Effects of Periodic Rhythm of Light Signal on Growth and Leaf Injuries of Tomato Plants

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Tomato plants grown under continuous light (CL) suffer very specific injuries, including leaf chlorosis, epinasty and growth retardation, which prevents the application of CL in cultivation and production of tomato. Although the mechanism of this phenomenon has not yet been revealed, a lot of evidence points to the disruption of the plant circadian rhythm due to CL signal as an important factor in the development of these injuries. To test this hypothesis and investigate whether periodic rhythm of light spectrum can help resetting the plant circadian rhythm and mitigating CL injuries in tomato, we cultivated tomato seedlings (Solanum lycopersicum cv. Momotaro) for 14 days under two periodic rhythms (12/12 hour or 6/6 hour), each with two different light signals (white light/darkness or red/blue wavelength), and compared the performance and injuries of these plants with those grown under continuous white light. Under light/dark rhythm of 6/6 hour, the plants suffered from both significant growth inhibition and severe leaf chlorosis, similar to plants grown under continuous white light, although the occurrence of leaf epinasty in this treatment was the same as under 12/12 hour photoperiod. Periodically changing light spectrum from monochromatic red (wavelength 655.0 ± 27.2 nm) to monochromatic blue light (wavelength 449.2 ± 13.4 nm), either in 12/12 hour or 6/6 hour cycle, significantly alleviated leaf chlorosis and epinasty, as well as increased plant dry weight as compared to plants under either continuous or 12/12 hour photoperiod of white light. Taken together, these results showed that plant circadian rhythm is involved in the development of CL injuries in tomato, and an unnatural photoperiod that can disrupt normal plant circadian rhythm can also cause injuries similar to CL. On the other hand, a periodic rhythm of light spectrum can help reset plant circadian clock and mitigate the injury while improving plant growth. This opens the potential for application of CL in tomato transplant production, significantly increasing growth and shortening production time.

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