International Journal of Agricultural and Applied Sciences, June 2023, 4(1): 12-16
https://www.agetds.com/ijaas
ISSN: 2582-8053
https://doi.org/10.52804/ijaas2023.412

Research Article

OPEN ACCESS

Period of effective catching of insect pests and natural enemies in light traps

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(**Received:** 23/01/2022; **Revised:** 14/03/2023; **Accepted:** 20/04/2023)

ABSTRACT
Light trap helps to protect natural enemies and manage destructive insect pests in rice farming ecosystem. Light trapping time at night is not identified, for organic farming in farmers level its essential to identified proper timing at night. The experimental light trap was set up at Sagordi rice farm, Bangladesh Rice Research Institute, Barishal, during T. Aman rice season in 2019-2020. The time of catching insects by light trap were divided in six different times in a night and defined as treatments (T_1= 17.20 to 18.20, T_2= 18.20 to 19.20, T_3= 19.20 to 20.20, T_4 =20.20 to 21.20, T_5=21.20 to 22.20, T_6= 22.20 to rest of night insects caught at light trap) in this study. Each treatment has had four replications. Yellow sticky trap used to catch and trapped insect and natural enemyRice insect pests and their natural enemies were counted and recorded manually. The caught of yellow stem borer increased and green leafhopper were decreased from treatment, T_1 to treatment, T_6. During dusk to first four hours, the percentage of caught was approximately 69.28% insect pests. Overall, the percentages of insect pests trapping were 89.65% and natural enemies were 10.35% during the experimental period. The ratio of destructive insect pests caught was highest compared to that of natural enemies in light trap of rice ecosystem.
Keywords: Light trap, management, insects, monitoring, Rice (*Oryza sativa* L.).

INTRODUCTION

Rice, *Oryza sativa* L., is an essential staple food for half of the world's population. In 2012, rice was grown on over 158 million hectares and produced 465 million tons globally, with Bangladesh alone producing 34 million tons of milled rice (Akhtar et al., 2010; Hu et al., 2014; IRRI, 2014; Ali et al., 2021). In Bangladesh, rice is the primary food crop and occupies 75% of cultivated land, providing crucial calories and protein for the average daily diet of adults (Ganesh-Kumar et al., 2012). Rice is also a major source of income, supporting nearly 15 million farm households, predominantly small and marginal farmers (Bhuiyan et al., 2004; Bangladesh Bureau of Statistics, 2008).

However, the increasing global population requires an increase in rice production, yet this is hindered by various obstacles, including biotic stressors such as insect pests (Hossain et al., 2007; Ali et al., 2020; Kennedy, 2002; Miao et al., 2011). Insect pests can have a significant impact on rice cultivation in Bangladesh. These pests can cause significant yield losses (Islam et al., 2003; Datta et al., 2021), which can negatively impact the livelihoods of farmers and the overall food security of the country. It has been recorded that a total of 266 different types of herbivores have been found in rice ecosystems, with 232 of them being arthropod species found in Bangladesh. These herbivores cause significant yield losses in the country (BRRI, 2016). However, when considering only the major insect pests that cause significant yield losses in large numbers, the number narrows down to only 15-20 species (Islam et al., 2003). Insect pests such as green leafhopper, zigzag leafhopper, brown planthopper, and white-backed planthopper are known to cause significant damage to rice crops. These pests can suck the sap from the plant, weakening it and reducing its ability to produce grain. Additionally, these pests can act as vectors, spreading pathogens that further damage the crop. Insect pests can also impact the quality of the grain produced. For example, the brown planthopper can cause grain to become discolored and shrunken, making it less desirable for consumption or sale. This not only results in financial losses for farmers, but it also affects the overall food security of the country as less grain is available for consumption.

Currently, the control of insect pests in rice cultivation in Bangladesh relies heavily on the use of chemical pesticides. During the years 2011 and 2012, around 20-24 thousand tons of formulated insecticide were used in Bangladesh, with more than half of that amount being applied to control rice insect pests (BCPA, 2013). However, this approach can have negative impacts on both human health and the environment. Additionally, the overuse of pesticides can lead to the development of pesticide resistance in insect populations, making pest control increasingly difficult. Effective pest management strategies are needed to address this issue, including the use of non-toxic pest control methods, integrated pest management, and research on new pest control technologies.

Light traps have been widely used in agriculture, forestry, and other industries to control insect pests. They are considered to be an efficient and cost-effective method for monitoring and reducing pest populations and can provide valuable data for research and pest management programs. (Young, 2005). Light traps can be used to attract a wide range of insects, including moths, beetles, and other nocturnal insects (Leinonen et al., 1998; Fayle et al., 2007). The efficiency of light traps can be affected by various factors such as the type of trap, the time of day and night, the season, and the duration of sampling (Thomas & Thomas, 1994; Axmacher & Fiedler, 2004; Summerville & Crist 2005; Beck & Chey, 2007). Light traps are commonly used in rice farming in Bangladesh to control pests, as they are considered to be the most efficient method for monitoring nocturnal insects, particularly moths, by providing population and comparable data. They can be set up as permanent installations or used as portable devices, depending on the specific application.

Visual lures, such as bright colors and shapes, are used to attract pests in light trapping. The efficiency of trapping harmful insects depends on factors like the amount of moonlight, the percentage of polarized light, and the phase of the moon. Studies have shown that the highest number of species can be collected during the new moon or close to the first and last quarter (Nowinszky and Puskas, 2012). This research has been effective in identifying the optimal lighting period for trapping insects and comparing the catch of rice pests and natural enemies.

MATERIALS AND METHODS

Setting light trap: Arthropods that are attracted to light, such as insect pests and predators, were collected from a light trap device known as the Pennsylvania type (Fig. 1) at the rice farm of the Bangladesh Rice Research Institute (BRRI) Regional station in Barishal (22°67'29″N, 90°35'49″E). This trap is a permanent set-up at the farm.

Treatments: The treatments were as follows, (T_1= 17.20 to 18.20, T_2= 18.20 to 19.20, T_3= 19.20 to 20.20, T_4 =20.20 to 21.20, T_5=21.20 to 22.20, T_6= 22.20 pm to rest of night caught at light trap.

Data collection: Data were collected from 17 to 20 November 2020 at Sagardi rice farm, BRRI, Barishal in T. Aman 2019 - 2020. Yellow sticky trap was used to catch and trapped insect and natural enemies. The four replications yellow sticky trap were used. Rice insect pests and their natural enemies counted and recorded manually.

Statistical analysis: The results are displayed in the form of average values obtained from multiple samples (replications), accompanied by error bars showing the standard deviation (SD). Significance was evaluated using a one-way ANOVA test in combination with Tukey's multiple comparison analysis.

Fig. 1. Pennsylvania type light trap at BRRI, R/S, Barishal during experiment period

RESULTS AND DISCUSSION

Light trap is an important tool for monitoring rice insect pest and natural enemy at farming ecosystem. Light attracts both the harmful insect pests and predatory natural enemies. Light trap caught green leafhopper (GLH), white leafhopper (WLH), orange leafhopper (OLH), zigzag leafhopper (ZLH), brown planthopper (BPH), white backed planthopper (WBPH), yellow stem borer (YSB), leaf folder (LF), caseworm (CW), long horn grasshopper (LHG), Long horn cricket (LHC) and rice bug (RB) insect pest. Another side same device was also caught beneficial carabid beetle (CDB), ladybird beetle (LBB), staphylinid beetle (STPD), spider (SPD), green mirid bug (GMB), dragon fly (D. fly), ear wig (EW) and parasitoids natural enemies. Highest number of insect pest caught at second day first trapping hour (T_1), second highest insect pest trapping found first day then third and fourth day at same treatment (T_1) in Pennsylvania light trap (Fig. 2). Young (2005) also reported moths were caught in light trap and demonstrated the insects with comparing data. In case of natural enemies, higher caught follows fourth, first and second consecutive days (Fig. 2). Second treatment (T_2) found higher insect caught in second day that follows first, third and fourth consecutive days (Fig. 2). Beneficial natural enemy caught found higher to lower rate at first to fourth days continuously (Fig. 2). Third treatment follows first to fourth day's insect and natural enemy caught decreasing pattern exceptional second days of natural enemy (Fig. 2). Fourth and fifth treatment follows first to third days insect and natural enemy caught at decreasing pattern without fourth day (Fig. 2). Last treatment (T_6) follows decreasing pattern of insect caught but in case of natural enemy follows first, fourth, second and third consecutive days caught (Fig. 2). From the data it is crystal clear that all the treatments are capable to catch insect pests in different time periods. The result is similar to previously reported data of Fayle et al. (2007). During whole experimental period highest insect pest (1663) caught 18 November and lowest (200) caught 20 November 2019. Same experiment natural enemy caught highest (341) in 19 November and lowest (35) in 18 November, 2019.

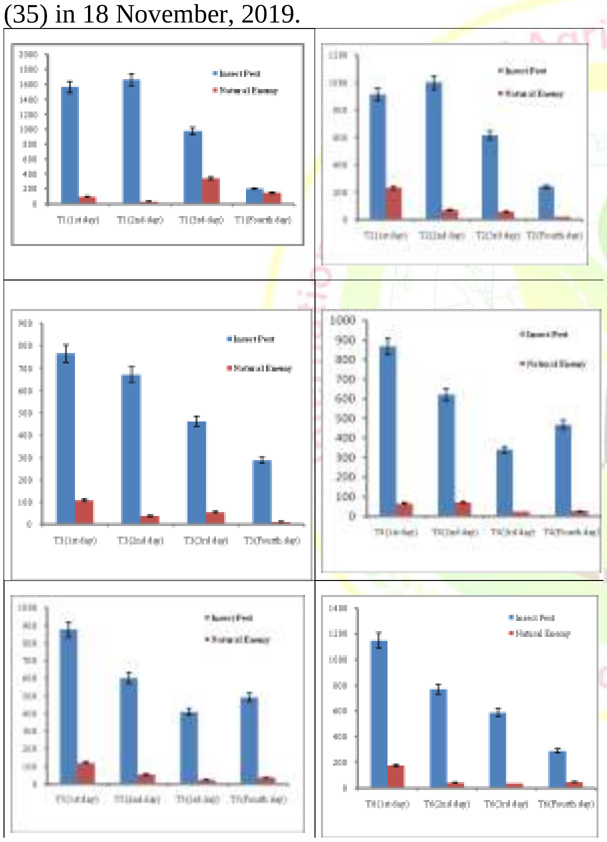

Figure 2. Treatment wise caught of insect pests and natural enemies in light trap

Yellow stem borer, another destructive pest was also found in light trap. With the increasing period, treatment T_1 to T_6, yellow stem borer caught also increased, for example a number of 24, 41, 109, 124, 135, 188 yellow stem borers caught at T_1, T_2, T_3, T_4, T_5, T_6 treatment, respectively. Green leafhopper, vector of rice tungro virus, caught was in decreasing with the treatment. There might be several reasons for the low number of trapped insects. Dusk to midnight, the ratio of yellow stem borer and green leafhopper caught was vice versa. Insect pest and natural enemy has relationship with trapping hour in light trap. Different insect pest and natural enemy follows to highest caught in different pattern of trapping hours in light trap. Borer and hopper have strong inverse relationship to attract and trapped in light trap.

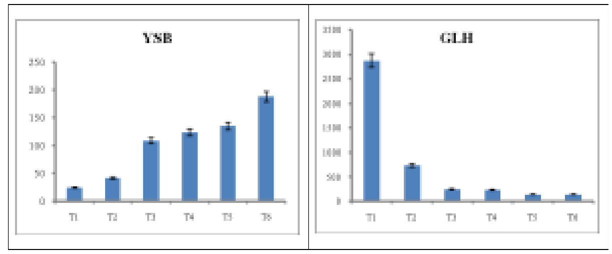

Fig.3. Yellow stem borer and green leafhopper caught pattern at different treatment in light trap

Table 1. Percentage of insect pest and natural enemies' population of different treatment in light trap

Population	T1	T2	T3	T4	T5	T6
Insect (%)	26.14	16.47	12.99	13.66	14.12	16.60
Natural Enemy (%)	32.03	19.62	11.02	9.73	12.05	15.55

Out of all the treatments, T1, which refers to the twilight (godhuli) traps, caught the highest number of insect pests (26.14%) and natural enemies (32.03%) (Table 1). This treatment trapped destructive pests such as the green leafhopper, zigzag leafhopper, brown planthopper, and white-backed planthopper, as well as beneficial pests such as the carabid beetle, green mirid bug, staphylinid beetle, and parasitoids. From dusk to the first four hours, 69.28% of insect pests were caught. The number of insect pests caught decreased during the first three hours (17.20 to 20.20) and the number of beneficial natural enemies caught also decreased during the first four hours (17.20 to 21.20). Therefore, trapping light during the twilight to the first three or four hours is important for catching the maximum number of insect pests.

Table 2. Comparative caught of insect and natural enemy population in light trap

Population	Insect	Natural enemy
Total Caught	16825	1942
Percentage (%)	89.65	10.35

Generally, more than 8.5 times insect pest caught than natural enemies in light trap during experiment. Its good sign for protect and preserve our natural enemy biodiversity within rice ecosystem. During study period highest 16825 no. insect pest and 1924 no. of natural enemy caught and trapped. Higher percentage of insect pest population (89.65%) caught compared to natural enemies (10.34%) in light trap. Light trap is comparatively safer in case of protect beneficial natural enemy in rice field at farmers' level.

CONCLUSION

This study found that yellow stem borer and green leafhopper insect caught inverse relationship at increasing night period. Among all the treatments, first one (T_1=17.20 to 18.20) caught highest insect pest and natural enemy. Dusk to first four hours treatment (T_1 to T_4) caught maximum 69.28% insect pests. Overall insect pest trapping and caught 89.65% and natural enemy 10.35% during experimental period. Every treatment was hours interval period from twilight to dawn, but last treatment T_6 (22.20 to down) time period was so high. Future recommendation is to split dusk to down every single hour's interval treatment. Biotic and abiotic factors should also be considered for relationship with insect pests and natural enemy caught.

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Citation: M. M. Moniruzzaman Kabir*, Md. Panna Ali, Juel Datta, S. N. Topy, A. Debonath, Saifullah Omar Nasif, Tapon Kumar Roy and ABMA Uddin 2023. Period of effective catching of insect pests and natural enemies in light traps. *International Journal of Agricultural and Applied Sciences*, 4(1): 12-16. https://doi.org/10.52804/ijaas2023.412