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Safety Selected Insecticides to Predators and Egg Parasitoids of Planthoppers in Rice Ecosystem

Baehaki.S.E[1], Erwin Cuk Surahmat[2], Aryo Susetyo[2], Robert Senn[2]
[1]*Entomological Society of Indonesia, Bandung Branch, Faculty of Agriculture, Padjadjaran University, Bandung-Sumedang street Km 21-Jatinangor, West Java-Indonesia*
[2]*Syngenta Crop Protection AG*

Abstract: *The research safety selected insecticides to predators and egg parasitoids of planthoppers in rice ecosystem was carried out in the wet season of 2014 at Subang District. The several insecticides of mixture chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate and deltamethrin were sprayed on rice plots at 20 and 35 days after transplanted (dat). Observation to planthoppers and predators by visual counting, while observation to egg parasitoids through parasitism by BPH eggs trap. The result showed that pimetrozine had reduced BPH population, followed by chlorantranilprole + thiamethoxam. In the other hand chlorantranilprole + thiamethoxam, pimetrozine and deltamethrin had reduced WBPH population. Insecticides of chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate and deltamethrin highly safety against L. pseudoannulata, P. fuscipes, and Coccinella sp., but those insecticides moderately safety to O. nigrofasciata and spiders (without L. pseudoannulata). Insecticides of chlorantranilprole + thiamethoxam, emamectin benzoate and deltamethrin moderately safety against C. lividipennis, but pymetrozine moderately unsafety to this predator. Chlorantranilprole + thiamethoxam were moderately unsafety to parasitism of eggs parasitoids Anagrus sp., but was moderately safety to parasitism of eggs parasitoids Oligosita sp.. Pymetrozine and emamectin benzoate were moderately safety to Anagrus sp., but moderately unsafety to Oligosita sp.*

Keywords: *predators, parasitoids, planthoppers, rice, safety insecticides*

I. INTRODUCTION

The rice planthoppers Delphacidae of Hemiptera widespread throughout Asia, especially in Indonesia existed two rice planthoppers namely brown planthopper (BPH), *Nilaparvata lugens* Stal. and whitebacked planthopper (WBPH), *Sogatella furcifera* Horvath. In the others country as China and Vietnam, besides the two planthoppers mentioned there was small brown planthopper (SBPH), *Laodelphax striatellus*.

BPH is one of the most economically important insects and the most famous planthoppers which caused a major problem to increase rice production. Both nymphs and adults of the BPH damage rice directly by removing nutrients and indirectly by transmitting rice grassy stunt virus (RGSV) and rice ragged stunt virus (RRSV). The rice black-streaked dwarf virus (RBSDV) is transmitted by the SBPH in a persistent manner and can be experimentally transmitted to rice, maize, wheat and other cereal and grass hosts (1). In the other hand WBPH as a virus vector of RBSDV-2 or Southern rice black-streaked dwarf virus (SRBSDV) (1,2) distribute in North Vietnam and China (3,4).

Jena *et al*. (6) called the BPH as a most destructive phloem-sap-sucking insect pest of tropical and temperate rice plantations in Asia. In Indonesia, the BPH was called as executive-major rice pest (4), because in the history of the BPH outbreak in 1986 was followed by a Presidential Instruction No.3 in 1986 that banded 57 insecticides formula and at the BPH outbreak in 2010 followed by Presidential Instruction No. 5 in 2011 which one of the content was a rules to help farmers whose their rice crops damaged by BPH. In the other hand in case of BPH outbreak the government will intervene to deploy brigade of pest control and even when the BPH attack just a few hectares the executive immediately to handle it. This planthopper has ability changes into new biotype rapidly due to the r-strategic insect characteristics and quickly adapt to the new resistance rice varieties (7). The both problem changes into new biotype and quickly adapt to new habitat as genetic makeup phenomenon of BPH that have a high genetic plasticity. Various control techniques for reducing planthoppers have been widely applied ranging from resistant or tolerant rice varieties, cultivation techniques, planting times, manipulation of natural enemies, and use of insecticides. Hence, the interested control techniques are two last technology namely natural enemies and insecticides.

Natural enemies can make a major contribution to pest control in rice, particularly if combined with the others ecological system. Some natural enemies of predators and parasitoids are important contributions to pest control, and recently their value has been quantified in some systems (8, 9). Natural enemy of predators that contribute to reduce planthoppers are spiders, ladybird beetle, dragon fly, carabid beetle and staphylinid. In the other hand parasitoids that contribute to reduce planthoppers are *Anagrus* sp. and *Oligosita* sp..

Insecticides use are still the main choice of pests control in rice, although they may have negative effects on natural enemies and on other non-target organisms in the environment. However with the use of insecticides, in many cases it still fails to reduce BPH's population on field. The main problem with the use of insecticides on field is it also killing many natural enemies and many times the use of insecticides was blamed for the explosion of the brown planthoppers population.

In rice field to increase abundance of natural enemy and activity could compensate for losses of control resulting from decreasing pesticide use in an integrated pest management (IPM) program (10), but producers need to have a clear understanding of insecticides in order the natural enemies to persist in sustainable agriculture. In well farming systems, crop losses to insects can often be kept by deploying resistant varieties, conserving predators and managing crop nutrient levels to reduce insect reproduction. When necessary, lower risk synthetic pesticides should be used for targeted control, in the right quantity and at the right time. Integrated pest management can be promoted through farmer field schools, local production of biocontrol agents, strict pesticide regulations, and removal of pesticide subsidies (11). The Objective of this study to evaluate the safety of selected insecticides to some common predators and parasitism of parasitoids of rice insect, but still effective to control planthoppers under rice field conditions.

II. MATERIALS AND METHODS

The research was carried out in the wet season of 2014 at Subang District-West Java-Indonesia, used randomized block design with 5 insecticides treatment and 4 replications. Insecticides treatment were mixture chlorantranilprole + thiamethoxam 300SC (200 g/lt+100 g/l), pymetrozine 50WG (500 g/kg), emamectin benzoate 5WG (50 g/kg) and deltamethrin 25EC (25 g/l), and control without insecticide. Amount insecticides concentrate were 750, 1500, 1000,1500 and 0 ppm respectively.

The seedlings of Ciherang rice variety of 21 days old were planted 2 tillers per hole at a spacing of 25 cm x 25 cm on 5 m x 8 m (= 40 m^2) plot size. The recommended dose as basal fertilizer of 40 kg N/ha (from urea) and 40kg P_2O_5 (from TSP) and then 80 kg N/ha (from urea) were applied in two equal split doses at 25 and 50 days after transplanting (dat). Application each liquid of insecticides amount 200 lt/ha or 0.8 lt liquid/40m^2 were sprayed on rice plots at 20 and 35 dat respectively.

Observation to planthoppers and predators by visual counting, while observation to parasitism of eggs parasitoid of BPH by eggs trap method. All data were analyzed by analysis of variance (ANOVA) and differences in the value was tested by Duncan's Multiple Range Test (DMRT) in 5% least significance different (LSD) level. The detail observation activity as follows:

1. Visual Observation to Planthoppers and Predators

Visual observation to planthoppers and predators were carried out in 1 and 3 days after each sprayed of insecticides. Observation from 30 hills of rice plant per plot on cross diagonal direction to recording abundance of BPH, WBPH, and predators of *Paederus fuscipes, Lycosa pseudoannulata, Coccinella* sp., *Cyrtorhinus lividipennis, Ophionea nigrofasciata,* and all spiders (without *L. pseudoannulata*).

2. BPH Eggs Trap to Assessment Parasitism of Egg Parasitoids of Brown Planthopper

Egg parasitoids in the rice field were trapped using eggs of brown planthopper as the BPH eggs trap were carried out in 1 and 3 days after each sprayed of insecticides. This activity was started from the screen house by rearing of BPH in cage and rice seedbed Pelita I/1. The 20 days old rice seedlings were planted in small pots 7 cm in diameter and 13 cm in high. After the rice in the pot were 20 and 35 days old to form one hill was cleaned and remains five healthy stems. Five BPH brachypterous pregnant females (ready to lay eggs) selected from rearing cage and put on the rice pot, caged for oviposition over night. In the morning all female of BPH was removed from cages, because the hopper had laid eggs in the tissue of rice stem. Rice pot that have eggs of BPH was brought to the field, and put at random four pot/plot for 3 days in other the eggs of BPH infested by field-egg parasitoids of BPH.

After that time, the plant was taken to the laboratory. Eggs in the rice stem tissue were dissected with special scissors dissection under microscope binocular. Eggs of BPH are thrust in a straight line generally along the mid-region of the sheath blade, though sometimes eggs are laid on the leaf midribs. Calculate number of BPH eggs that usually form in a group like bunches of banana and transferred into petridish that was coated filter paper with treated nivagin solution 0.05%.

Parasitoids *Anagrus* sp. and *Oligosita* sp. will emergence after 12 days, as an adult parasitoid. Sometimes parasitoids do not emergence and remained in the BPH eggs. When the BPH eggs in unhatch is red color indicate that the BPH eggs infested by *Anagrus* sp., but when the BPH eggs in unhatch is yellow color indicates that the BPH eggs infested by Oligosita sp.. Calculate number of parasitoids *Anagrus* sp. and *Oligosita* sp. from hatched and unhatched parasitoids. The percentage of parasitism the BPH eggs due to each species were calculated as follows:

$$\text{Parasitism of } Anagrus\ sp = \frac{\text{Numbers of } Anagrus \text{ sp.}}{\text{Total eggs of brown planthopper}} \times 100\%$$

$$\text{Parasitism of } Oligosita\ sp = \frac{\text{Numbers of } Oligosita \text{ sp.}}{\text{Total eggs of brown planthopper}} \times 100\%$$

To measure the safety insecticides to predators/parasitoids or the percentage of parasitism of the parasitoid uses frequency unaffected (FUA). Unaffected of insecticide was showed by population of predators/parasitoids or percentage parasitism of the parasitoid on treated insignificantly or significantly more higher compared to the population of predators/ parasitoids or percentage parasitism of parasitoids on untreated in the analysis of variance (ANOVA). The Formulae frequency unaffected (FUA) as follows:

$$\text{FUA} = \frac{\Sigma \text{ unaffected insecticide to natural enemies of all observations}}{\text{Total observations}} \times 100\%$$

Criteria to determine the safety of insecticides on natural enemies and parasitism of the parasitoid is highly unsafety (FUA = 0%), unsafety (FUA> 0-25%), moderately unsafety (FUA> 25-50%), moderately safety (FUA> 50 -75%), safety (FUA> 75 <100%), and highly safety (FUA = 100%)

III. RESULTS AND DISCUSSIONS

1. Planthoppers after insecticides application

One day after first application (1 daa 1), BPH populations in control treatment was low about 12.2 BPH/30 hills but insignificant compare to insecticides treatment. BPH populations on chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate, and deltamethrin treatments were insignificant one to another. In the other hand WBPH population in control treatment was 213.8 WBPH/30 hills and significantly different to WBPH on chlorantranilprole + thiamethoxam, pymetrozine, and deltamethrin treatments, but insignificant different with WBPH population on emamectin benzoate (Table 1).

In 3 daa 1, BPH populations on control was low about 17.2 BPH/30 hills, and insignificantly different compare to BPH populations on chlorantranilprole + thiamethoxam, emamectin benzoate, and deltamethrin treatment except insignificantly different to BPH populations on pymetrozine treatment. WBPH populations on control considered higher about 227.6 WBPH/30 hills and significantly different compare to WBPH populations on all insecticides treatment, while WBPH populations on pymetrozine were smallest and on chlorantranilprole + thiamethoxam and (Table 1) more smaller than emamectin benzoate, and deltamethrin treatment.

Table 1. Effect of insecticides to planthoppers after first application

Treatments	Dose (ppm)	Number planthoppers/30 hills			
		1daa 1		3 daa 1	
		BPH	WBPH	BPH	WBPH
Chlorantranilprole + Thiamethoxam	750	4.0 a	127.2 b	11.0 ab	84.6 c
Pymetrozine	1500	10.2 a	141.6 b	6.6 b	76.6 c
Emamectin benzoate	1000	10.0 a	195.0 a	14.8 ab	139.4 b
Deltamethrin	1500	8.6 a	152.6 b	11.0 ab	156.6 b
Untreated	-	12.2 a	213.8 a	17.2 a	227.6 a

Remarks: Mean values in each column followed by the same letter are insignificantly different at the 5% level base on Duncan's Multiple Range Test = DMRT. 1 daa 1= one days after application 1, BPH = Brown planthopper, WBPH = Whitebacked planthopper.

BPH populations in control treatment of 1 daa 2 observation was 97.4 BPH/30 hills and on insecticides treatment were lower. BPH populations on insecticides treatment of chlorantranilprole + thiamethoxam and pymetrozine were significantly different to BPH populations on control, but to emamectin benzoate and deltamethrin treatment insignificant compared to control. In the other hand WBPH populations in all insecticides treatments significantly different compared to control (Table 2).

Table 2. Effect of insecticides to planthoppers after second application

Treatments	Dose (ppm)	Number planthoppers/30 hills			
		1daa 2		3 daa 2	
		BPH	WBPH	BPH	WBPH
Chlorantranilprole + Thiamethoxam	750	64.6 b	30.0 b	88.4 b	23.0 a
Pymetrozine	1500	62.2 b	17.6 b	81.0 b	17.6 a
Emamectin benzoate	1000	76.8 ab	30.0 b	93.2 b	22.6 a
Deltamethrin	1500	89.4 ab	21.6 b	85.2 b	21.4 a
Untreated	-	97.4 a	59.0 a	122.2 a	22.4 a

Remarks: Mean values in each column followed by the same letter are insignificantly different at the 5% level base on Duncan's Multiple Range Test = DMRT. 1 daa 2= one days after application 2, BPH = Brown planthopper, WBPH = Whitebacked planthopper

At 3 daa 2 populations of BPH in all insecticides treatment were significantly different compared to control (122.2 BPH/30 hills), but WBPH populations in all insecticides treatment were low and insignificantly to WBPH on control. The overall data showed that all insecticides treatment have reduced the populations of BPH and WBPH. However, sometimes the data obtained were fluctuated, because BPH and WBPH populations in the treatment did not different from control, related to biological process in growth stage.

All data showed that pimetrozine was high reduced BPH, followed by chlorantranilprole + Thiamethoxam. In the other hand emamectin benzoate and deltamethrin were lower reduce to BPH. Over all data application of chlorantranilprole + Thiamethoxam, pimetrozine and deltamethrin were high reduced WBPH, followed by emamectin benzoate.

Thiamethoxam and chlorantraniliprole insecticides have been important tools for controlling pests in rice. The mixture of those insecticides, which contains 200 g/lt chlorantraniliprole (= rynaxypyr) and 100 g/lt thiamethoxam as Virtako 300 SC against the BPH. The toxic effects of Virtako against the BPH nymphal indicated that all instars were sensitive to the five concentrations (16, 8, 4, 2, 1 mg/lt) (12). This results indicate that virtako might be an effective alternative for the control of BPH by delaying the resistance levels of thiamethoxam, because thiamethoxam has been used for controlling BPH for a long time and resulted in a gradual decrease of efficacy against the BPH. The resistance levels of BPH populations in Ningbo, Hangzhou and Shaoguan to thiamethoxam ranging from 9.4 to 15.8 fold compared with the susceptible strain (13, 14). In the other hand thiamethoxam might be an effective alternative for the control of BPH by breaking the resistance levels of old insecticides as a BPH populations from Gangavati, Kathalagere and Kollegala exhibited higher resistance to some of the old insecticide chlorpyriphos but low resistance to new insecticide thiamethoxam (15).

2. Predators after insecticides application

Observation on 1 daa 1 indicates that predators *Lycosa pseudoannulata, Paederus fuscipes, Ophionea nigrofasciata, Coccinella*, and *Cyrtorhinus lividipennis* on all insecticide treatments insignificantly different from the number of predators in control treatment (Table 3). In the other hand the number of spiders (without *L. pseudoannulata*) in all insecticides treatment were significantly lower than the number of predators in the control treatment.

Table 3. Effect of insecticides to predators 1 day after first application

Treatments	Dose (ppm)	Number of predators 1 daa 1/30 hills					
		Lyc	Spd	Pae	Oph	Coc	Cyr
Chlorantranilprole + Thiamethoxam	750	0 a	6.8 b	1.6 a	0	0.2 a	0.6 a
Pymetrozine	1500	0 a	8.6 b	1.6 a	0	0.4 a	0.4 a
Emamectin benzoate	1000	0 a	7.4 b	3.0 a	0	0 a	1.4 a
Deltamethrin	1500	0.8 a	6.2 b	5.0 a	0	0 a	1.2 a
Untreated	-	1.2 a	22.4 a	4.2 a	0	0.2 a	1.4 a

Remarks: Mean values in each column followed by the same letter are insignificantly different at the 5% level base on Duncan's Multiple Range Test = DMRT. Lyc= *L. pseudoannulata*, Spd = Spiders without *L. pseudoannulata*, Pae=*P. fuscipes*, Oph=*O. nigrofasciata*, Coc = *Coccinella*, Cyr=*C. lividipennis*

Observation on 3 daa 1 indicate that predators *L. pseudoannulata*, spiders, *P. fuscipes*, *O. nigrofasciata*, and *Coccinella* sp. on all insecticides treatment insignificantly different from the number of predators in the control treatment (Table 4). In the other hand the number of *C. lividipennis* on pymetrozine and emamectin benzoate treatment were significantly and lower than *C. lividipennis* on the control treatment.

Table 4. Effect of insecticides to predators 3 days after first application

Treatments	Dose (ppm)	Number predators 3daa 1/30 hills					
		Lyc	Spd	Pae	Oph	Coc	Cyr
Chlorantranilprole + Thiamethoxam	750	0.4 a	3.6 a	2.6 a	0 a	0 a	1.0 ab
Pymetrozine	1500	0.2 a	5.6 a	1.6 a	0 a	0 a	0.6 b
Emamectin benzoate	1000	0.2 a	3.0 a	2.2 a	0.2 a	0 a	0.6 b
Deltamethrin	1500	0 a	5.6 a	3.0 a	0 a	0 a	1.6 ab
Untreated	-	0 a	6.6 a	3.6 a	0 a	0 a	2.2 a

Remarks: Mean values in each column followed by the same letter are insignificantly different at the 5% level base on Duncan's Multiple Range Test = DMRT. Lyc= *L. pseudoannulata*, Spd = Spiders without *L. pseudoannulata*, Pae=*P. fuscipes*, Oph=*O. nigrofasciata*, Coc = *Coccinella*, Cyr=*C. lividipennis*

Observation on 1 daa 2 indicates that *L. pseudoannulata*, Spiders, *P. fuscipes*, *O. nigrofasciata*, *Coccinella* sp. and *C. lividipennis* on all insecticides treatment insignificantly different from the number of predators in the control treatment (Table 5). The result on 3 daa-2 indicates that the number of predators of *L. pseudoannulata*, *P. fuscipes, O. nigrofasciata,* and *Coccinella* sp. on all insecticides treatment insignificantly different from the number of predators in the control treatment (Table 6). The number of spiders and *C. lividipennis* on all insecticides treatment were significantly lower compared by the numbers of *L. pseudoannulata* and *C. lividipennis* on control treatment. spiders and *C. lividipennis* on control were 41.6 and 28.0/30hills respectively.

Application of chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate and deltamethrin did not showed any negative effect against *L. seudoannulata*, *P. fuscipes*, *O. nigrofasciata*, and *Coccinella*, but gave negative effect to spiders (without *L. pseudoannulata*) and gave little effect to *C. lividipennis*. Chlorantraniliprole is a kind of systemic insecticide and also so-called low risk insecticide targeting at the ryanodine receptor. Chlorantraniliprole has been recently registered for controlling the rice stem borer in China and Indonesia. The higher or similar to the field recommended dose (40 mg/ L) which indicates that chlorantraniliprole is a safe insecticide for natural enemies. However, the outcome from toxicity test does not necessary suggest its safety on mirid bug *C. lividipennis* because there still are some negative effects, to reduced fecundity and adult mating ability (16). In foliar application of chlorantraniliprole (Coragen) 18.5 SC at 27.75 g a. i. /Ha, thiamethoxam (Actara) 25 WG at 25.00 g a. i. /Ha, emamectin benzoate (Proclaim) 5 SG at 12.50 g a. i./ ha have recorded low population of coccinellids and spiders compare with control treated (17). The predatory population mirid bug recorded at 3 days after spray indicated insignificant among the thiamethoxam and untreated control treatments (18). In the other hand Koichi *et al.* (19) observed that phenthoate, imidacloprid and deltamethrin were found toxic to *C. lividipennis.*

Table 5. Effect of insecticides to predators 1 day after second application

Treatments	Dose (ppm)	Number predators 1 daa 2/30 hills					
		Lyc	Spd	Pae	Oph	Coc	Cyr
Chlorantranilprole + Thiamethoxam	750	2.2 a	21.8 a	5.0 a	0.4 b	0 a	3.8 a
Pymetrozine	1500	2.0 a	23.4 a	7.6 a	0.4 b	0 a	4.4 a
Emamectin benzoate	1000	1.6 a	22.8 a	6.6 a	0 b	0.2 a	5.0 a
Deltamethrin	1500	1.2 a	22.4 a	6.0 a	0 b	0 a	2.6 a
Untreated	-	2.0 a	27.6 a	5.0 a	1.4 a	0.2 a	5.6 a

Remarks: Mean values in each column followed by the same letter are insignificantly different at the 5% level base on Duncan's Multiple Range Test = DMRT. Lyc= *L. pseudoannulata*, Spd = Spiders without *L. pseudoannulata*, Pae=*P. fuscipes*, Oph=*O. nigrofasciata*, Coc = *Coccinella*, Cyr=*C. lividipennis*

Table 6. Effect of insecticides to predators 3 days after second application

Treatments	Dose (ppm)	Number predators 3 daa 2/30 hills					
		Lyc	Spd	Pae	Oph	Coc	Cyr
Chlorantranilprole + Thiamethoxam	750	3.6 a	32.8 ab	13.0 a	2.4 a	0 a	15.8 b
Pymetrozine	1500	3.2 a	37.6 ab	11.6 a	0.6 a	0.2 a	16.8 b
Emamectin benzoate	1000	5.6 a	31.8 ab	9.6 a	0 a	0 a	23.2 ab
Deltamethrin	1500	2.2 a	28.6 b	16.0 a	1.2 a	1.0 a	15.2 b
Untreated	-	4.2 a	41.6 a	12.4 a	0.4 a	0 a	28.0 a

Remarks: Mean values in each column followed by the same letter are insignificantly different at the 5% level base on Duncan's Multiple Range Test = DMRT. Lyc= *L. pseudoannulata*, Spd = Spider without *L. pseudoannulata*, Pae=*P. fuscipes*, Oph=*O. nigrofasciata*, Coc = *Coccinella*, Cyr=*C. lividipennis*

In the stability rice ecosystem, usually the ecosystem kept in the biological balance, abundance of natural enemies as a roles superior biological agents and never prophylactic use of insecticide for depend insect infestation below the economic threshold level (ETL). Bari *et al*. (20) reported that natural enemies of spiders, ladybird beetle, dragon fly, damsel fly, carabid beetle and staphylinid beetle were noticed in both treated and untreated locations were found insignificant differences.

3. Parasitism of Eggs Parasitoids of BPH after insecticides application

On 1 daa 1 parasitism level of *Anagrus* sp. and *Oligosita* sp. on the control treatment were 10.5 and 41.5 % respectively. It was significantly higher than eggs parasitism on all insecticides of chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate and deltamethrin treatment (Table 7).

On 3 daa 1 parasitism level of *Anagrus* sp. on control was 10.7%, did not different with all insecticides treatment, except for chlorantranilprole + thiamethoxam. Parasitism level of *Oligosita* sp. was 36% but insignificantly different from all insecticides treatment (Table 7). Total eggs parasitism on control treatment was high about 46.8 % and significantly different compared to all insecticides treatment, except for deltamethrin treatment.

On 1 daa 2 parasitism of *Anagrus* sp. on control only 6.5%, insignificantly different from all insecticides treatment, except for deltamethrin. Parasitism level of *Oligosita* sp. was 35.6% also insignificantly different with eggs parasitism on all insecticides treatment (chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate and deltamethrin) (Table 8). Total number of eggs parasitism on control treatment was 42.1 % also insignificantly different compared to all insecticides treatments.

Table 7. Effect of insecticides to parasitism of egg parasitoids of BPH after first application (20 dat)

Treatments	Dose (ppm)	Parasitism of eggs parasitoids of BPH after first application					
		1daa 1 (%)			3daa 1 (%)		
		Anagrus sp	*Oligosita* sp	Total	*Anagrus* sp	*Oligosita* sp	Total
Chlorantranilprole + Thiamethoxam	750	5.5 b	25.8 a	31.4 b	3.9 b	17.5 a	21.4 c
Pymetrozine	1500	5.5 b	22.9 bc	28.4 bc	4.3 ab	21.2 a	25.6 bc
Emamectin benzoate	1000	5.1 b	19.3 bc	24.4 d	5.4 ab	18.1 a	23.4 bc
Deltamethrin	1500	4.6 b	22.2 bc	26.9 cd	9.0 ab	27.0 a	36.0 ab
Untreated	-	10.5 a	41.5 a	52.0 a	10.7 a	36.0 a	46.8 a

Remarks: Mean values in each column followed by the same letter are insignificantly different at the 5% level base on Duncan's Multiple Range Test = DMRT

Table 8. Effect of insecticides to parasitism of egg parasitoids of BPH after second application (35dat)

Treatments	Dose (ppm)	Parasitism of Eggs parasitoids of BPH after second application					
		1daa 2 (%)			3daa 2 (%)		
		Anagrus sp.	*Oligosita* sp.	Total	*Anagrus* sp.	*Oligosita* sp.	Total
Chlorantranilprole + Thiamethoxam	750	5.7 ab	23.5 a	29.2 a	6.1 a	34.5 b	40.6 b
Pymetrozine	1500	7.0 ab	17.6 a	24.6 a	10.6 a	27.9 b	38.4 b
Emamectin benzoate	1000	10.3 a	22.4 a	32.7 a	7.1 a	32.5 b	39.6 b
Deltamethrin	1500	2.3 b	25.2 a	27.5 a	7.9 a	31.1 b	39.1 b
Untreated	-	6.5 ab	35.6 a	42.1 a	12.3 a	47.6 a	59.9 a

Remarks: Mean values in each column followed by the same letter are insignificantly different at the 5% level base on Duncan's Multiple Range Test = DMRT

Observation at 3 daa 2, the eggs parasitism of *Anagrus* sp. on control treatment reach 12.3% and insignificantly different with eggs parasitism on all insecticides treatment. Parasitism level of *Oligosita* sp. on control treatment recorded 47.6% significantly higher than parasitism level on all insecticides treatment. In addition total eggs parasitism on untreated was 59.6 % and significantly different compared to eggs parasitism on all insecticides treatment chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate and deltamethrin (Table 8)

4. Safety of Insecticides to Natural Enemies

Based on the population of predators on insecticide chlorantranilprole + insecticide thiamethoxam, pymetrozine, emamectin benzoate, and deltamethrin treatments have frequency unaffected (FUA) value were 100 and 75% to *L. pseudoannulata* and spiders (without *L. pseudoannulata*) respectively (Table 9). This gives the meaning these insecticides were highly safety against *L. pseudoannulata* and moderately safety of the spiders. Likewise chlorantranilprole + insecticide thiamethoxam, pymetrozine, emamectin benzoate, and deltamethrin treatments have FUA value were 100 and 75% to *P. fuscipes* and *O. nigrofasciata* respectively

(Table 10). In other words that the insecticide highly safety against *P. fuscipes* and moderately safety to *O. nigrofasciata*. In Table 11 shows that the insecticide chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate, and deltamethrin treatment have FUA value was 100% to *Coccinella* sp that indicating these insecticides highly safety against *Coccinella* sp.. Chlorantranilprole + thiamethoxam, emamectin benzoate, and deltamethrin have FUA value was 75%, that indicating moderately safety against *C. lividipennis*, whereas insecticides pymetrozine gives FUA by 50% which means that the insecticide moderately unsafety against *C. lividipennis*. In connection with the results of this study indicate that the insecticides chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate, and deltamethrin highly safety against *L. pseudoannulata*, *P. fuscipes, and Coccinella* sp., as well as Shanwei *et al*. (21) evaluated the newer insecticide, chlorantraniliprole was highly safe to beneficial arthropods in the fields.

Table 9. Frequency un-affected (FUA) of insecticides to *L. pseudoannulata* and spiders

Treatments	affected to predator *L. pseudoannulata*				FUA (%)	affected to predator Spiders*				FUA (%)
	daa 1		daa 2			daa 1		daa 2		
	1	3	1	3		1	3	1	3	
Chlorantranilprole + Thiamethoxam	no	no	no	no	100	yes	no	no	no	75
Pymetrozine	no	no	no	no	100	yes	no	no	no	75
Emamectin benzoate	no	no	no	no	100	yes	no	no	no	75
Deltamethrin	no	no	no	no	100	yes	no	no	no	75
Untreated	no	no	no	no	100	no	no	no	no	100

Remarks: *spiders =(spiders without *L. pseudoannulata*). yes=significantly different with control, no=insignificantly different with control.

Table 10. Frequency unaffected (FUA) of insecticides to *P. fuscipes* and *O. nigrofasciata*

Treatments	affected to predator *P. fuscipes*				FUA (%)	affected to predator *O. nigrofasciata*				FUA (%)
	daa 1		daa 2			daa 1		daa 2		
	1	3	1	3		1	3	1	3	
Chlorantranilprole + Thiamethoxam	no	no	no	no	100	no	no	yes	no	75
Pymetrozine	no	no	no	no	100	no	no	yes	no	75
Emamectin benzoate	no	no	no	no	100	no	no	yes	no	75
Deltamethrin	no	no	no	no	100	no	no	yes	no	75
Untreated	no	no	no	no	100	no	no	no	no	100

Remarks: yes=significantly different with control, no=insignificantly different with control.

Table 11. Frequency unaffected (FUA) of insecticides to *Coccinella* sp. and *C. lividipennis*

Treatments	affected to predator *Coccinella* sp.				FUA (%)	affected to predator *C. lividipennis*				FUA (%)
	daa 1		daa 2			daa 1		daa 2		
	1	3	1	3		1	3	1	3	
Chlorantranilprole + Thiamethoxam	no	no	no	no	100	no	no	no	yes	75
Pymetrozine	no	no	no	no	100	no	yes	no	yes	50
Emamectin benzoate	no	no	no	no	100	no	yes	no	no	75
Deltamethrin	no	no	no	no	100	no	no	no	yes	75
Untreated	no	no	no	no	100	no	no	no	no	100

Remarks: yes=significantly different with control, no=insignificantly different with control.

UA insecticides of chlorantranilprole + thiamethoxam and deltamethrin were 50% (moderately unsafety) to parasitism of eggs parasitoids *Anagrus* sp., whereas insecticides pymetrozine and emamectin benzoate were 75% that mean moderately safety to *Anagrus* sp. FUA insecticides of chlorantranilprole + thiamethoxam were 75% (moderately safety) to parasitism of eggs parasitoids *Oligosita* sp., whereas insecticides pymetrozine, emamectin benzoate and deltamethrin were 50% that mean moderately unsafety *Oligosita* sp. (Table 12).

Table 12. Frequency unaffected (FUA) of insecticides to parasitism of egg parasitoids of BPH

Treatments	affected to parasitism of *Anagrus* sp.				FUA (%)	affected to parasitism of *Oligosita* sp.				FUA (%)
	daa 1		daa 2			daa 1		daa 2		
	1	3	1	3		1	3	1	3	
Chlorantranilprole + Thiamethoxam	yes	yes	no	no	50	no	no	no	yes	75
Pymetrozine	yes	no	no	no	75	yes	no	no	yes	50
Emamectin benzoate	yes	no	no	no	75	yes	no	no	yes	50
Deltamethrin	yes	no	yes	no	50	yes	no	no	yes	50
Untreated	no	no	no	no	100	no	no	no	no	100

Remarks: yes=significantly different with control, no=insignificantly different with control.

The parasitoid *Anagrus* sp is a major natural enemy of the BPH, it plays an important role in the integrated pest management (IPM), although chemical control is also effective. The communities of hopper egg parasitoids *Anagrus* sp. were positively related to the number of the brown planthopper in rice field during the plant growth. The percentages of BPH eggs with hopper egg parasitoids during the early, middle, and late period of rice growth were about 76, 70, and 50 % respectively (22). Thiamethoxam, triazophos, and fipronil also had long residual toxicity to the wasps with 7-d mortalities as 66.8%, 54.6%, and 50.0%, respectively (23). Application of rynaxypyr, fipronil, imidacloprid and BPMC on rice planthoppers have affected light hampered recolonization index (HRI) on *Oligosita* sp. and *Anagrus* sp. (24). In the other hand insecticide deltametrin application to rice plants could reduce the potently of *A. nilaparvatae* as a biological control agent of BPH (25), this fact is a little bit same to the result of our research, because the deltamethin insecticides only 50% did not effect to parasitism of eggs BPH parasitoids.

IV. CONCLUSIONS

Insecticide pimetrozine had reduced BPH population, followed by chlorantranilprole + Thiamethoxam. In the other hand application of chlorantranilprole + Thiamethoxam, pimetrozine and deltamethrin had reduced WBPH population, followed by emamectin benzoate. Application of chlorantranilprole + thiamethoxam, pymetrozine, emamectin benzoate and deltamethrin were highly safety against *L. pseudoannulata, P. fuscipes,* and *Coccinella* sp and those insecticides moderately safety to *O. nigrofasciata* and spiders (without *L. pseudoannulata*). Application of chlorantranilprole + thiamethoxam, emamectin benzoate and deltamethrin moderately safety against *C. lividipennis*, but pymetrozine moderately unsafety to this predator.

Insecticides of chlorantranilprole + thiamethoxam and deltamethrin were moderately unsafety to parasitism of eggs parasitoids *Anagrus* sp., whereas insecticides pymetrozine and emamectin benzoate were moderately safety to *Anagrus* sp. Insecticides of chlorantranilprole + thiamethoxam were moderately safety to parasitism of eggs parasitoids *Oligosita* sp., whereas insecticides pymetrozine, emamectin benzoate and deltamethrin were moderately unsafety to this parasitoid.

The best insecticides were pimetrozine and chlorantranilprole + Thiamethoxam had reduced BPH and WBPH population. The both insecticides highly safety against *L. pseudoannulata, P. fuscipes,* and *Coccinella*sp., although moderately safety to *O. Nigrofasciata and* spiders (without *L. pseudoannulata*). In the other hand insecticides pymetrozine and chlorantranilprole + thiamethoxam were moderately safety to parasitism of eggs parasitoids *Anagrus*sp. and *Oligosita*sp. respectively.

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REFERENCES

[1]. H.M. Zhang, J. Yang, J.P. Chen, and M.J. Adams. A black-streaked dwarf disease on rice in China is caused by a novel fijivirus. Arh Virol. 153, 2008, 1893-1898.

[2]. G.H. Zhou, J.J. Wen, D.J. Cai, P.Li, D.L. Xu, and S.G. Zhang. Southern rice black-streaked dwarf virus: A new proposed Fijivirus species in the family Reoviridae. Chinese Science Bull. 53(23), 2008, 3677-3685.

[3]. G.H. Zhou. New Rice Virus Disease Spreading in China. http://Ricehoppers.net/ 2010/05/southernrice-black-streak-dwarf.

[4]. Q. Wang, J. Yang, G.H. Zhou, H.M. Zhang, J.P. Chen, and M.J. Adams. The complete genome sequence of two isolates of Souhtern rice black-streaked dwarf virus, a new member of the genus Fijivirus. J. Phytopathol. 158(11-12), 2010,733-737.

[5]. S.E. Baehaki. Case histories of pests control in Indonesia. Paper presented on Workshop: Ecological methods in agro-biodiversity and pest management research held in IRRI, Philippines. 2004,1-8.

[6]. K.K. Jena, J.U. Jeung, J.H. Lee, H.C. Choi, and D.S. Brar. High-resolution mapping of a new brown planthopper (BPH) resistance gene, Bph 18(t), and marker-assisted selection for BPH resistance in rice (Oryza sativa L.). Theor. Appl. Gene. 112, 2006, 288-297.

[7]. S.E. Baehaki. Perkembangan biotipe hama wereng coklat pada tanaman padi. Iptek Tanaman Pangan. 7(1), 2012, 8-17.

[8]. J.E. Losey and M.Vaughan. The economic value of ecological services provided by insects. BioScience. 56, 2006, 311-323.
[9]. D.A. Landis, M.M. Gardiner, W. van der Werf, and S.M. Swinton. Increasing corn for biofuel production reduces biocontrol services in agricultural landscapes. Proc. Natl. Acad. Sci. U.S.A. 105, 2008, 20552-20557.
[10]. D.L. Epstein, R.S. Zack, J.F. Brunner, L. Gut, and J.J. Brown. Effects of broad-spectrum insecticides on epigeal arthropod biodiversity in Pacific Northwest apple orchards. Environ. Entomol. 29, 2000, 340-348.
[11]. FAO. Save and Grow A policymaker's guide to the sustainable intensification of smallholder crop production. Food and Agriculture Organization of the United Nations Rome. 2011, 1-116.
[12]. [Y. Chen, X. Qing, J. Liu, J. Zhang, and R. Zhang. Toxic effects of virtako on the brown planthopper, Nilaparvata lugens (Hemiptera: Delphacidae). Revista Colombiana de Entomología. 39(2), 2013, 197-200.
[13]. Y.H. Wang, S.G. Wu, Y.C. Zhu, J. Chen, F.Y. Liu, X.P. Zhao, Q. Wang, Z. Li, X.P. Bo, and J.L. Shen. Dynamics of imidacloprid resistance and cross-resistance in the brown planthopper Nilaparvata lugens. Entomologia Experimentalis et Applicata. 131, 2009, 20-29.
[14]. X.G. Liu, X.H. Zhao, Y.H. Wang, J.J. We, J.L. Shen, J. Kong, M.Z. Cao, W.J. Zhou, and C.H. Luo. Dynamic changes of resistance to fipronil and neonicotinoid insecticides in brown planthopper, Nilaparvata lugens (Homoptera: Delphacidae). Chinese Journal of Rice Science. 24(1), 2010, 73-80.
[15]. YS. Basanth, V.T. Sannaveerappanav, and D.K. Sidde Gowda. Susceptibility of different populations of ar Nilaparvata lugens from major rice growing areas of Karnataka, India to different groups of insecticides. Rice Science. 20(5), 2013, 371-378.
[16]. Y. Hong, W. Zhao, and J. Daochao. Effects of chlorantraniliprole on experimental populations of Cyrtorhinus lividipennis (Reuter) (Hemiptera: Miridae). Acta Ecologica Sinica. 32(16), 2012), 5184-5190.
[17]. K.S. Karthick, M. Kandibane, and K.Kumar. Effect of newer insecticides to natural enemies in the coastal rice ecosystem of Karaikal district, Union Territory of Puducherry. Asian Journal of Bio Science. 10(1), 2015), 39-42.
[18]. M. Hegde and J. Nidagundi. Effect of newer chemicals on planthoppers and their mirid predator in rice. Karnataka J. Agric. Sci., 22(3), 2009, 511-513.
[19]. T. Koichi, E. Shozo, and K. Hikaru. Toxicity of insecticides to predators of rice planthoppers: Spiders, the mirid bug and the dryinid wasp, Appl. Ent. Zool. 35, 2000, 177-187.
[20]. M.N. Bari, N. Ahmed, S.S. Haque, M.F. Rabbi, and K.M. Iftekharuddaula. Validation of integrated pest management practices for rice insect in North-West region of Bangladesh. Bangladesh Rice J. 19(1), 2015, 17-31.
[21]. B. Shanwei, X. Bengui, and L. Fang. Control effectiveness of chlorantraniliprole on Cnaphalocrocis medinalis and evaluation of its safety to beneficial arthropods in the rice fields. Oyrza, 7, 2009, 144 – 157.
[22]. M.R. Qian, G.D. Xanig, Z.G. Ren, and Z.W. Qing. A preliminary investigation on structure and dyna mics of egg parasitoid community on the brown planthopper in rice field. Acta Entomologica Sinica. 45(3), 2002, 408-412.
[23]. H.Y. Wang, Y. Yang, J.Y. Su, J.L. Shen, C.F. Gaoa, and Y.C. Zhu. Assessment of the impact of insecticides on Anagrus nilaparvatae (Pang et Wang) (Hymenoptera: Mymaridae), an egg parasitoid of the rice planthopper, Nilaparvata lugens (Hemiptera: Delphacidae). Crop Protection. 27, 2008, 514-522.
[24]. S.E. Baehaki, E.H. Iswanto, D. Munawar, N. Sumaryono. Kecepatan dan hambatan rekolonisasi musuh alami setelah aplikasi insektisida di pertanaman padi. Jurnal Agrikultura. 27(1), 2016, 49-58.
[25]. A. Meilin, Y.A. Trisyono, E. Martono, D. Buchori. The effects of deltamethrin applied at sublethal concentrations on the adults of Anagrus nilaparvatae (Hymenoptera: Mymaridae). ARPN Journal of Agricultural and Biological Science. 7(12), 2012, 1032-1037.