



## Research Article

## Toxicity of some commonly used insecticides / herbicides on *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae)

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**ABSTRACT:** Study on relative toxicity of different insecticides/ herbicides on grubs and adults of *Zygogramma bicolorata* revealed that chlorpyrifos 0.05 per cent, atrazine 1 kg a.i. per ha, thiomethoxam 0.005 per cent, glyphosate 1 kg a.i. per ha, metribuzin 1 kg a.i. per ha and imidacloprid 0.005 per cent were most toxic to the grubs and adults. Endosulfan 0.075 per cent were moderately toxic to the grubs and adults and dimethoate 0.03 per cent was found moderately toxic to the adults. Moreover, 2, 4-D sodium salt 1 kg a.i. per ha was found to be least toxic to the larvae and adults of *Z. bicolorata*.

**KEY WORDS:** *Zygogramma bicolorata*, insecticides, herbicides, toxicity

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### INTRODUCTION

The Neotropical weed, *Parthenium hysterophorus* L. is a serious weed of agricultural field, pastures and waste lands in most parts of India. The Mexican beetle, *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae) reported to be effective in controlling the Parthenium in India, Australia, Nepal, South America and Vietnam. Both the adults and larvae of *Z. bicolorata* are capable of feeding leaves, terminal buds and leaf blades of parthenium. Since the first release in the field in 1984 at Bangalore, the beetles have established in most part of the South India and many parts of the Central and North India. In many states of India, beetles have established and contributing to the management of several hundred hectares of land fully infested with parthenium (Anonymous, 2010). Hence, by releasing *Z. bicolorata*, parthenium can be managed very effectively and economically without causing hazards to the existing ecosystem. A number of herbicides have been recommended for the control of *P. hystrophorus* in India. *Z. bicolorata*, infesting the parthenium weed in the crop fields are being exposed to the many insecticides applied for the management of crop pests. In situations where chemical methods are preferred, it would be ideal to use insecticides/herbicides that are least harmful to *Z. bicolorata*. With this view, the impacts of some

commonly used insecticides/herbicides were tested for relative susceptibility to *Z. bicolorata* for their safety to the beetle.

### MATERIALS AND METHODS

Larvae and adults of *Z. bicolorata* were reared under laboratory condition for susceptibility test to nine insecticides/herbicides viz., dimethoate @ 0.03%, imidacloprid @ 0.005%, endosulfan @ 0.075%, chlorpyrifos @ 0.05%, thiamethoxam @ 0.005%, 2,4-D sodium salt @ 1 kg a.i./ha, glyphosate @ 1 kg a.i./ha, metribuzin @ 1 kg a.i./ha and atrazine @ 1 kg a.i./ha with control (water) at laboratory conditions. Spray fluid of each insecticide/herbicide was prepared (as per treatment detail) separately in glass jar (10 cm in height and 5 cm in diameter). Fresh leaves of parthenium were plucked from parthenium growing plot, brought to laboratory, cleaned with fresh tap water and allowed to dry. Bouquet of leaves prepared with their cut ends covered with moist cotton swab in order to prevent the leaves from drying during the three days of observation period. The bouquets of parthenium leaves were treated with spray fluid of each insecticide/herbicide with the help of an atomizer, allowed to dry under fan for 15 minutes and then transferred to petridishes (110mm). Ten third instar larvae and ten adults of *Z. bicolorata*

previously starved for 24 hours were released on the “treated leaves kept in petridishes. The petridishes were closed to prevent the loss of moisture from wrapped cotton swab. There were three repetitions for each treatment. Observations on the mortality of *Z. bicolorata* larvae and adults were recorded at 12, 24, 48 and 72 hrs after exposure. The data obtained were statistically analyzed after due arcsine transformations.

## RESULTS AND DISCUSSION

### Against Larva of *Z. bicolorata*

Perusal of the mortality data obtained after 12 hrs of treatments indicated that chlorpyrifos 0.05 per cent caused the highest mortality (59.97%) and thus found to be toxic to the *Z. bicolorata* larvae (Table 1). This was followed by atrazine 1 kg a.i. per ha (49.97%). While the lowest mortality was recorded on plants treated with

2, 4-D sodium salt 1 kg a.i. per ha (2.52%) to the larvae of *Z. bicolorata*. The data obtained after 24 h of the treatments revealed that chlorpyrifos 0.05 per cent and atrazine 1 kg a.i. per ha gave consistently highest mortality and remained relatively more toxic by causing nearer to cent per cent (99.98%) mortality. This was followed by a treatment of glyphosate 1 kg a.i. per ha (79.96%).

The data on per cent mortality obtained 48 h after treatment indicated that chlorpyrifos 0.05 per cent, thiomethoxam 0.005 per cent, glyphosate 1 kg a.i. per ha, metribuzin 1 kg a.i. per ha and atrazine 1 kg a.i. per ha recorded significantly the highest mortality (99.98%), followed by imidacloprid 0.005 per cent (61.20%). While treatment of endosulfan 0.075 per cent (54.76%) and dimethoate 0.03 per cent (56.97%) remained at par with each other and found moderately toxic to the larvae of

**Table. 1** Relative toxicity of different insecticides/ herbicides against larvae of *Zygotogramma bicolorata*

Sl. No.	Treatments	Dose (kg a.i./ha or % solution)	Mean per cent mortality at different intervals			
			12 h	24 h	48 h	72 h
1	Dimethoate 30% EC	0.03%	33.21* (30.00)	48.83 (56.67)	56.97 (70.29)	89.06 (99.98)
2	Imidacloprid 17.8% SL	0.005%	39.22 (39.98)	48.83 (56.67)	61.20 (76.79)	89.06 (99.98)
3	Endosulfan 35% EC	0.075%	18.43 (9.99)	41.14 (43.28)	54.76 (66.70)	89.06 (99.98)
4	Chlorpyrifos 20% EC	0.05%	50.75 (59.97)	89.06 (99.98)	89.06 (99.98)	89.06 (99.98)
5	Thiomethoxam 25% WG	0.005%	39.22 (39.98)	61.20 (76.79)	89.06 (99.98)	89.06 (99.98)
6	2,4-D Sodium salt 80% WP	1 kg a.i./ha	0.91 (2.52)	0.91 (2.52)	30.98 (26.49)	46.90 (53.32)
7	Glyphosate 41% SL	1 kg a.i./ha	26.56 (19.99)	63.41 (79.96)	89.06 (99.98)	89.06 (99.98)
8	Metribuzin 70% WP	1 kg a.i./ha	33.20 (29.99)	54.76 (66.70)	89.06 (99.98)	89.06 (99.98)
9	Atrazine 40% WP	1 kg a.i./ha	44.98 (49.97)	89.06 (99.98)	89.06 (99.98)	89.06 (99.98)
10	Control (Water)	–	6.75 (1.38)	6.75 (1.38)	6.75 (1.38)	6.75 (1.38)
	General Mean	–	29.32	50.39	65.60	76.61
	SEm. ±	–	1.85	2.33	2.48	1.94
	C.D. at 5%P	–	5.45	6.86	7.30	5.74
	C.V. %	–	10.91	8.00	6.54	4.40

\* Figures outside the parenthesis are arcsine transformed values

*Z. bicolorata*. In the treatment of 2,4-D sodium salt 1 kg a.i. per ha lowest mortality was recorded (26.49%).

At 72 h after exposure, significantly higher cumulative mortality (99.98%) was recorded in the treatments of dimethoate 0.03 per cent, imidacloprid 0.005 per cent, endosulfan 0.075 per cent, chlorpyrifos 0.05 per cent, thiomethoxam 0.005 per cent, glyphosate 1 kg a.i. per ha, metribuzin 1 kg a.i. per ha and atrazine 1 kg a.i. per ha. However, the treatment of 2, 4-D sodium salt 1 kg a.i. per ha was found moderately toxic (46.90%) to the larvae of *Z. bicolorata*. Jayanth and Bali (1993) recorded more or less similar observations and revealed that glyphosate 4 kg a.i. per ha and 2, 4-D Na salt 4 kg a.i. per ha were found to be safer against larvae of *Z. bicolorata*. While, a treatment atrazine 3 kg a.i. per ha (30%), pendimethalin 1 kg a.i. per ha (10%) and diuron 2.5 kg a.i. per ha (10%) were found to be less hazardous. Whereas, paraquat 2 kg

a.i. per ha recorded highest mortality (52%) of *Z. bicolorata* larvae. The findings of above workers more or less support the present findings.

#### Against adults of *Z. bicolorata*

The mortality data obtained 12 h after treatment indicated that metribuzin 1 kg a.i. per ha caused the highest mortality (53.32%) which was at par with the treatment chlorpyrifos 0.05 per cent (49.97%) and thus found to be toxic to the adults of *Z. bicolorata* (Table 2). It can be seen from the data obtained 24 h after treatment that chlorpyrifos 0.05 per cent and metribuzin 1 kg a.i. per ha showed consistently the highest mortality and remained relatively more toxic by causing nearer to cent per cent (99.98%) mortality. This was followed by the treatment of atrazine 1 kg a.i. per ha (76.79%). The data on per cent mortality obtained

**Table. 2** Relative toxicity of different insecticides/ herbicides against adults of *Zygotogramma bicolorata*

Sl. No.	Treatments	Dose (kg a.i./ha or % solution)	Mean per cent mortality at different intervals			
			12 h	24 h	48 h	72 h
1	Dimethoate 30% EC	0.03%	30.98* (26.50)	43.06 (46.62)	58.98 (73.44)	83.22 (98.60)
2	Imidacloprid 17.8% SL	0.005%	26.55 (19.98)	46.90 (53.32)	66.12 (83.61)	77.38 (95.22)
3	Endosulfan 35% EC	0.075%	35.20 (33.22)	48.83 (56.67)	61.20 (76.79)	89.06 (99.98)
4	Chlorpyrifos 20% EC	0.05%	44.98 (49.97)	89.06 (99.98)	89.06 (99.98)	89.06 (99.98)
5	Thiomethoxam 25% WG	0.005%	35.20 (33.22)	58.98 (73.44)	89.06 (99.98)	89.06 (99.98)
6	2,4-D Sodium salt 80% WP	1 kg a.i./ha	0.91 (0.03)	12.59 (4.75)	35.20 (33.22)	41.14 (43.28)
7	Glyphosate 41% SL	1 kg a.i./ha	37.21 (36.57)	54.76 (66.70)	89.06 (99.98)	89.06 (99.98)
8	Metribuzin 70% WP	1 kg a.i./ha	46.90 (53.32)	89.06 (99.98)	89.06 (99.98)	89.06 (99.98)
9	Atrazine 40% WP	1 kg a.i./ha	39.22 (40.07)	61.20 (76.79)	89.06 (99.98)	89.06 (99.98)
10	Control (Water)	–	0.91 (0.03)	0.91 (0.03)	0.91 (0.03)	0.91 (0.03)
	General Mean	–	29.81	50.53	66.77	73.70
	SEm. ±	–	1.78	2.43	1.46	2.68
	C.D. at 5%P	–	5.26	7.17	4.29	7.91
	C.V. %	–	10.35	8.33	3.77	6.30

\* Figures outside the parenthesis are arcsine transformed values

after 48 h of treatment indicated that chlorpyrifos 0.05 per cent, thiamethoxam 0.005 per cent, glyphosate 1 kg a.i. per ha, metribuzin 1 kg a.i. per ha and atrazine 1 kg a.i. per ha caused significantly highest mortality (99.98%), which was followed by the treatment of imidacloprid 0.005 per cent (83.61%). However, the treatment of 2, 4-D sodium salt 1 kg a.i. per ha caused minimum mortality (33.22%) to the adults of *Z. bicolorata*. At 72 h after exposure, significantly higher cumulative mortality (99.98%) was recorded in the treatments of endosulfan 0.075 per cent, chlorpyrifos 0.05 per cent, thiomethoxam 0.005 per cent, glyphosate 1 kg a.i. per ha, metribuzin 1 kg a.i. per ha and atrazine 1 kg a.i. per ha and were at par with dimethoate 0.03 per cent (98.60%) and imidacloprid 0.005 per cent (95.22%). However, the treatment of 2, 4-D sodium salt 1 kg a.i. per ha was moderately toxic (43.28%) to the adults of *Z. bicolorata*. Jayanth and Bali (1993) recorded more or less similar observations and revealed that paraquat 2 kg a.i. per ha caused 20 per cent mortality to adults of *Z. bicolorata*. Whereas, butachlor 2 kg a.i. per ha, fluchloridone 2 kg a.i. per ha, fluazifop-butyl 0.75 kg a.i. per ha, glyphosate 4 kg a.i. per ha, and 2, 4-D Na salt 4 kg a.i. per ha were

found safe to adults of the *Z. bicolorata*. The findings of above workers support the present findings.

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