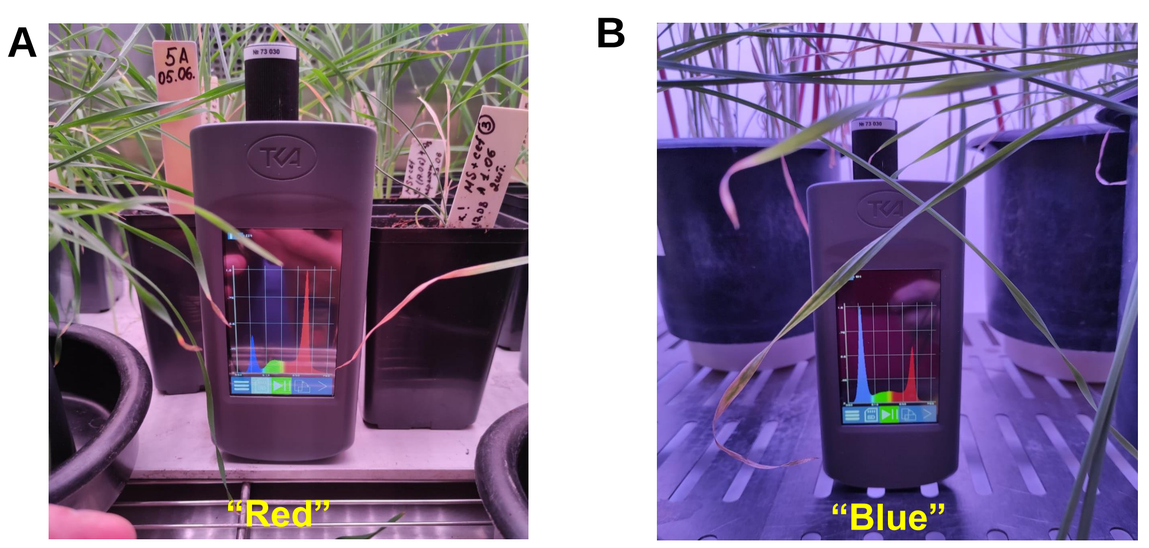

Fig. 1. Spectral composition of LED light sources. A - UnieL, China (“Red”); B - Agroaspect, Russia (“Blue”).

Table 1. Biochemical analysis and weight of wheat seeds

LED light sources	Protein content, %	Gluten ratio, %	Weight of 1000 seeds, g
Red (UnieL)	16.75	38.0	30.10
Blue (Agroaspect)	17.65	41.6	41.75

RESULTS & DISCUSSION

Cultivation under prevalence of red light resulted in faster plant development, earlier heading, flowering and ripening of cv. Zlata. Under prevalence of blue light, the time from sowing to harvesting was 107 days, while the application of the red spectral range reduced the growth time to 79 days. This led to a 2-fold decrease in the number of ears per plant, a shortening of the flag leaf and a 2-fold decrease in the total number of seeds per plant (Fig. 1). Under blue light the average weight of 1000 seeds of cv. Zlata was 41.75 g, the protein content reached 17.65% (Table 1). In contrast, plant growing under red light led to a decrease in the average seed weight to 30.1 g, and the protein content reduced to 16.75%.

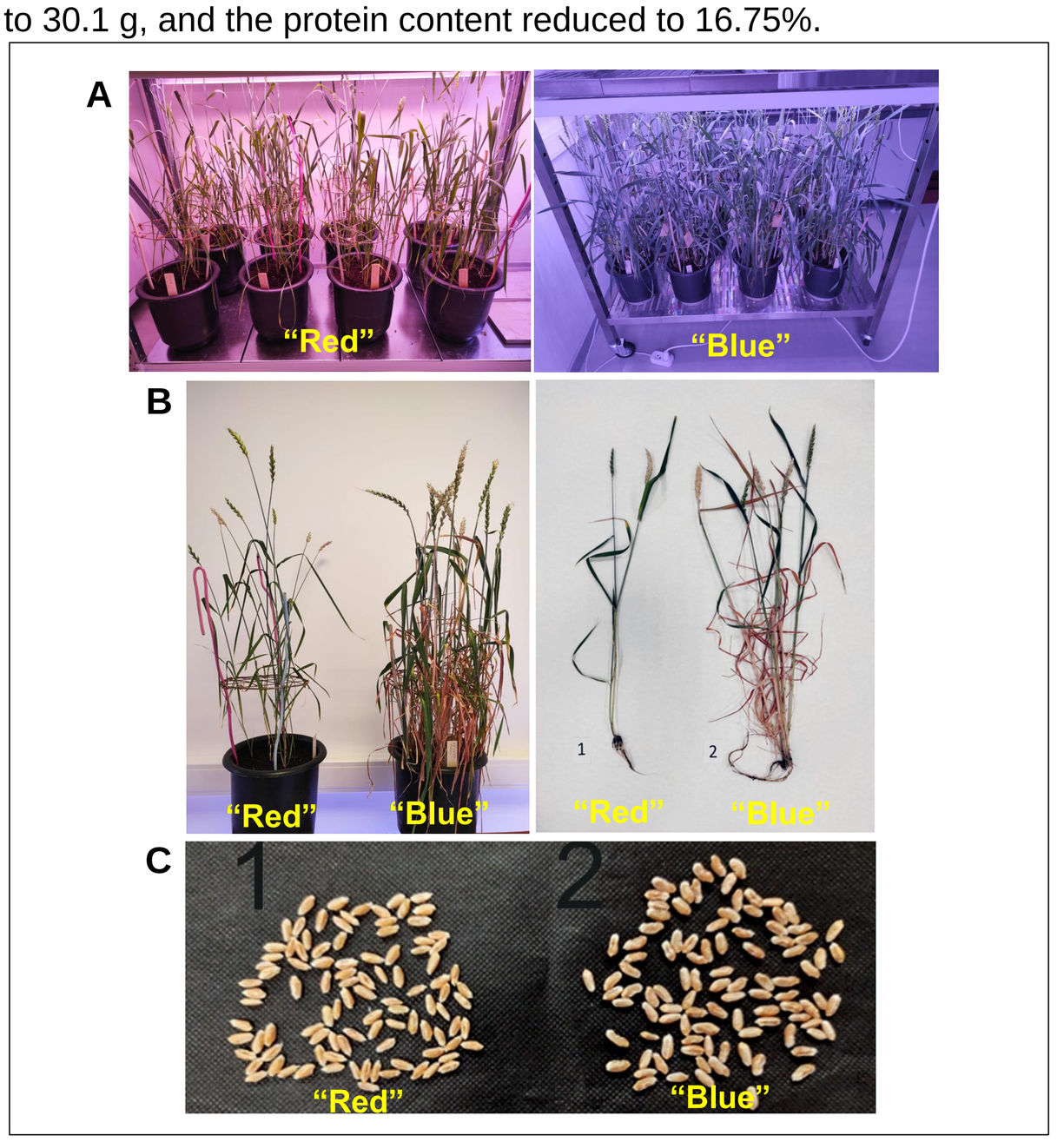

Fig. 2. Phenotype of wheat plants cultivated under two spectral composition of lights. A – plant at earing stage; B – the differences between wheat plants grown under two LED-lights; C – average amount of seeds harvested.

CONCLUSION

Although the prevalence of red light spectral range leads to a decrease in the yield and quality of wheat seeds, this technical approach makes it possible to shorten the growth time and achieve four cycles of growing wheat plants per year in well-controlled installations. The use of the spectral range with prevalence of blue light can be used for production of sufficient number of high-quality seeds to speed up the wheat breeding.