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Soybean plant growth under different light conditions

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The soybean (*Glycine max* (L.) Merr.) is one of the major food crops and an alternative protein source. It is a self-pollinated species with low genetic variation. To expand the range of genetic variation, biotechnological method of inducing somatic embryogenesis, i.e. the formation of embryoid structures (embryoids) in the cell culture without any additional mutagens influence on the plant can be used. Somatic embryogenesis is a process in which a plant is derived from a single haploid or diploid somatic cell through characteristic embryological stages without gamete fusion [1]. Regenerated plants are considered to be clones, varying at the same time from the parent plants by one or a few characters [2]. An influence of light of different spectra and intensities on embryogenesis of soybean plants was studied previously in connection with hormone regulation [3].

Investigation of somatic embryogenesis induction in soybean *in vitro* by mono- and polychromatic radiation using the light-emitting diodes (LEDs) with a wavelength range from 440 to 660 nm and subsiquent selection the optimal spectrum for developing the fully formed plants were the aim of our research.

To induce somatic embryogenesis, immature cotyledons without the embryonic axis, isolated from unripe beans were used. The cotyledons were placed onto nutrient medium MS [4] with phytohormones. Test-tubes with embryoids under the cotyledonary development stage were placed in boxes with different LEDs. Light irradiation with intensity of 48 mmol/(m2*s) was generated by different types of LEDs with various spectra: cold white (CW), white (W), warm white (WW), full spectrum (FS, 450 nm and 660 nm), red (630 nm), and royal blue (RB, 440 nm). Three variants of white light sources had the first emission maximum at approximately 440 nm corresponding to blue light, with different intensity for each type of white light. The second maximum corresponded to red-to-green spectrum within the wavelength range of 540–660 nm. Fluorescent lamps OSRAM L 36W/765 were used as control illumination (K) in the same climate conditions and photoperiod (16/8 h). An innovative LED light source sunbox (SB) simulating the solar spectrum in the wavelength range of 440–660 nm [detailed description in: 5] was also used.

The results showed that embryoids had different growth rates during two months of cultivation, depending on the light spectrum. For the first month of cultivation the maximum growth rate was observed in boxes with the FS and SB spetra, and an increase coefficient in embryoid height was 2.1 and 1.8, respectively, against the data on the intact embryoid height. The rapid growth was probably determined by the proportion of red LEDs (more than 30%), since red light is known to promote plant extention. The lower growth rate was registered in boxes with R and RB spectra – 1.62 and 1.59, respectively. Formation of one, sometimes two and three roots and the first true leaf was noted by the end of the first month of cultivation for plants under mentioned spectra, as well as under FS spectrum. The lowest growth rate was observed for embryoids cultured under the polychromatic spectra CW, W, WW and K. The increase coefficients of embryoid height were 1.49, 1.41, 1.19, and 1.21, respectively. A decrease in the growth rate can probably be explained by the difference in spectral composition.

During the second month of cultivation the growth rate remained the same for embryoids under CW, W, WW spectra. Growth intensity for embryoids under other light variants slowed down, in comparance with that during the first month of cultivation. Despite that, plants under FS spectrum had the maximum height at the end of the experiment. Size of the roots and true leaves increased during the second month of culturing in plants grown inder R and FS light. All soybean plants obtained during the experiments have been adapted to growth in soil. Thus, according to the results, application of FS, R, RB seems to be preferable for obtaining soybean fully formed plants from embryoids *in vitro*.

The experiments showed that light spectrum is an effective non-chemical agent promoting the survival of soybean embryoids and their development into viable plants.

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