IOSR Journal of Applied Chemistry (IOSR-JAC)
e-ISSN: 2278-5736.Volume 13, Issue 10 Ser. I (October. 2020), PP 19-26
www.iosrjournals.org

Safety Evaluation of Certain Insecticides on *Cryptolaemusmontrouzieri* Mulsant

A.Maneesha[1*], S. R. Koteswara Rao[1], T. Murali Krishna[2] and P. Sudhakar[3]
[1]*Department of Entomology, S.V. Agricultural College, Tirupati, ANGRAU, Andhra Pradesh, INDIA.*
[2] *Institute of Frontier Technology, Regional Agricultural Research Station, Tirupati.Andhra Pradesh, INDIA*
[1]*Department of Crop Physiology, S.V. Agricultural College, Tirupati,Andhra Pradesh, INDIA*

Abstract: *An experiment was conducted to study the safety evaluation of certain insecticides on C. montrouzieri at Insectary, S. V. Agricultural college, Tirupati. C. montrouzieri is an important coccinellid predator of psuedococcidae. In recent times, it is well known that the natural enemies are getting affected by the usage of harmful pesticides in huge amount which is a major concern. Hence, we have taken up the study of safety evaluation of certain new insecticides on CryptolaemusmontrouzieriCultures of C. montrouzieri was maintained on Maconellicoccushirsutus.Spray fluid of respective insecticides at desired concentration was sprayed on mealybugs using micro applicator which were placed in Petriplates. The grub and adult stages of C. montrouzieri were transferred to the petriplates containing treated mealybugs. The mortality of grubs and adult was recorded 24, 42 and 78 hours after treatment and calculated overall mean per cent mortality in each treatment.The mean mortality percentage of C.montrouzieri treated with dimethoate was significantly different with that of the other treatments and are on par with Acephate and Imidacloprid.Among safety evaluation of different insecticides on life stages of C. montrouzieri, dimethoate was found to be highly toxic whereas, flonicamid, buprofezin and neem oil were found to be non- toxic through food contamination method.*

Keywords: *C. montrouzieri, Food contamination method, Dimethoate, Flonicamid, Buprofezin, Neem oil.*

Date of Submission: 20-09-2020 Date of Acceptance: 04-10-2020

I. Introduction

Among the predators of mealybugs, the Australian lady beetle, *Cryptolaemusmontrouzieri*Mulsant (Coleoptera: Coccinellidae) has been reported to be a general predator of mealybugs at all stages of its development. Both the stages of the predator that is grub and adult are voracious feeder of all the stages of mealybug. It is commonly referred as mealybug destroyer. It has been employed as the possible solution for combating the menace of the pest around the world. It is native of Australia and was introduced in California for the control of citrus mealybug. Following the success, the beetle was introduced in India in 1898 by H.O. Newport to control the coffee green scale [1]. Though, the predator did not establish on green scale, it was responsible to check mealybug in coffee growing zones[2,3].

The biological suppression of mealybugs through this potent predator in India was well documented[4,5]. In other countries, *C. montrouzieri*had proved effective as it is evident from the study of [6] that succeeded in keeping under the destructive mealybugs in California by large scale multiplication of beetles. It has played a major role in the control of different sucking pests especially mealybugs[7,8]. In order to achieve the pest control at higher level as well as safety to the consumers, integration of chemical insecticides and bio-agents have been followed as IPM strategies. However, in most cases, use of chemical insecticides along with bio-agents exhibited mortality of the predatory stages. So, there is a need for the search of selective chemicals which are less toxic to grubs and adults of the predator.

II. Materials and Methods

This comparative study was taken up at Insectary, S. V. Agricultural college, Tirupati, Andhra Pradesh at 13.54815^{o} N, 79.5449^{o} ELatitude, Longitude and 189.2 above MSL.

Laboratory Multiplication of Mealybug, *Maconellicoccushirsutus*

The mass production of mealybugs was done on medium sized ripened red pumpkin (*Cucurbita maxima*Duch.) under laboratory conditions at 25 ± 5°C temperature and 75 ± 5 per cent relative humidity [2,9].

Maintenance of mealybug culture

Initial culture was obtained from National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru.Just ripened red pumpkins with ridges and grooves and bearing a small stalk were selected for easy handling. They were washed with water to remove dust on them. In order to prevent rotting, the pumpkins were treated with 0.1

per cent carbendazim 50 WP (1 g L^{-1})[10]. Wounds on the pumpkins were plugged with paraffin wax. The egg sacs of mealybugs from which the eggs have just started hatching were placed on pumpkins. The inoculation was done at regular intervals to ensure regular supply of all the stages of mealybugs throughout the study period. The inoculated pumpkins were kept in wooden cages (30 × 30 × 33 cm) with sliding glass in the front and cloth on either sides [11,12]. Care was taken to close all cracks and crevices with wax to prevent the escape of early instars. Fully matured mealybugs developed within 30 to 40 days.

Multiplication of the predator *C. montrouzieri*

The method adopted by [2,9]was followed for rearing the predator after sufficient development of mealybugs on pumpkins. About 8-10 pairs of predators were released into the cage. The beetles besides feeding on the mealybugs, laid their eggs singly or in groups inside the ovisacs of mealybugs. Full grown grubs pupated on pumpkins or corner of the rearing cage. The first beetle emerged within 30 days from the date of exposure of mealybugs to the beetle, the emerging adults were used for further studies. The beetles were provided with enough number of preys during the study period.

Food contamination method

In this method, spray fluid of respective insecticide at desired concentration was sprayed on mealybugs using micro applicator which were placed in Petriplates. The grub and adult stages of *C. montrouzieri* were transferred to the petriplates containing treated mealybugs. The mortality of grubs and adult was recorded 24, 42 and 78 hours after treatment and calculated overall mean per cent mortality in each treatment.

Table 1: Details of insecticides used in the study

S. No.	Treatment	Trade name	Dosage	Source
1	Acetamiprid 20 SP	Prize	0.20 g L^{-1}	Jai Shree RasayanUdyog Ltd., Delhi
2	Acephate 75 SP	Tremor	1.50 g L^{-1}	Biostadt India Limited, Mumbai
3	Imidacloprid 200 SL	Confidor	0.25 ml L^{-1}	Bayer Crop Sciences, Thane
4	Thiamethoxam 25 WDG	Sitara	0.20 g L^{-1}	Jai Shree RasayanUdyog Ltd., Delhi
5	Dichlorvos 76 EC	Nuvan	1.00 ml L^{-1}	Insecticides (India) Limited, Agra
6	Profenophos 50 EC	Profex	2.00 ml L^{-1}	NagarjunaAgrichem Limited, Hyderabad
7	Neem oil 0.5%	Neemark	5.00 ml L^{-1}	West Coast Herbochem Limited, Mumbai
8	Dimethoate 30% EC	Rogarin	2.00 ml L^{-1}	Insecticides (India) Limited, Agra
9	Buprofezin 25 SC	Addvant	2.00 ml L^{-1}	Sumitomo Chemical India Pvt., Ltd., Gujarat
10	Flonicamid 50 WG	Ulala	0.30 g L^{-1}	United Phosphorus Limited, Mumbai
11	Untreated control	-	-	-

Statistical analysis: The average percentage mortality of grubs and adults was worked out for each treatment and the data were subjected to statistical analysis using OPSTAT.

III. Result

Evaluation of toxicity of insecticides on first instar grub

The results on safety of different insecticides against I instar grub of *C. montrouzieri* at 72 h after the application (Table 2) revealed that dimethoate recorded the significantly higher mortality of (100.00%) of the grubs and proved to be most toxic followed by acephate (86.67%), imidacloprid (85%) and are on par with each other followed by acetamiprid (78.33%), profenophs (78.33%) and are said to be on par with each other. The remaining treatments *viz.,* thiamethoxam, dichlorvos, flonicamid, buprofezin, neem oil recorded 65.00, 43.33, 14.99, 0.00 and 0.00 per cent of mortality, respectively. However, no mortality was observed in untreated control, buprofezin and neem oil was found to be safest to the predator. Simliar trend was followed at 24 and 48 h after the application (Fig. 1).

Evaluation of toxicity of insecticides on second instar grub

The results of present study revealed that toxicity of different insecticidesagainst II instar grub of *C. montrouzieri* at 72 h after the application (Table 3) revealed that dimethoate recorded the significantly higher mortality of (100.00%) of the grubs and proved to be most toxic followed by acephate (86.67%), and imidacloprid (75%), acetamiprid (66.67%), profenophs (65.00%) and are said to be on par with each other. The remaining treatments *viz.,* thiamethoxam, dichlorvos, flonicamid, buprofezin, neem oil recorded 58.33, 33.33, 11.67, 0.00 and 0.00 per cent of mortality, respectively (Fig. 2). However, least per cent of mortality was observed in untreated control. While, buprofezin and neem oil were found to be safest to the predator. Simliar trend was followed at 24 and 48 h after the application.

Evaluation of toxicity of insecticides on third instar grub

Similar trend as that of II instar grub was observed in evaluation of toxicity of different insecticide on III instar grub in the Table (4). The safest chemicals on predator was buprofezin (0.00%), neem oil (0.00%)

followed by flonicamid (8.33%) and dichlorvos (25.00%). Dimethoate (100.00%) was recorded to be highly toxic followed by acephate (91.67%). Imidacloprid (63.33%), acetamiprid (56.67%) and profenophos (56.67%) are found to be moderately toxic and are on par with each other followed by thiamethoxam (48.33). Similar trend was followed at 24, 48 h after the application (Fig 3).

Evaluation of toxicity of insecticides on fourth instar grub

The results on safety of different insecticides against IV instar grub of *C. montrouzieri* at 72 h after the application (Table 5) revealed that dimethoate recorded the significantly higher mortality of (100.00%) of the grubs and proved to be most toxic followed by acephate (86.67%), whereas, imidacloprid (63.33%) and profenophs (63.00%) are on par with each other followed by acetamiprid (51.66%). The remaining treatments *viz.*, thiamethoxam, dichlorvos, flonicamid, buprofezin, neem oil recorded 43.33, 15.00, 6.67, 0.00 and 0.00 per cent of mortality, respectively (Fig 4). However, least per cent of mortality of grubs was observed in untreated control, buprofezin, neem oil and were found to be safest to the predator. Simliar trend was followed at 24, 48 h after the application.

Evaluation of toxicity of insecticides on adult stages

Similar trend of IV instar grub was followed by the adult stages of *C.montrouzeiri* with regard to toxicity of insecticides represented in the table (6). Among different insecticides tested against different life stages of *C. montrouzieri*the highest per cent of mortality through food contamination was dimethoate > acephate > imidacloprid > acetamiprid > profenophos > thiamethoxam > dichlorvos > flonicamid = neem oil = buprofezin = untreated control (Fig 5).

Table 2. Evaluation of toxicity of different insecticides against first instar grub of *Cryptolaemusmontrouzieri* by food contamination method

Treatments	Per cent mortality (Hours after treatment)		
	24 h	**48 h**	**72 h**
T_1 : Acetamiprid 20% SP @ 0.2 $g.L^{-1}$	50.00 (44.98)	58.33 (49.83)	78.33 (62.30)
T_2 : Acephate 75 SP @ 1.50 $g.L^{-1}$	86.67 (68.82)	86.67 (68.82)	86.67 (68.82)
T_3 : Imidacloprid 200 SL @ 0.25 $ml.L^{-1}$	68.33 (55.97)	75.00 (60.44)	85.00 (67.47)
T_4 : Thiamethoxam 25 WDG @ 0.20 $g.L^{-1}$	46.67 (43.06)	60.00 (50.79)	65.00 (53.86)
T_5 : Dichlorvos 76% EC @ 1 $ml.L^{-1}$	18.33 (25.20)	26.67 (30.98)	43.33 (41.14)
T_6 : Profenophos 50% EC @ 2 $ml.L^{-1}$	55.00 (47.86)	75.00 (60.54)	78.33 (62.90)
T_7 : Neem oil 0.5% @ 5.00 $ml.L^{-1}$	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_8 : Dimethoate 30% EC @ 2 $ml.L^{-1}$	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_9 : Buprofezin 25% EC @ 2 $ml.L^{-1}$	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_{10} : Flonicamid 50 WG @ 0.30 $g.L^{-1}$	3.33 (6.14)	5.33 (8.85)	10.00 (14.99)
T_{11} : Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
S. Em ±	1.75	2.17	2.11
C. D. at 5%	4.98	6.16	6.02

Figures in the parentheses are angular transformed values

Table 3. Evaluation of toxicity of different insecticides against second instar grub of *Cryptolaemusmontrouzieri* by food contamination method

Treatments	Per cent mortality (Hours after treatment)		
	24 h	**48 h**	**72 h**
T_1 : Acetamiprid 20% SP @ 0.2 $g.L^{-1}$	36.67 (37.20)	46.67 (43.06)	66.67 (54.86)
T_2 : Acephate 75 SP @ 1.50 $g.L^{-1}$	86.67 (68.27)	86.67 (68.82)	86.67 (68.27)
T_3 : Imidacloprid 200 SL @ 0.25 $ml.L^{-1}$	46.67 (43.06)	58.33 (49.97)	75.00 (60.08)
T_4 : Thiamethoxam 25 WDG @ 0.20 $g.L^{-1}$	36.67 (37.21)	55.00 (47.86)	58.33 (49.82)

T_5 : Dichlorvos 76% EC @ 1 ml.L^{-1}	15.00 (22.49)	23.33 (28.76)	33.33 (35.20)
T_6 : Profenophos 50% EC @ 2 ml.L^{-1}	46.67 (43.06)	63.33 (52.90)	65.00 (53.90)
T_7 : Neem oil 0.5% @ 5.00 ml.L^{-1}	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_8 : Dimethoate 30% EC @ 2 ml.L^{-1}	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_9 : Buprofezin 25% EC @ 2 ml.L^{-1}	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_{10} : Flonicamid 50 WG @ 0.30 g.L^{-1}	5.00 (9.21)	10.00 (14.99)	11.67 (16.34)
T_{11} : Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
S. Em ±	1.69	2.13	2.12
C. D. at 5%	4.82	6.07	6.03

Figures in the parentheses are angular transformed values

Table 4. Evaluation of toxicity of different insecticides against third instar grub of *Cryptolaemusmontrouzieri* by food contamination method

Treatments	**Per cent mortality (Hours after treatment)**		
	24 h	**48 h**	**72 h**
T_1 : Acetamiprid 20% SP @ 0.2 g.L^{-1}	26.67 (30.98)	36.67 (37.21)	56.67 (48.86)
T_2 : Acephate 75 SP @ 1.50 g.L^{-1}	86.67 (68.82)	91.67 (74.61)	91.67 (74.61)
T_3 : Imidacloprid 200 SL @ 0.25 ml.L^{-1}	36.67 (37.16)	48.33 (44.02)	63.33 (52.75)
T_4 : Thiamethoxam 25 WDG @ 0.20 g.L^{-1}	26.67 (30.98)	40.00 (39.17)	48.33 (44.02)
T_5 : Dichlorvos 76% EC @ 1 ml.L^{-1}	8.33 (13.64)	13.33 (19.42)	25.00 (29.87)
T_6 : Profenophos 50% EC @ 2 ml.L^{-1}	38.33 (38.21)	53.33 (46.94)	56.67 (48.91)
T_7 : Neem oil 0.5% @ 5.00 ml.L^{-1}	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_8 : Dimethoate 30% EC @ 2 ml.L^{-1}	10.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_9 : Buprofezin 25% EC @ 2 ml.L^{-1}	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_{10} : Flonicamid 50 WG @ 0.30 g.L^{-1}	1.67 (3.07)	6.67 (10.56)	8.33 (13.64)
T_{11} : Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
S. Em ±	1.94	2.45	2.06
C. D. at 5%	5.51	6.98	5.85

Figures in the parentheses are angular transformed values

Table 5. Evaluation of toxicity of different insecticides against fourth instar grub of *Cryptolaemusmontrouzieri* by food contamination method

Treatments	**Per cent mortality (Hours after treatment)**		
	24 h	**48 h**	**72 h**
T_1 : Acetamiprid 20% SP @ 0.2 g.L^{-1}	23.33 (28.77)	36.67 (37.17)	51.66 (45.98)
T_2 : Acephate 75 SP @ 1.50 g.L^{-1}	86.67 (68.82)	86.67 (68.82)	86.67 (68.82)
T_3 : Imidacloprid 200 SL @ 0.25 ml.L^{-1}	28.33 (31.99)	55.00 (47.91)	63.33 (52.75)
T_4 : Thiamethoxam 25 WDG @ 0.20 g.L^{-1}	18.33 (23.24)	36.67 (37.21)	43.33 (41.13)
T_5 : Dichlorvos 76% EC @ 1 ml.L^{-1}	6.67 (8.85)	11.67 (19.78)	15.00 (22.49)
T_6 : Profenophos 50% EC @ 2 ml.L^{-1}	28.33 (32.09)	55.00 (47.91)	63.00 (52.90)
T_7 : Neem oil 0.5% @ 5.00 ml.L^{-1}	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_8 : Dimethoate 30% EC @ 2 ml.L^{-1}	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_9 : Buprofezin 25% EC @ 2 ml.L^{-1}	0.00	0.00	0.00

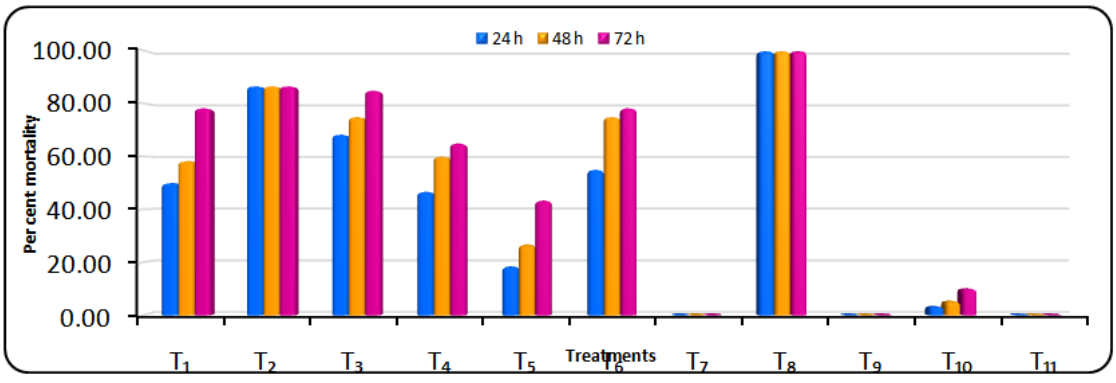
	(0.00)	(0.00)	(0.00)
T_{10} : Flonicamid 50 WG @ 0.30 $g.L^{-1}$	0.00 (0.00)	3.33 (6.14)	6.67 (8.85)
T_{11} : Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
S. Em ±	2.41	1.80	2.19
C. D. at 5%	6.86	5.11	6.23

Figures in the parentheses are angular transformed values

Table 6. Evaluation of toxicity of different insecticides against adult stages of *Cryptolaemusmontrouzieri* by food contamination method

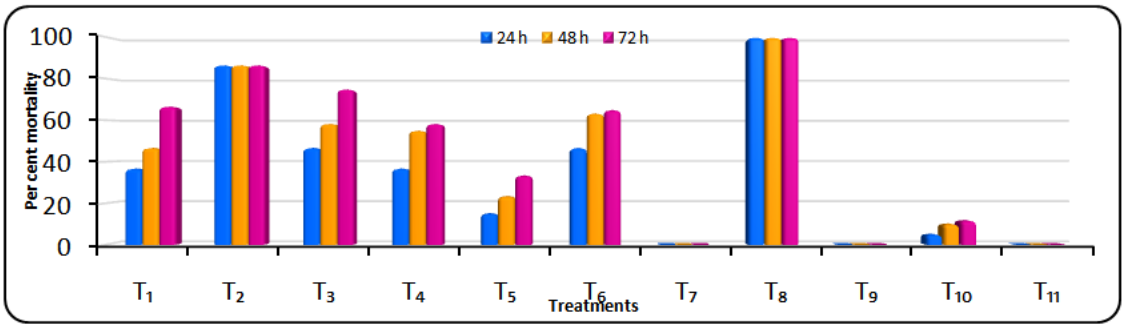
Treatments	**Per cent mortality (Hours after treatment)**		
	24 h	**48 h**	**72 h**
T_1 : Acetamiprid 20% SP @ 0.2 $g.L^{-1}$	23.33 (36.21)	36.67 (43.06)	51.67 (51.89)
T_2 : Acephate 75 SP @ 1.50 $g.L^{-1}$	86.67 (68.82)	86.67 (68.82)	86.67 (68.83)
T_3 : Imidacloprid 200 SL @ 0.25 $ml.L^{-1}$	28.33 (46.90)	55.00 (52.75)	63.33 (58.98)
T_4 : Thiamethoxam 25 WDG @ 0.20 $g.L^{-1}$	18.33 (37.19)	36.67 (43.06)	43.33 (46.90)
T_5 : Dichlorvos 76% EC @ 1 $ml.L^{-1}$	6.67 (19.78)	11.67 (27.66)	15.00 (29.88)
T_6 : Profenophos 50% EC @ 2 $ml.L^{-1}$	28.33 (30.31)	55.00 (54.90)	63.33 (60.08)
T_7 : Neem oil 0.5% @ 5.00 $ml.L^{-1}$	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_8 : Dimethoate 30% EC @ 2 $ml.L^{-1}$	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T_9 : Buprofezin 25% EC @ 2 $ml.L^{-1}$	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_{10} : Flonicamid 50 WG @ 0.30 $g.L^{-1}$	0.00 (0.00)	3.33 (10.57)	6.67 (16.35)
T_{11} : Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
S. Em ±	1.49	1.93	2.51
C. D. at 5%	4.26	5.51	7.12

Figures in the parentheses are angular transformed values



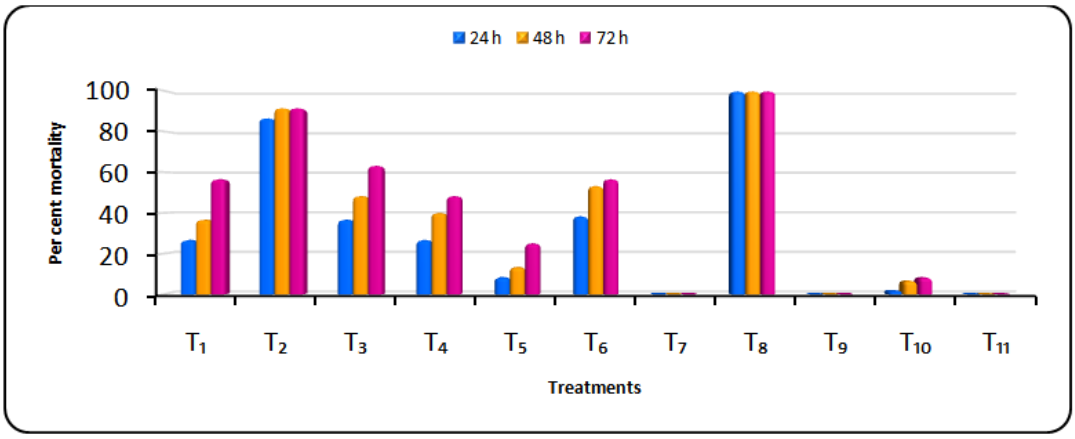
T_1 : Acetamiprid 20% SP @ 0.2 g/lit
T_2 : Acephate 75 SP @ 1.50 g/lit
T_3 : Imidacloprid 200 SL @ 0.25 ml/ lit
T_4 : Thiamethoxam 25 WDG @ 0.20 g/ lit
T_5 : Dichlorvos 76% EC @ 1 ml/lit
T_6 : Profenophos 50% EC @ 2 ml/lit
T_7 : Neem oil 0.5% @ 5.00 ml/lit
T_8 : Dimethoate 30% EC @ 2 ml/lit
T_9 : Buprofezin 25% EC @ 2 ml/lit
T_{10} : Flonicamid 50 WG @ 0.30 g/lit
T_{11} : Untreated control

Fig. 1. Evaluation of toxicity of different insecticides on first instar of *C. montrouzieri*by food contamination method



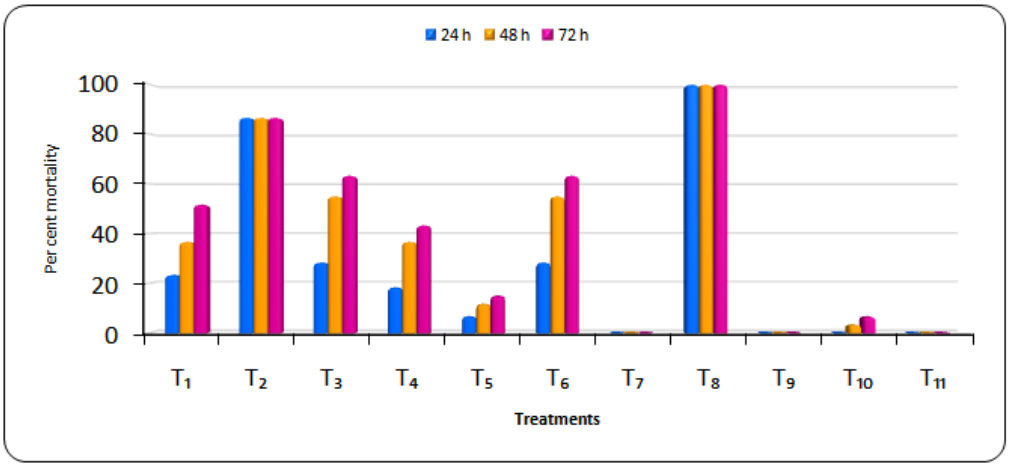
T_1 : Acetamiprid 20% SP @ 0.2 g/lit
T_2 : Acephate 75 SP @ 1.50 g/lit
T_3 : Imidacloprid 200 SL @ 0.25 ml/ lit
T_4 : Thiamethoxam 25 WDG @ 0.20 g/ lit
T_5 : Dichlorvos 76% EC @ 1 ml/lit
T_6 : Profenophos 50% EC @ 2 ml/lit
T_7 : Neem oil 0.5% @ 5.00 ml/lit
T_8 : Dimethoate 30% EC @ 2 ml/lit
T_9 : Buprofezin 25% EC @ 2 ml/lit
T_{10} : Flonicamid 50 WG @ 0.30 g/lit
T_{11} : Untreated control

Fig. 2. Evaluation of toxicity of different insecticides on second instar of *C. montrouzieri*by food contamination method



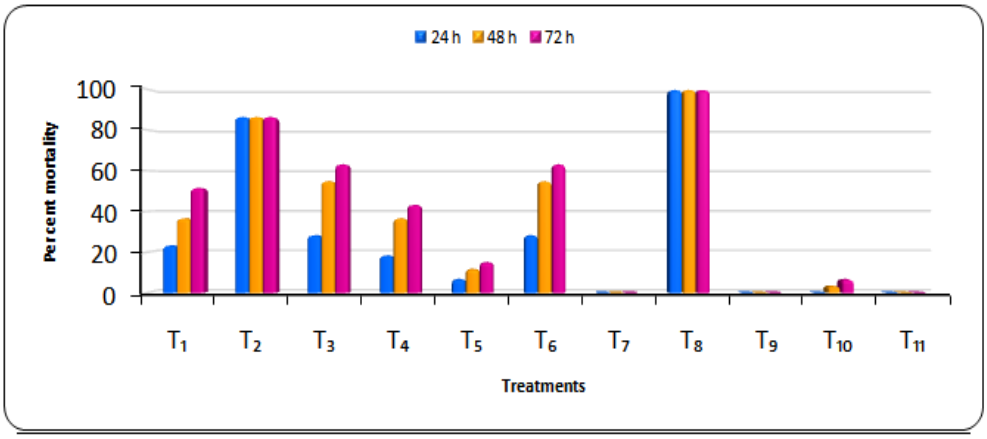
T_1 : Acetamiprid 20% SP @ 0.2 g/lit
T_2 : Acephate 75 SP @ 1.50 g/lit
T_3 : Imidacloprid 200 SL @ 0.25 ml/ lit
T_4 : Thiamethoxam 25 WDG @ 0.20 g/ lit
T_5 : Dichlorvos 76% EC @ 1 ml/lit
T_6 : Profenophos 50% EC @ 2 ml/lit
T_7 : Neem oil 0.5% @ 5.00 ml/lit
T_8 : Dimethoate 30% EC @ 2 ml/lit
T_9 : Buprofezin 25% EC @ 2 ml/lit
T_{10} : Flonicamid 50 WG @ 0.30 g/lit
T_{11} : Untreated control

Fig. 3. Evaluation of toxicity of different insecticides on third instar of *C. montrouzieri*by food contamination method



T_1 : Acetamiprid 20% SP @ 0.2 g/lit
T_2 : Acephate 75 SP @ 1.50 g/lit
T_3 : Imidacloprid 200 SL @ 0.25 ml/ lit
T_4 : Thiamethoxam 25 WDG @ 0.20 g/ lit
T_5 : Dichlorvos 76% EC @ 1 ml/lit
T_6 : Profenophos 50% EC @ 2 ml/lit
T_7 : Neem oil 0.5% @ 5.00 ml/lit
T_8 : Dimethoate 30% EC @ 2 ml/lit
T_9 : Buprofezin 25% EC @ 2 ml/lit
T_{10} : Flonicamid 50 WG @ 0.30 g/lit
T_{11} : Untreated control

Fig. 4. Evaluation of toxicity of different insecticides on fourth instar of *C. montrouzieri*by food contamination method



T_1 : Acetamiprid 20% SP @ 0.2 g/lit
T_2 : Acephate 75 SP @ 1.50 g/lit
T_3 : Imidacloprid 200 SL @ 0.25 ml/ lit
T_4 : Thiamethoxam 25 WDG @ 0.20 g/ lit
T_5 : Dichlorvos 76% EC @ 1 ml/lit
T_6 : Profenophos 50% EC @ 2 ml/lit
T_7 : Neem oil 0.5% @ 5.00 ml/lit
T_8 : Dimethoate 30% EC @ 2 ml/lit
T_9 : Buprofezin 25% EC @ 2 ml/lit
T_{10} : Flonicamid 50 WG @ 0.30 g/lit
T_{11} : Untreated control

Fig. 5. Evaluation of toxicity of different insecticides on adult stages of *C. montrouzieri*by food contamination method

IV. Discussion

The results of the present study are comparable with [13] whose findings revealed that dimethoate was highly toxic to the predatory grubs and adults. [14] reported that buprofezin and neem oil was found to be least toxic. Similarly, [15] reported that flonicamid was least toxic and safest to the predator.

V. Conclusion

Among safety evaluation of different insecticides on life stages of *C. montrouzieri*, dimethoate was found to be highly toxic whereas, flonicamid, buprofezin and neem oil were found to be non- toxic through food contamination method.

Acknowledgement

Bayer crop science is acknowledged for awarding fellowship for post graduate studies.

References

[1]. Mayne, W.W. CryptolaemusmontrouzieriMulsant in South India. Nature. **1953**. 172: 85.
[2]. Chacko, M.J., Bhat, P.K., Ananda Rao, L.V., Deepak Singh, M.B., Ramanarayan, E.P and Sreedharan, K. The use of the lady bird beetle, Cryptolaemusmontrouzierifor the control of coffee mealybugs. Journal of Coffee Research. **1978**. 8: 14-19.
[3]. Mani, M., Jhansilakshmi, V and Krishnamoorthy, A. Side effects of some pesticides on the adult longevity, progeny production and prey consumption of Cryptolaemusmontrouzieri(Coccinellidae: Coleoptera). Indian Journal of Plant Protection. **1997**. 25 (1): 48-55.
[4]. Rao, T.V., Gahani, M.A., Sankaran, T and Mathur, K.C. A review of biological control of insects and other pests in South East Asia and Pacific Region. Commonwealth Institute of Biology and Technology Communication.**1971**.6: 142 pp.
[5]. Babu, T.R and Azam, K.M. Biological control of grape mealybug, Maconellicoccushirsutus(Green). Indian Journal of Plant Protection. **1989**.17:123-126.
[6]. Smith, H.S and Armitage, H. M. Biological control of mealybugs in California. California State Department of Agriculture Monthly Bulletin. **1920**. 9: 104-158.
[7]. Mani, M and Krishnamoorthy, A. Biological suppression of the mealybugs Planococcuscitri(Risso), Ferrisiavirgata(Cockerell) and Nipaecoccusviridis(Newstead) on pummelo withCryptolaemusmontrouzieriMulsant in India. Journal of Biological Control. **2008**. 22: 169-172.
[8]. Shylesha, A.N., Rabindra R.J and Bhumannavar, B.S. The papaya mealybug Paracoccusmarginatus(Coccoidae: Pseudococcidae). Proceedings of the National consultation meeting on strategiesfor deployment and impact of the imported parasitoids of papaya mealybug classical biological control of papaya mealybug Paracoccusmarginatusin India. NBAII, Bangalore. **2011**. pp: 1- 8.
[9]. Singh, S.P. Propagation of a coccinellid beetle for the biological control of citrus and coffee mealybugs. Scientific Conference, December.**1978**. pp. 2.
[10]. Babu, B.G and David, P.M.M. A simple technique for mealybug multiplication on groove less pumpkins. Journal of Biological Control.**1999**.13(1-2): 59-63.
[11]. Padmaja, C.H., Babu, T.R., Reddy, D.D.R and Sriramulu, M. Biology and predation potential of ScymnuscoccivoraAyyar (Coleoptera; Coccinellidae) on mealybug. Journal of Entomological Research society. **1995**.19(1): 79-81.
[12]. Katke, M and Balikai, R. A. Comparative biology of grape mealybug, Maconellicoccushirsutus(Green) on sprouted potato during winter and summer. Indian Journal of Entomology.**2008**.70(4): 395-397.
[13]. Mani, M. and Thontadarya, T.S. Response of *Cryptolaemusmontrouzieri* Muls. (Coccinellidae: Coleoptera) to commonly used pesticides in vineyards. *J. Biol. Control*. **(1988g).**

[14]. Halikatti G, Pokharkar DS, Vibhute S, Upper V. Toxicity of newer insecticides on adults of CryptolaemusmontrouzieriMulsant under laboratory condition. Environment and Ecology. **2014**. 32(3):928-932.
[15]. Cloyd R.A and Dickinson A. Effect of insecticides on mealybug destroyer (Coleoptera: Coccinellidae) and parasitoidLeptomastixdactylopii (Hymenoptera: Encyrtidae), natural enemies of citrus mealybug (Homoptera: Pseudococcidae). Journal of Economic Entomology.**2006**.99(5):1596-1604.

A.Maneesha, et. al. "Safety Evaluation of Certain Insecticides on Cryptolaemusmontrouzieri Mulsant." *IOSR Journal of Applied Chemistry (IOSR-JAC),* 13(10), (2020): pp 19-26.