TEPIAN Vol. 6 No. 2 (June 2025) 127-132 p-ISSN 2721-5350 e-ISSN 2721-5369
https://doi.org/10.51967/tepian.v6i2.3251 © 2025 Tepian Politeknik Pertanian Negeri Samarinda

Automatic Temperature and Humidity Regulation System Design for Oyster Mushroom Growth

Kadek Reda Setiawan Suda *
Electronic Engineering, National Polytechnic, Denpasar, 80239, Indonesia
Redasetiawan1@gmail.com
Corresponding author

I Wayan Arsa Suteja
Electronic Engineering, National Polytechnic, Denpasar, 80239, Indonesia
4rs41982@gmail.com

Made Adi Surya Antara
Electronic Engineering, National Polytechnic, Denpasar, 80239, Indonesia
adisuryaantara.huawei@gmail.com

I Gede Eka Wiantara Putra
Electronic Engineering, National Polytechnic, Denpasar, 80239, Indonesia
videline@yahoo.com

Ida Bagus Putu Wija
Electronic Engineering, National Polytechnic, Denpasar, 80239, Indonesia
ibpwidja@gmail.com

Submitted: 0000-00-00; Accepted: 0000-00-00; Published: 0000-00-00

***Abstract*—**Oyster mushrooms are safe for consumption. The growth of mushrooms in mushroom houses is highly dependent on physical factors such as temperature, humidity, light, pH of the growing medium, and aeration. In this paper researcher concern research physical factors of temperature as a control growth of mushrooms in mushroom houses. The temperature in the mushroom house is very important to note because temperature is one of the factors that affects the performance of enzymes and the metabolism of oyster mushrooms. By implementing automatic temperature and humidity control in mushroom houses, the quality of oyster mushroom harvests can be improved and the income of local oyster mushroom farmers can be increased, thereby helping the government in increasing regional income. The results obtained from this automatic control are that the automatic temperature and humidity device was successfully made according to the design. Furthermore, the results of the tool testing, namely for the electronic tool expert test, obtained 95.45% in very decent qualifications, the results of the small group test were 90.85% in very good qualifications, and the results of the large group test were 91.80% in very good qualifications. The temperature and humidity control device can be of positive benefit to the community, especially to oyster mushroom farmers.

***Keywords*—**Automatic, Control, Oyster Mushrooms, Temperature

I. INTRODUCTION

Currently, oyster mushrooms are no longer foreign to the public. This is evidenced by the existence of various types of oyster mushroom preparations on the market. Oyster mushrooms (Pleurotus ostreatus) are one type of mushroom that is considered safe for consumption and has a distinctive aroma because it contains muscorin, and is important for health. Based on the results of research conducted by the Department of Science, Ministry of Industry of Thailand (Yulianto, 2011), it is known that oyster mushrooms contain 5.94% protein; 50.59% carbohydrates; 1.56% fiber; 0.17% fat (Cahya, 2017). In addition, it is estimated that every 100 grams of fresh oyster mushrooms contain 45.65 kJ calories; 8.9 mg calcium; 1.9 mg iron; 17.0 mg phosphorus; 0.15 mg vitamin B1; 0.75 mg vitamin B2; and 12.40 mg of vitamin C. According to the National Conference for Community Service with the research title Application of Automatic Temperature and Humidity Control System in Mushroom House at UD Mitra Jamur Jember in 2022 with the results for the ideal growth of oyster mushrooms requires a temperature between 22-28^{0}C with a humidity of 70-80%, but in this study it has a weakness that when the temperature and humidity are the ideal nominal the tool cannot return the temperature and humidity conditions in the mushroom house back to the ideal position. According to the Indonesian Mushroom Agribusiness Society (Ardhi, 2023), of the various types of edible mushrooms known in Indonesia, oyster mushrooms are the most in demand by consumers. Currently, oyster mushrooms dominate 55% - 65% of the total national mushroom production. In the Journal of Food Technology Applications with the research title Application of Automatic Temperature and Humidity Control for Increasing Straw Mushroom Cultivation Productivity in 2015 (Karsid, 2015), this study resulted in the ideal growth of oyster mushrooms with temperatures ranging between 30-35^{0}C and humidity between 80-90%, the resulting tool can control the temperature and humidity stable in the range of 28-35^{0}C (Riski, 2021). The tool made is not equipped with a blower to increase the temperature and humidity when it is the ideal provisions. The high consumer interest in oyster mushrooms has caused most people to start looking at oyster mushroom cultivation business opportunities.

Before cultivating oyster mushrooms, of course there are various aspects that must be considered. One aspect that must be considered is the place of oyster mushroom cultivation. Mushroom houses or mushroom houses are places that are specifically designed as a place for mushroom cultivation. Mushroom growth in mushroom houses is highly dependent on physical factors such as temperature, humidity, light, pH of the planting medium, and aeration. According to (Amsier, 2017), the temperature needed for mycelium growth is 20°-30°C. and the temperature for the formation of fruiting bodies (frutting bodies) ranges from 22°-26°C with a pH of the planting medium ranging from 5-6 (Rochman,2018).

The obstacles often faced by farmers are controlling the temperature and humidity of mushroom houses which are still less effective and efficient. So far, the efforts made by farmers are spraying water on the floor and walls of the mushroom house every morning, afternoon and evening. Controlling the temperature and humidity of the mushroom house by utilizing human power (manual method) is still less effective and efficient because it requires an operator to control the temperature and humidity in the mushroom house continuously. In addition, the temperature and humidity in the mushroom house are not well controlled because there are no adequate measuring instruments.

In fact, for the growth of oyster mushrooms, the temperature and humidity of the mushroom house must be constant in order to harvest the mushrooms optimally. The temperature inside the mushroom house is very important to note because temperature is one of the factors that affects the performance of enzymes and oyster mushroom metabolism. Changing temperatures will affect the metabolic activity of oyster mushrooms so that the more extreme the temperature changes that occur, the more it will inhibit the metabolic activity of oyster mushroom growth (Nabillah, 2023). In addition to temperature, humidity inside the mushroom house must also be considered because the higher the humidity level in the mushroom house, the less evaporation will occur. Very high evaporation in mushroom mushrooms will cause dry baglogs so that it will affect the growth of mycelium (Patadungan, 2023). As a result of the temperature and humidity of the mushroom house which are regulated using manual methods, namely from 1000 cultivated planting media, each day the baglogs that are grown with mushrooms are only 10-20 baglogs with an average harvest of 1 baglog, which is 0.2 kg so that farmers can harvest 2-4 kg of oyster mushrooms per day which should be able to harvest 20-40 kg per day. In addition to the quantity of the harvest which is still small, the quality of the mushrooms produced is still not good, such as yellowish mushroom caps which should be pure white, small mushroom cap diameters of 3-5 cm which should be 10-15 cm in diameter, and watery caps. The existence of this SMS gateway-based temperature and humidity control tool is due to the application of the tool to more remote areas that have not been touched by the internet, so this tool is very suitable and in accordance with the environmental conditions where oyster mushroom cultivation is applied.

II. METHODS

A. Research and Development R&D

The research method used in this study uses a research and development approach (Research & Development) (Suda, 2020). The research and development method is a research method used to produce a particular product, and test the effectiveness of the product. In order to produce a particular product, research is used that is in the form of needs analysis and to test the effectiveness of the product so that it can function. So research and development are longitudinal (gradual, can be multi-year) (Sidik, 2019). The steps of R&D research consist of 10 steps as follows: (1) Potential and Problems; (2) Data Collection; (3) Product Design; (4) Design Validation; (5) Design Revision; (6) Product Trial; (7) Product Revision; (8) Usage Trial; (9) Product Revision; and (10) Mass Production. Figure 1 shows the steps of R&D research (Hakim, 2021).

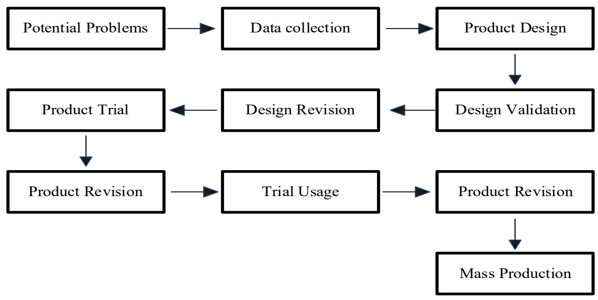

Figure 1. R&D Research Steps

This research will use several steps of the R&D method. The steps that will be used in this research only use up to step 8, namely until the Trial of Using the Tool (Hibaoui,2018).

Data analysis techniques in this study were carried out using descriptive percentage techniques and the type of data used in this study was quantitative data (Pradnya, 2020). In the assessment of tool validation, several criteria were used, namely very good/very agree, good/agree, sufficient, lacking and very lacking (Uin, 2018). In order to obtain quantitative data, the alternative answers were given a score, namely very good/very agree = 5, good/agree = 4, sufficient = 3, lacking = 2, very lacking = 1. The criteria were given by the validator who filled out the validation sheet. To analyze quantitative data obtained from the questionnaire filled out by the validator, the formula shown in Equation (1) was used, namely as follows:

$$P = \frac{f}{N} \times 100\% \quad (1)$$

Description (1)
P = percentage score
f = total score obtained
N = maximum score

To determine the qualification criteria of the assessment eligibility level based on the percentage, as follows (Heriyanto, 2018):

a. Determine the ideal score percentage (maximum score), namely (5:5) x 100% = 100%
b. Determine the lowest score percentage (minimum score), namely (1:5) x 100% = 20%
c. Determine the range, namely 100% - 20% = 80%
d. Determine the interval class, namely = 5 (Very Good, Good, Fairly Good, Less Good, Very Less Good)
e. Determine the interval length, namely 80:5 = 16%

For the qualification of the eligibility level based on the percentage, it can be seen in Table 1.

Table 1. Qualification of the eligibility level based on the percentage

Number	Interval	Criteria
1	84,01% - 100%	Very Eligible
2	68,01% - 84,00%	Eligible
3	52,01% - 68,00%	Quite Eligible
4	36,01% - 52,00%	Less Eligible
5	20,00% - 36,00%	Not Eligible

If the validation score obtained is at least 68.01%, then the tool produced or developed can be used as a tool for controlling electrical equipment remotely using SMS or applications that have been provided (Pardika, 2020). The distribution table for the percentage range and qualitative criteria for user responses to the tool can be determined as follows, in Table 2.

Table 2 The Assessment Reference Benchmark

Number	Percentage score	Criteria
1	20,00% ≤ S< 30,00%	Very Poor
2	30,01% ≤ S< 52,00%	Poor
3	52,01% ≤ S< 68,00%	Sufficient
4	68,01 ≤ S< 84,00%	Good
5	84,01% ≤ S≤ 100%	Very Good

If the validation score obtained is at least 68.01%, then the tool produced or developed has received a good response from tool users and can be used as a tool for controlling electrical equipment remotely using SMS or applications that have been provided (Suda, 2022).

III. Result And Discussion

Based on the literature review and the problems found, the design of the oyster mushroom control device is a temperature and humidity control system that works without using human power. This system works based on input signals in the form of 4 SHT 11 sensors installed at each corner of the mushroom barn. The read signal will be processed by the Arduino Nano R3 microcontroller and the processing results will be presented in the form of water spray and hot air. These two variables will be able to change the temperature and humidity of the air in the mushroom barn. After the system is completed, the next step is the testing process. The automatic temperature and humidity control test for the mushroom barn was carried out in the mushroom barn of Bali Bukit, Loaddem Village, Karangasem. With the mushroom barn size, namely length x width x height = 8m x 5m x 5m. After testing the tool, the following results were obtained;

Tool Operation Feasibility Test: When the tool is activated, the tool works as expected. This feasibility test is carried out by changing the Arduino Nano R3 program. During the test, the temperature and humidity of the mushroom cultivation are 250C and 85%. To test the tool, the program embedded in the microcontroller is 18C and 78%. When the temperature and humidity of the mushroom cultivation are the values specified in the microcontroller program, a work reaction occurs in the form of an active water pump and an inactive blower. Based on this, the automatic control system is said to be operating properly. After testing, the microcontroller program is returned to its original state (according to the initial design).

Sensitivity Test: This test was conducted when the system had not been installed in the mushroom house. The test location was conducted in the Polnas Electrical Lab by providing heat and cold treatment. The heat source came from a gas lighter and the cold source came from ice wrapped in plastic. The temperature value in the program on the microcontroller was set at 200C. When one of the sensors was given a heat source, the room temperature value changed from 200C to 210C. The change in value ordered the water pump to turn on and then the water was atomized through the sprayer. And when the SHT 11 sensor was brought close to the cold source, the room temperature value changed from 200C to 190C. The change in value ordered the blower to activate. Based on this, the automatic mushroom house temperature and humidity control system can work sensitively.

A. Temperature and Humidity Difference Graph for Mushroom House

To determine the effect of the system on the temperature and humidity in the mushroom house, here the author conducted observations for two days. On the first day, observations of the temperature and humidity of the mushroom house were carried out without an automatic control system. While on the second day, the author observed the temperature and humidity of the mushroom house by automatically regulating the temperature and humidity of the mushroom house. The following is a graph of the temperature and humidity of the mushroom house obtained during the observation, which can be seen in Figure 2.

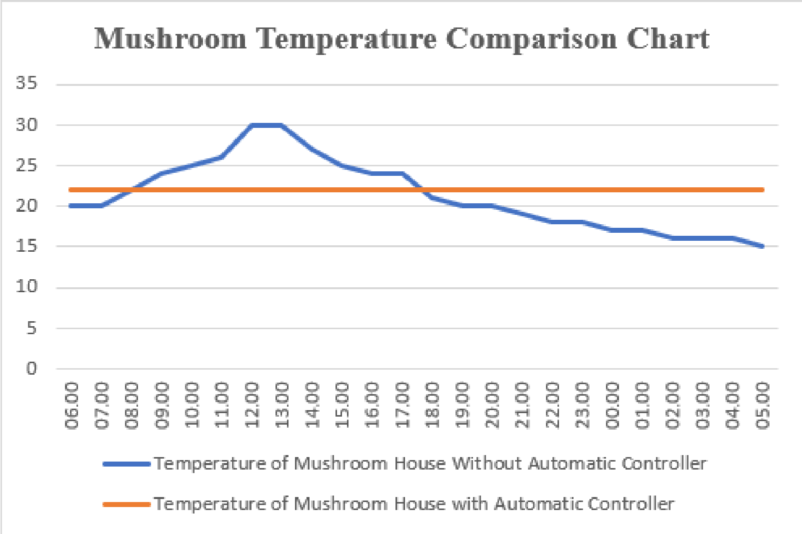

Figure 2. Comparison Graph of Mushroom Temperature

Based on the graph data, temperature instability occurs when the mushroom house is not treated with automatic temperature and humidity settings. The highest mushroom house temperature occurs at 12.00-13.00, which is 300C and the lowest temperature occurs at 05.00, which is 150C. However, when the mushroom house is treated with temperature and humidity settings, the mushroom house automatically has a stable temperature of 22(C (the temperature value is in accordance with the value specified in the microcontroller program). Likewise, the humidity of the mushroom house recorded during the study is shown in Figure 3.

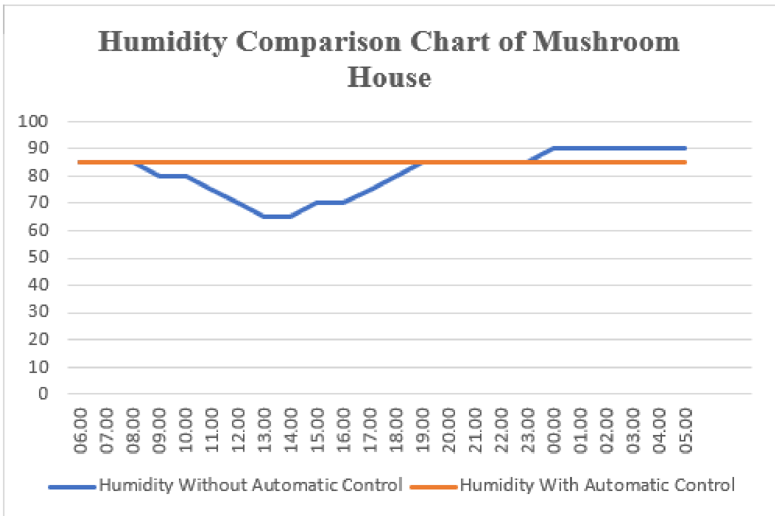

Figure 3. Comparison of Mushroom Humidity

Based on the graph data, there is instability of humidity when the mushroom is not treated with automatic temperature and humidity settings. The highest mushroom humidity occurs at 00.00-05.00, which is 90% and the lowest humidity occurs at 13.00-14.00, which is 65%. However, when the mushroom is treated with temperature and humidity settings, the mushroom automatically has a humidity stability of 85% (the humidity value is in accordance with the value specified in the microcontroller program). With an automatic control tool, the stability of the mushroom habitat can be maintained even in extreme conditions or weather.

B. Determination of Mushroom Temperature and Humidity

Parameters for determining the ideal mushroom temperature and humidity for oyster mushroom growth are determined by testing the quality of the oyster mushroom harvest. The best quality of the oyster mushroom harvest at a certain temperature and humidity will be the reference value that will be applied to the microcontroller.

Suda, K. R. S., Suteja, I. W. A., Antara, M. A. S., Putra, I. G. E. W., & Wija, I. B. P. (2025). Automatic Temperature and Humidity Regulation System Design for Oyster Mushroom Growth. TEPIAN, 6(2). https://doi.org/10.51967/tepian.v6i2.3251

Table 3 The research results obtained during the study.

Variable of *Kumbung*		Oyster Mushrooms Research Results				
Temperature (°C)	Humidity (%)	Mushroom Cap Color	Average Mushroom Cap (cm)	Tudung		
				Watery	Dry	Medium
15	90	White	11	√		
20	80	White	15			√
25	75	White	10			√
30	70	Yellowish	8		√	
35	65	Yellowish	6		√	

Based on the table data, the best quality of oyster mushroom harvest is at a temperature of 20°C and a humidity of 80% of the mushroom house. The quality of the harvest obtained is as follows: white mushroom cap color, medium cap water content and cap diameter of 15 cm. While for other temperature and humidity variables still have shortcomings, namely yellowish cap color, small cap diameter, watery, and dry. From the data obtained, the temperature and humidity of the mushroom house are set at a temperature of 20°C with a humidity of 80%. The setting is done using an automatic control tool.

The use of Information and Communication Technology (ICT) in the Automatic Control Tool system applied to local oyster mushroom farmers in Loaddem Village, Karangasem, has gone well so that it can optimize the quantity and quality of oyster mushroom harvests for farmers in Bali Bukit Mushroom. By using automatic temperature and humidity regulators for mushroom houses, oyster mushroom farmers can increase their business results so that they have a positive impact on the welfare of local farmers and help the government in increasing regional income.

IV Conclusion

In the testing of this automatic temperature and humidity control device, it was proven that the tool is effective in regulating air temperature and humidity to optimize the yield of oyster mushrooms. Based on the experiments conducted, it can be concluded that this device has been successfully designed and applied as a temperature regulator for oyster mushroom houses. The results from the expert testing of the electronic device show that the automatic temperature and humidity control device received a score of 95.45%, with an excellent qualification, indicating that the device functions very well and meets the established standards. Additionally, the results of the small group test gave a score of 90.85%, also with an excellent qualification, and the large group test achieved a score of 91.80%, with an excellent qualification as well. With these achievements, the device demonstrates stable and effective performance in maintaining optimal conditions for oyster mushroom growth. This temperature and humidity control tool is expected to bring significant benefits to oyster mushroom farmers, as it helps them control temperature and humidity more efficiently, as well as monitor the conditions within the mushroom house automatically, ensuring a more optimal and high-quality harvest.

References

A. El Hibaoui, M. Essaaidi, Y. Zaz, and Institute of Electrical and Electronics Engineers, *Proceedings of 2018 6th International Conference on Multimedia Computing and Systems (ICMCS)*.

A. R. Uin and A. Banjarmasin, "Analisis Data Kualitatif," *Jurnal Alhadharah*, vol. 17, no. 33, pp. 81–95, 2018.

Amsier, M. (2017). *Rancang bangun alat pengatur suhu untuk ruang budidaya jamur tiram berbasis PLC (Programmable Logic Controller) OMRON CP1E* (Doctoral dissertation, Universitas Muhammadiyah Semarang).

Ardhi, S., Gunawan, T. P., & Tjandra, S. (2023). Pengendalian Suhu dan Kelembaban Budidaya Jamur Kuping dengan Kendali PID Penalaan Ziegler-Nichols. *INSYST: Journal of Intelligent System and Computation*, *5*(2), 83-95.

Cahya Ningrum, N. (2017). *Pemanfaatan Ubi Jalar Kuning Sebagai Media Alternatif Untuk Pertumbuhan Bibit F0 Jamur Tiram Putih Dan Jamur Merang* (Doctoral dissertation, Universitas Muhammadiyah Surakarta).

G. Pardika, N. Santiyadnya, and A. Adiarta, "Pembuatan Media Pembelajaran Perencanaan Instalasi Listrik Rumah Tinggal Dengan Menggunakan Autocad Berbasis Multimedia Interaktif Autoplay," *Jurnal Pendidikan Teknik Elektro Undiksha*, vol. 9, no. 3, 2020.

Heriyanto, "Thematic Analysis sebagai Metode Menganalisa Data untuk," *ANUVA*, vol. 2, no. 3, pp. 317–324, 2018.

I. Gede, P. Wibawa, I. Gede Ratnaya, and N. Santiyadnya, "Pengembangan Media Pembelajaran Air Conditioner (AC) Split Pada Mata Kuliah Teknik Pendingin," *Jurnal Pendidikan Teknik Elektro Undiksha*, vol. 9, no. 1, 2020.

K. R. S. Suda, E. Purwanto, B. Sumantri, A. A. Muntashir, And R. O. Y. Hendra, "Pemodelan Sistem Kendali Motor Induksi Tiga Fasa menggunakan Pengendali Neuro-Fuzzy Melalui Metode Direct Torque Control," *ELKOMIKA: Jurnal Teknik Energi Elektrik, Teknik Telekomunikasi, & Teknik*

Suda, K. R. S., Suteja, I. W. A., Antara, M. A. S., Putra, I. G. E. W., & Wija, I. B. P. (2025). Automatic Temperature and Humidity Regulation System Design for Oyster Mushroom Growth. TEPIAN, 6(2). https://doi.org/10.51967/tepian.v6i2.3251

Elektronika, vol. 10, no. 4, p. 888, Oct. 2022, doi: 10.26760/elkomika.v10i4.888.

K. Reda, S. Suda, N. Santiyadnya, and I. G. Ratnaya, "Pengembangan Media Pembelajaran Trainer Instalasi Penerangan Listrik Inbow Portable Pada Mata Kuliah Dasar-Dasar Instalasi Listrik Di Program Studi S1 Pendidikan Teknik Elektro," *Jurnal Pendidikan Teknik Elektro Undiksha*, vol. 9, no. 1, 2020.

Karsid, K., Aziz, R., & Apriyanto, H. (2015). Aplikasi Kontrol Otomatis Suhu dan Kelembaban untuk Peningkatan Produktivitas Budidaya Jamur Merang. *Jurnal Aplikasi Teknologi Pangan*, *4*(3).

L. Hakim, "Pengembangan Media Trainer Instalasi Untuk Pengendalian Motor Induksi 3 Fasa," *Repository Politeknik Enjinering Indorama*, 2021.

M. Sidik, "Perancangan dan Pengembangan E-commerce dengan Metode Research and Development," 2019.

Nabillah, A. N., Nurbaeti, A., & Sudrajat, I. (2023, July). Program Budidaya Jamur Tiram dalam Meningkatkan Minat Berwirausaha Warga Belajar di Pusat Kegiatan Belajar Masyarakat (PKBM) Abdi Pertiwi Kota Serang. In *Prosiding Seminar Nasional Pendidikan Non Formal* (Vol. 1).

Patadungan, A., & Galla, E. A. (2023). Pengaruh Cangkang Telur Ayam dan Daun Pisang Kering terhadap Pertumbuhan dan Produksi Jamur Tiram Putih (Pleurotus ostreatus). *AgroSainT*, *14*(1), 62-72.

Riski, M., Alawiyah, A., Bakri, M., Putri, N. U., Jupriyadi, J., & Meilisa, L. (2021). Alat penjaga kestabilan suhu pada tumbuhan jamur tiram putih menggunakan Arduino UNO R3. *Jurnal Teknik dan Sistem Komputer (JTIKOM, vol. 2, no. 1*.

Rochman, A. (2018). Perbedaan Proporsi dedak dalam media tanam terhadap pertumbuhan jamur tiram putih (Pleurotus florida). *Jurnal Agribis*, *4*(2), 56-56.

Yulianto, S. (2011). Budidaya Jamur Tiram (Pleurotus ostreatus) di Balai Pengembangan dan Promosi Tanaman Pangan dan Hortikultura (BPPTPH) Ngipiksari Sleman, Yogyakarta.