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Toxicity of insecticides to *Cryptolaemus montrouzieri* (Mulsant)

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ABSTRACT : Study on relative toxicity of different insecticides on larvae and adults of *Cryptolaemus montrouzieri* (Mulsant) revealed that treatments of monocrotofos (0.04 %), malathion (0.1 %), endosulfan (0.075 %), prophenofos (0.075 %) and acephate (0.1 %) proved toxic to the larvae and adults of *C. montrouzieri*. Acetamiprid (0.004 %) was moderately toxic to the larvae and adults while, thiamethoxam (0.005 %) was moderately toxic to the larvae. Chlorpyriphos (50 %) + cypermethrin (5 %) @ (0.055 %) and imidacloprid (0.005 %) were found least toxic to the larvae while, chlorpyriphos (50 %) + cypermethrin (5 %) @ (0.055 %), thiamethoxam (0.005 %) and imidacloprid (0.005 %) were found least toxic to the adults of *C. montrouzieri*.

Key words: *Cryptolaemus montrouzieri,* insecticides and toxicity

Cotton, *Gossypium hirsutum* plays a key role in the national economy in terms of generation of direct and indirect employment in the agricultural and industrial sectors. Due to ready availability of *Bt* cotton seeds since 2002 and apparent advantages over non *Bt* counterparts, *Bt* spread rapidly in India within a short span of time. Changes in insect pest complex were expexted with changed micro-climate. Since 1960 new pest, mealybug which was hitherto not familiar earlier started destroying cotton crops reducing yields up to 40-50 per cent in affected fields. Mealybug infestation was recorded in 2006 on *G. hirsutum* in all cotton growing states of India. Severe economic damage to *G. hirsutum* was reported in 2007 (Dhara, *et al.*, 2008). A survey conducted (Nagrare, *et al.*, 2009) over 47 locations in 9 cotton growing states of India showed that 2 mealybug species, the *solenopsis* mealybug, *Phenococus solenopsis* Tinsley, and the pink hibiscus mealybug, *Maconellicoccus hirsutum* Green, were found to infest cotton plants. However, *P. solenopsis* was observed to be the predominant mealybug species, comprising 95 per cent of the samples examined. *P. solenopsis*, which was not reported to occur in India, now appears to be widespread on cotton in almost all cotton growing states of the country.

Now a days several tactics are adopted in Integrated Pest Management (IPM) programme. Among the various methods of pest management, the biological control is a living weapon over chemical control and is prestigious adoption at global level. Coccinellids contain more than 4000 predacious species having great economic importance, as majority of them are predacious both in larval and adult stages, which frequency suppress the pest population of many crops (Sathe and Bhosle, 2001).

Cryptolaemus montrouzieri is a good predator reported to prey on nearly 25 different species of mealybugs, 8 species of scale insect and 2 species of whitefly and aphid in their both larval and adult stages (Mani and Krishnamoorthy, 1997). In situations where chemical methods are preferred for control of insect pests, it would be ideal to use insecticides that are least harmful to *C. montrouzieri.* With this view, the impacts of some commonly used insecticides were tested for relative susceptibility to *C. montrouzieri* for their safety to the predatory beetle.

Larvae and adults of *C. montrouzieri*, larvae and adults were obtained from laboratory culture and were used in susceptibility test to different insecticides at Biocontrol Laboratory, Department of Agricultural Entomology, Navsari Agricultural University, Navsari during 2009.

Method of insecticidal application : The relative toxicity of insecticides was tested by using the thin film method. Desired concentrations of insecticides were prepared in water. For preparing the insecticidal film, plastic vials (5 x 2.5 cm) were treated by dipping them in respective insecticidal solutions for 2 min. The insecticidal film formed was dried under fan for 15 min. Ten treatments repeated thrice along with control (water dipping) were maintained for each repetition separately. Ten third instar larvae and adults of *C. montrouzieri* were released/treatment/repetition; were allowed to remain in contact with insecticides for 45 mins. Thereafter, larvae and adults were transferred to fresh plastic vials (5 x 2.5 cm) containing 50 mealybug nymphs as food.

Method of recording observations : To evaluate the toxicity of insecticides, 30 third instar larvae and adults of *C. montrouzieri* were released/treatment. Observations on the cumulative mortality of *C. montrouzieri* larvae and adults were recorded at 12, 24, 48 and 72 h after release. The data was statistically analyzed. A laboratory experiment was conducted using completely randomized design (CRD) with 10 treatments, repeated thrice during 2009. The data are presented in Table 1 and 2.

Relative toxicity of different insecticides against larvae *:* Perusal of the cumulative mortality data (Table 1) obtained 12 h after treatment indicated that monocrotophos (0.04 %) caused the highest mortality (98.61%) and thus found to be most toxic to *C. montrouzieri* larvae. This was followed by malathion (0.1 %) (89.97%) which was *at par* with endosulfan (0.075%) (86.97%) and prophenophos (0.075%) (83.61%).While the lowest mortality was exhibited by chlorpyriphos (50 %) + cypermethrin (5 %) (Combi 505) @ (0.055 %) (29.98%) though *at par* with imidacloprid 0.005 %) (33.23%). No mortality occurred in control. It can be seen from the data obtained 24 h after the treatment that monocrotophos (0.04 %), malathion (0.1 %), endosulfan (0.075 %) and prophenofos (0.075 %) showed consistently highest mortality and remained relatively more toxic by causing nearer to cent per cent (99.97%) mortality. Imidacloprid (0.005 %) (46.62%) and chlorpyriphos (50 %) + cypermethrin (5 %) @ (0.005 %) (39.98%) were the least toxic.

The data on per cent cumulative mortality obtained 48 h after treatment indicated that monocrotophos (0.04 %), acephate (0.1 %), malathion (0.1 %), endosulfan (0.075 %) and prophenofos (0.075 %) recorded significantly highest mortality (99.97%), followed by acetamiprid (0.004 %) (63.87%). While treatment chlorpyriphos (50 %) + cypermethrin (5 %) (0.055%) (43.28%) and imidacloprid (0.005 %) (46.62%) remained *at par* with each other and found moderately toxic to the larvae. In the control treatment the lowest mortality was recorded (1.38%) and at 72 h after exposure, the trend was same at 48 h after treatment.

The chronological order of toxicity of different insecticides to third instar larvae of was monocrotofos (0.04 %) > malathion (0.1 %) > endosulfan (0.075 %) > prophenofos (0.075 %) > acephate (0.1 %) > acetamiprid (0.004 %) > thiamethoxam (0.005 %) > imidacloprid (0.005 %) > chlorpyriphos (50 %) + cypermethrin 5 %) (0.055 %).

Relative toxicity of different insecticides against adults : The cumulative mortality data (Table 2) obtained 12 h after treatment indicated that monocrotophos (0.04 %) caused the highest mortality (93.01%) which was *at par* with the treatment malathion (0.1 %) (83.61%) and thus found to be most toxic to the adults. While, a treatment of endosulfan (0.075%) (79.97%) and prophenofos (0.075 %) (76.79%) remained *at par* with each other and found moderately toxic to the adults. The treatment of imidacloprid (0.005 %) (15.57%), chlorpyriphos (50%) + cypermethrin (5 %) (0.055 %) (19.30%) and thiamethoxam (0.005 %) (23.16%) were *at par* with each other, exhibited the lowest mortality and recordded less toxic to the adults. However, the control treatment had the zero (%) mortality.

It can be seen from the data obtained 24 h after the treatment that monocrotophos (0.04%)

Table 1. Relative toxicity of different insecticides against larvae of *Cryptolaemus montrouzieri*

Sr. No.	Treatments	Concentration (%)	Mean per cent mortality at different intervals (h)			
			12	24	48	72
1	Monocrotophos 36SL	0.04	83.22* (98.61)	89.06 (99.97)	89.06 (99.97)	89.06 (99.97)
2	Acephate 75 SP	0.1	54.76 (66.71)	68.83 (86.96)	89.06 (99.97)	89.06 (99.97)
3	Malathion 50EC	0.1	71.54 (89.97)	89.06 (99.97)	89.06 (99.97)	89.06 (99.97)
4	Endosulfan 35 EC	0.075	68.83 (86.96)	89.06 (99.97)	89.06 (99.97)	89.06 (99.97)
5	Thiamethoxam 25WG	0.005	39.22 (39.98)	46.90 (53.31)	50.83 (60.11)	50.83 (60.11)
6	Imidacloprid 17.8SL	0.005	35.20 (33.23)	43.06 (46.62)	43.06 (46.62)	43.06 (46.62)
7	Prophenofos 50EC	0.075	66.12 (83.61)	89.06 (99.97)	89.06 (99.97)	89.06 (99.97)
8	Chlorpyriphos (50%) + Cypermethrin (5%)	0.055	33.20 (29.98)	39.22 (39.98)	41.14 (43.28)	41.14 (43.28)
9	Acetamiprid 20SP	0.004	43.06 (46.62)	48.91 (56.80)	53.05 (63.87)	53.05 (63.87)
10	Control (Water spray)	-	0.91(0.00)	6.75(1.38)	6.75(1.38)	6.7 (1.38)
	General mean	**-**	**49.60**	**60.99**	**64.01**	**64.01**
	S. Em. ±		2.46	2.53	2.88	2.88
	C.D. (p= 0.05)		7.26	7.48	8.48	8.48
	C.V. (%)	-	8.59	7.20	7.78	7.78

* Figures outside the parenthesis are arcsine transformed values

showed consistently the highest mortality and remained relatively more toxic by causing almost to cent per cent (99.97%) mortality. This was *at par* with (0.1 %), endosulfan (0.075 %) and prophenofos (0.075 %) treatments. The toxicity of remaining insecticides in descending order was acephate (0.1 %) > acetamiprid (0.004 %) and imidacloprid (0.005 %) and chlorpyriphos (50 %) + cypermethrin (5%) @ (0.055%) > thiamethoxam (0.005%). The control treatment had zero per cent mortality.

The data on per cent mortality obtained 48 h after treatment indicated that monocrotophos (0.04 %), malathion (0.1 %) and endosulfan (0.075 %) recorded significantly the highest mortality (99.97%), which remained *at par* with the treatment acephate (0.1 %) (98.61%) and prophenofos (0.075 %) (98.61%). The treatment aceamiprid (0.004%) remained moderately toxic by causing (63.51 %) mortality. While, treatment of chlorpyriphos (50 %) + cypermethrin (5 %) (0.055 %) (39.83%), thiamethoxam (0.005%) (36.08%) and imidacloprid (0.005 %) (33.23%) remained at par with one another. The control treatment had zero per cent mortality. At 72 h after exposure, the result was same as at 48 h. The control treatment had zero per cent mortality.

The descending chronological order of toxicity of different insecticides to adults of C. *montrouzieri* were monocrotofos (0.004 %) > malathion (0.1 %) > endosulfan (0.075 %) > prophenofos (0.075 %) > acephate (0.1 %) > acetamiprid (0.004 %) > chlorpyriphos (50 %) + cypermethrin (5 %) (0.055 %) > thiamethoxam (0.005 %) > imidacloprid (0.005 %).

Recorded more or less similar observation and revealed that the order of relative toxicity against adults of *C. montrouzieri* as per persistent toxicity values was monocrotophos (82.86%)> methyl parathion (68.10%)> dichlorvos (52.22%)> malathion (51.93%)> phosalone (32.24%)> agricultural spray oil (31.85%)> dimethoate (27.78%)> methyl demeton (25.26%)> quinalphos (23.19%). They also stated that highest mortality of adults of *C. montrouzieri* was recorded in the treatment of monocrotophos, endosulfan and quinalphos. The present findings support the findings of these workers (Mani and Krishamoorthy, 1997).

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Table 2. Relative toxicity of different insecticides against adults of *Cryptolaemus montrouzieri*

Sr. No.	Treatments	Conccention (%)	Mean per cent mortality at different intervals (h)			
			12	24	48	72
1	Monocrotophos 36SL	0.04	74.67*(93.01)	89.06(99.97)	89.06(99.97)	89.06(99.97)
2	Acephate 75SP	0.1	50.75(59.97)	63.41(79.97)	83.22(98.61)	83.22(98.61)
3	Malathion 50EC	0.1	66.12(83.61)	83.22(98.61)	89.06(99.97)	89.06(99.97)
4	Endosulfan 35EC	0.075	63.41(79.97)	77.38(95.23)	89.06(99.97)	89.06(99.97)
5	Thiamethoxam 25 WG	0.005	28.77(23.16)	32.99(28.60)	36.92(36.08)	36.92(36.08)
6	Imidacloprid 17.8SL	0.005	23.84(15.57)	35.20(33.23)	35.20(33.23)	35.20(33.23)
7	Prophenofos 50EC	0.075	61.20(76.79)	77.38(95.23)	83.22(98.61)	83.22(98.61)
8	Chlorpyriphos (50% + Cypermethrin (5 %)	0.055	26.06(19.30)	35.20(33.23)	39.13(39.83)	39.13(39.83)
9	Acetamiprid 20SP	0.004	41.14 (43.28)	48.83(56.66)	52.84(63.51)	52.84(63.51)
10	Control (Water spray)	-	0.91(0.00)	0.91(0.00)	0.91(0.00)	0.91(0.00)
	General mean	**-**	**43.69**	**54.36**	**59.86**	**59.86**
	S. Em. ±		3.22	3.57	3.59	3.59
	C.D. (p= 0.05)		9.50	10.53	1059	10.59
	C.V. (%)	-	12.77	11.38	10.39	10.39

* Figures outside the parenthesis are arcsine transformed values

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