Journal of Biological Control, 35(4):272-276, 2021, DOI: 10.18311/jbc/2021/29159

Research Note

Effect of insecticides on predatory assassin bug, *Sycanus collaris* (Fabricius) (Hemiptera: Reduviidae)

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ABSTRACT: Six insecticides were evaluated for their toxicity against nymphs and adults of assassin bug, *Sycanus collaris* (Fab.) through contact and stomach mode. The studies revealed that emamectin benzoate (0.4g/L), chlorantraniliprole (0.25ml/L), flubendiamide (0.25 ml/L) and thiamethoxam (0.25 g/L) were considered as relatively safer insecticides for all the nymphal instars and adults of *S. collaris*. Fenazaquin (1.25ml/L) and quinalphos (2ml/L) caused higher mortality (85-100%) in all the stages of *S. collaris*. The higher mortality observed in nymphs and relatively lesser mortality rate of adults indicate that the application of the chemical should not be carried out immediately after the release of nymphal instars of *S. collaris* and adult releases would be ideal in Integrated Pest Management (IPM).

KEY WORDS: Biological control, insecticides, mortality, *Sycanus collaris*

(Article chronicle: Received: 07-12-2021; Revised: 30-12-2021; Accepted: 31-12-2021)

Assassin bugs known as Reduviids (Hemiptera: Reduviidae), are predatory insects that prey on a variety of economically significant insect pests. Agro-ecosystems, semiarid zones, scrub jungles, and tropical rainforest environments possess rich diversity of reduviids (Ambrose, 1999; Sahayaraj, 2007). They approach the prey and ambush it before injecting the poison that kills it. The rostrum of these bugs is arched outwards from the head, which is a distinguishing trait of this family of insects (Sheikh *et al*., 2016). Insecticides, on the other hand, play an important role in controlling insect pests in crop fields. However, a major risk effect has been proven as a result of increased reliance on various chemical pesticides for crop pest management. There has been a strong demand for environmentally beneficial and protracted solutions, such as utilising and conserving naturally occurring bio-control agents like Reduviid predators. They occur in diverse habitats in agro-ecosystems, as well as being exposed to insecticides used to control insect pests. Natural enemies can only be included in Integrated Pest Management (IPM) programmes if they are safeguarded from insecticides used against insect pests. With the introduction of new agrochemicals, it is critical to analyse the possible impact of these compounds on natural enemy survival, dispersal, and beneficial capacity in order to develop selective insecticides for inclusion in IPM programmes (Paul and Thyagarajan, 1992). Pesticides can affect the chemical communication between arthropods and reduce the ability of predators to locate their partners for mating (Griesinger *et al.,* 2011) and consumption of pests (He *et al.,* 2012). Pesticides applied can negatively affect parasitoids and predators even when releases are carefully timed, therefore, it is essential to ascertain their compatibility prior to use (IOBC, 2018). So, the present study was taken up to evaluate the safety of regularly used insecticides to reduviid bug, Sycanus collaris, so that their inclusion in IPM programme may be ascertained.

Rearing of *Sycanus collaris*

The adults and nymphs of *S. collaris* were procured from Central Integrated Pest Management Centres (CIPMC), Bengaluru. The insect culture was maintained at ICAR - National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru. The temperature and relative humidity were maintained at 26±2°C and 65±5 %, respectively as recommended (Yi and Kyi, 2000).

The bugs were kept in one liter plastic jars with blotting paper inside and provided with disease-free larvae of *Spodoptera litura* as regular prey. Aeration was provided using muslin cloth in the jars. Eggs deposited by female bugs of *S. collaris* on blotting paper were kept separately in the breeding dishes with a sieve cap for hatching. The cotton wool was soaked with water as the food source for the newly hatched nymphs. After the first moult, the second instar nymphs were provided with *Spodoptera litura* as prey. Nymphs from the third instar onwards were kept in groups of 10 in separate dishes (7x5 cm) with prey larvae to avoid cannibalism among nymphs. Newly emerged adults were paired and females were transferred to the oviposition cages.

Rearing of *Spodoptera litura*

The stock culture of *Spodoptera litura* was obtained. The culture was maintained at 28 ± 2°C, 60% RH on an artificial diet following the method of Shorey and Hale (1965) and Wakamura (1988). The egg masses were collected and surface-sterilized with sodium hypochlorite at a concentration of 0.01 per cent (Gupta *et al*., 2013). Initially, the larvae were gregariously reared by providing castor leaves in a plastic container with blotting paper at the bottom. The newly emerged *S. litura* moths were placed in 20 X 15 cm plastic containers that were sufficiently ventilated. Adult moths were provided with 50 per cent honey solution and water. To obtain egg masses, the inner wall of the container was lined with paper. To prevent bacteria, fungi, and virus contamination, freshly laid egg masses were surface sterilized by dipping them in 10 per cent formalin.

Evaluation and observation of insecticides against *S. collaris*

Six different and widely used insecticides in okra were dissolved separately in water at their field recommended dose to obtain individual insecticide solutions. One untreated control using normal water was also maintained as a check. Ten individuals of 1st, 2nd, 3rd, 4th, 5th instar nymphs and adults of *S. collaris* were taken per treatment with six replications. They were released on to the okra leaves sprayed with a respective insecticide solution. The bugs are provided with *S. litura* as prey to observe its mortality effect against these treatments. Observations on survival of *S. collaris* were taken at 24 hours intervals up to 2 days after treatment. Data collected on the observations made during the experimentation period was analyzed using one-way ANOVA and post ANOVA, Tukey test was carried out.

One day after treatment (1 DAT)

The highest mortality percentage was observed in quinalphos (2 ml/L) followed by fenazaquin (1.25 ml/L). In quinalphos, a higher mortality rate was observed in 1st instar and 2nd instar (100%) nymphs at 1DAT. It was statistically on par with the mortality rate of 3rd instar (90%) nymphs. Whereas, the per cent mortality in the case of 4th instar (73.33%), 5th instar (71.67%), and adults (70%) were significantly on par. In fenazaquin, a higher mortality rate was observed in 1st instar (80%) nymphs at 1DAT. It was statistically at par with the mortality rate of 2nd instar (76.67%), 3rd instar (76.67%), 4th instar (75%), and 5th instar (73.33%), and adults (70%).

In treatment with emamectin benzoate (0.4 g/L), a higher mortality rate was observed in 1st instar (26.67%) nymphs at 1DAT. It was statistically on par with the mortality rate of 2nd instar (23.33%), 3rd instar (20%), and 4th instar (16.67%). Whereas, the per cent mortality in each case of 5th instar (10%) and adults (5%) was significantly on par with water-treated control. In chlorantraniliprole (0.25 ml/L), a higher mortality rate was observed in 1st instar (13.33%) nymphs at 1DAT. It was statistically on par with the mortality rate of 2nd instar (10%), 3rd instar (11.67%), 4th instar (6.67%), and 5th instar (3.33%). Whereas, the per cent mortality in the case of adults (1.67%) was significantly on par with water-treated control. In flubendiamide (1.25 ml/L), a higher mortality rate was observed in 1st instar (18.33%) nymphs at 1DAT. It was statistically on par with the mortality rate of 2nd instar (13.33%), 3rd instar (10%), and 4th instar (8.33%). Whereas, the per cent mortality in case of 5th instar (5%) and adults (3.33%) was significantly on par with water-treated control. In thiamethoxam (0.25 g/L), a higher mortality rate was observed in 1st instar (21.67%) nymphs at 1DAT. It was statistically on par with the mortality rate of 2nd instar (18.33%) and 3rd instar (15%) nymphs. Thereafter, more or less statistically at par inferior mortality rate was observed in 4th instar (10%) nymphs. Whereas, the per cent mortality in case of 5th instar (6.67%) and adults (5%) was significantly at par with water treated control.

Two days after treatment (2 DAT)

Comparing this mortality with 1 DAT, each insecticide resulted in higher mortality (%) to *S. collaris*.

The highest mortality percentage was observed in quinalphos (2 ml/L) followed by fenazaquin (1.25 ml/L). In quinalphos, a higher cumulative mortality rate was observed in 1st instar (100%) nymphs at 2DAT. It was statistically at par with the cumulative mortality rate of 2nd instar (100%), 3rd instar (100%), 4th instar (100%), and 5th instar (100%) followed by adults (96.67%).In fenazaquin, higher cumulative mortality was observed in 1st instar (96.67%) nymphs at 2DAT. It was statistically at par with the cumulative mortality rate of 2nd instar (93.33%), 3rd instar (91.67%), 4th instar (90%), and 5th instar (88.33%) nymphs. Thereafter, more or less statistically at par inferior mortality rate was observed in adults (81.67%).

In emamectin benzoate (0.4 g/L), higher cumulative mortality was observed in 1st instar (43.33%) nymphs at 2DAT. It was statistically at par with the cumulative mortality rate of 2nd instar (41.67%), 3rd instar (38.33%), and 4th instar (33.33%) nymphs. Thereafter, more or less statistically at par inferior mortality rate was observed in 5th instar (26.67%) nymphs and adults (13.33%). In chlorantraniliprole (0.25 ml/L),higher cumulative mortality was observed in 1st instar (31.67%) nymphs at 2DAT. It was statistically at par with the cumulative mortality rate of the 2nd instar (23.33%). Thereafter, more or less statistically at par inferior mortality rate was observed in 3rd instar (21.67%), 4th instar (16.67%) and 5th instar (13.33%) and adults (11.67%). In flubendiamide (1.25 ml/L), higher cumulative mortality was observed in 1st instar (33.33%) nymphs at 2DAT. It was statistically at par with the cumulative mortality rate of 2nd instar (25%) and 3rd instar (21.67%). Whereas, the percent mortality in case of 4th instar (15%), 5th instar (13.33%), and adults (11.67%) were significantly at par with water treated control. In thiamethoxam (0.25g/L),higher cumulative mortality was observed in 1st instar (36.67%) nymphs at 2DAT. It was statistically at par with the cumulative mortality rate of 2nd instar (31.67%), 3rd instar (28.33%), and 4th instar (25%). Thereafter, more or less statistically at par inferior mortality rate was observed in 5th instar (20%) and adults (13.33%).

Emamectin benzoate, Chlorantraniliprole, Flubendiamide and Thiamethohexam are considered relatively safer insecticides for all the nymphal instars and adults of *S. collaris* while. Fenazaquin and Quinalphos are highly toxic.

Present findings are in accordance with the observation of Jyoti and Goud (2008) who reported that emamectin benzoate 5 SG was safer to coccinellids in the brinjal ecosystem and also Dunbar *et al*. (1998) observed that emamectin benzoate is a safe chemical to coccinellids and *Chrysoperla carnea*. This might be due to the rapid breakdown of the active ingredient by photo-oxidation to a non-toxic level on the leaf surface, limiting contact activity to a very short period.This lower toxicity for the predators was expected for chlorantraniliprole

Table 1. Cumulative mortality percentage of nymphs and adults of *Sycanus collaris* caused by different chemicals

Chemicals	**Mortality (%) of *S. collaris***					
	I Instar	II instar	III instar	IV instar	V instar	Adult
Emamectin benzoate 5 SG	35a (36.27)	32.5a (34.76)	29.17ab (32.69)	25bc (30)	18.33c (25.35)	9.17d (17.63)
Chlorantraniliprole 18.5 SC	22.5a (28.32)	16.67ab (24.1)	16.67ab (24.1)	11.67bc (19.97)	8.33bcd (16.77)	6.67cd (14.97)
Fenazaquin 10 EC	88.33a (70.02)	85ab (67.21)	84.17ab (66.55)	82.5ab (65.27)	80.83ab (64.03)	75.83b (60.55)
Flubendiamide 39.35 SC	25.83a (30.55)	19.17ab (25.97)	15.83ab (23.44)	11.67bc (19.97)	9.17bc (17.63)	7.5bc (15.89)
Thiamethoxam 25 WG	29.17a (32.69)	25ab (30)	21.67abc (27.74)	17.5bcd (24.73)	13.33cd (21.41)	9.17de (17.63)
Quinalphos 25 EC	100ab (90)	100a (90)	95b (77.08)	86.67c (68.59)	85.83c (67.89)	83.33c (65.90)
Control	0a (0)	0a (0)	0a (0)	0a (0)	0a (0)	0a (0)

Figure in parenthesis indicates angular transformation, Mean followed by common letter are not significantly different at 5% level by Tukey's range test.

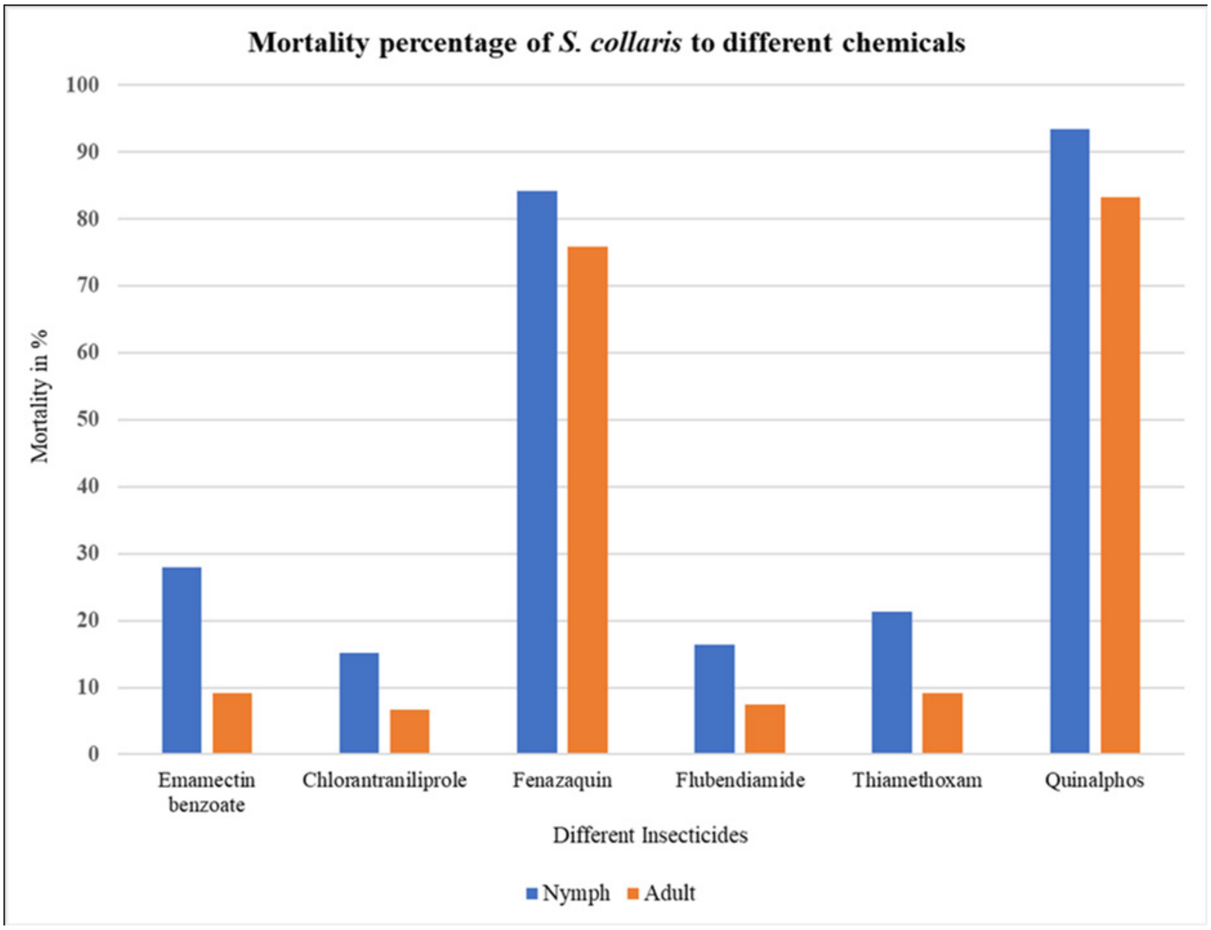

Fig. 1. Mortality percentage of nymphal instars and adults of *Sycanus collaris* to different chemicals

and flubendiamide because of its high affinity towards Lepidoptera ryanodine receptors due to the conformation and structure of the insecticide molecule (Lahm *et al.*, 2009).The lower mortality was observed in Thiamethoxam. Esquivel *et al*. (2020) stated that thiamethoxam proved to be compatible with convergent lady beetles and insidiosus flower bugs because of the rapid systemic uptake of thiamethoxam which resulted in a high degree of ecological selectivity. The high mortality was observed in Quinalphos. The extensive usage of poses a hazard in non-target organisms because of severe inhibition of acetylcholinesterase (AChE) (Gupta *et al*., 2011).

In the present study, mortality rate of adults is relatively lesser than the nymphs. This result corroborates with the findings of Pereira *et al*. (2005), who reported that gamma cyhalothrin (P) is more toxic against *Podisus nigripinus* Dallas (Hemiptera: Pentatomidae) in the nymph than in the adult stage, perhaps due to the thicker cuticle of adults compared to that of nymphs. Curkovic *et al*. (2007) reported that some insects, particularly adults, are protected against the entry of insecticides by thick and sclerotized cuticles and that larvae and nymphs become progressively less permeable as their cuticle thickens. This result suggested that the chemical application could be compatible with the release of adult stage predators.

CONCLUSION

Emamectin benzoate, Chlorantraniliprole, Flubendiamide and Thiamethoxam are considered relatively safer insecticides because of the minimum negative impact on the predator population and may be considered as ideal chemicals for use in integrated pest management programmes. Adults are relatively tolerant to the chemicals than nymphal instars. This indicated that the chemicals application should not be carried out immediately after the release of nymphal instars of *S. collaris* as it causes mortality of the immature instars of the predator. And that the chemical application could be compatible with the release of adult stage predators.

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