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Schedule and Need Based Chemical Control of Brown Planthopper and their Impact on the Predator *Ophionea indica* (Thunberg)

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Abstract: Effectiveness of two chemical approaches in controlling brown planthopper, *Nilaparvata lugens* (Stal.) and their impact on the predator carabid beetle, *Ophionea indica* (Thunberg) were evaluated at Bangladesh Agricultural University during aman season. Carbofuran (Brifer 5G) was applied in Need Based Control (NBC), as judged by periodic monitoring on the level of the pest population and recommended economic thresholds. Schedule Based Control (SBC) consist of application of carbofuran (Brifer 5G) and monocrotophos (Azodrin 40 WSC) on a schedule basis. Mean number of brown planthoppers and the carabid beetles were compared in different control approaches including the natural control, where no insecticide was applied and the control was largely by the activities of naturally occurring predators. In natural control approach a high level of predatory carabid beetle was found in the field compared to the need based and schedule based protection. The population of carabid beetle fluctuated quite synchronously with the density of brown planthopper. The carabid beetle, *O. Indica* was found to keep the brown planthopper population down to a considerable level when chemical insecticide was not applied.

Key words: Brown planthopper, *Nilaparvata lugens*, *Ophionea indica*, predator, scheduled, need based control

INTRODUCTION

The brown planthopper, *Nilaparvata lugens* (Stål.) is one of the important pest of rice and can be threat to rice production. It causes widespread and severe yield losses of rice plants, which needs to be controlled effectively in the field. The most commonly practiced method of controlling brown planthopper in Bangladesh is the application of synthetic insecticide. The success of the 'green revolution' in rice in Bangladesh has been limited by the problems caused by insecticides that induce the resurgence of brown planthopper population. Use of synthetic insecticides has also exposed limitation of providing temporary control and furthermore it is evident that the use of broad-spectrum pesticide has almost inevitably been followed by the development of pesticide resistance, pest resurgence and out breaks of secondary pest etc.[1,2].

Ophionea indica (Coleoptera:Carabidae) is one of the important predator of nymph and adult of brown planthopper[3]. Both the grubs and adults of the carabid beetle are reported as an important predator of brown planthopper[4]. It is found to maintain a good predator prey relationship between carabid beetle and brown planthopper[5].

Biological control agents provide about 60% natural control of insect pests. They are to be protected and conserved by avoiding frequent use of chemical pesticides[6]. In tropical rice ecosystem natural enemies are sufficient to reduce different insect pests to a minimum level if they are conserved properly[7]. Therefore conservation of natural populations of the predators should be of the prime strategy for sustainable control of brown planthopper and other insect pests of rice. The judicious use of chemical pesticides is the key consideration to natural enemy conservation. The efficacy of carabid beetle as biological control agent has been increased through their conservation and augmentation in agroecosystem[8].

There are only a few reports on the effect of different approaches of brown planthopper and their impact on the natural enemies of the pest. As the carabid beetle, *Ophionea indica* is a promising predator of brown planthopper, the present research was conducted to compare effectiveness of schedule and need based approaches of chemical control of brown planthopper and to study the existence of the predator in the treated rice field.

MATERIALS AND METHODS

The study on different control approaches of brown planthopper was conducted at three different places of Bangladesh Agricultural University Farm located at

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24.75°N latitude and 90.5°E longitude using the rice variety BR23 (Dishari) in Aman season. The field trial comprised of three treatments such as (1) Schedule Based Control (SBC)-consisted of application of the insecticide carbofuran (Brifer 5G) at the recommended dosages of 1.0 kg a.i/ha at 25 and 70 days after transplanting and monocrotophos (Azodrin 40 WSC) 500 g a.i/ha at 50 days after transplanting on a schedule basis involving application of insecticides based on a schedule commonly adopted by farmers. (2) Need Based Control (NBC)-application of carbofuran (Brifer 5G) at the recommended dose of 1.0 kg a.i/ ha at 50 and 80 days after transplanting as judged by periodic monitoring on the level of economic threshold of the pest and (3) Natural Control (NC) with no application of insecticide throughout the crop season. Each experimental fields comprised of the area about 250 m^2. So the total area covered by three plots were 750 m^2. The agronomic practices such as weeding, application of fertilizer, irrigation etc. were common for all the plots.

Data collection started when crop was one month old. The number of brown planthopper per 25 hills of rice were recorded fortnightly. Estimation of population of the common predator, carabid beetle *Ophionea indica* (Thunberg) was made based on net sweeps (5 double sweep nets per plot) at same time interval.

Collected data were analyzed using two way ANOVA and the means were separated using Least Significant Difference (LSD). The correlation between carabid beetle and brown planthopper was determined. All the analysis was done using the MSTAT-C statistical program.

RESULTS AND DISCUSSION

The brown planthopper population was significantly influenced by the different management approaches after different date of transplanting (Table 1). The mean number of brown planthopper per 25 hills was higher in schedule based control ranging from 9.0 to 158.25 while in natural control approaches ranged from 25.25 to 73.0 and need based control approach ranged from 6.5 to 57.75 at 30 to 90 days after transplanting.

Mohapatra *et al.*[9] studied that monocrotophos was the most toxic insecticide to brown planthopper, *N. lugens* followed by chlorpyrifos, carbaryl and phosalone. Huang and Pang[10] stated the toxic effects to quinalphos, a broad spectrum insecticide on the natural enemy population, while buprofezin a very selective insecticide, affected most Homoptera, but saved most natural enemies such as spiders, carabids and staphylinids.

The population density of carabid beetle was fluctuated enormously among the three different management approaches at different days after transplanting (Table 2). The number of carabid beetle ranged from 4.0 to 7.25 per 5 double sweep nets in natural control approach. Comparatively a reduced number of carabid beetle was found in need based control approaches which ranged from 1.75 to 5.75. Minimum number of carabid beetle was present in the field treated with schedule based chemical control approach where number of carabid beetle varied from 1 to 4.5.

Table 1: Population of brown planthopper at different days after transplanting (DAT) in different management practices

	Mean number of brown planthopper				
Management practice	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
Schedule based control	21.50b	30.00b	158.25a	92.00a	9.00b
Need based control	27.00a	35.00ab	57.75c	33.00c	6.50b
Natural control	25.25a	37.00a	73.00b	56.00b	32.00a
Level of significance	0.01	0.05	0.01	0.01	0.01
CV (%)	7.14	9.52	6.67	10.10	10.10
LSD at 5%	2.80	5.64	10.28	9.74	2.55

In a column values with same letter do not differ significantly (LSD at 5% level)

Table 2: Population of carabid beetle at different Days After Transplanting (DAT) in different management practices

	Mean number of carabid beetle				
Management practice	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
Schedule based control	2.00b	3.75b	3.25b	4.50	1.00b
Need based control	2.50b	4.50b	3.25b	5.75	1.75b
Natural control	4.00a	6.50a	7.25a	5.75	4.00a
Level of significance	0.01	0.01	0.01	NS	0.01
CV (%)	26.31	20.05	25.45	25.39	38.49
LSD at 5%	1.19	1.57	1.86	1.63	1.38

In a column means with same letter do not differ significantly (LSD at 5% level). NS =Non-significant.

The experimental results revealed that the highest number of carabid beetle was found in natural control and the lowest number was in schedule based control approach during different days of transplanting. The decreased number of carabid beetle was due to the higher and injudicious application of insecticide which was toxic to the predator. Huang and Pang[10] stated a similar toxic effect of the broad spectrum insecticide to the carabid beetle.

The results demonstrate that need based protection was superior to natural control and schedule based protection approaches. In all ecosystems, there are natural mortality factors that keep most pests at low numbers. When pesticides are applied, these beneficial predators are destroyed, so immigrating pests can reproduce and survive without any mortality. For brown planthopper it is even more interesting-they don't have to migrate back into the field. The eggs of brown planthopper are embedded in the stem of the rice, so they are protected from the insecticides, they just hatch into a favourable environment where there are no predators to eat them, they rapidly develop a good number of population. The

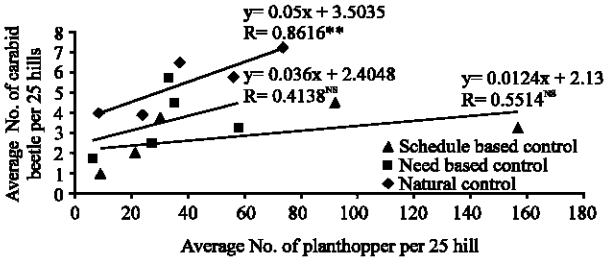

Fig. 1: Relationship between number of brown planthopper and carabid beetle in different management approaches

natural approach was found as the best one in maintaining higher level of predator populations of carabid beetle followed by need based and schedule based control approaches.

Toxicity of different insecticides especially monocrotophos and carbaryl were reported to be most destructive against many predator[11]. Temporal coincidence of populations of brown planthopper and carabid beetle on rice should be potential value as a basis for biological control of the pest but from the field observation unfortunately it has been shown that these two chemicals were sprayed while predator carabids were in pre-imaginal stage when these were highly vulnerable to Monocrotophos and Carbofuran.

The relationship of brown planthopper and carabid beetle were determined by using correlation and regression analysis (Fig. 1). Brown planthopper and carabid beetle population was significantly correlated in natural control approach ($r = 0.8616^{**}$, $y = 0.05x + 3.5035$). In case of Need Based Control (NBC), brown planthopper and carabid beetle were weakly correlated ($r = 0.4138$ NS, $y = 0.036x + 2.4048$) while in schedule based approach, there was a poor correlation between brown planthopper and carabid beetle population ($r = 0.5514$ NS, $y = 0.0124x + 2.13$). The survival of brown planthopper and carabid beetle was affected by application of insecticides both in the field of need based and schedule based chemical control.

In the present study, it could be concluded that, minimum use of insecticides in effective dose and frequencies would be helpful in the long run for the conservation of the carabid beetle, which are encouraged for the effective control of the pest, brown planthopper. There was strong correlation between brown planthopper and carabid beetle in natural control approach but little or no correlation was found between the population of brown planthopper and carabid beetle in need based protection and schedule based control. Need based control considered the economic threshold level of the pest which resulted in considerable build up of the natural enemy populations in rice ecosystems.

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