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ENVIRONMENT CONTROL IN AN ARTIFICIAL LIGHT GROWTH CHAMBER FOR SIMULATING A SPECIFIC CLIMATE OF A LOWLAND RICE FIELD AT A LOCAL AREA IN JAPAN

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WATANABE T., TOH K., OHWAKI J., NAGAO Y., FUJIYAMA, M., TSURUNAGA A. and YOSHIDA S. *Environment control in an artificial light growth chamber for simulating a specific climate of a lowland rice field at a local area in Japan.* BIOTRONICS **30**, 115–118, 2001. In a lowland rice field at the end of a rainy season (early summer) in Japan, it is suggested that drastic change in the climate could cause symptom of rice leaf chlorosis and blight without a pathogen. For reproducing the symptom and investigating its process, daily changes in air temperature, relative humidity, wind velocity and light intensity were simulated using an artificial light growth chamber in Biotron Institute, Kyushu University. The exact control in the growth chamber enabled the simulation of environmental procedure causing the disease of rice plants, and the investigation could be useful for the disease prevention.

Key words: environment control; lowland rice field; simulation; growth chamber; leaf blight

Rice plants are grown in a lowland rice field in various small places of Japan, and sometimes there is an unfortunate climate problem caused by a local geographic feature in some areas. The rice plants grown in Southwestern Japan are exposed to much higher humidity and lower natural light during a long spell of rainy weather in early summer. When the rainy season is over, the rice plants are subjected suddenly to higher solar radiation and hot and dry air. In some places of Nagasaki Prefecture, a strong, hot and dry wind often rises just after the rainy season. Under the condition of the post-rainy season, a symptom of chlorosis and blight of leaf tip and edge can be found. It is similar to a

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bacterial leaf blight (*Xanthomonas oryzae* (Uyeda et Ishiyama) Dowson), and however any pathogens have not ever been found. It is thought that the symptom without a pathogen could be caused by the drastic climatic change at the sudden transition from the rainy season to full summer. Therefore, we aimed to reproduce the symptom of potted rice plants in a growth chamber by simulating the typical climate change, and to find an effective method for the disease prevention. For the simulation of the climatic change, the growth chamber has to make an exact control of air temperature, humidity, wind and light intensity in a wide region from the rainy season to the post-rainy season. Biotron Institute, Kyushu University has an artificial light growth chamber for various botanical experiments under controlled ambient air, and we tried to use the growth chamber for the simulation. Figure 1 shows a diagram of environment control manner and devices of the growth chamber. The technique and devices are quite basic to exact control of plant environment, and its widely -controllable range of the ambient air makes the drastic change in temperature and humidity possible. Table 1 shows a procedure of the environment control for the simulation. In this study, we were able to obtain measured values of the environmental factors corresponding to these desired values. A wind velocity of the controlled air was set at $0.3\ m\ s^{-1}$, which might induce no apparent influence of a mechanical stimulation on plant leaves, and a big ventilator (an electrical fan) was used to obtain strong wind after the transition from the rainy season to the post-rainy season.

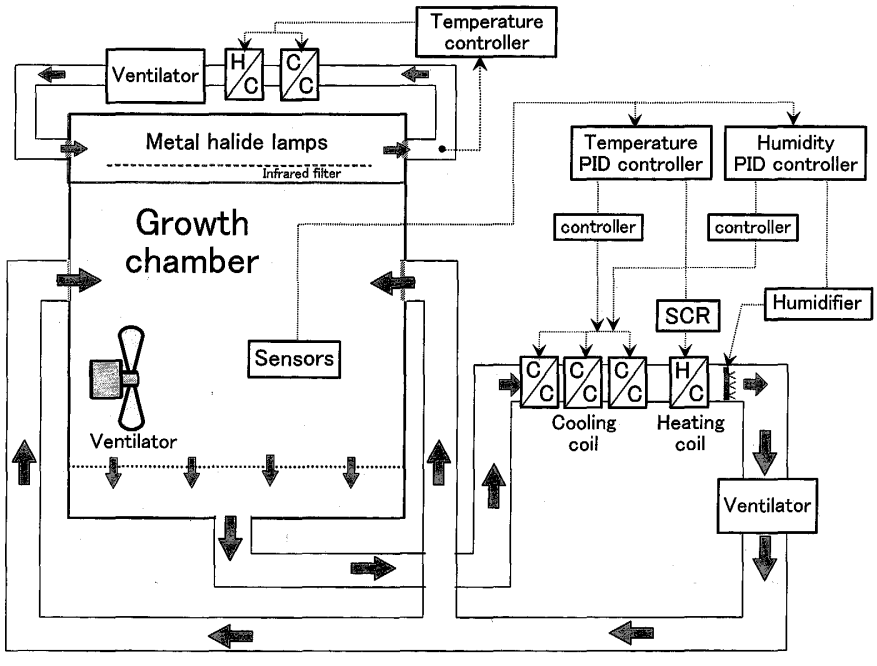

Fig. 1. Schematic diagram of manner and devices on environment control in an artificial light growth chamber.

Rice seedlings potted in a 3.5 Liter plastic pot were grown under natural field condition, and the rice plants at a maximum tiller number stage were installed in the growth chamber on July 17, 2001 (Fig. 2). By growing the plants in the procedure of the environment control, we have already obtained some results indicating that the symptom of leaf blight without a pathogen can reproduce under the condition (data not shown), and the symptom is considered to be caused through changes in water balance in a whole plant at the drastic transition of air temperature, humidity and light intensity. Thus, simulation of the climatic change for investigating the rice leaf blight without a pathogen became possible using the growth chamber.

Table 1. Experimental procedure of environment control for simulating a specific climatic change of a lowland rice field: a drastic transition from rainy season to post-rainy season.

	Treatment 1 6 days (July 17 to 22)	Treatment 2 3 days (July 23 to 25)	Treatment 3 4 days (July 26 to 29)
Air temperature (℃) : day/night	30/20	25/20	30/20
Relative humidity (%) : day/night	65/90	80/90	50/90
Wind velocity ($m\ s^{-1}$)	0.3	0.3	5.0
Light intensity (lux)	6,000	6,000	35,000

Fig. 2. Photograph of potted rice plants in an artificial light growth chamber.

A phytotron and a growth chamber are useful for analysis of plant response (output) according to environment control (input) (for example, *3*). On the other hand, it is known that a phytotron's fundamental role on simulating a climate in field has already ended in the history of environment control (*2*). In this paper, however, our study indicates that simulation of plant environment could still play a certain role in an applicable aspect of plant production in field, although there are some problems of artifacts such as "pot effect (*1*)".

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