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Biosafety of pesticides and entomopathogens to the anthocorid predator *Blaptostethus pallescens* Poppius (Heteroptera: Anthocoridae)

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ABSTRACT: Laboratory experiments conducted to study the biosafety of insecticides, acaricides and entomopathogens *viz.* imidacloprid, chlorpyriphos, fenazaquin, spiromesifen, azadirachtin, *Beauveria bassiana* and *Lecanicillium lecanii* in different concentrations to *Blaptostethus pallescens,* revealed that imidacloprid and chlorpyriphos were highly toxic with maximum mortality. The acaricides fenazaquin and spiromesifen were less toxic which recorded minimum mortality of predator and more egg laying and hatching. Azadirachtin showed higher oviposition and was on par with spiromesifen. Azadirachtin and acaricides are compatible with *B. pallescens* than entomopathogens. © 2020 Association for Advancement of Entomology

KEYWORDS: Biosafety, insecticides, acaricides, entomopathogens, *Blaptostethus pallescens*

INTRODUCTION

Anthocorid predators are recognized as potential biocontrol agents. They feed on small lepidopteran larvae, small grubs, psocids, mites, thrips, aphids and storage pests and are commonly known as minute flower bugs or minute pirate bugs. Studies carried out so far indicated that anthocorid bug can be used as effective biocontrol agent for controlling the mites (Barber, 1936; Oku and Kobayashi, 1966; Muraleedharan and Ananthakrishnan, 1978). *Blaptostethus pallescens* Poppius (Heteroptera: Anthocoridae) has been reported as a potential predator (Tawfik and El-Sherif, 1969; Tawfik and El-Husseini, 1971; Tawfik *et al*., 1974). *B. pallescens* was reported from Tamil Nadu (Muraleedharan, 1977) and Bangalore (Jalali and Singh, 2002) in vegetable ecosystem. *B. pallescens* has also been recorded from Madagascar (Muraleedharan, 1977) and from warehouses in Egypt, where mites were common (Tawfik and El-Husseini, 1971).

Conservation of natural enemies through selective use of pesticides has been the main criterion for integrated plant protection (Nasreen *et al*., 2005). Naranjo (2001) evaluated the impact of various pesticides on whitefly predators and parasitoids to develop strategies for conversation of natural enemies. The main limiting factor in large scale use of bio pesticides is high toxicity to beneficial insect (Chatterjee and Choudhury, 2003). In view of this,

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adverse effects of some commercial insecticides and entomopathogens were investigated under laboratory condition against anthocorid predator *B. pallescens.*

MATERIAL AND METHODS

Present study was carried out at the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore (11°0'45" N, 76°55'57"E). Insecticides, Imidacloprid 17.8% SL (Confidor), Chlorpyriphos 20 EC (Chlorocure), Fenazaquin 10 EC (Magister), Spiromesifen 22.9 SC (Oberon) and botanical Azadirachtin 1500ppm (Neem Gold) and entomopathogens *viz*., *Beauveria bassiana* ($1x10^9$cfu/mg) and *Lecanicillium lecanii* ($1x10^8$cfu/mg) were used in the biosafety studies. Mass culturing of *B. pallescens* was carried out by the method followed by Ballal *et al*. (2003). UV irradiated *Corcyra cephalonica* eggs were sprinkled on cotton pad placed at the bottom of the transparent plastic container (500ml). Nymphs were released into the container along with bean pods which supply the required water for the nymphs. Fresh eggs of *Corcyra* were provided on alternate days till the adults emerge. Freshly emerged adults were shifted to plastic containers with green bean pods for oviposition. The pods with the eggs were removed daily and fresh pods were given.

Biosafety of pesticides to nymph of *B. pallescens:*

Mortality: Imidacloprid 17.8 SL, chlorpyriphos 20 EC, fenazaquin 10 EC, spiromesifen 22.9 SC, azadirachtin 0.15% and entomopathogenic fungi *viz*., *B. bassiana* and *L. lecanii* were sprayed in scintillation glass tube at their recommended dosage by crop protection guide, Tamil Nadu Agricultural University. There were eight treatments including untreated control and three replications. The test tubes treated with the above chemicals and entomopathogens were refrigerated overnight. Fourth instar nymphs of *B. pallescens* were released @ 10/tube and allowed to have contact with the chemicals for a period of two hours. After the exposure period of two hours, the nymphs were transferred to the normal container provided with the UV treated Corcyra eggs. The mortality of the nymphs was observed at 24, 48, 72 and 96 hours after exposure.

Oviposition: The effect of treatments on the oviposition of *B. pallescens* was studied under the laboratory conditions. The green French bean pods used as oviposition substrate in mass culturing of *B. pallescens* was treated with various treatment solutions and air dried. The egg laying mated female after 5 days was enclosed in the plastic container along with treated French bean pod. The number of eggs laid on the pod was recorded 24 hours after release.

Hatching of eggs: Newly laid eggs on the ovipositional substrate was treated with the chemical pesticides, entomopathogens and azadirachtin using an atomizer. The treated French bean pods laden with eggs were kept in separate plastic container and observed for the hatching of the eggs. The number of eggs hatched was noted and the percent hatching worked out.

The collected data were transformed through square root transformation and subjected to ANOVA for completely randomized design (CRD) experiments. The mean values of the treatments were compared using Duncan's Multiple Range Test (DMRT) at 5 per cent level of significance in SPSS (Statistical Package for the Social science).

RESULTS AND DISCUSSION

Mortality of fourth instar nymph

Among treatments, the mortality of nymph at 24 hours after treatment (HAT) in chlorpyriphos was maximum (80%) as against the least mortality (10 %) observed in *L. lecanii* at 2g/l of water. Maximum mortality of predator (cent per cent) noted in chlorpyriphos treatment at 72 HAT. Rest of the treatments showed mortality of predator up to 36.67 per cent during the same period of observation. The acaricides fenazaquin and spiromesifen were less toxic to the predator, which showed mortality of 20 and 23.33% at 96 HAT respectively (Table 1).

Table 1. Effect of insecticides and entomopathogens on the fourth instar nymph of *Blaptostethus pallescens*

Treatments	Dose (%)	Mortality*(%)				
		24 HAT	48HAT	72 HAT	96 HAT	Mean
T1- Imidacloprid 17.8 SL	0.0036	26.67 (10.02)b	33.33 (11.27)c	36.67 (11.76)b	36.67 (11.76)b	33.34
T2 - Chlorpyriphos 20 EC	0.0400	80c (16.88)c	96.67 (18.59)d	100 (18.91)c	100 (18.91)c	94.17
T3- Fenazaquin 10 EC	0.0250	13.33 (7.72)ab	16.67 (8.28)bc	16.67 (8.41)ab	20 (8.97)ab	16.67
T4 -Spiromesifen 22.9 SC	0.0183	13.33 (7.29)ab	16.67 (7.98)bc	20 (8.47)ab	23.33 (9.03)ab	18.33
T5-Azadirachtin 1500 ppm	0.0008	23.33 (9.03)b	26.67 (10.02)bc	26.7 (9.61)b	26.7 (9.61)b	25.85
T6- *Lecanicillium lecanii* (1x 10x cfu) 2g/l	0.2	10 (7.04)ab	10 (6.73)ab	13.33 (7.29)ab	13.33 (7.29)ab	11.67
T7- *Beauveria bassiana* (1x 10x cfu) 2g/l	0.2	20 (8.97)b	20 (8.54)bc	20 (8.54)ab	20 (8.54)ab	20.00
T8- Untreated Control	-	0 (4.05)a	0(4.05)a	0(4.05)a	0 (4.05)a	0.00
SE(D)	-	1.98	1.97	2.34	2.41	-
CD	-	4.19	4.18	4.96	5.11	-

*Mean of three observations; HAT – hours after treatment; Values in the parentheses are arc sine transformed values. Means followed by the common letter (s) are not significantly different at P=0.05 level by DMRT

Table 2. Effect of insecticides and entomopathogens on the mortality of adult *Blaptostethus pallescens*

Treatments	Dose (%)	Mortality*(%)				
		24 HAT	48HAT	72 HAT	96 HAT	Mean
T1- Imidacloprid 17.8 SL	0.0036	20.00 (26.57)b	26.67 (31.09)a	33.33 (35.26)b	33.33 (35.26)b	28.33
T2 - Chlorpyriphos 20 EC	0.0400	93.33 (75.04)c	96.67 (79.48)b	100.00 (90.00)c	100.00 (90.00)d	97.50
T3- Fenazaquin 10 EC	0.0250	13.33 (21.42)b	16.67 (24.09)a	20.00 (26.57)ab	20.00 (26.57)ab	17.50
T4 -Spiromesifen 22.9 SC	0.0183	16.67 (24.09)b	16.67 (24.09)a	23.33 (28.88)b	26.67 (31.09)bc	20.83
T5-Azadirachtin 1500 ppm	0.0008	10.00 (18.43)ab	20.00 (26.57)a	30.00 (33.21)b	33.33 (35.26)c	23.33
T6- *Lecanicillium lecanii* (1x 10x cfu) 2g/l	0.20	16.67 (24.09)b	20.00 (26.57)a	26.67 (31.09)b	26.67 (31.09)bc	22.50
T7- *Beauveria bassiana* (1x 109 cfu) 2g/l	0.20	20.00 (26.57)b	23.33 (28.88)a	26.67 (31.09)b	26.67 (31.09)bc	24.17
T8- Untreated Control	-	0.00 (0.00)a	0.00 (0.00)a	0.00 (0.00)a	0.00 (0.00)a	0.00
SE(D)	-	1.55	1.21	1.16	0.94	
CD	-	3.29	2.60	2.45	1.99	

*Mean of three observations; HAT – hours after treatment; Values in the parentheses are arc sine transformed values. Means followed by the common letter (s) are not significantly different at P=0.05 level by DMRT

Mortality of adult

The mortality of adult observed at 24 HAT was maximum (93.33%) in chlorpyriphos 20 EC 0.04% followed by imidacloprid 17.8 SL 0.0036% (20%) and *B. bassiana* 2g/l (20%). The adult predator showed maximum mortality (cent per cent) in chlorpyriphos treatment at 72 HAT. The other treatments, which showed hgher mortality of adult at 96 HAT were imidacloprid 17.8 SL 0.0036% and azadirachtin 1500ppm (33.33%). The acaricides fenazaquin and spiromesifen (0.0183%) tested showed lesser mortality of 20 and 26.67% respectively at 96 HAT (Table 2).

Oviposition

The oviposition of *B. pallescens* on green pods treated with pesticides indicated that imidacloprid treated pods received the lowest number of eggs 0.25 per pod as against 15 eggs/pod in the untreated control at 24 HAR. Imidacloprid treatment (0.25egg/pod) was on par with chlorpyriphos (1.00 egg/pod). Spiromesifen and azadirachtin recorded an oviposition of 10.50 eggs/pod during the same period of observation (Table 3).

Hatching

The effect of the pesticides and entomopathogens on egg hatching of *B. pallescens* revealed that the hatching was relatively higher in acaricides treated eggs (43%) and lowest in chlorpyriphos treated eggs (6.67%). The hatching per cent in *L. lecanii* and *B. bassiana* treated eggs were 20 and 16.67 respectively. The reduction in egg hatching was 90.48 % in chlorpyriphos over the control, while in acaricide treated eggs the reduction over the control was 38.10% (Table 4).

Biosafety studies to insecticides revealed that acaricides *viz,* fenazaquin 5 EC, spiromesifen 22.9 SC and entomopathogen *Lecanicillium lecanii* @ 2g/l recorded the lower mortality and were relatively safer to the nymphs and adults of the predator, whereas chlorpyriphos 20 EC was more toxic followed by imidacloprid. The oviposition substrates treated with imidacloprid 17.8 SL reduced the egg laying up to 98.33% followed by chlorpyriphos 20 EC (93.33%), whereas acaricides

Table 3. Effect of insecticides and entomopathogens on the oviposition (eggs laid on treated green pod 24 HAR) of *Blaptostethus pallescens*

Treatments	Dosage (%)	No. of eggs laid	Reduction over Control (%)
T1- Imidacloprid 17.8 SL	0.0036	0.25 (0.50)d	98.33
T2- Chlorpyriphos 20 EC	0.0400	1.00 (1.00)d	93.33
T3- Fenazaquin 10 EC	0.0250	8.50 (2.92)b	43.33
T4- Spiromesifen 22.9 SC	0.0183	10.50 (3.24)ab	30.00
T5- Azadirachtin 1500 ppm	0.0008	10.50 (3.24)ab	30.00
T6- *Lecanicillium leacnii* (1x 10x cfu) 2g/l	0.2	5.00 (2.24)b	66.67
T7- *Beauveria bassiana* (1x 109 cfu) 2g/l	0.2	4.75 (2.18)b	68.33
T8- Untreated Control	-	15.00 (3.87)a	0.00
SE(d)	-	0.32	-
CD	-	0.66	-

*Mean of three observations; HAT – hours after treatment; Values in the parentheses are arc sine transformed values. Means followed by the common letter (s) are not significantly different at P=0.05 level by DMRT

reduced the egg laying up to 30%. The pungent odour of the chemicals might have deterred the predator from egg laying. In contrast, the chemicals with absence or fewer odours had more egg laying of the predator than the insecticides chlorpyriphos and imidacloprid. Regarding the hatching of the treated eggs, chlorpyriphos showed maximum inhibition (90.48%) followed by imidacloprid. The chemicals imidacloprid and chlorpyriphos being insecticides, exhibited toxicity to eggs of predator as the operculum of this egg was exposed outside the tissue of the pod. The above reason can be attributed to the toxicity of insecticides and safe nature of acaricides to the hatching of predator eggs. The results were similar to the findings of Duso *et al*. (2008) who compared the toxicity of botanicals to predatory mite *Phytoseiulus persimilis* and reported that azadirachtin, pymetrozine and

Table 4. Effect of insecticides and entomopathogens on hatching of *Blaptostethus pallescens*

Treatments	Dose (%)	No.of eggs hatched*	Hatching (%)*	Reduction over Control (%)
T1- Imidacloprid 17.8 SL	0.0036	2.00 (8.97)cd	20.00	71.43
T2- Chlorpyriphos 20 EC	0.0400	0.67 (6.04)d	6.67	90.48
T3- Fenazaquin 10 EC	0.0250	4.33 (12.60)b	43.33	38.10
T4- Spiromesifen 22.9 SC	0.0183	4.33 (12.48)b	43.33	38.10
T5- Azadirachtin 1500 ppm	0.0008	3.67 (11.76)bc	36.67	47.62
T6- *Lecanicillium leacnii* (1x 10x cfu) 2g/l	0.2	2.00 (8.97)c	20.00	71.43
T7- Beauveria bassiana (1x 109 cfu)2g/l	0.2	1.67 (8.41)d	16.67	76.19
T8- Untreated Control	-	7.00 (15.87)a	70.00	0.00
SE(d)	-	1.48	-	-
CD	-	3.14	-	-

*Mean of three observations; HAT – hours after treatment; Values in the parentheses are arc sine transformed values. Means followed by the common letter (s) are not significantly different at P=0.05 level by DMRT

B. bassiana were safer to *P. persimilis*. The findings of Elzen (2001) was also similar to the present study that insecticides like malathion and spinosad were significantly less toxic to male *Geocoris punctipes*. The lethal response of *B. pallescens* to the bioinsecticide azadirachtin and to two synthetic insecticides, chlorpyrifos and deltamethrin revealed that the mild effect of the azadirachtin on the predator (median lethal time of 27 days), relative to deltamethrin and chlorpyrifos (with median lethal time of 25 and 60 min, respectively) (Celestino *et al*., 2014).

The insecticides imidacloprid 17.8 SL 0.0036% and chlorpyriphos 20 EC 0.04% were highly toxic to anthocorid bug which showed maximum mortality, low egg laying and maximum inhibition of egg hatching. The acaricides fenazaquin 10 EC 0.025% and spiromesifen 22.9 SC 0.0183% were found less toxic which recorded minimum mortality of predator and more egg laying and hatching. Hence, the selection of insecticides which are safer to natural enemies are very important as it will increase the effectiveness of biological control and proved to be an eco-friendly insect pest management.

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REFERENCES

Ballal C. R., Singh S. P., Poorani J. and Gupta T. R. (2003) Biology and rearing requirements of an anthocorid predator, *Blaptostethus pallescens* Poppius (Heteroptera: Anthocoridae). Journal of Biological Control 17: 29-34.

Barber G. W. (1936) *Orius insidiosus* (Say), an important natural enemy of the corn ear worm. US Dept. of Agriculture, USA.

Celestino D., Braoios G. I., Ramos R. S., Gontijo L. M. and Guedes R. N. C. (2014) Azadirachtin-mediated reproductive response of the predatory pirate bug *Blaptostethus pallescens*. BioControl 59 (6): 697-705.

Chatterjee H. and Choudhury P. P. (2003) Persistent toxicity of some microbial pesticides against *Bombyx mori* (L) feeding on mulberry leaves in Terai region of West Bengal. Pesticide Research Journal 15 (1): 80-84.

Duso C., Malagnini V., Pozzebon A., Castagnoli M., Liguori M. and Simoni S. (2008) Comparative toxicity of botanical and reduced-risk insecticides to Mediterranean populations of *Tetranychus urticae* and *Phytoseiulus persimilis* (Acari Tetranychidae, Phytoseiidae). Biological Control 47 (1): 16-21.

Elzen G. W. (2001) Lethal and sublethal effects of insecticide residues on *Orius insidiosus* (Hemiptera: Anthocoridae) and *Geocoris punctipes* (Hemiptera: Lygaeidae). Journal of Economic Entomology 94 (1): 55-59.

Jalali S. K. and Singh S. P. (2002) Seasonal activity of stem borers and their natural enemies on fodder maize. Entomon 27: 137-146.

Muraleedharan N. (1977) Some genera of anthocorinae (Heteroptera: Anthocoridae) from South India. Entomon 2: 231-235.

Muraleedharan N. and Ananthakrishnan T. N. (1978) Bioecology of four species of Anthocoridae (Hemiptera: Insecta) predaceous on thrips with key to genera of anthocorids from India. Controller of Publications, India.

Naranjo S. E. (2001) Conservation and evaluation of natural enemies in IPM systems for *Bemisia tabaci*. Crop protection 20 (9): 835-852.

Nasreen A., Mustafa G. and Ashfaq M. (2005) Mortality of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) after exposure to some insecticides; laboratory studies. South Pacific studies 26 (1): 1- 6.

Tawfik M. F. S. and El-Husseini M. M. (1971) The life history of the anthocorid predator, *Blaptostethus piceus* Fieber var. *pallescens* Poppius (Hemiptera: Anthocoridae). Bulletin of Entomological Society of Egypt 55: 239-252.

Tawfik M. F. S. and El-Sherif S. I. (1969) The biology of *Pyroderces simplex* Wlsm., an important pest on maize plants in UAR (Lepidoptera: Lavernidae). Bulletin of Entomological Society of Egypt 53: 615-628.

Tawfik M. F. S., Kira M. T. and Metwally S. M. I. (1974) On the abundance of major pests and their associated predators in corn plantations. Bulletin of Entomological Society of Egypt 58: 168-177.

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