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Comparative toxicity of insecticides and biopesticides against predatory beetle, *Menochilus sexmeculatus* Fab. In laboratory

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Abstract
An experiment was carried out to determine the comparative toxicity of insecticides and bio-pesticides against *Menochilus sexmaculatus* Fab. in laboratory after different intervals 24, 48, 72, 96 and 120 hours, in the Department of Entomology, Faculty of Crop Protection, S.A.U Tando Jam during 2015. Life stages of predatory beetle treated with insecticide Curacron (Profenophos) in which egg and adult stages not survived, however, the immature stages of 1st, 2nd, 3rd and 4th instar larva survived. Egg and adult stages were not survived after application of Novastar insecticide, therefore, 1st, 2nd, 3rd and 4th instar survived. It was observed that the highest survival was recoded in egg stage after 24 hours, after exposure of bio-pesticide Hazropattar (Tobacco extract). The highest survivor was recorded in the 4th instar followed by 3rd, 2nd and 1st instar larvae from 24 to 120 hours, respectively after exposure of bio-pesticide of Balkhi (Tobacco extract). It is concluded that insecticides i.e. Curacron and Novastar were found toxic, whereas, bio-pesticides i.e. hazropattar and Balkhi showed least toxicity against *M. sexmaculatus*.

Keywords: Lady Bird beetle, toxicity, insecticide, bio-pesticide, laboratory

1. Introduction
Agro-chemicals are widely used for quick and active managements of arthropod insect pests in the field as well as agricultural crops [1, 2]. The unselective use of insecticides have resulted the serious problems such as pest revival, insecticides resistance and crops residues [3]. This control to take other supervision practices of insect pest, with applying of bio-control agents. The predators and parasitoids are considered as main tools in integrated pest management of cost-effective insect pests. Current revival of sucking insect pests such as mealy bugs and whiteflies, made essential to use and develop native parasitoids and predators [4]. *Menochilus sexmaculatus* is extra dynamic predator to control its prey [5]. Also [6] perceived that zigzag beetle, *M. sexmaculatus* is very active predator of small soft body insect pest such like ground nut aphid, *Aphis caccivora* (Koch); coffee green bug, *Coccus viridis* (G); Mustard aphid, *Lipaphis erysimi* (Kalt); sugarcane leaf hopper, *Pyrilla perpusilla* (W); castor white fly, *Trialeurodes richini* (Misra); Sorghum shoot fly *Pereginus maidis* (Ashond) and Maize aphid, *Rhopalosiphum maidis* (Fitch) and other small insects. *M. sexmaculatus* is main killer of aphids, it initiate in some ecosystems of south East Asia [7] [8] [9]. Earlier studies have observed damaging effects of old-generation pesticides on coccinellids [10] but only imperfect studies on neonictinoids have been done. For example, imidacloprid and acetamiprid have been always used against sucking insect pests of cotton for several years [11] [12] But there is little evidence about their effect on predators. In addition, these pesticides are measured as selective to some helpful insects, containing families Cybocephalidae, Coccinellidae, Syrphidae and Chrysopidae [13, 14] and are suggested for combined pest management (IPM). Keeping in view the importance of "Comparative toxicity of insecticides and bio pesticides against *Menochilus sexmaculatus*", the experiment was carried out to determine the comparative toxicity of insecticides and bio-pesticides against *Menochilus sexmaculatus* Fab. in Laboratory. The results of present study will be helpful for farmers, growers and cultivater in relation to choice the smallest toxic insecticide and bio pesticides against *M. sexmaculatus* so as the beetle may be oppressed as a tool in IPM plans. The present research work is focused on following objectives.

2. Material and Methods

The experiments were conducted in the Biocontrol Research laboratory, Department of Entomology, Faculty of Crop protection, Sindh Agriculture University Tandojam during 2015 at 26 ± 2 ºC and relative humidity 60 ± 5%.

Treatments÷

T_1 Curacran (Profenophos 500 EC product of Syngenta)
T_2 Novastar (Emamectin+ Bifenthrin 56 EC)
T_3 Hazaropattar (Tobacco variety)
T_3 Balkhi (Tobacco variety)

2.1 Preparation of Tobacco extract

To get leaf extract of tobacco varieties, the leaves of both tobacco varieties were grinded separately. The powder was soaked in water overnight. The material was sieved in muslin cloth the extract was preserved in plastic bottle.

2.2 Experimental design

The experimental design was Complete Randomized Design (CRD) with four replications and four treatments T1= Curacran 500 EC (5ml/lit. water), T2= Novastar 56 EC (5ml/lit. water), T3= Hazropattar tobacco extract (250ml/life stage) T4= Balkhi tobacco extract (250ml/life stage) and T5= Control. The predatory beetle was collected from the Akk plant at the vicinity of the CPT Faculty and reared on aphid for stock culture in the laboratory. Ten each of eggs, 1st instar, 2nd instar, 3rd instar, 4th instar larva, pupa and adult stages were released on aphid in Petri dish separately for treatment. The solution of insecticides and bio pesticides was sprayed with the help of hand sprayer on Petri dishes. The data was recorded after treatment at 24 hours, 48 hours, 72 hours and 96 hours, on mortality of predator. The percentage of mortality was calculated by using following formula.

$$\text{Mortality \%} = \frac{\text{Pre-treatment population} - \text{Post treatment population}}{\text{Pre-treatment population}} \times 100$$

3. Results

3.1 Effect of Curacron 500 EC insecticide on life stages of *Menochilus sexmaculatus*

The insecticide Curacron (Profenophos) 500 EC was applied on the life stages of predatory beetle *M. sexmaculatus* along with aphid on the leaves of respective host crop. The result presented in the (Table 1) indicated that the no egg was hatched at different intervals 24, 48, 72, 96 and 120 hours after treatment of Curacron (Profenophos) insecticide. The first instar larvae survived 1.0 only out of 10 after 24 hours after that it became died. In this stage 90% mortality was observed similarly, second instar larvae survived after 24 hours exposure of insecticide 3.5 and mortality 65% was recorded. No single survival was recoded after 48, 72, 96 and 120 hours after treatment of Curacron (Profenophos) insecticide. Third instar larvae survived 5.5 after 24 hours than it become gradually declined after 48 hours was recorded after treatment of same insecticide. The mortality was recorded 45 and 95% in the both intervals of 24 and 48 hours respectively the larvae not survived after 72, 96 and 120 hourrs after treatment of Curacron (Profenophos) insecticide. The fourth instar larval survival was observed 4.5, 1.5 and 0.5 after 24, 48 and 72 hours respectively the mortality was seen 55, 85 and 95% after the exposure of insecticide 24, 48 and 72 hourrs respectively. The pupae survived 1.0 and 0.5 after 24 and 48 hours respectively after treatment of insecticide. No survival of pupal stage was seen after 72, 96 and 120 hours after treatment of Curacron (Profenophos) insecticide. The adult beetles not survived after 24, 48 and 72 hours exposure of insecticide. It was observed that the egg and adult stages not survived; however, the immature stages of 1st and 2nd instar larva survived for 24 hours and 3rd instar survived for 48 hours and 4th instar lived for 72 hours and pupae survived for 48 hours after exposure of insecticide. The analysis of the data indicated that there was significant difference in exposure periods of insecticide ($P<0.05$).

Table 1: Effect of Curacron 500 EC insecticide on life stages *Menochilus sexmaculatus* Fab. in the laboratory.

Life Stages	Pre-treatment	Post- treatment													
		24 Hrs.			48 hours			72 hours			96 hours			120 hours	
		Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality
Egg	10	0	10	100	0	10	100	0	10	100	100 c	10	100	0	10
1st instar	10	1 c	9	90	0	10	100	0	10	100	100 c	10	100	0	10
2nd instar	10	3.5 b	6.5	65	0	10	100	0	10	100	100 c	10	100	0	10
3rd instar	10	5.5 a	4.5	45	0.5 c	9.5	95	0	10	100	100 c	10	100	0	10
4th instar	10	4.5 ab	5.5	55	1.5 c	8.5	85	0.5 c	9.5	95	95 c	10	100	0	10
Pupa	10	1 c	9	90	0.5 c	9.5	95	0	10	100	100 c	10	100	0	10
Adult	10	0	10	100	0.5 c	9.5	95	0	10	100	100 c	10	100	0	10

Different letters within a row indicate significant difference (Fisher's Protected LSD test: P< 0.05)

3.2 Effect of Novastar 56 EC insecticide on life stages of *Menochilus sexmaculatus*

(Table 2) showed the exposure of insecticide Novastar (Emamectin + Bifenthrin) 56 EC on the life stages of predatory beetle *M. sexmaculatus* along with aphid provided as host on the leaves of host plant. The result depicted that the egg was not hatched after the exposures of insecticide at different periods 24, 48, 72, 96 and 120 hours respectively. The survival of first instar larvae was 1.5 and mortality 85% was observed after 24 hours after that it become gradually declined after 48 hours. The second instar larvae lived for 24 and 48 hours after the exposure of insecticide 2.0 and mortality 80% and 0.5 survival of larvae and mortality 95% was observed the larval survival was not observed after 72, 96 and 120 hours after application of Novastar insecticide. Similarly, survival of third instar larvae was recorded 6.5, 3.0, 0.5 and 0.25 and mortality 35, 70, 95 and 97.5% after 24, 48, 72 and 96 hours respectively after that it become died in reaming period of exposure of insecticide. The survival rate of fourth instar was 6.5, 3.0 and 0.75 after 24, 48 and 72 hours

respectively. The mortality was recorded 35, 70 and 92.5% after the application of insecticide 24, 48 and 72 hours respectively the result further revealed that in pupal stage survivor was recorded 1.5, 0.5 and 0.25 after the exposure of insecticide 24, 48 and 72 hours respectively. The pupal mortality was seen 85, 95 and 97.5% after 24, 48 and 72 hours respectively the pupal stage was not survived after the period of 96 and 120 hours after treatment of Novastar insecticide. The adult stage not survived after exposure of insecticides for 24, 48, 72, 96 and 120 hours. It was observed that the egg and adult stages were not survived after application of Novastar insecticide, therefore, 1st instar larva survived for 24 hours, while 2nd instar larva survived for 48 hours. The 3rd instar larva was survived for 96 hours and 4th instar lived for 72 hours after treatment of insecticide. Similarly, pupal stage survived for 72 hours after application of insecticides. The analysis of the data showed that there was significant

Table 2: Effect of Novastar 56 EC insecticide on life stages *Menochilus sexmaculatus* Fab. in the laboratory.

Life Stages	Pre-treatment	Post- treatment													
		24 hours			48 hours			72 hours			96 hours			120 hours	
		Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality
Egg	10	0	10	100	0	10	100	0	10	100	0	10	100	0	10
1st instar	10	1.5 cd	8.5	85	0	10	100	0	10	100	0	10	100	0	10
2nd instar	10	2 bc	8	80	0.5 de	9.5	95	0	10	100	0	10	100	0	10
3rd instar	10	6.5 a	3.5	35	3 b	7	70	0.5 de	9.5	95	0.25 e	9.75	97.5	0	10
4th instar	10	6.5 a	3.5	35	3 b	7	70	0.75 de	9.25	92.5	0	10	100	0	10
Pupa	10	1.5 cd	8.5	85	0.5 de	9.5	95	0.25 e	9.75	97.5	0	10	100	0	10
Adult	10	0	10	100	0.5 de	9.5	95	0	10	100	0	10	100	0	10

Different letters within a row indicate significant difference (Fisher's Protected LSD test: *P< 0.05*)

Difference in exposure periods of insecticide application (*P<0.05*).

3.3 Effect of bio-pesticide Hazropattar (Tobacco variety) on the life stages of *Menochilus sexmaculatus*

The result depicted in (Table 3) that influence of bio-pesticide Hazropattar (Tobacco extract) on the life stages of predatory beetle *M. sexmaculatus* along with aphid provided as host on the leaves of host plant. The egg was survived 7.5 and mortality 55% was recorded after the exposures of bio-pesticide at 24 and 48 hours followed by 6 and 5 for 72, 96, and 120 hours respectively. The highest mortality 50% was recorded after exposure of bio-pesticide 120 hours. The first instar larvae survived 3.0, 2.0 and 1.5 and mortality 70, 80 and 85% was recorded after 24, 48, 72, 96 and 120 hours respectively after the application of bio-pesticide. The second instar larvae 4.5, 4.0, 3.5 and 3.0 were seen active after 24, 48, 72, 96 and 120 hours respectively. The mortality 55, 60, 65 and 70% were recorded after bio-pesticide exposure 24, 48, 72, 96 and 120 hours respectively. Third instar larvae survived 5.5, 5.0, 4.5, 4 and 3.0 after 24, 48, 72, 96 and 120 hours treated with bio-pesticide. The mortality 45, 50, 55, 60 and 70% were observed after 24, 48, 72, 96 and 120 hours respectively the survival rate of fourth instar was recorded 8.0 and 7.0 after 24, 48, 72, 96 and 120 hours respectively. The mortality was found 20 and 30% at 24, 48, 72, 96 and 120 hours respectively after application of bio-pesticide. The result further depicted that pupal stage survivor 8.0 and 7.0 after exposure of bio-pesticide at 24, 48, 72, 96 and 120 hours respectively. The highest pupal mortality was observed after 120 hours whereas, lowest was observed after 24 hours the adult beetles were survived 10, 8 and 7 hours after treatment with bio-pesticide for 24, 48, 72, 96 and 120 hours. The highest survivor was recorded after 24 hours and lowest was seen after 120 hours it was observed that the highest survival was recoded in egg after 24 hours than it gradually declined and reached its lowest level after 120 hours exposure of bio-pesticide. The highest survival recorded in 4th instar larva followed by 3rd, 2nd and 1st respectively the pupal and adult stages have the same trend of survival after 120 hours when treated with bio-pesticide. The analysis of the data showed that there was significant difference in exposure periods of insecticide application.

Table 3: Effect of bio-pesticide Hazropattar (Tobacco variety) on life stages *Menochilus sexmaculatus* Fab. in the laboratory.

Life Stages	Pre-treatment	Post- treatment													
		24 Hrs.			48 hours			72 hours			96 hours			120 hours	
		Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality
Egg	10	7.5 bc	2.5	25	7.5 bc	2.5	25	6 c	4	40	6 c	4	40	5 cd	5
1st instar	10	3 de	7	70	2 f	8	80	2 f	8	80	1.5 fg	8.5	85	1.5 fg	8.5
2nd Instar	10	4.5 d	5.5	55	4 cd	6	60	3.5 de	6.5	65	3.5 de	6.5	65	3 de	7
3rd instar	10	5.5 cd	4.5	45	5 cd	5	50	4.5 cd	5.5	55	4 cd	6	60	3 de	7
4th instar	10	8 b	2	20	6 c	4	40	5 cd	5	50	5 cd	5	50	5 cd	5
Pupa	10	8 b	2	20	8 b	2	20	8 b	2	20	7 bc	3	30	7 bc	3
Adult	10	10 a	0	0	8 b	2	20	7 bc	3	30	7 bc	3	30	7 bc	3

Different letters within a row indicate significant difference (Fisher's Protected LSD test: *P< 0.05*)

3.4 Effect of bio-pesticide Balkhi (Tobacco variety) on the life stages of *Menochilus Sexmaculatus*

The result described in (Table 4) that impact of bio-pesticide Balkhi (Tobacco extract) on the life stages of predatory beetle *M. sexmaculatus* along with aphid provided as host on the leaves of host plant. The result depicted that the eggs were survived 8.0 after 24 and 48 hours followed by 7.5 and 6.0 after application of bio-pesticide mortality at 72, 96 and 120 hours respectively. The lowest mortality was recorded 20% after the exposures of bio- pesticide at 24 and 48 hours respectively. The maximum survival of first instar larva was recorded 5.5 after 24 hours followed by 5 and 6 hours after 48, 72, 96 and 120 hours after the application of bio-pesticide. The second instar larvae survived 7.0, 6.5 and 5.0 after 24, 48, 72, 96 and 120 hours respectively the lowest mortality was observed 45, 50 and 60% after 24, 48, 72, 96 and 120 hours respectively treated with bio-pesticide. Similarly, third instar larvae survived 8.0 and 7.0 after 24, 48, 72, 96 and 120 hours respectively the mortality 20 and 30% were recorded at 24, 48, 72, 96 and 120 hours respectively. The survival rate of fourth instar was 10.0, 8.0 and 7.0 after 24, 48, 72, 96 and 120 hours respectively the mortality was observed 20, and 30% at 48, 72, 96 and 120 hours after bio-pesticide exposure. The survival rate of pupal stage was 10.0, 8.0 and 7.0 after 24, 48, 72, 96 and 120 hours respectively treated with bio-pesticide. The pupal mortality was seen 20 and 30% after 48, 72, 96 and 120 hours respectively the adult beetle survived 10.0 after 24 hours followed by 8.0 and 7.0 after 48, 72, 96 and 120 hours exposure of bio-pesticide. The highest mortality was recoded after 120 hours and lowest after 24 hours it was detected that the highest egg survival was recorded after 24 hours and reached at its lowest level gradually after 120 hours. The highest survivor was recorded in the 4th followed by 3rd, 2nd and 1st instar larvae from 24 to 120 hours, respectively the highest pupal and adult survivor was observed after 48 hours and lowest was recorded after 120 hours respectively after exposure of bio-pesticide. The analysis of the data showed that there was significant difference in exposure periods of insecticide application (*P<0.05*).

Table 4: Effect of bio-pesticide Balkhi (Tobacco variety) on life stages *Menochilus sexmaculatus* Fab. in the laboratory.

Life Stages	Pre-treatment	Post- treatment													
		24 Hrs.			48 hours			72 hours			96 hours			120 hours	
		Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality	Mortality %	Survival	Mortality
Egg	10	8 b	2	20	8 b	2	20	7.5 bc	2.5	25	6 cd	4	40	6 cd	4
1st instar	10	5.5 cd	4.5	45	5 cd	5	50	5 cd	5	50	4 d	6	60	4 d	6
2nd instar	10	7 bc	3	30	6.5 c	3.5	35	5 cd	5	50	5 cd	5	50	5 cd	5
3rd instar	10	8 b	2	20	8 b	2	20	7 c	3	30	7 bc	3	30	7 bc	3
4th instar	10	9 ab	1	10	8 b	2	20	8 b	2	20	7 bc	3	30	7 bc	3
Pupa	10	10 a	0	0	8 b	2	20	8 b	2	20	8 b	2	20	7 bc	3
Adult	10	10 a	0	0	9 ab	1	10	9 ab	1	10	8 b	2	20	8 b	2

Different letters within a row indicate significant difference (Fisher's Protected LSD test: *P< 0.05*)

4. Discussion

The result revealed that the life stages treated with insecticide Curacron (Profenophos) in which egg and adult stages not survived, however, the immature stages of 1st and 2nd instar larva survived for 24 hours and 3rd instar survived for 48 hours where 4th instar lived for 72 hours while pupae survived for 48 hours. The result further depicted that egg and adult stages were not survived after application of Novastar insecticide, therefore, 1st instar larva survived for 24 hours and 2nd instar larva survived for 48 hours while 3rd instar larva was survived for 96 hours where 4th instar lived for 72 hours after treatment of insecticide, similarly, pupal stage survived for 72 hours after application of insecticides. Furthermore, it was observed that the highest survival was recoded in egg stage after 24 hours than it gradually declined and reached its lowest level after 120 hours exposure of bio-pesticide Hazropattar (Tobacco extract). The highest survival recorded in 4th instar larva followed by 3rd, 2nd and 1st, respectively. The pupal and adult stages have the same trend of survival after 120 hours when treated with bio-pesticide. The result further revealed that the egg survived for 48 hours whereas larval instars 1st, 2nd, 3rd, and 4th survived for 96 hours. It was detected that the highest egg survival was recorded after 24 hours and reached at its lowest level gradually after 120 hours. The highest survivor was recorded in the 4th followed by 3rd, 2nd and 1st instar larvae from 24 to 120 hours, respectively. The highest pupal and adult survivor was observed after 48 hours while lowest was recorded after 120 hours, respectively, after exposure of bio-pesticide of Balkhi (Tobacco extract). Our results are conformity with the previous investigators Tank *et al.* [15] reported that Cypermethrin showed toxic effect on the eggs of *M. sexmaculatus*. Kaethner, [16] narrated that Neem oil showed less toxicity on the egg stage of *C. septempunctata*. The findings of our results have the more or less conformity with the findings of Sechser *et al.* [17] who detected that the Emamectin benzoate was found comparatively harmless for larvae of *Coccinella undecimpunctata* L.and *Scymnus* spp. Markandeya and Divakar [18] described that Neem formulation found harmless for larvae of *M. sexmaculata*. Sechser *et al.* [17] found that Emamectin benzoate showed less toxicity to predators *Coccinella undecimpunctata* L. and *Scymnus* spp, Galvan *et al.* [19] determined the influence of Indoxacarb and Spinosad on *Harmonia axyridis* and found that the first instar larvae takes more time in their development to adult stage when applied Spinosad. Abdullah *et al.* [20] investigated that *M. sexmaculatus* was presented in less numbers crop treated with Cypermethrin. Sharma and Kaushik [21] and Swaran *et al.* [22] evaluated the Cypermethrin they comparatively found that this insecticide showed toxicity against ladybird beetles and

adult *M. sexmaculatus*. Markandeya and Divakar [18] and Sakthivel and Qadri [23] investigated that Neem formulation less toxic for adult *M. sexmaculatus* and Coccinellid predatory beetles. Jyoti and Basavana [24] detected that Emamectin benzoate 5 SG safer for Coccinellid predator.

5. Conclusion

Curacron 500 EC and Novastar 56 EC insecticides showed severe toxicity to the egg and adults of *M. sexmaculatus.* The maximum survival was recorded in 3rd and 4th instar larvae of *M. sexmaculatus* after treatment of Curacran 500 EC and Novastar 56 EC insecticides. The tobacco extract of Hazropattar and Balkhi variety was found least toxic against all life stages of *M. sexmaculatus.* The highest survivor was found in adult and pupae, 4th, 3rd, 2nd and 1st instars larvae of *M. sexmaculatus* after treatment of bio-pesticide Hazropattar and Balkhi tobacco varieties.

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