

# Improvement Effect of Thermal Environment for Temporary Housing by Green Curtain

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## 1. Introduction

Great East Japan Earthquake occurred in March, 2011. By this earthquake, the accident of the nuclear power plant occurred, and many people live in temporary housing now. Temporary housing becomes very hot in summer, and damage to health has increased. A green curtain project aiming at cool environment was planned under such a background (*Photo 1*).



*Photo 1* Open space of residents in Temporary House planted green curtain

In this study, I investigated how temperature environment was improved by the green curtains.

## 2. Method

The experiment was conducted in temporary housing in TOBU-KOEN in Aizu-Wakamatsu City (*Photo 2*). The experimental object is a green curtain planted at temporary housing. I measured a dwelling unit without a green curtain for comparison. Before the measurement, I planted seedlings of *Momordica* and *Hedera canariensis* for green curtains on June 3, 2012



*Photo 2* Residents in Temporary House

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**Photo 3** Hedera for green curtain



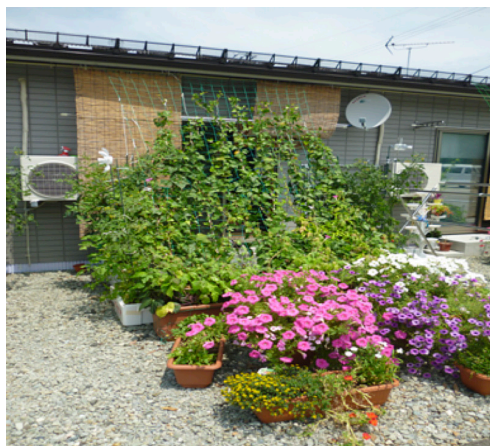
**Photo 4** The planting situation of Hedera



**Photo 5** Momordica I & II ward

(Photo 3, 4).

And the Momordica I & II ward (Photo 5), the Hedera ward (Photo 6) and the non-planting ward (Photo 7) were set as an experiment



**Photo 6** Hedera ward



**Photo 7** non-planting ward



**Photo 8** Thermo-recorder

section. I measured the temperature every ten minutes from June 25 to September 27 in 2012 and analyzed the data for 70 days from July 19 to September 26. I recorded the temperature





**Photo 9** Thermo-recorder for measurement of the neighborhood air temperature



**Photo 10** Thermo-recorder for measurement of the surface temperature

with a thermorecorder (*Photo 8*) and took pictures with a thermocamera. Temperature sensors were set to measure the neighborhood air temperature (*Photo 9*), the gravel part surface temperature, the concrete facing surface temperature (*Photo 10*), and the surface temperature of the houses outer wall.

### 3. Results and consideration

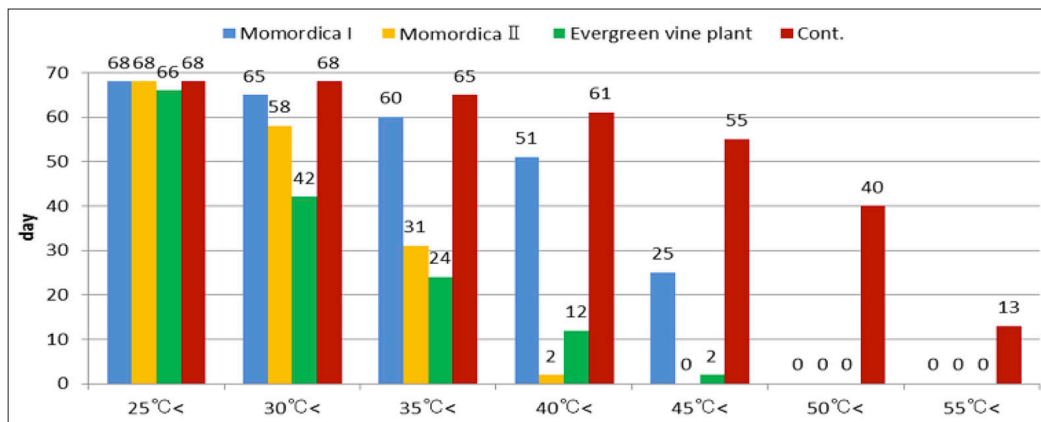
#### 1) The high temperature record number of days

As for the neighborhood air temperatures more than 40 °C, there were 7 days in the green curtain area by the evergreen vine plant, 7 days in the green curtain area by Momordica II, 14 days in the green curtain area by Momordica I, while 38 days in the non-planting area. As for more than 45 °C, 2 days were recorded in the

non-planting area. As for the gravel surface temperature, more than 40 °C were recorded for 61 days in the non-planting area, while 51 days in the green curtain area by Momordica I, 12 days in the green curtain area by the evergreen vine plant, and 2 days in the green curtain area by Momordica II. There were 2 days of over 45 °C in the green curtain area by the evergreen vine plant, in Momordica II area 0 day, in Momordica I area 25 days, while in the non-planting area 55 days. There were 40 days of more than 50 °C in the non-planting area (*Fig. 1*).

#### 2) A temperature change in a day

The heat environment was severe in summer in the non-planting area and it became clear that green curtains have improvement effects on



**Fig. 1** The high temperature record number of days

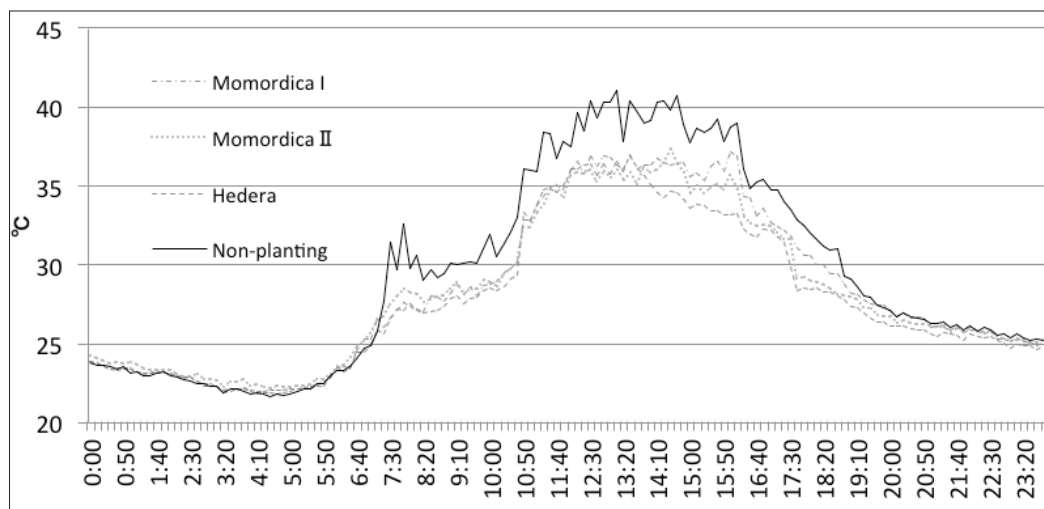


Fig. 2 Change in a day of the neighborhood air temperature (27, July, 2012)

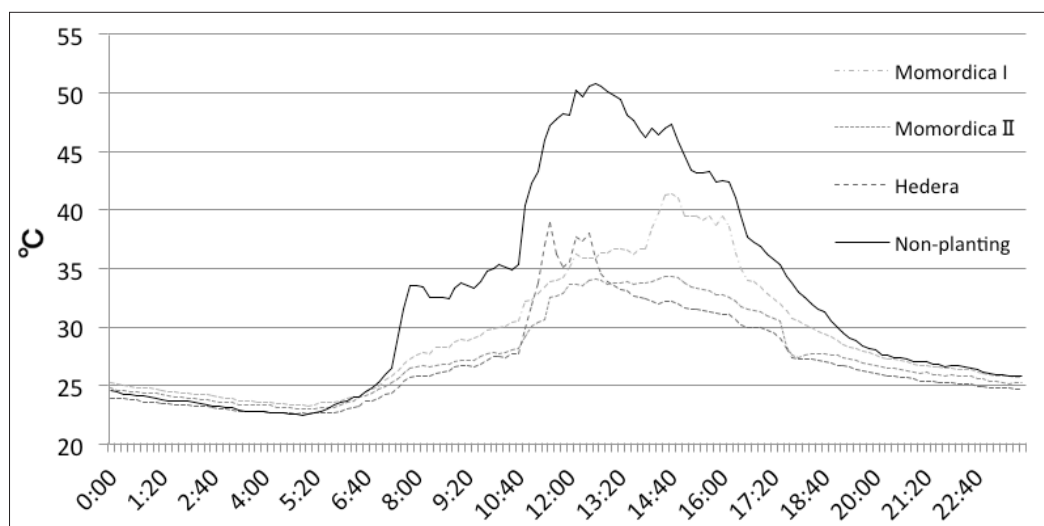
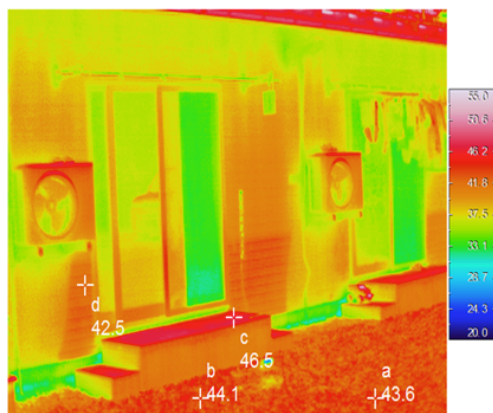


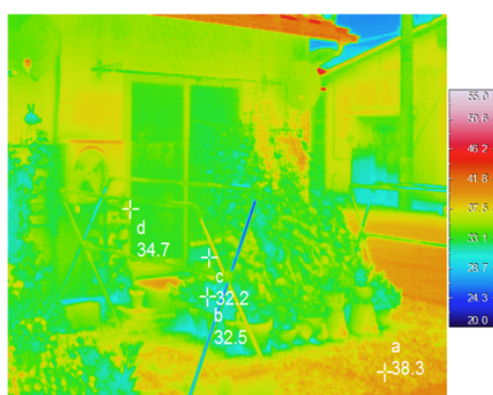
Fig. 3 Change in a day of the gravel part surface temperature (27, July, 2012)

the heat environment. Next, I will compare the daily change of neighborhood air temperatures. When the temperature was 36.3 °C in the green curtain area by Momordica I, 36 °C in Momordica II area, and 36.5 °C in the evergreen vine plant area, the highest temperature 41 °C in July was recorded in the non-planting area. In August, when the temperature was 39.9 °C in the green curtain area by Momordica I, 38.3 °C in Momordica II area, and 36.4 °C in the evergreen vine plant area, the non-planting area recorded the highest temperature of 44 °C. The green

curtains dropped the temperatures by approximately 5 °C (Fig. 2). The daily change of the gravel surface temperatures is as follows. When the temperature was 35.9 °C in the green curtain area by Momordica I, 34.1 °C in Momordica II area, and 35.7 °C in the evergreen vine plant area, the non-planting area recorded the highest temperature of 50.7 °C in July. And in August, when the temperature was 40.7 °C in the green curtain area by Momordica I, 33.9 °C in Momordica II area, and 33.8 °C in the evergreen vine plant area, non-planting area recorded



**Fig. 4** Thermography of non-planting area



**Fig. 5** Thermography of green curtain area

55.7 °C. It was demonstrated that the green curtains had a big drop effect by 15–20 °C on the earth surface temperature (*Fig. 3*).

When a thermography is seen, high temperature state is distributed over non-planting ward (*Fig. 4*). And Cool spot is distributed over the back of the green curtain (*Fig. 5*).

The ground in front of the housing reaches more than 50 °C in summer. And the neighborhood air temperature exceeded 40 °C. But solar radiation was sheltered by a green curtain and the surface temperature of the ground which becomes the shadow was lowered about 10 °C. As a result, the air temperature in front of housing was improved and was comfortable space.

## Reference

- 1) Kentaro IJJIMA, Hiromi ADACHI, Shiro WAKUI, Yasuhiro Oomori and Kazui YOSHIDA (2013): Improvement Effect of Thermal Environment for Temporary Housing by Green Curtain, J. Jpn. Soc. Turfgrass Sci42, Separate volume 1, pp.62–63

