ADVANCES IN AGRICULTURAL AND FOOD RESEARCH JOURNAL

Original Research Article

Identification of Optimum Time for Brown Planthopper (*Nilaparvata Lugens*) Sampling using the Light Traps

Nuraini Ahmad Ariff. Shah.[1*], Arina Mohd Noh.[1], Nur Muhammad Hakim Johari.[2] , Mohd Zulfadzli Marzuki.[1], Wan Mohd Syafiq Wan Harun.[3]

[1]Engineering Research Centre, Malaysian Agricultural Research and Development Institute, MARDI Headquarter, Serdang, Selangor, Malaysia

[2]Engineering Research Centre, Malaysian Agricultural Research and Development Institute, MARDI Seberang Perai,Penang, Malaysia

[3]Engineering Research Centre, Malaysian Agricultural Research and Development Institute, MARDI Parit,Perak, Malaysia

*Corresponding author: Nuraini Ahmad Ariff Shah; Engineering Research Centre, Malaysian Agricultural Research and Development Institute, MARDI Headquarter, Serdang, Selangor, Malaysia; eniass@mardi.gov.my

Abstract: Monitoring of brown planthopper (BPH) populations is important to prevent damage and loss of paddy yields. Malaysia Agriculture Research and Development Institute (MARDI) has developed a light trap system to monitor the BPH pest population. Compare to the manual process, this system increased the efficiency of monitoring BPH pests by 50%. As the power source of the light trap system is limited and to avoid the complication of counting the BPH population, the time to capture the pest is limited. Therefore, the objective of this study is to find the best time to capture the BPH samples that represents the actual BPH population of the night. Three light traps were installed at a paddy plot, MARDI Parit, Perak, Malaysia, as to determine the best possible time for sampling. The experiment was carried out from 7:00 p.m. to 10:00 p.m. At every one-hour interval, samples were taken, and the number of BPH trapped by each light trap system was manually counted. The result shows that the optimal time to capture BPH is between 7:00 p.m. and 8:00 p.m. By using a one-hour sampling time interval, the efficiency of monitoring the population can be increased and at the same time minimize power consumption of the light trap.

Keywords: light trap; brown planthopper; pest monitoring; peak time catches

Received: 16th March 2022

Received in revised form: 12th September 2023

Available Online: 30th December 2023

Published: 4th June 2024

Citation: Ahmad Ariff Shah, N., Mohd Noh, A., Johari. N. M. H., *et al.* Identification of optimum time for brown planthopper (*Nilaparvata Lugens*) sampling using the light traps. *Adv Agri Food Res J* 2024; 5(1): a0000373. https://doi.org/10.36877/aafrj.a0000373

1. Introduction

Brown planthopper (BPH), or *Nilaparvata lugens* in scientific terms, is a major rice pest in Malaysia. Attacks by BPH can caused a 30 % to 100 % reduction of paddy yield. The plant would turn yellowish and damaged due to large population of BPH attack. This condition is known as hopper burn. (IRRI, 1979; Heong *et al*., 2015).

Rice pest monitoring is an important activity in paddy production as to prevent pest outbreaks. The conventional practice of pest monitoring, which is the scheduled spraying method, is inefficient because it leads to the overused of insecticides. This could cause harm to human health as well as negative impacts to the environment (Jali *et al*., 2012; Ahmad *et al*., 2014). To overcome the drawbacks in the conventional practice, BPH populations can be controlled with early detection by applying pesticides at the right time, right amount and right place, depending on estimated BPH population at certain areas.

BPH population sampling is a common method used by government agencies to monitor and predict BPH attacks. This activity is done manually, depending on the age of the rice plants. It is normally done five times in one season. This method is, however, laborious and high-time consuming as to cover large field area which results in insufficient data and inaccurate monitoring of BPH population levels and patterns during the growing season.

MARDI has developed a new sampling approach that uses light traps and collect data weekly to replace the manual BPH sampling method. A novel light trap system has been developed for weekly data acquisition. This system provides simplification of the entire sampling procedure includes reducing labor usage and saving time. The light trap system is currently configured to operate for three hours, from 7:00 p.m. to 10:00 p.m., and uses a 20 W compact fluorescent lamp (CFL). However, due to limited power supply, some of the lights did not sustain until the end of the three hours. Furthermore, the number of BPH sampled from 7.00 p.m. to 10.00 p.m. was too frequent which caused difficulty for the operator to identify and count the pest. Therefore, the objective of this study is to determine the best time interval to trap the BPH using the developed light trap.

2. Materials and Methods

The experiment was conducted at a paddy plot in MARDI, Parit. Three light traps (4.4357124,100.8857939), (4.4343408,100.8875481) and (4.4357040,100.8821766) were installed at a distance of 500 m from one another as shown in Figure 1. Each light trap consists of a light box, a lamp, an insect sticker, a timer and a solar panel to power up the system. There were 2.0 mm diameter holes on all side of the light box that was specially designed to prevent larger insects than BPH from entering the light box. In the light box, a white CFL type, 20W lamp was installed as a light source to attract the BPH. Inside the light box, there was also A3 sized insect stickers that serve to trap and collect the BPH. The timer regulates turn on. To avoid light source contamination and to ensure single and controlled illumination from the light trap, the system was installed inside the paddy field that was located far from the external light source. A total of two samples were taken at 25 October 2021 and 13 December 2021 from 7:00 to 10:00 p.m., the lights were turned on every hour for sampling. The replacement of the insect stickers in the three light traps were done every hour until 10 p.m. Timers have been set to turn on the lights from 7:00 to 8:00 p.m., from 8:00 to 9:00 p.m., and from 9:00 to 10:00 p.m. Following the completion of the sampling task, all of the insect stickers were brought to the laboratory for sample calculation.

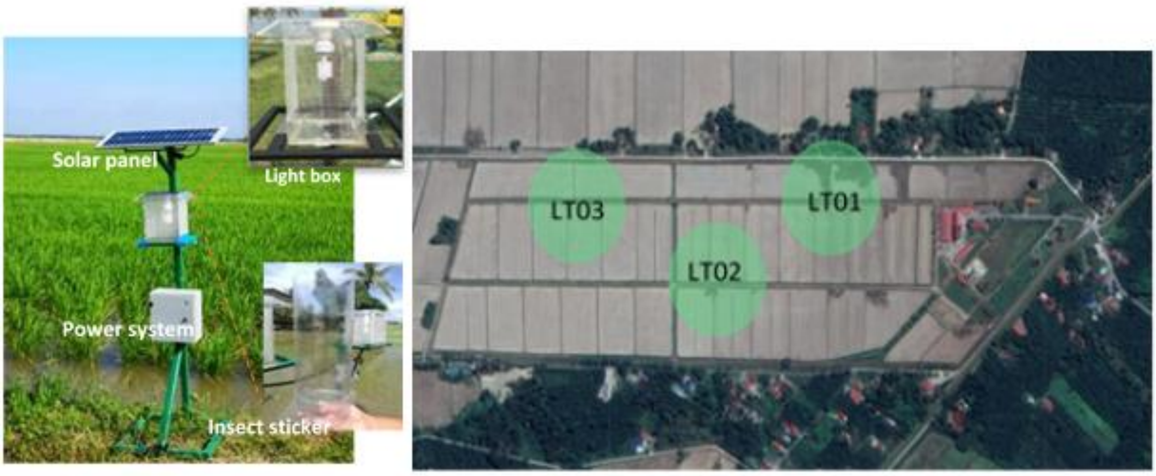

Figure 1. Light trap and location for sampling at MARDI Parit

3. Results

Table 1 shows the overall population of each light trap based on different sampling dates and times. The data was organized to make it easier to analyze. The number of BPH trapped on the insect sticker was identified and counted.

Table 1. Total population of each light trap with different date and time sampling

Date sampling	Light trap	Total population for 3 hours (7-10)	No of BPH 7:00-8:00 pm	No of BPH 8:00-9:00 pm	No of BPH 9:00-10:00 pm
25/10/2021	LT01	97	1	23	73
25/10/2021	LT02	65	0	17	48
25/10/2021	LT03	91	3	63	25
13/12/2021	LT01	1275	367	815	93
13/12/2021	LT02	34	5	22	7
13/12/2021	LT03	467	139	172	156

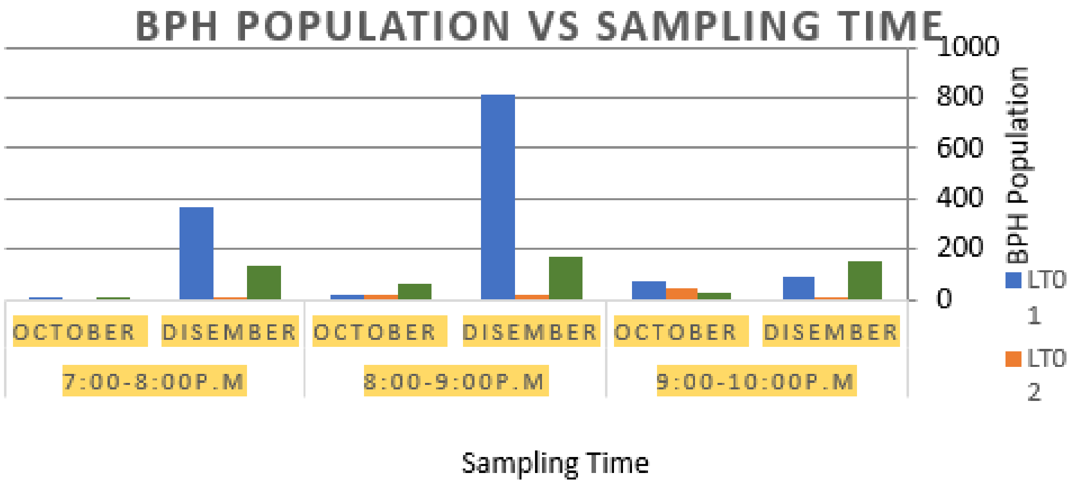

Figure 2. Bar Plot of BPH population vs sampling time for two-month sampling.

As shown in Figure 2, the BPH population was high during the sampling date in December from 8:00 to 9:00 p.m., with the maximum population number of 815. This is due to the fact that the age of the rice crop reaches 60 days after seeding (DAS). According to a study by Hirao (1979), when rice plants reach the age of 60 DAS, the BPH population grows. Weather parameters such as temperature and humidity also have an impact on the total population of BPH (Bae *et al*., 1968).Brown planthopper development in Asia is optimal between the temperatures of 25 and 29 °C, but over 33 °C it will negatively affect all stages of brown planthopper development (Yu & Wu, 1991; Liu *et al*., 2004).

To determine the correlation between each one-hour sampling to the total population of the night, the data analysis function in the excel software was used to build a correlation matrix. Correlation matrix is a square table that shows the correlation coefficients for several variables. The matrix shows how each possible pair of values in a table correlate with one another. The correlation matrix was generated as a result of this analysis.

Table 2. Correlation matrix between the total population of BPH with different time sampling.

Correlation	Total Population of BPH	Sampling Time 7:00 - 8:00 p.m	Sampling Time 8:00 - 9:00 p.m	Sampling Time 9:00 - 10:00 p.m
Total Population of BPH	1			
Sampling Time 7:00–8:00 p.m	0.997519934*	1		
Sampling Time 8:00–9:00 p.m	0.98729318	0.979312778	1	
Sampling Time 9:00–10:00 p.m	0.523799439	0.541212919	0.384475148	1

*Correlation is a significant at the 1

4. Discussions

The correlation coefficient defines the relation between two variable which is, the total population of BPH with different time sampling. It has a value between -1 and 1 where -1 represents a perfect negative linear correlation between two variables, 0 represents no linear correlation between two variables, and 1 represents a perfect positive linear correlation between two variables is called Pearson correlation coefficient. The formula for calculating the Pearson correlation coefficient, abbreviated as r, for a set of data is as follows:

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{(x_i - \bar{x})}{}^2 \sum_{(y_i - \bar{y})}{}^2}} \quad (1)$$

r = correlation coefficient
x_i = value of the total population of BPH
$\bar{x}$ = mean of the value of the total population of BPH
y_i = value of the sampling time

$\bar{y}$ = mean of the value of the sampling time correlation between the total population of BPH and sampling time (7:00–8:00 p.m.) is 0.997 which indicates strongly positively correlated, so the sampling time (7:00–8:00 p.m.) is the best time frame to represent the actual population of BPH compared to correlation between sampling time (8:00–9:00 p.m.) which is 0.987 are also strongly positively correlated but slightly lower than sampling time (8:00–9:00 p.m.) with is difference of 0.010. The correlation between the total population of BPH and sampling time (9:00–10:00 p.m.) is the lowest which is 0.5. Therefore, there isn't strong evidence for a significant relationship between these two variables. According to this result, the sampling time that has a high correlation with the entire BPH population is between 7:00 and 8:00 p.m. The result also shows that with sufficient power supply, the best period to sample the BPH population is between 7:00 and 9:00 p.m. Therefore, in a situation where the weather is bad which effecting the BPH movement, the sampling duration can be extended until 9.00 p.m. Environmental factors such rain and wind should be taken into research when using light traps to catch pests like BPH when they fly from one plant to another as these factors would affect the BPH data population sampling.

5. Conclusions

According to the findings of this study, BPH population monitoring using light traps can be done in just one hour between 7:00 and 8:00 p.m., as compared to three hours between 7:00 and 10:00 p.m. previously. This study found that monitoring BPH population in rice plants for one hour using a light trap can indicate BPH population. A one-hour sampling helps optimize light trap catches for BPH which reducing the cost of BPH monitoring operation.

Author Contributions: Conduct the experiment, data collection, and analysis, prepared, and edited the manuscript.

Funding: This work was funded by the RMK11 Development Project with project number K-RM240.

Acknowledgments: The author thanked all the parties involved in this research.

Conflicts of Interest: The authors declare no conflict of interest.

References

Ahmad, M.I., Ahmad, N. A. *et al* (2014). A survey on use, hazards and potential risks of rice farming pesticides in Permatang Keriang, Pulau Pinang (Malaysia). *International Journal of Scientific and Research Publications*.

Bae, S. H., and M. D. Pathak. 1968. Effectiveness off egg-nymphal predation by a mirid bug, Cyrtorhinus lividipennis Reuter, for control of the brown planthopper.

Heong, K. l., Cheng, J. & Escalada, M. M. (2015) Rice planthoppers: Ecology, management, socio economics and policy. *Advanced Topics in Science And Technology In China*.

Hirao J. (1979). Forecasting brown planthopper outbreaks in Japan. *Brown Planthopper: Threat to Rice Production in Asia.* Los Baños, Philippines: International Rice Research Institute.

IRRI (1979). *Brown Planthopper: Threat to Rice Production in Asia.* International Rice Research Institute

(IRRI), Los Banos, Philippines,

Jali, Mohd Fuad, M., Junaidi, A. B., *et al*. (2012). The Impact of Pesticides on Paddy Farmers and Ecosystem. Advances in Natural and Applied Sciences,

Liu, Z. W. Han, Z. J. Wang, Y. C. *et al*. (2004). Effect of temperature on population growth of susceptible and resistant strains of Nilaparvata lugens to imidacloprid. *Chinese Bulletin of Entomology*, *40*, 47–50.

Yu, X. P., Wu, G. R. (1991). Influence of high temperature and humidity on reproduction and survival of the brown planthopper. *Acta Agriculturae Zhejiangensis*, *5*, 239–241