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LED Light Effects on Soybean Phenology and Agronomics Characters for Speed Breeding

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Abstract

This study was conducted to determine the effects of different LED light spectra on the phenological development and key agronomic traits of soybean (*Glycine max*) cultivars grown under controlled environmental conditions, with a particular focus on their potential application in speed breeding protocols. The experiment was carried out in a controlled growth chamber at the Department of Field Crops, Faculty of Agriculture, Akdeniz University. Five soybean varieties; Lider, AKD 22, AKD 23, Antsoy, and Cinsoy were grown under three distinct LED light conditions. These included combinations of deep blue (DB, 445 nm), high red (HR, 660 nm), far-red (FR, 730 nm), cool white (cW, 6500 K) wavelengths, as well as a 3000K white LED treatment. In all treatments, the photo period was set to 16 hours of light and 8 hours of darkness. Day and night temperatures were maintained at 25°C and 20°C, respectively, while relative humidity was controlled at 60% during the day and 50% at night.

The parameters evaluated were germination time, days to first flowering, plant height, and number of branches. The results showed that LED light spectra significantly influenced phenological development. Notably, under the light spectrum where red light was balanced with blue and white light, soybean plants reached flowering in a shorter time which an advantageous trait for speed breeding systems aimed at rapid generation turnover. Conversely, the 3000K white LED treatment led to a longer flowering period. Varietal differences were also observed for agronomic traits. Overall, the findings indicate that optimizing LED light spectra can effectively shorten the generation time in soybean, making them highly suitable for speed breeding applications. This study provides a scientific result for future breeding programs and controlled-environment research, especially those aiming to accelerate crop improvement through manipulated light regimes.

Keywords: *Soybean, Speed breeding, LED lighting, Controlled environment*