CAFEi2016-132

Effect of fans and humidifier on temperature and relative humidity in cages

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Abstract

Acage was developed by attaching fans and humidifier to conduct an experiment on the effect temperature and relative humidity (RH) to simulate a conducive environment on the growth of Green Leaf Hopper (GLH) population. GLH is a pest that spread tungro virus which damages paddy plants and causes a huge loss to paddy farmers.Arduino Uno and DHT22 sensor were placed at inside and outside the cage. The fans and humidifier were set to run at every 15 minutes and the readings were recorded for three days. Comparison of both values of temperature and RH were conducted by t-test to justify the significant level and later to check the influence of the fans and humidifier. Results showed that temperature values significantly dropped to 30.62^{o}C and RH values significantly increased up to 60.60% for the experiment 1. Meanwhile, temperature values significantly dropped to31.03^{o}C and RH values significantlyincreased upto79.05% for the experiment 2when operating fans and humidifier.This indicated that a controlled system developed based on micro-controller (Arduino Uno) to operate fans and humidifier is successful and can be used to control temperature and RH.This set up can be used for an experiment on the rearing of GLH growth at various levels of temperature and RH.

Keywords: temperature, relative humidity, arduino uno, DHT22 sensor, green leafhopper (GLH)

INTRODUCTION

Studies onplant diseases problems can emerge in greenhouse situations. These diseases can create extensive damage if precaution steps are not taken to control the environment in the greenhouse. Since plant diseases are emphatically influenced by temperature and relative humidity, the most ideal approach to preventdisease is by controlling the greenhouse environment. Unlike the weather outdoors, the greenhouse environment could be controlled. Brian et al. (2004) state that high level of humidity lead to the growth of many plant diseases. Usually, the humidity is 25%-70% during the day in greenhouse and increasingly until 90-100% during the night. In addition, the temperature inside the greenhouse could be easily hot and it could be increased highly if there is no proper ventilation inside the greenhouse.

An arduinosoftware is one of the system that could be used in controlling system. Groener et al. (2015) statedthat arduino is an open-source hardware and programming stage for the microcontroller because of its relative minimal cost, large user community and flexible. Behan et al. (2013) mentioned that the arduino platform is probably the best we have encountered, when speaking about the realization of sensoric measurements.

More than that, fans and humidifier plays important role during the fluctuation of temperature and RH. Montero et al. (1990) conducted an experiment on cooling greenhouse with fogging nozzle. Meanwhile, Kittas et al. (2001) and Jain and Tiwari (2002) said that greenhouse temperature were lower about 4-5 ° C than outside temperature respectively if there are good ventilation in greenhouse. The purpose of this paper is to find out the

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temperature and RH inside the glass house and outside the glass housewhen operating fans and humidifier. The finding of the temperature and relative humidity can be used for an experiment on the effect of temperature and RH on the population growth of GLH.

MATERIALS AND METHODS

Study Area

For experiment 1, a setup of cage with Arduino Uno was conducted inside a room (in the lab). Arduino Uno read the data of temperature and RH inside and outside the cagein order to know the differences of temperature inside and outside as well as RH inside and outside. Meanwhile, for experiment 2, a setup of cage with fansand humidifier attachment was run at a greenhouse in Ladang 2, UPM. The data of temperature and RH were also read by using Arduino Uno.

Experimental Setup

An experimental setup in the cage was conducted to find out the differencesbetween temperature and relative humidity inside the cage and outside the cage. The dimension for the cage is 0.5m X 1m X 0.5m (Figure 1). DHT22 sensor was used to read the temperature and RH inside and outside the cage (Figure 2). The DHT22 sensor is suitable for 0-100% humidity reading with 2-5% accuracy and also suitable for -40°C – 125 °C temperature reading with ± 0.5°C accuracy. Furthermore, fans and humidifiers were attached along with the sensor during experiment.

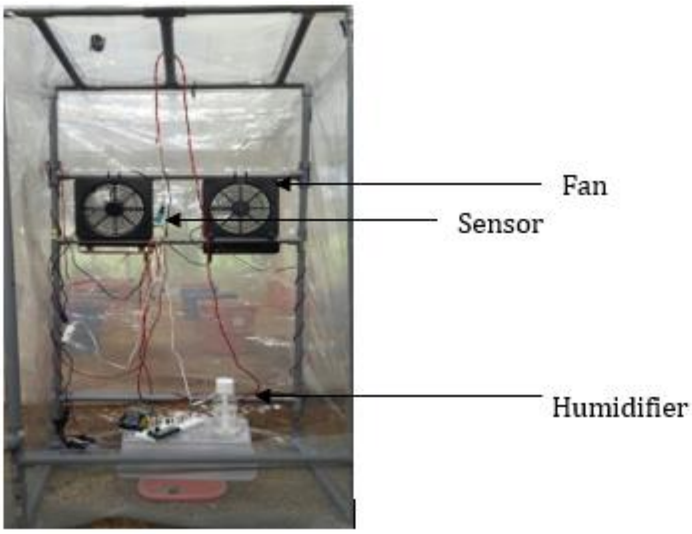


Figure 1. Cage attached with fan, humidifier, and sensors.

Temperature and Relative Humidity Data Logger Using DHT22 and Arduino Uno

MicroSD shield for Aduino Uno was used to store data of temperature and RH. The SD card shield saves data files in coma separated-values (csv) format and the data is in plain text. Comma-separated values (CSV) file stores tabular data (numbers and text) in plain text. Each line of the file is a data record. Each record consists of one or more fields, separated by commas. Due to this, the file size is extremely small, and using a microSD card even as small as 1 GB should be sufficient to store many data. To make sure the temperature and RH data were read, a coding was developed to read and store data in microSD.

e-ISBN 978-967-960-401-6

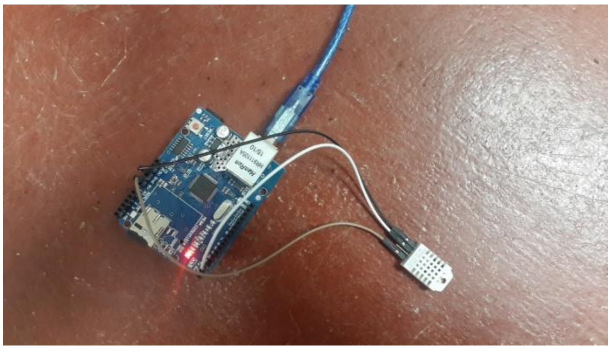


Figure 2. DHT22 sensor connected with microcontroller Arduino to read data of temperature and RH.

Experiment1

During the experiment, Arduino with DHT22 sensors were placedinside and outside the cage. The microSD read the data of temperature and RH every five minutes. For reading of the data, a coding in Arduino software was developed. After two days, the data of temperature and RH were analysed by using t-test to check the significant level between temperature and RH inside and outside the cage.

Experiment 2

During the experiment, Arduino with DHT22 sensors were placed inside the cageand connectedto fans and humidifier. Both fans and humidifier were ranalternately every 15 minutes. Besides, DHT22 sensor was placedoutside the cage to read the environmental temperature and RH. The data in microSD card were analyzed using t-test to find out the significant level between temperature inside the cage that have fans and humidifier and outside the cage without any operating equipment.

RESULTS AND DISCUSSION

Experimental 1

From the experiment, significantdifferences were found based on the finding between temperature inside and temperature outsides as well as RH. Temperature inside during night is low up to 30.62°C while outside at night is 30.78°C (Figure 3). For RH, the inside values during night was 60.60% while outside was 65.27%. At a certain time, the temperature outside the cage were high compared to the inside the cage. This is due to the outside the cage absorbed heatdirectly meanwhile, inside the cage absorbed heat indirectly. This indirect absorption means, the air temperature inside the room will pass through the plastic wall of the cage beforedetected by the sensor installed inside the cage (heat transfer rate is low due to a low thermal conductivity of a plastic).

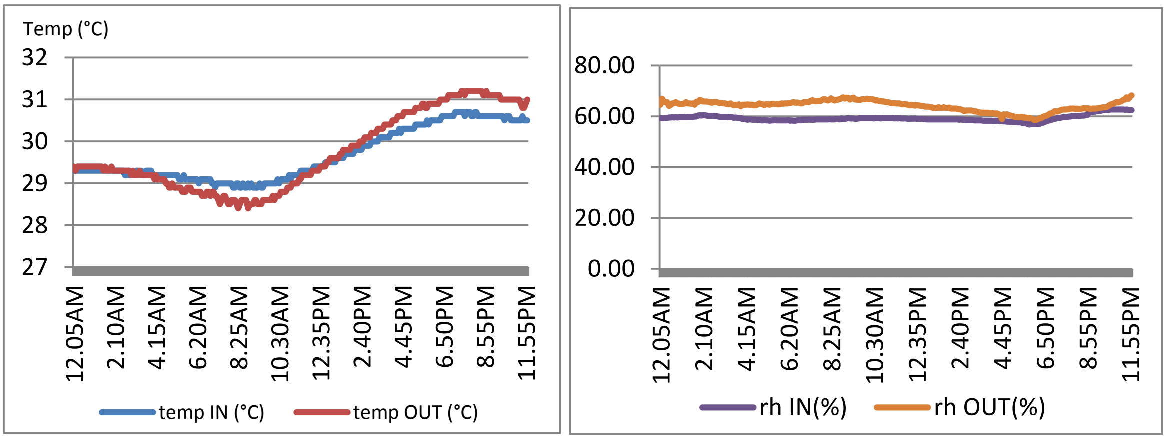
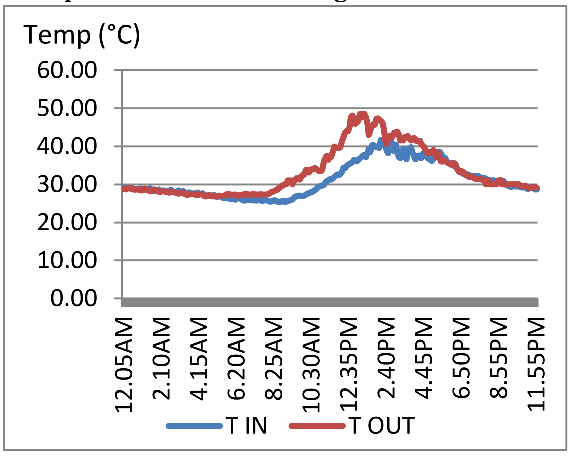


Figure3. Graph for (a) temperature and (b) relative humidity inside and outside the cage in laboratory

Experimental 2

From the experiment, significant differences were found based on the results between temperature inside and temperature outside the cages as well as relative humidity (Figure 4). Based on the finding, the temperatures inside the cage were lower compared to outside the cage since there was an operating fan inside the cage which allowed hot air to flow out from the cage. Temperature inside is low up to 31.03°C while temperature outside is 33.22°C at night time. In addition, the fluctuation of RH also was influenced by the operating of humidifier inside the cage. When the humidifier was ON, the RH inside the cage was higher compared t outside the cage.RH inside is 79.05% while RH outside is 71.55% at night time.



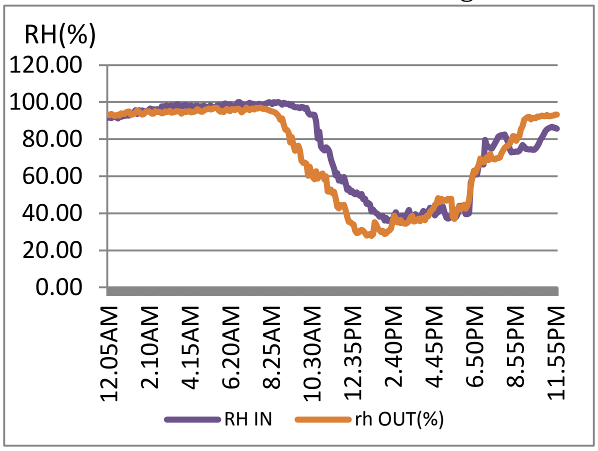


Figure 4. Graph of (c) temperature and (d) RH inside and outside the cage in Ladang 2, UPM.

Table1. Mean value of temperature and RH inside and outside the cage.

	Experiment 1		Experiment 2	
	Inside	Outside	Inside	Outside
Temperature (°C)	30.62	30.78	31.03	33.22
RH (%)	60.60	65.27	79.05	71.55

From table 1, experimental 1 recorded that the mean of temperature and RH inside the cage was lower than outside the cage. On the other hand, experimental 2 showed that the mean of temperature inside the cage lower compared to outside and the mean of RH inside the cage higher compared to outside. The comparison between experiment 1 and experiment 2, the temperature for both inside and outside for experiment 1 was lowered compared to experiment 2. Meanwhile the RH for both inside and outside for experiment 1 was lowered compared to experiment 2.

CONCLUSIONS

The following conclusions can be drawn from the study:

- The experimental results show that the temperature and RH inside the greenhouse vary rapidly in response to changes of outside environmental conditions. Temperature and relative humidity inside and outside the cage are significantly differences especially during the operation of fan and humidifier alternately in the cage.
- The using of Arduino Uno and DHT22 sensor to read the data could help the researcher to read data in microSD since DHT22 sensor has accuracy to read temperature and relative humidity.
- As conclusion, the finding of the temperature and relative humidity can be used for an experiment for rearing of GLH growth at various levels of temperature and relative humidity.

ACKNOWLEDGEMENTS

Special thanks to Universiti Putra Malaysia for the financial support (Grant Number: 9442500) and my friends for the support in completing this paper.

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