

# Periodical analysis and control of bioluminescent lettuce

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## Abstract

In the future, the world population will largely increase and so will the need for food all the year round. One of the solutions to this problem is plant production in plant factories. However, the cost is high, and the improvement of productivity in the plant factory is paramount. In this study, circadian clock which coordinates many physiological processes and plant growth was addressed. The study included the following three steps. First, to investigate circadian rhythm in transgenic lettuce introduced to luciferase gene for measurement of the expression of clock gene *CCA1*. Luciferase bioluminescence was then recorded using cooled CCD camera. Second, to establish measurement method for circadian rhythm without luciferase bioluminescence, but by measurement of chlorophyll fluorescence from lettuce leaves using photomultiplier tubes. Third, to establish the correlation between chlorophyll fluorescence and luciferase bioluminescence. Fourth, to control the circadian rhythm, by illuminating lettuce leaf spatially and with temporally varying the illumination using a projector. The phase-inverse of circadian rhythm in lettuce leaf was observed. In conclusion, it had been demonstrated that the circadian rhythm in lettuce was capable to be analyzed by chlorophyll fluorescence in plant factory, and controlled spatially by temporally varied illumination using a projector. The measurement of circadian rhythm improved the quality of production of plant factories.