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学 位 論 文 題 目	Enhancing Radiation Use Efficacy of Dwarf Tomato Cultivation in a Plant Factory with Artificial Light 植物工場における矮性トマト生産の光利用効率の向上
論 文 審 査 委 員	（主査）教　授　椎名　武夫 （副査）教　授　後藤　英司　　准教授　浄閑　正史 准教授　彦坂　晶子

論　文　内　容　の　要　旨

Dwarf tomatoes are advantageous when cultivated in a plant factory with artificial light because they can grow well in a small volume. The effects of photosynthetic photon flux density (PPFD) and light quality on radiation-use efficacy (RUE) and fruit biomass radiation-use efficacy (FBRUE) of dwarf tomatoes are still unknown. It is crucial to develop a strategy for controlling light conditions of dwarf tomatoes during the different growth stages to improve RUE and FBRUE.

In Chapter 1, a general introduction including the background on dwarf tomatoes, RUE and FBRUE, related studies, and the objectives of this study are described.

In Chapter 2, two experiments were performed to investigate the effects of PPFD and light quality on growth and RUE of a dwarf tomato cultivar ('Micro-Tom') at the vegetative growth stage. The results clearly demonstrated that higher PPFD decreased RUE. A higher blue light proportion inhibited dry mass production with the same intercepted light because the leaves under high blue light proportion had low Pn. In conclusion, 300 μmol m-2 s-1 PPFD and R9B1 are the recommended proper PPFD and light quality, respectively.

In Chapter 3, the effects of PPFD on FBRUE, source strength (Ssource), and fruit sink strength (Sfruit-sink) of 'Micro-Tom' were analyzed to determine the suitable PPFD for enhancing the FBRUE and yield at the reproductive growth stage. The results demonstrated that FBRUE and RUE were the highest under 300 μmol m-2 s-1. In addition, Ssource and Sfruit-sink increased with PPFD. In conclusion, 300 and 700 μmol m-2 s-1 PPFDs are recommended to improve the FBRUE and yield at the reproductive growth stage, respectively.

In Chapter 4, the effects of light quality on RUE, FBRUE and light electric energy proclivity in two dwarf tomato cultivars at the reproductive growth stage were studied. The results showed that RUE, FBRUE and light electric energy proclivity were the highest under white LED light (W) among four light qualities and white light is recommended to improve FBRUE at the reproductive growth stage.

Chapter 5 presents the conclusions of the research which demonstrated that higher PPFD from 300 to 700 μmol m-2 s-1 led to lower RUE and FBRUE. R9B1 and W are recommended to improve RUE and FBRUE at the vegetative and reproductive growth stage, respectively.