Growth Response of Seedlings of Major Fruit Vegetables as Affected by Supplemental Irradiation of Far-red for Producing Uniform Seedlings Suitable for Use in Grafting Robots

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In grafting using automatic robots, it is important to produce seedlings for scion and rootstock having uniform stem diameter and hypocotyl length, and to determine the optimal environmental condition for doing it. Monochromatic far red light is known to have the effect of plant stem elongation and its appropriate control can be useful for controlling the elongation of the hypocotyl length. Supplemental far-red light irradiation can be expected to reduce the seedling production time for scion and rootstock used for robot-grafted transplant production, since securing their hypocotyl length and stem diameter are crucial for successful grafting using robot. We conducted this study to examine the effects of supplemental far-red LEDs on growth and morphology of scion and rootstock seedlings. Seeds of scions and rootstocks of cucumber ('Joeunbaegdadagi', Seminis Korea, Korea; 'Heukjong', Hungnong Bio Co., Ltd., Korea), tomato ('Super Doterang', Takii Korea, Korea; 'B-Blocking', Nongwoo Bio Co., Ltd., Korea; 'Tanme', Nongwoo Bio Co., Ltd., Korea) and watermelon ('Sambokkul', Hungnong Bio Co., Ltd.; 'Bulrojangsaeng', Syngenta Korea, Korea) were sown and cultured in a plant factory with LED lighting. The seedlings were cultured at PPF of 200 µmol·m⁻²·s⁻¹, photoperiod of 16 h·d⁻¹, air temperature during photo- and dark periods of 26/22°C, and CO₂ concentration of 600 µmol·mol⁻¹.

The light treatments were W5F0 (treatment code for cool white LEDs: far-red LEDs = 5 : 0), W5F1 (cool white LEDs : far-red LEDs = 5 : 1), W5F2 (cool white LEDs : far-red LEDs = 5 : 2), and W5F3 (cool white LEDs : far-red LEDs = 5 : 3) in photon flux density. The scions of Cucubitaceae (cucumber and watermelon) in treatment W5F2 had the longest hypocotyl length while the scions of Solanaceae (pepper and tomato) cultivated under the conditions of treatment W5F1 had the longest hypocotyl length. The hypocotyls of rootstocks of all tested cultivars were elongated by irradiation of far-red light, but no significant difference was found among the treatment of different photon flux density of far-red light. Stem diameter of all tested cultivar except tomato scions in treatment W5F1 and W5F2 were greater than those in other treatments. The fresh weights of Cucubitaceae scions in treatment W5F2 was the greatest and that of rootstock was not significantly different among treatments. Results indicate that supplemental LED lighting of far-red light has strong effects on hypocotyl elongation and of seedlings and production period of scions and rootstock can be shortened by doing that.

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