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BIOEFFICACY OF COMMONLY USED INSECTICIDES AGAINST RICE BROWN PLANTHOPPER, *Nilaparvata lugens* (STÅL)

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ABSTRACT

Studies on the bio-efficacy of commonly used insecticides against brown planthopper (BPH), *Nilaparvata lugens* (Stål) population were carried out at ICAR-Indian Institute of Rice Research, Hyderabad during 2017. To assess efficacy of insecticides against BPH population, the insecticides were diluted to specified doses with water and sprayed on 60 day old potted TN1 rice plants with the help of fine atomizer and 7-9 day old nymphs of BPH were released and confined to treated plants. Observations on BPH mortality were recorded at 2, 24, 48 and 72 hours after release of nymphs. The results revealed that after two hours of treatment, dichlorvos recorded highest per cent mortality *i.e.* 62.5. Dinotefuran and chlorpyriphos recorded 100 per cent mortality after 24 hours of insecticidal treatment followed by dichlorvos (88.7%), thiamethoxam (85.0%), fipronil (85.0%), ethiprole (79.2%), monocrotophos (70.0%), acephate (65.0%), imidacloprid (53.7%), combination product ethiprole + imidacloprid (48.7%) and pymetrozine (38.7%). Buprofezin recorded least per cent mortality *i.e.* 32.5. With the progression of time (48 and 72 hours after application of insecticides), the mortality of BPH nymphs increased in all the treatments. Dinotefuran, dichlorvos, chlorpyriphos, thiamethoxam, monocrotophos, ethiprole and fipronil were found to be highly effective against BPH while acephate, ethiprole + imidacloprid, imidacloprid and pymetrozine were moderately effective. Buprofezin failed to control BPH.

Rice brown planthopper (BPH), *Nilaparvata lugens* (Stal) (Hemiptera: Delphacidae) is the most important sucking insect pest attacking rice crop throughout the rice growing countries. Extensive yield losses due to BPH have been reported from several parts of the country (Chandana *et al*. 2015). The emergence of BPH as a key pest was due to the suitable microclimate created by the cultivation of high yielding varieties and hybrids (Krishnaiah and Jhansi Lakshmi, 2012). Both the nymphs and adults remain at the base of the rice plant and suck the sap from the phloem and xylem resulting in yellowing, wilting, drying up and death of the rice plant. Under field conditions, the damage spreads in a circular fashion and is termed as "hopper-burn". If timely control measures are not taken up, the entire field could be affected within a span of 15-20 days. In addition to direct feeding, BPH also transmits viral diseases like grassy stunt and ragged stunt (Ling, 1977). Use of insecticides is the most sought after strategy for BPH management by farmers despite several draw backs such as development of insecticide resistance and resurgence (Baehaki *et al*. 2016). BPH has become a very serious problem causing severe yield losses due to monoculturing of rice in an extensive area, use of susceptible rice varieties, availability of irrigation water in addition to indiscriminate use of insecticides. Among the different groups of insecticides used against BPH, monocrotophos, acephate (organo-phosphates) imidacloprid, thiamethoxam, dinotefuran (neonicotinoids), buprofezin (insect growth regulator), pymetrozine (feeding inhibitor), and fipronil (phenyl pyrazole compounds) are important ones. There is a need to assess the bioefficacy of insecticides against brown planthopper and to monitor the development of insecticides resistance in the field populations. As a part of this study, bioefficacy of insecticides was assessed against the glasshouse BPH population unexposed to insecticides.

MATERIAL AND METHODS

Insecticides

Fresh and ready to use insecticide formulations were obtained from the manufacturing companies (Table 1). The test insecticides include three neonicotinoids *viz*., imidacloprid 17.8 SL (Confidor), thiamethoxam 25 WG (Actara) and dinotefuran 20 SG (Token); four organophosphates *viz.,* monocrotophos

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36 SL (Monostar), acephate 75 WP (Starthene), dichlorvos 76 EC (Nuvan) and chlorpyriphos 20 EC (Dursban); two phenyl pyrazoles *viz*., fipronil 5 SC (Regent) and ethirprole 100 SC (Ethiprole). In addition, pymetrozine (Chess), a pyridine azomethine compound, insect growth regulator cum chitin synthesis inhibitor, Buprofezin 25 SC (Applaud) and one combination product containing Ethiprole 40% + Imidacloprid 40% (Glamore) were also evaluated.

Toxicity tests for bioefficacy of insecticides

The tests were carried out under controlled glass house conditions at a temperature of 30 ± 5^0 C and RH of 60 ± 5%, following the methodology standardized by Jhansi Lakshmi *et al*. 2010a. To assess the efficacy of insecticides, all the insecticides were tested at doses as detailed in Table 1. The insecticides were diluted to the required concentrations with tap water and sprayed on 60 day old potted rice plants with the help of fine atomizer upto runoff stage. Tap water spray without any insecticide served as control. The spray deposits were allowed to dry in the shade. Twenty 7-9 day old BPH nymphs collected from glass house BPH population were confined to the treated plants with mylar cages covered with muslin cloth. Observations on BPH mortality were recorded at 2, 24, 48 and 72 hours after release of nymphs. The insects that were unable to move when touched with camel hair brush were considered as dead insects. Per cent mortalities were computed, angular transformed and statistically analyzed in completely randomized block design (CRBD).

RESULTS AND DISCUSSION

Results pertaining to the efficacy of insecticides on the third instar nymphs of BPH are presented in the Table 2. Dichlorvos registered highest BPH nymphal mortality (62.5%) after two hours of application followed by fipronil (53.7%), dinotefuron (42.5%), chlorpyriphos (38.7%), combination product, ethiprole 40% + imidacloprid 40% 80 WG (36.2%) and thiamethoxam (35.0%) while imidacloprid, buprofezin, pymetrozine and acephate recorded very low mortality of 21.2, 11.2, 10.0 and 7.5 per cent, respectively.

After 24 hours of application, dinotefuran and chlorpyriphos were the most effective in reducing BPH nymphal population (100.0% mortality) followed by dichlorvos (88.7 % mortality), thiamethoxam (85.0%), fipronil (85.0%), ethiprole (79.2%), monocrotophos (70.0%) and acephate (65.0 % mortality). Imidacloprid, ethiprole + imidacloprid 80 WG, pymetrozine and buprofezin recorded 53.7, 48.7, 38.7 and 32.5 per cent mortality, respectively.

After 48 hours of application apart from dinotefuran and chlorpyriphos, dichlorvos also recorded cent per cent mortality of BPH nymphs, followed by ethiprole, fipronil and monocrotophos which recorded 95.0, 95.0 and 92.5 per cent mortality, respectively. Thiamethoxam, imidacloprid, combination product ethiprole + imidacloprid 80 WG and acephate showed 90.0, 78.7, 76.2 and 75.0 per cent mortality, respectively. Buprofezin and pymetrozine recorded 45.0 and 43.7 per cent mortality, respectively. With the progression of time after application of insecticides, the mortality of BPH nymphs increased in all the treatments. Seventy two hours after treatment, dinotefuran, monocrotophos, chlorpyriphos, dichlorovos, imidacloprid, thiamethoxam, ethiprole, fipronil and ethiprole + imidacloprid 80 WG (Glamore) recorded cent per cent mortality, followed by acephate (92.5%) and pymetrozine (75.0%). Buprofezin recorded only 60.0% mortality.

Dinetofuron exhibited 85.0% mortality after one day of exposure, and similar results were observed by Jhansi Lakshmi *et al*. (2010a). Dinotefuran was quite effective against BPH under field conditions (Ghosh *et al*. 2014). It showed good degree of effectiveness in the present study (93-100% mortality) also. Monocrotophos and acephate were found effective against BPH population with 92.5 -100% nymphal mortality which is in conformity with Randeep *et al*. (2016). In the present study, results related to chlorpyriphos are in conformity with the findings of Kharbade *et al*. (2015) who reported that chlorpyriphos application was highly effective against BPH. The combination product ethiprole + imidacloprid exhibited 100% mortality at 72 hours after release of nymphs and similar results were observed by Jhansi Lakshmi *et al*. (2010b). Pymetrozine caused 38.7% mortality at 24 hours showing slow action initially and the result is in concurrence with that of Atanu and Naik, (2017) and Jhansi Lakshmi *et al*. (2010b). The previous results indicated that buprofezin could kill all the exposed BPH population within three days (Shashank *et al*. 2012). However, in the present study, it could exhibit only 60.0 per cent mortality even after 3 days of exposure.

Table 1: Details of insecticides used in the present investigation

S.No	Common Name	Trade name and formulation	Insecticide Group	Source of supply
1.	Acephate	Starthene 75SP	Organophosphates	Swal Corporation Limited
2.	Buprofezin	Applaud 25SC	Chitin synthesis inhibitors	Rallis India Limited
3.	Chlorpyriphos	Dursban 20 EC	Organophosphates	Dow Agro Science
4.	Dichlorvos	Nuvan 76 EC	Organophosphates	Insecticides (India) Limited
5.	Dinotefuran	Token 20SG	Neonicotinoids	Indofil Industries Limited
6.	Fipronil	Regent 5SC	Phenyl pyrazoles	Bayer Crop Science Limited
7.	Ethiprole	Ethiprole 100SC	Phenyl pyrazoles	Bayer Crop Science Limited
8.	Imidacloprid	Confidor 17.8 SL	Neonicotinoids	Bayer Crop Science Limited
9	Monocrotophos	Monostar 36SL	Organophosphates	Swal Corporation Limited
10.	Pymetrozine	Chess 50WG	Pyridine azomethine	Syngenta India Limited
11.	Thiamethoxam	Actara 25WG	Neonicotinoids	Syngenta India Limited
12.	Ethiprole + imidacloprid	Glamore 80WG	Combination insecticide	Bayer Crop Science Limited

Table 2: Toxicity of insecticides to glasshouse brown planthopper population at different exposure periods

S. No.	Insecticides	Dose g or ml /l water	Mortality of BPH nymphs (%)			
			2 h	24 h	48 h	72 h
1.	Acephate (Starthene) 75 SP	1.0 g	7.5 (16.4)f	65.0 (53.7)e	75.0 (60.6)e	92.5 (76.2)b
2.	Monocrotophos (Monostar) 36 SL	2.0 ml	11.2 (19.5)f	70.0 (56.8)de	92.5 (78.7)abc	100.0 (90.0)a
3.	Chlorpyriphos (Dursban) 20 EC	2.5 ml	38.7 (38.5)cd	100.0 (90.0)a	100.0 (90.0)a	100.0 (90.0)a
4.	Dichlorvos (Nuvan) 76 EC	1.0 ml	62.5 (52.2)a	88.7 (70.5)b	100.0 (90.0)a	100.0 90.0)a
5.	Imidacloprid (Confidor) 17.8 SL	0.5 ml	21.2 (27.4)e	53.7 (47.16)f	78.7 (66.8) cde	100.0 (90.0)a
6.	Thiamethoxam (Actara) 25 WG	0.5 g	35.0 (36.2)d	85.0 (67.4)b	90.0 (74.2)bcd	100.0 (90.0)a
7.	Dinotefuran (Token) 20 SG	0.4 g	42.5 (40.6)c	100.0 (90.0)a	100.0 (90.0)a	100.0 (90.0)a
8.	Ethiprole 40% + imidacloprid 40% (Glamore) 80 WG	0.25 g	36.2 (37.0)d	48.7 (44.3)f	76.2 (61.4)de	100.0 (90.0)a
9.	Ethiprole 100 SC	0.25 ml	40.0 (39.2)cd	79.2 (63.0)c	95.0 (80.8)ab	100.0 (90.0)a
10.	Fipronil (Regent) 5 SC	2.0 ml	53.7 (47.1)b	85.0 (67.4)b	95.0 (80.8)ab	100.0 (90.0)a
11.	Pymetrozine (Chess) 50 WG	0.6 g	10.0 (18.4)f	38.7 (38.5)g	43.7 (41.4)f	75.0 (60.6)c
12.	Buprofezin (Applaud) 25 SC	2.0 ml	11.2 (19.5)f	32.5 (34.6)h	45.0 (42.1)f	60.0 (51.0)d
13.	Untreated Control (Water spray)		0.0 (0.0)g	0.0 (0.0)i	0.0 (0.0)g	0.0 (0.0)e
	S.Em ±		1.1	1.4	4.5	3.0
	C.D (0.05)		3.1	4.0	12.9	8.6
	C.V		6.2	4.5	9.6	7.1

*Figures in parentheses are angular transformed values

*Values in a column followed by same letter were on par at P = 0.05 by LSD

Based on the study, it can be deduced that dinotefuran, monocrotophos, dichlorovas thiamethoxam, chlorpyriphos, ethiprole and fipronil exhibited good bioefficacy while acephate, ethiprole + imidacloprid 80 WG, imidacloprid and pymetrozine were moderately effective. Buprofezin was least effective against BPH.

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