International Journal of Entomology Research
ISSN: 2455-4758; Impact Factor: RJIF 5.24
Received: 15-06-2019; Accepted: 19-07-2019
www.entomologyjournals.com
Volume 4; Issue 5; September 2019; Page No. 54-57

Time oriented mortality of brown planthopper, *nilaparvata lugens* by some new chemistry insecticides

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Abstract
This experiment was conducted at the net house and laboratory to evaluate some new chemistry and conventional insecticides against Brown Plant Hopper (BPH), *Nilaparvata lugens* of rice. Insect pests are mainly controlled with synthetic insecticides over the last 50 years and Bangladesh is not beyond in that but the audacious uses of these insecticides make this insect stronger to combat with these chemicals and in addition these chemicals have negative effects on non-target organisms, including humans and the environment. So the main purpose of this experiment is to find out the appropriate chemicals among many ones and handover it to the farmers for the ultimate control of *Nilaparvata lugens* with less disturbing the ecosystem. Here six insecticides viz., Thiamethoxam & Chlorantraniliprole, Imidacloprid, Fenitrothion, Diazinon, Carbofuran and Azadirectin were used and their efficacy against brown planthopper, *N. lugens* were determined on the basis of mortality percentage of brown planthopper at 24, 48 and 72 hours after treatment. The findings of these experiments indicate that the chemicals namely Fenitrothion, Imidacloprid, Thiamethoxam & chlorantraniliprole and Carbofuran are the promising options in reducing brown planthopper population successfully but among them the insecticide Fenitrothion was highly effective against the pest resulting in 100% mortality. The insecticides Imidacloprid, Carbofuran and Thiamethoxam & Chlorantraniliprole showed identical efficacy while Diazinon and Azadirectin were less effective against brown planthopper.

Keywords: rice, brown planthopper, insecticides, insect management

1. Introduction

Bangladesh is an agro-based country where almost 95% of population in this country depends on rice as their major food (BRRI, 2012) [7]. Rice (*Oryza sativa* L.) is one of the world's most important cereal crops providing a staple food for more than half of the global population. It is the predominant dietary energy source for 17 countries in Asia and the Pacific, 9 countries in North and South America and 8 countries in Africa. It alone provides 20% of the world's dietary energy supply (Fui and Chuan, 2013) [9]. Rice covers about 74.35% of the total cropping area of Bangladesh. It is also grown throughout the year in our country. The average rice yield in Bangladesh is only 1.90 t ha-1 (BBS, 2010) [5] which are less than the world average (3.2 t ha-1) and much below the highest country average (9.0 t ha-1). Rice is an ideal host for many species of insect pests. In Bangladesh, about 175 species of insect pests have been recorded on rice (Kamal, 1998) [12] which cause about 17% (BRRI, 2013). The estimated annual loss of rice in our country due to insect pest and diseases amounts to 2.0 to 2.5 million tons (Pasalu and Katti, 2006) [18]. Rice suffers heavy losses every year due to attack of many pests like maize crop (Alam *et al.*, 2019) [1]. Among them, the Rice Brown Plant Hopper (BPH), *Nilaparvata lugens* is widespread and also become a major threat to rice production in many parts of Bangladesh in recent years. But, the brown plant hopper was formerly a minor pest in most tropical countries of Asia. The BPH was first recorded in 1969 in Bangladesh. The first outbreak of this pest was occurred in April-May, 1976 on Boro rice near Dhaka city (Suri *et al.*, 2012) [21]. The major outbreak areas of BPH was recorded in Rajshahi, Gazipur, Mymensingh and Netrokona in transplanted aman rice, and high incidence of BPH was observed in Netrokona and Nandigram which caused significant yield loss (Anonymous, 1997) [4]. The Brown plant hopper infests the rice crop at all stages of plant growth as like maize aphid (Alam *et al.*, 2018 & 2014) [2, 3]. The large scale damaged by the pest has been reported from India, Indonesia, Philippines, Sri-Lanka and Bangladesh since the early 1970's (Sogawa and Cheng, 1979) [20]. Low infestation causes reduced plant height, crop vigor, tiller production, while heavy infestation turns the plants yellow which dry up rapidly. At early infestation, round yellow patches appear which soon turn brownish due to drying up of the plants. Feeding damaged caused by BPH is commonly called "hopper-burn". The patches of infestation may spread out and cover the entire field. It also acts as a vector of the virus diseases viz., grassy stunt, ragged stunt and wilted stunt (Chen and Chiu, 1981) [8]. It causes loss of yield of rice.

Farmers rely heavily on insecticides for their management and almost 50% of the insecticides used in rice are targeted against this pest alone (Reddy *et al.*, 2012) [19]. That's why, the most commonly used method of controlling BPH in Bangladesh is the application of insecticides. Many conventional insecticides though have been evaluated against this insect, yet, most of the chemicals have failed to provide adequate control. However, the over application of insecticides can cause several problems: development of insecticide resistant biotype, environmental pollution and undesirable effects on non-target organisms including the natural enemies of the target resurgence of the target pests and outbreak of secondary pest (Heinrich *et al.*, 2011) [11]. In contrast, use of selective insecticides that are less toxic to natural enemies than to pests should conserve natural enemy populations and these surviving natural enemies may suppress the pest populations. Hence, new molecules are being added for their evaluation with an aim to least disruption of environmental quality. Keeping mind the idea of agro-ecosystem, the research program was undertaken to investigate the effectiveness of different approaches of insecticides against Brown Plant Hopper, *Nilaparvata lugens*.

2. Materials and Methods

The experiment was conducted at the net house and laboratory of the Entomology Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, Bangladesh from March to July, 2016 to evaluate the effectiveness of insecticides for controlling brown plant hopper, *Nilaparvata lugens* of rice. The experiment was laid out in a completely randomized design with three replications.

2.1 Collection and rearing of brown planthopper, *N. lugens*

Gravid females of brown planthopper were collected with the help of aspirator from infested rice fields of Bangladesh Agricultural University, Mymensingh. Immediately after collection, the insects were placed in test tube of medium size (15 cm in length). The mouth of the test tubes were then closed with pieces of fine nets and fastened with rubber bands. The collected insects were then brought to the net house of BINA and reared to build up a large population. The gravid females were immediately released on 30-40 days old rice plant of TN 1 variety grown in pots and then the pots were placed in a 0.75x0.5x0.2 m (length x breadth x height) tray which was filled with water to one third of its height, so that the soil could not dry. The potted rice plants were covered with 0.9 x 0.5 m (height x breadth) rearing cages. The plants were observed for egg laying every day. For a continuous supply of 30-40 days old rice plants, TN 1 seeds were sown in seed beds at an interval of 15 days regularly starting well ahead of commencement to the experiment. Then 15-20 days old seedlings were transplanted in pots having 35 cm height and 25 cm diameter and containing 3.0-3.5 kg soil. The TN 1 plants (3 hills/pot were transplanted @of 2 seedlings/hill) were allowed to grow for 30-40 days under net house condition. The pots were kept in another same size tray filled with water as previously described. All recommended cultural practices including fertilizer and insecticide application were followed for optimum plant growth. Sevin dust, an insecticide with least residual effect was used whenever necessary to protect the brown planthopper from ants.

For egg laying purposes, adult brown planthopper were released in caged-fresh rice plants on every Sundays and Wednesdays in every week. The gravid or adult female brown planthopper was transferred from one used plant to another fresh plant with the help of an aspirator. After removal of the adults the plants were kept under the cages for a sufficient time so that the brown planthopper eggs on these plants can hatch and reach the adult or gravid stage. Moreover, before using the plants for the egg laying of brown planthopper, the outer leaf sheaths of each tiller were removed to eliminate any brown planthopper populations from the plants. After hatching of eggs, nymphs were provided with sufficient food plants for their growth and development. As soon as most of the insects from the new hatching became adults, the females and the males were transferred to another cage with fresh plants twice a week as mentioned earlier. These insects were preserved in new cages with dates of egg laying marked on them. The brown planthopper was provided with fresh plants for their food as and when necessary. In this way, brown planthopper populations of uniform age were established and within 3-4 generations, sufficient numbers of insects became available for the production of required numbers of nymphs and adults for the different experiments.

2.2 Specifications of treatments

To determine the efficacy of insecticides on the mortality percentage of brown planthopper an experiment was conducted in the laboratory of BINA. The seedlings of 30-40 days rice plant were transplanted in plastic pot. The rice plants were grown in plastic pots with Mylar film cage and kept in the laboratory. Ten brown planthopper were released in each pot that was selected randomly. Fenitrothion, Imidacloprid, Azadirectin, Thiamethoxam & Chlorantraniliprole were sprayed and Diazinon, Carbofuran were applied in the soil. The control pot with TN 1 rice plants with brown planthopper was sprayed with water only. Mortality of insect was recorded at 24, 48 and 72 hours after treatment. The experiment was laid out in a completely randomized design with three replications.

Table 1: Specification of treatments, their chemical and group name.

Treatments	Chemical name	Group
Sumithion 50 EC 2 ml/L	Fenitrothion	Organophosphate
Tiddo 20 SL 0.25 ml/L	Imidacloprid	Neonicotinoids
Brifer 5G 10 kg/ha	Carbofuran	Carbamate
Virtako 40 WG 0.15 g/L	Thiamethoxam & Chlorantraniliprole	Anthranilic diamide & Neonicotinoids
Basudeb 10G 16.8 kg/ha	Diazinon	Organophosphate
Bioneem plus 1 ml/L	Azadirectin	Neem based insecticide

2.4 Data collection

In determining the effectiveness of six insecticides mortality of brown planthopper was recorded at 24, 48 and 72 hours after treatment (HAT).

2.5 Statistical Analysis

The obtained data were statistically analyzed to find out the significance of differences among the treatments. The mean values of all parameters were evaluated and analysis of variance was performed by MSTAT-C software package and the mean differences were adjudged by Duncans Multiple Range Test (Gomez and Gomez, 1984) [10].

3. Result and Discussion

3.1 Effect of insecticides on the mortality of brown plant hopper, *N. lugens*

The result of mortality (%) of *N. lugens* using six insecticides at different time interval was presented in table 01. The percentage of mortality differed significantly (P≤0.05) among the treatments. The range of percentage of mortality was recorded in 43.33 to 100. The results clearly revealed that the effect was clearly dose and time dependent. Significant level of mortality was found at 24 HAT which was further increased at 48 HAT and reached to the peak level by 72 HAT. At 24 HAT, The highest percentage of mortality (100%) of brown plant hopper was found in T3 which was statistically similar to T2 (93.33%) and T5 (90.0%), respectively. The lowest percentage of mortality of brown plant hopper was observed in T7 (0.0%). At 48 HAT, The maximum percentage mortality (100%) of brown plant hopper was recorded in T3 which was statistically similar to T5 (100%), T2 (100%) and T1 (93.33%), respectively whereas, the minimum percentage mortality (0.0%) was found in T7. On the other hand, the maximum percentage mortality (100%) of brown plant hopper was recorded in T3 which was statistically similar to T5 (100%), T2 (100%) and T1 (96.67%), respectively whereas, the minimum percentage mortality (0.0%) was found in T7 at 72 HAT. Although all the insecticides had a remarkable effect on brown plant hopper, the overall effect of Fenitrothion, Imidacloprid, Carbofuran and Thiamethoxam & Chlorantraniliprole were significant. But, Fenitrothion @2ml/L was the better performance on brown plant hopper than others tested insecticides and also less effect on agro-ecosystem & natural enemies. The present result is in agreement with the findings of Misra and Sontakke (1980) [16], Uthamasamy & Karuppuchamy (1988) [22] and Kumar *et al.* (1988) [15]. Bhavani (2010) [6] observed the effectiveness of Fenitrothion @ 2ml/L for BPH management. Different scientists were also reported the effectiveness of Thiamethoxam + Chlorantraniliprole and Imidacloprid for hopper management (Kendappa *et al.*, 2005 [13]; Suri *et al.*, 2012) [21]. Kirankumar, 2016 [14] studied the efficacy of Diazionon, Carbofuran and Azadirctin against brown plant hopper of rice and found it is quite effective for *N. lugens* management, and Fenitrothion treated plots gave higher yield with least effect on natural enemies (Naik *et al.*, 2016) [17].

Table 2: Percentage of Mortality of brown plant hopper, *Nilaparvata lugens* sprayed with different insecticides at different interval of time under laboratory condition

Name of insecticides	% of mortality of Brown plant hopper at		
	24 Hat	48 Hat	72 Hat
T_1	83.33b	93.33a	96.67 a
T_2	93.33ab	100.0a	100.0a
T_3	100.0a	100.0a	100.0a
T_4	43.33 c	43.33 b	50.0 b
T_5	90.00ab	100.0a	100.0a
T_6	46.67 c	50.0b	50.0b
T_7	0.00d	0.00c	0.00c
Level of significant	*	*	*
CV (%)	7.86	9.30	6.92
LSD	10.11	11.30	7.84

In column, means followed by different letters are significantly different. *means at 5% level of probability. T_1= Thiamethoxam + Chlorantraniliprole @0.15g/L, T_2 = Imidacloprid @ 0.25 ml/L, T_3 = Fenitrothion @2ml/L, T_4 = Diazinon @16.8 kg ha-1, T_5= Carbofuran @10 kg ha-1, T_6= Azadirectin @ 1ml/L, T7= Control

4. Conclusion

Considering the above result of the evaluation of the efficacy of six insecticides for controlling the brown plant hopper, *N. lugens*, it was observed that Fenitrothion @2ml/L was the better performance on brown plant hopper than others tested insecticides. Therefore, from the results, it could be recommended that Fenitrothion @2ml/L treated plots gave higher yield with least effect on natural enemies and eco-system.

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