

# Application of the Green Curtain Concept Using Passion Fruit (*Passiflora edulis*) as an Energy Efficiency Solution for Residential Houses

Mohamad Jahja<sup>1\*</sup>, Sri Yanti Bauna<sup>1</sup>, Masayuki Sakakibara<sup>2</sup>, and Idawati Supu<sup>1</sup>

<sup>1</sup>Physics Departement, Universitas Negeri Gorontalo, Jend. Sudirman Street at 6, Gorontalo City, Post Code 96128

<sup>2</sup>SRIREP Project Research Institute for Humanity and Nature, 457-4 Motoyama, Kamigamo, Kita-ku, Kyoto, 603-8047 JAPAN

**Abstract.** The application of green curtains is one of the important things for thermal comfort and energy efficiency. This research was conducted from April to September 2022, aiming to measure differences in temperature and humidity in rooms with green curtain and without green curtain and to find out the response of occupants in room with green curtains. In this study the plant used was the passion fruit vine, because this plant is one of the many fruits that grow in tropical and sub-tropical regions. The vine medium uses aluminium wire with a diameter of 3 mm, a width of 90 cm x 1 meter long, the distance between the wires is 15 cm x 15 cm. in April there was no difference in temperature between the two rooms, with an area of 133cm<sup>2</sup> while in September, the room temperature with the green curtain was lower than in rooms without green curtain with a difference of 1.8 °C. In this study the application of green curtain is very significant as a solution to thermal comfort.

## 1 Introduction

Electrical energy has an important role in people's lives, such as being used in several sectors, namely the household sector, industry, social business, government office buildings, and public street lighting [6]. The main cause of the problem in global warming is characterized by the presence of greenhouse gases, which cause thermal comfort [11]. Thermal comfort is said to be a feeling of heat or cold that is felt by the human body and a form of response from the sensory sensors found on the skin to the surrounding temperature stimuli [10], meanwhile according to [12] climate affects constant comfort and situation. According to [3] one way to construct buildings is by applying architectural concepts. Based on the standard of thermal comfort in SNI 03-6572-2001 the effective temperature is (cool-comfortable = 20.5°C-22.8°C, optimal comfort = 22.8°C-25.8°C, warm-comfortable = 25.8°C-27.2°C [8]. From the previous data is very difficult to obtain thermal comfort for residents, this is one of the efforts for researchers to apply the method of using green buildings with the concept green curtains. Green building or known as environmentally friendly is not only in terms of design but also the capacity of the building and its surroundings to reduce the impact on the environment [14]

The application of green curtains according to [13] is beneficial for buildings to make them more durable and long lasting. With the spread of the corona virus that causes various activities take place in the body which will affect thermal comfort and can increase energy consumption.

According to [2] the amount of the consumption target is the intensity value of electricity consumption per the unit area of the building used, based on the parameter value criteria IKE.

English "Tirai Hijau", which is very suitable applied in energy efficiency and thermal comfort, because of the green effect curtains or green curtains for thermal mitigation can help create comfortable thermal environment and reduce energy use [1][15]. According to [9] green curtains placed on indoor window frames to observe plant growth from spring to late season. It can be concluded that green curtains are very efficient when applied at home residence in the Gorontalo area to be precise in Molosipat, Kota Barat sub-district will get sunlight from 12 pm- 3 pm which will have an effect on the temperature rise in the residential house, To reduce the temperature of hot air, the arrangement of vegetation becomes solution in lowering the temperature of the heat. Vegetation arrangement can be in the form of vines, one of which is passion fruit (*Passiflora edulis*). This procedure was carried out to show some of the benefits of green curtains for thermal comfort [4]. According to [5] if the air is weak your body will not be able to protect sweat anymore.

## 2. Research methods

The research data to be presented were obtained when the Passion Fruit plants were 1 week old to 6 months old, and other data were also obtained through documentation and observation.

\*Corresponding author: [mj@ung.ac.id](mailto:mj@ung.ac.id)

The purpose of this research is to find out how to measure difference between room that used and without applied Passion Fruit in Green Curtain Concept.

Quantitative method is a method used by the author to obtain existing data in the field by analysing various theoretical foundations about efficiency energy with the green curtain concept while qualitative methods are used to collect occupant responses for thermal comfort. This research consists of several stages starting from a literature review on energy efficiency. Study The literature includes collecting data on electricity consumption, field observations were carried out in residential houses in the Molosipat W sub-district, Gorontalo area by measuring temperature and humidity in different rooms. Room 1 applied the concept of green curtains, room 2 without green curtains.

In the Materials and Methods section, you explain clearly how you conducted your research order to: (1) enable readers to evaluate the work performed and (2) permit others to replicate your research. Checking experiments were run, what, how much, how often, where, when, and why equipment and materials were used. The main consideration is to ensure that enough detail is provided to verify your findings and to enable the replication of the research. You should maintain a balance between brevity (you cannot describe every technical issue) and completeness (you need to give adequate detail so that readers know what happened).

The research will take place after the passion fruit plant nursery (*Passiflora*) with a period of approximately 80 days from April to September 2022. The research location is at the house which is located at Molosipat W Village, Kota Barat District, Gorontalo area, with a population of 2,291 people. Based on the communication and coding service, the city of Gorontalo has an area of 64.79 km<sup>2</sup> or around 0.53% of the area of Gorontalo Province. This research was conducted for several reasons: With the condition of the Covid-19 pandemic which causes most activities to be carried out at home so that the use of electrical energy is classified as large and wasteful; Gathering of all families for a long time has an impact on decreasing thermal comfort in the house. The tools used in this research are temperature and humidity measuring devices, namely the *Xiomi Mijia* Thermometer Hygrometer, which has an accuracy 0.1% RH. In this study, temperature and humidity measurements were made with the following specifications: *Brand XIOMI Mijia*, *BT 4.2 BLE* wireless connection, Measurement range 0-60 Deg.C, Temperature display resolution 0.1 Deg.C, Humidity range 0%-99% RH, Humidity display resolution 1% RH.

### 3. Results and Discussion

#### 3.1 Presentation of Data Before and after the Implementation of the Green Curtain

Data collection was carried out by measuring the intensity of energy consumption (IKE) before applying the green curtain concept and after implementing the

green curtain concept, by measuring temperature and humidity in different rooms by using the *Xiomi Mijia* Thermometer Hygrometer as shown in Figure 1.

#### 3.2 Temperature and Humidity Measurement

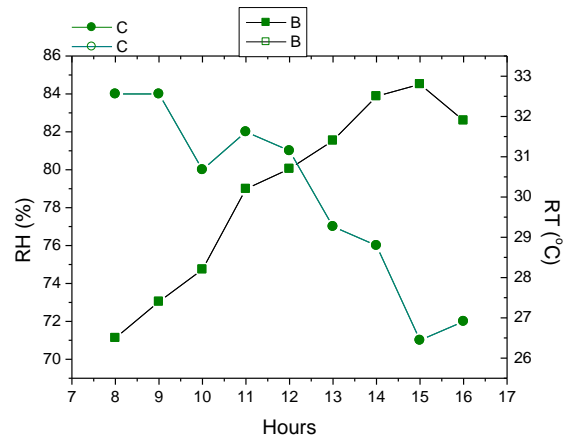


Fig. 1. Room temperature (RT) and humidity (RH) measurements in April used and without Passion Fruit

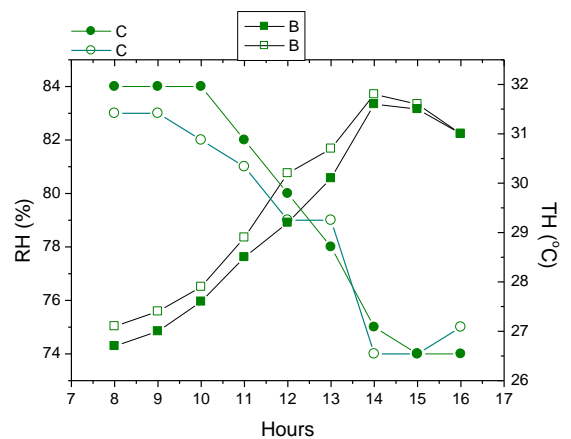


Fig. 2. Room temperature (RT) and humidity (RH) measurements on May used and without Passion Fruit

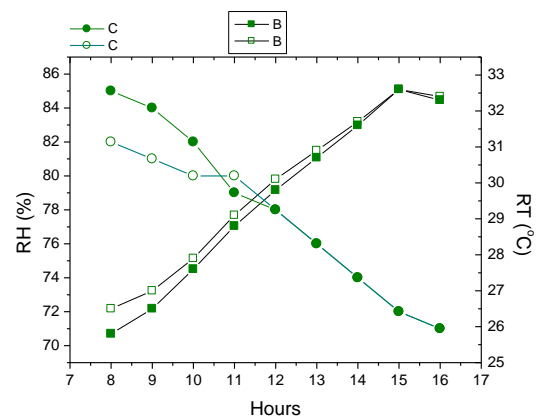
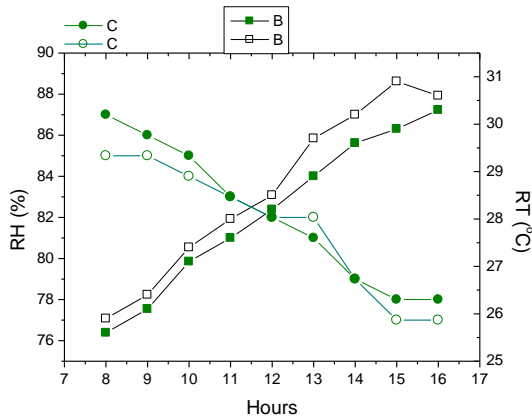
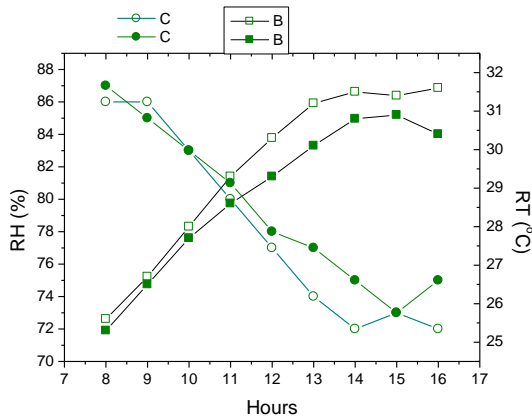


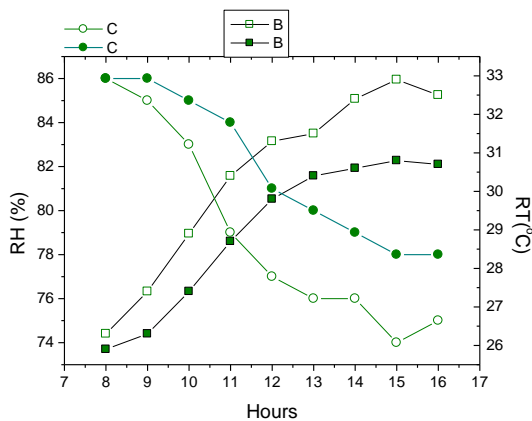
Fig. 3. Room temperature (RT) and humidity (RH) measurements on June used and without Passion Fruit



**Fig. 4.** Room temperature (RT) and humidity (RH) on July used and without Passion Fruit



**Fig. 5.** Room temperature (RT) and humidity (RH) measurements on August used and without Passion Fruit



**Fig. 6.** Room temperature (RT) and humidity (RH) Average measurement on August used and without Passion Fruit

In step 1 with Fig. 1 the maximum temperature value in the room where the green curtain is applied is around 31.9 °C with 84% humidity while the minimum value is around 26.5 °C with 72% humidity. In the room where the green curtain is not applied the maximum value is around 31.9 °C, the humidity is 84% while the minimum value is around 26.5 °C with a humidity of 73%. In the 2nd stage, in a room where

green curtains are not applied, the maximum value is around 31 °C, the humidity is 82%, in Fig. 2, the minimum value is around 27.9 °C with a humidity of 71%. In the third stage, graph 4.3 already shows a temperature difference. In a room where green curtains are not applied, the maximum value is around 32.4 °C, the humidity is 82%, while the minimum value is around 26.5 °C with humidity 71%. This stage is in the room where green curtains are applied and without green curtains, there is a maximum temperature difference of 0.1°C, minimum 0.7°C.

Based on Fig. 3 In a room where green curtains are not applied the maximum value is around 30.6 °C, the humidity is 85% while the minimum value is around 25.9 °C with humidity 77%. At this stage in the room where green curtains are applied and without green curtains, there is a maximum temperature difference of 0.3°C, minimum 0.3°C. The Fig. 4 showed a room which are green curtains not applied the maximum value is around 31.6 °C, the humidity is 86% while the minimum value is around 26.7 °C with humidity 72%. At this stage in the room where green curtains are applied and without green curtains, there is a maximum temperature difference of 1.2°C, minimum 0.2°C. and then Fig. 5 in a room where green curtains are not applied the maximum value is around 32.5 °C, the humidity is 86% while the minimum value is around 26.3 °C with a humidity of 75%. From the data above it can be observed, there is a change in temperature from June to September with a difference of 0.1-1.8 °C.

As time goes on the *Passiflora edulis* grows higher and number of leaves increases and covered a lot of area that prevented the sun entering the room; brings temperatures down and increases the production of water vapor so increases the humidity.

#### 4. Conclusion

According to the results of this research conducted that before and after the green curtain application, it can be described as follows: The temperature and humidity after the green curtain is applied are lower than before the green curtain is applied, the temperature is inversely proportional to the humidity.

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