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CONSEQUENCE OF SOME INSECTICIDES ON PREDATOR *COCCINELLA SEPTEMPUNCTATA*

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ABSTRACT

Studies were undertaken in the field and laboratory to investigate the effects of some insecticides viz., Diazinon, Fenitrothion, Cypermethrin and Chlorpyrifos used against mustard aphid *Lipaphis erysimi* (Kalt) or the predator, *Coccinella septempunctata* L. during November 2004 to February 2005 at the Sher-e-Bangla Agricultural University farm, Dhaka. The experiment was laid out in a randomized block design and replicated five times. Insecticides were sprayed @ 0.05% on 27 December 2004 and on 12 January 2005. Records on the mortality of mustard aphid and toxic effect on the predators under the different treatments were made at 1, 4 and 7 days after first and second spraying. The percent reduction of aphid infested plant, percent reduction of aphid population and percent reduction of the predator varied at different level of significant. The mortality of aphid, larvae and adult of the predator were significant at various levels. Mortality of the aphid reached highest after 24 hours of spraying. Cypermethrin was the most effective insecticide causing the highest mortality of mustard aphid and less toxic effect on the predator. Cypermethrin showed higher effectiveness than other three insecticides in increasing various growth parameters and seed yield of mustard. Considering benefit cost ratio (BCR), Cypermethrin was found to be the most economic and effective insecticide in controlling *L. erysimi.* and most safer for predator lady bird beetle.

Key words: Insecticides, predator, *Coccinella septempunctata*, toxicity, mustard

INTRODUCTION

Mustard (*Brassica* sp.) is one of the major oil seed crops in Bangladesh which is widely cultivated during the winter season and its contribution in total seed production is approximately 70%. The crop is well adapted to almost all agro-climatic zones of the country. Production of mustard is very low in Bangladesh in compared to other countries of the world. About 279235 hectares of land were used for mustard cultivation which produced 520108 tones of mustard but the average mustard production was only 753 kg ha^{-1} (BBS, 2005). The infestation by mustard aphid is one of the most important factors for lower yield of this oil seed crop. The mustard aphid, *Lipaphis erysimi* (Kalt.) (Aphididae ; Homoptera) is the most damaging pest of mustard in Bangladesh (Alam *et al.*,1964a; Ahmed *et al.,* 1977; Haque and Miah 1979; and Das and Islam, 1986). It is also a pest of many cruciferous vegetables (Kim *et al.,* 1986; and Lee, 1988). The pest is distributed in Bangladesh, India, Pakistan, U.S.A and many other countries of the world and is recognized as a serious pest of mustard (Arora *et al.*, 1969; Jarvis, 1970; Mukhopadhayay and Ghosh, 1979; and Hamid and Ahmed, 1980). The mustard aphid occurs in the field during December to February. Both the nymphs and adults cause damage to mustard plant from seedling to maturity (Verma and Singh, 1987) but maximum damage is caused at flowering stage (Brar and Sandu, 1974). They suck sap from leaves, flowers, flower-buds, pods and twigs of the plants and secrete sticky honeydew which acts as a medium for sooty mold fungus. As a result, the photosynthetic efficiency of the plant is reduced. The aphid infestation also causes stunted growth of plant. Severely attacked plants often fail to bear pods or end up with very poor pod settings (Das and Islam, 1986). In Bangladesh, very little report is available on the estimation of damages caused by this pest. But it is reported from India that the yield losses to rapeseed/ mustard due to the attack of *L. erysimi* alone varied from 35.4 to 96% depending upon the season (Sidhu and Singh, 1964; Saini and Chabra, 1966; Chanal and Sukhija, 1969; Singhvi *et al.*, 1973; Phadke, 1980; and Bakhetia, 1983).

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The predacious coccinellid beetles, commonly known as lady bird beetles are considered to be of great economic importance in the agro ecosystem. They have been successfully employed in the bio-control of many injurious insects (Nasiruddin and Islam, 1979; and Aggarwal *et al.*, 1988). In the mustard field aphid is naturally controlled to a large extent by its predator *Coccinella septempunctata* and plays a vital role in lowering the population of mustard aphid (Kalra, 1988). The control of aphids in Bangladesh is principally carried out by the conventional use of insecticides. Many workers have tried to control this pest with varying degrees of success by frequent application of insecticides as foliar treatments (Chowdhury and Roy, 1975). It is difficult to evaluate the effectiveness of particular synthetic insecticides out of many commercially available ones against a certain insect pest. These chemicals should be applied at appropriate dose and at right time against the target pests. For controlling the mustard aphid successfully and to save *C. septempunctata,* judicious application of insecticides is essential. The present study was undertaken to evaluate the consequences of some selected insecticides on the predaceous lady bird beetle, *Coccinella septempunctata*

MATERIALS AND METHODS

The study was laid out at experimental term of Sher-e-Bangla Agricultural University (SAU), Dhaka, Bangladesh during the rabi season, November, 2004 to February,2005 in randomized completely block design(RCBD) with five replication. There were 5 treatments including an untreated control were considered. The plot size was 4m x 2.5m having block to block distance 1m and plot to plot distance of 0.5m. The variety tori-7 was used as planting materials and seeds were sown in rows. All the test insecticides were liquid formulation and applied @ 0.05%. The application of insecticides was done twice, one in 45 days after sowing (DAS) and 65 DAS for controlling mustard aphids. The egg masses of *C. septempunctata* were collected from the field and reared in the laboratory to maintain a stock culture. Just after hatching of eggs, two newly hatched grubs were transferred to a petridishes and 100 mustard aphids of mixed aged and size were supplied to the predator's everyday on a mustard leaf. The base of the leaf was wrapped by a water soaked cotton ball to keep it fresh. The number of aphids consumed by each grub per day was recorded and it was continued up to its pupation. This experiment was laid out in a completely randomized design with five replications. For determining the predation efficiency of adult predator, one male and one female beetle were transferred to new petridishes. The adult beetles were collected from stock culture. The adults were provided with 150 aphids daily. The number of aphids consumed per adult per day were recorded daily. It was continued up to 30 days. This experiment was laid out in a completely randomized design with five replications. Adults and grubs of the predator were reared on mustard aphids for stock culture as described. At the flowering stage of mustard plant, insecticides were sprayed @ 0.05%. The untreated pots received no insecticides to study the consequence of insecticides on predator grubs and adults the following procedure was adopted. Just after spraying, the treated leaves were collected from the pots and kept in separate pertridishes under laboratory condition. Five 4th instar grub were taken from the stock culture and were released in the petridishes containing treated leaves. The untreated leaves were supplied to the grub in the same way. The mortality counts were taken at 1, 4 and 7 days after insecticide application (DAA). Mortality data were corrected by Abbott's (1925) formula-

$$\text{Corrected mortality} = \frac{\text{Observed mortality-Control mortality}}{\text{100-Control mortality}} \times 100$$

Similar procedures were also followed for other predators.

RESULTS AND DISCUSSION

Effect of insecticides on percent reduction of the predator *C. septempunctata* after first spray in the mustard

Insecticides effect on percent reduction of the predator *C. septempunctata* after the first spray as the field varied significantly (P> 0.01). Table 1 show that percent reduction of the predator ranged from 43.28 to 83.50 % at 1 DAA, 34.84 to 76.30 % at 4 DAA, and 28.92 to 79.56% at 7 DAA. The effect of insecticides on the predator 1 day after application (DAA) revealed that Fenitrothion provided the highest percent reduction of the predator (83.50%) and Cypermethrin resulted in the lowest reduction of the predator (43.28%), which were significantly different from each other at 4 DAA. The highest percent reduction of *C. septempunctata was* observed in the plots treated with Fenitrothion (76.30%), which was statistically similar to that Chlorpyrifos (70.24%). The lowest percent reduction of the predator was observed in the plots of Cypermethrin (34.84%), which were significantly different from other treated plots at 7 DAA the highest percent reduction of the lady bird beetle (79.56%) was found in the Fenitrothion treated plots and the lowest reduction was calculated from the plots treated with Cypermethrin (28.92%) and these were significant different from each other. All these insecticides (0.05%) affect lady bird beetle but Cypermethrin was the most responsible for the suppressing the predator.

Table 1. Effect of four insecticides on percent reduction of the predator *C. septempunctata* after first spray of insecticides in the mustard field at different days of application (DAA)

Name of insecticides		**Dose (%)**	**% Reduction of the predator *C. septempunctata.***		
Trade name	Common name		1DAA	4DAA	7DAA
Diazinon 60 EC	Diazinon	0.05	59.04 c	51.52 b	48.52 c
Sumithion 60 EC	Fenitrothion	0.05	83.50 a	76.30 a	79.56 a
Cymbush 10 EC	Cypermethrin	0.05	43.28 d	34.84 c	28.92 d
Dursban 20 EC	Chlorpyrifos	0.05	73.26b	70.24a	67.24b
Level of significance			0.01	0.01	0.01
CV (%)			7.71	11.26	5.46
Sx			2.016	2.931	1.369
Mean			64.77	58.24	56.11

Effect of insecticides on percent reduction of the predator *C. septempunctata* after second spray in the mustard field.

Percent reduction of the predator was influenced by insecticides at different days after application (DAA). The results on percent reduction of the predator after second spray is presented in the Table 2. Percent reduction of the predator *C. septempunctata* ranged from 38.30 to 78.74% at 1 DAA, 25.96 to 82.12% at 4 DAA and 32.46 to 80.64% at 7 DAA. The effect of insecticides on percent reduction of the predator at 1 DAA indicated that the application of Fenitrothion provided the highest percent reduction of the predator (78.74%) and the application of Cypermethrin gave the lowest percent reduction of the predator (38.30%) and they were significantly different from each others. At 4 DAA the treatment of Fenitrothion resulted the highest percent reduction of the predator *C. septempunctata* (82.12%) and the treatment of Cypermethrin provided the lowest percent reduction of the predator (25.96%), and the were significantly different from each others. AT 7 DAA the highest percent reduction of the predator *C. septumpunctata* (80.64%) was obtained in the plots treated with Fenitrothion and the lowest percent of predator reduction

(32.46%) was found in the plots treated with Cypermethrin and they were significantly different from each others. From this study it was evident that Fenitrothion was highly toxic to the predator *C. septempunctata*. On the other hand, Cypermethrin found to be safer insecticide both after first and second spray. Olszak (1982) reported that Fenitrothion had very high immediate toxicity and remained toxic for a relatively long period. Sharma and Adlakhal (1986) reported that Fenitrothion was the most harmful to the predator. All these findings are in agreement with the findings of the present study. Few variations were found which might be due to the variation of insecticides and location.

Table 2. Effect of four insecticides on percent reduction of the predator *C. septumpunctata* after second spray insecticide in the mustard field at different days after application (DAA)

Name of insecticides		Dose (%)	% Reduction of the predator *C. septempunctata*		
Trade name	Common name		1DAA	4DAA	7DAA
Diazinon 60 EC	Diazinon	0.05	47.08c	39.58c	41.7bc
Sumithion 60 EC	Fenitrothion	0.05	78.74a	82.12a	80.64a
Cymbush 10 EC	Cypermethrin	0.05	38.30d	25.96d	32.46d
Dursban 20 EC	Chlorpyrifos	0.05	57.38b	53.69b	57.46b
Level of significance			0.01	0.01	0.01
CV (%)			4.59	5.66	10.17
Sx			1.225	1.275	2.415
Mean			55.38	50.41	53.08

Predation efficiency of the grub C. *septempunctata* under laboratory condition

The results on predation efficiency of the grub *C. septempunctata* are presented in Table 3. The average feeding rate of the grub *C. septempunctata* during first day after hatching was 6.40±3.05 aphids. From the next day their feeding rate gradually increased and rose up to 53.00±8.34 aphids per day on the 8th day. There after it again started to decline and on the 10th day, the feeding rate was only 11.80± 4.44 aphids. This was due to initiation prepupal stage. From this study it was observed that a grub consumed on an average 224.60 aphids per day prior to pupation. Islam and Nasiruddin (1978) mentioned that *C. septempunctata* grub consumed on an average 3.5 cotton aphids *(A. gossypii)* during first day 24 hours after hatching. Consumption reached up to a maximum of 58.0 aphids per day on the 9th day. Lakhapal *et al.* (1998) found that *C. septempunctata* grub consumed a total of 215.42±15.2 aphids per day in the grub stages. The predation efficiency of the grub in the present study is similar to the finding of the above authors. However, the total aphid consumption differed which might be due to offering different prey size and prey quality.

Table 3. Number of aphids consumed by a grub of different aged *Coccinell septempunctat* under laboratory condition

Age of grub (days)	Aphid consumption rate Number ± SD
1st	6.40 ± 3.05
2nd	8.40 ± 3.78
3rd	15.60±3.36
4th	18.40±4.78
5th	21.40±4.28
6th	25.00±6.08
7th	26.00±6.67
8th	53.00±8.34
9th	38.60 ± 7.20
10th	11.80 ± 4.44

Predation rate of the adult *C. septempunctata* under laboratory condition

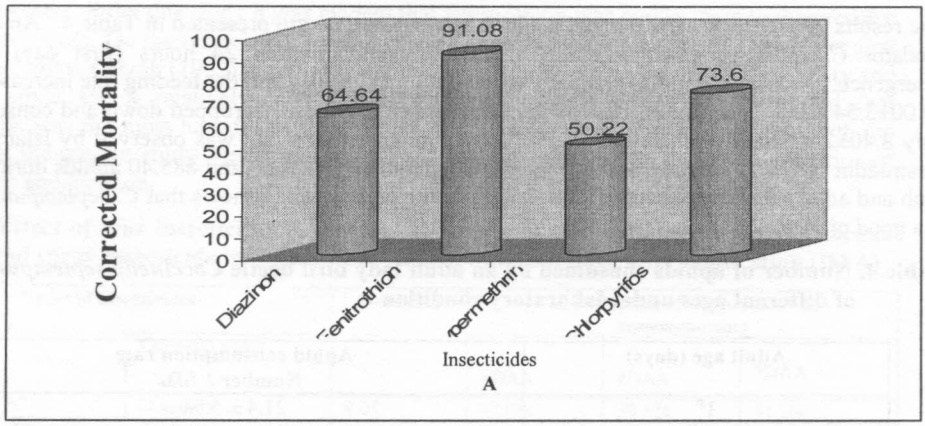
The results of predation efficiency of adult *C. septempunctata* are presented in Table 4 . An adult predator *C. septempunctata* consumed 21.4±5.94 aphids within 24 hours (first day) after emergence. Their consumption gradually increased up to 7th day and the feeding rate increased to 69.00±3.54 aphids per day on the 7th day. There after it gradually dropped down and consumed only 8.40±2.07 aphids per day on the 30th day. Similar feeding rate was observed by Islam and Nasiruddin (1978). This lady bird beetle consumed a total of 224.60 and 885.40 aphids during its grub and adult stage, respectively. The finding of the present study shows that *C. septempunctata* is a good predator of *L. erysismi*

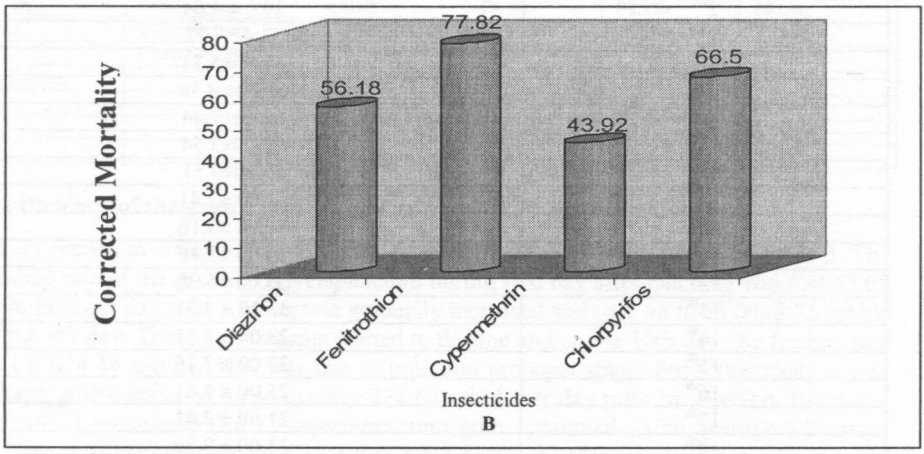
Table 4. Number of aphids consumed by an adult lady bird beetle *Coccinella septempunctata* of different ages under laboratory condition

Adult age (days)	Aphid consumption rate Number ± SD
1st	21.4 ± 5.94
2nd	30.4 ± 4.04
3rd	32.4± 7.72
4th	48.00±5.34
5th	61.20± 8.38
6th	62.40±7.44
7th	69.00±3.54
8th	59.60±3.51
9th	51.60 ±2.41
10th	40.00 ±3.16
11th	33.00 ±3.16
12th	33.00 ±6.08
13th	32.20 ± 4.21
14th	28.00 ± 3.81
15th	27.00 ± 3.16
16th	25.00 ± 3.61
17th	21.60 ± 2.41
18th	21.00 ± 3.39
19th	20.80 ± 1.92
20th	20.40 ± 3.98
21st	20.00 ± 4.64
22nd	18.00 ± 4.36
23rd	18.00 ± 4.30
24th	17.00 ± 2.24
25th	16.00 ± 2.24
26th	14.00 ± 2.55
27th	14.00 ± 2.55
28th	12.00 ± 3.74
29th	10.00 ± 2.24
30th	8.40 ±2.07

Effect of insecticides on the mortality of fourth instar grub of *Coccinella septempunctata* under laboratory condition

Insecticides had a significant (P>0.01) effect on the mortality of fourth instar grub *C. septempunctata* obtained at different sampling dates. The corrected mortality of fourth instar grub varied from 50.22 to 91.08% at 1 DAA, 43.92 to 77.82% at 4 DAA and 38.5 to 67.06% at 7 DAA. The percent corrected mortality of 4th instar larvae at 1, 4 and 7 DAA with different insecticides are presented in figure 1 (A,B,C).





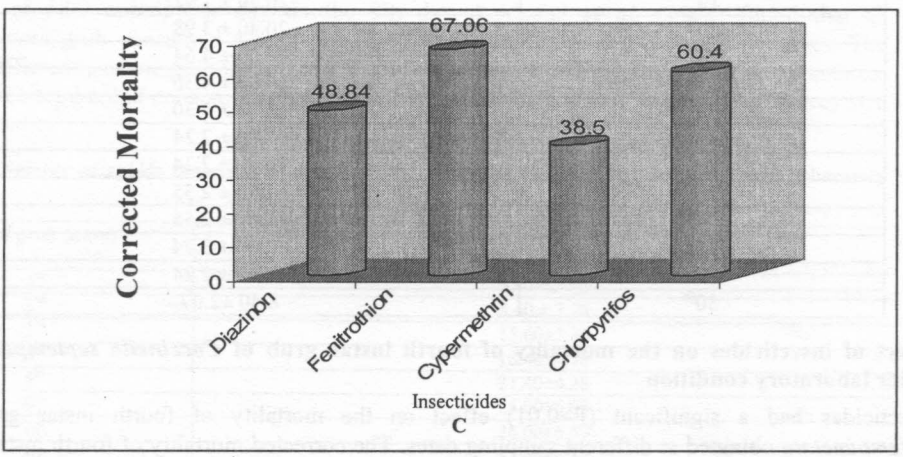


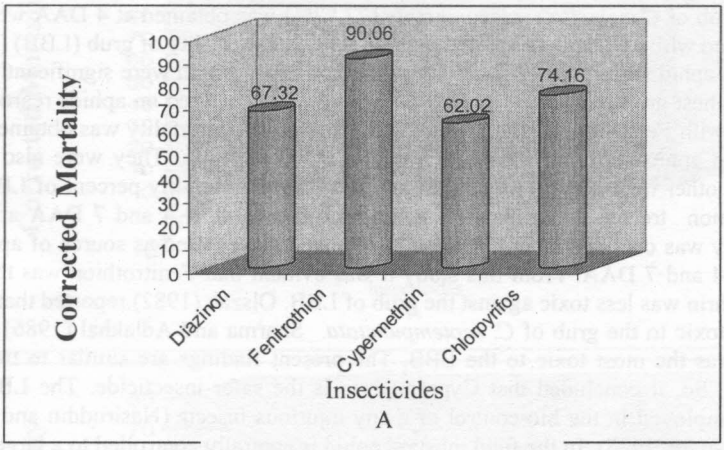
Fig 1. Corrected mortally of 4th instar grub of *Coccinella septempunctata* feeding on mustard leaves treated with four selected insecticides (0.05%) and recorded at 1,4 & 7 Days after application under laboratory environment.

The highest corrected mortality of grub (lady bird beetle, LBB) (91.08%) at 1 DAA was observed when they fed on aphides reared in the leaves treated with Fenitrothion and the lowest corrected morality of grub (50.22%) was obtained while feeding on the leaves sprayed with Cypermethrin and they were significantly different from each others. On the other hand the highest corrected mortality of grub of *Coccinella septempunctata* (77.82%) was obtained at 4 DAA when aphid fed on leaves treated with Fenitrothion and the lowest corrected mortality of grub (LBB) (43.92%) was recorded when aphid fed on leaves treated with Cypermethrin which were significantly different to others. The highest grub mortality of LBB was noted when they fed on aphids reared on mustard leaves treated with Fenitrothion (67.06%) and the lowest larval mortality was obtained when LBB fed on mustard aphid reared on leaves treated with Cypermethrin. They were also significantly different from other treatments. The highest corrected larval mortality percent of LBB was noted from Fenitrothion treated leaves used as aphid food source at 1, 4 and 7 DAA and the lowest larval mortality was obtained from Cypermethrin treated leaves used as source of aphid food bud retarded at 1, 4 and 7 DAA. From this study it was evident that Fenitrothion was the most toxic and Cypermethrin was less toxic against the grub of LBB. Olszak (1982) reported that Fenitrothion was the most toxic to the grub of *C. septempunctata.* Sharma and Adlakhal (1986) reported that Fenitrothion was the most toxic to the LBB. The present findings are similar to the findings of above authors. So, it concluded that Cypermethrin is the safer insecticide. The LBB have been successfully employed in the bio-control of many injurious insects (Nasiruddin and Islam, 1979; and Aggarwal *et al.,* 1988). In the field mustard aphid is naturally controlled to a large extent by its predator *Coccinella septempunctata* and plays a vital role in lowering the population of mustard aphid (Kalra, 1988).

Effect of insecticides on the morality of adult *C. septempunctata* under laboratory condition

Effect of insecticides on the mortality of adult predator *C. septempunctata* was statistically (P>0.01) varied at different samplings dates. The corrected mortality percent of adult predator *C. septempunctata* when fed on aphids reared on treated leaves of mustard with four selected insecticides at different days after spraying were different under laboratory condition (figure 2). The corrected mortality percent of adult *C. septempunctata* feeding on aphid reared on leaves treated with various insecticidal treatments ranged from 62.02 - 90.06% at 1 day, 54.56 to 73.30 at 4 days, and 40. 44 to 66.78% at 7 days after application (DAA). 1 DAA: The corrected mortality percent of adult *C. septempunctata* was the highest (90.06%) when fed on aphid reared on leaves treated with Fenitrothion and the lowest (62.02%) was recorded from Cypermethrin, at 1 DAA. They were significantly different from the others. 4 DAA. The highest corrected mortality of adult *C. septempunctata* was noted when LBB feed on aphid reared on leaves treated with Fenitrothion (73.30%) which was statistically similar to those of Chlorpyrifos treated ones (70.32%) at 4 DAA the lowest corrected mortality of adult *C. septempunctata* was noted we consuming aphids reared on leaves treated with Cypermethrin (54.56%), which was statistically similar to those of Diazinon (61.06%). The highest corrected mortality of adult predator was found when they ate aphids reared on leaves treated with Fenitrothion (66.78%) and the lowest corrected mortality of adult predator was found from those of Cypermethrin (40.44%). This were significantly different from all other treatments.At 1, 4 and 7 DAA, the highest corrected mortality of adult predator *C. septempunctata* was noted when Fenitrothion treated leaves was used as aphid food and the lowest from Cypermethrin treated leave sources. From this study, it was evident that Fenitrothion was the most toxic than the other insecticides and Cypermethrin was less toxic among these. Grub of *C. septempunctata* was less susceptible to the insecticides than their adult forms. Significant reduction of corrected mortality was found 1 DAA of insecticides than those at 4 and 7 DAA indicating the declining effectiveness with the elapse of time. Significantly the highest corrected mortality of adult *C. septempunctata* was observed Fenitrothion treated leaves as aphid diet source recorded at 1, 4 and 7 DAA of insecticides.

Olszak (1982) stated that malathion and Fenitrothion had very high immediate toxicity to egg, larva, pupa and the adult *C. septempunctata*.



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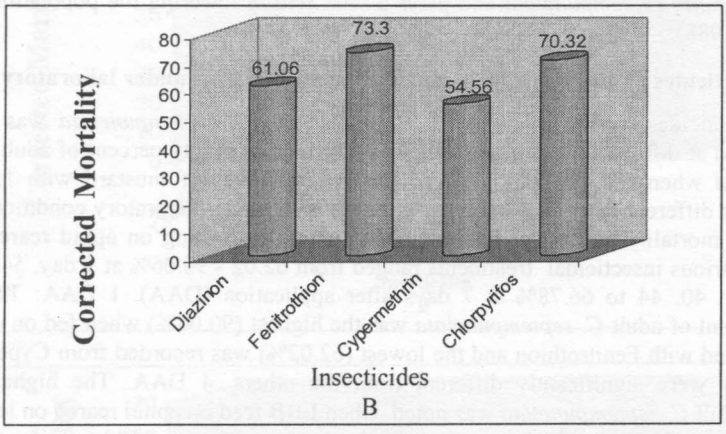

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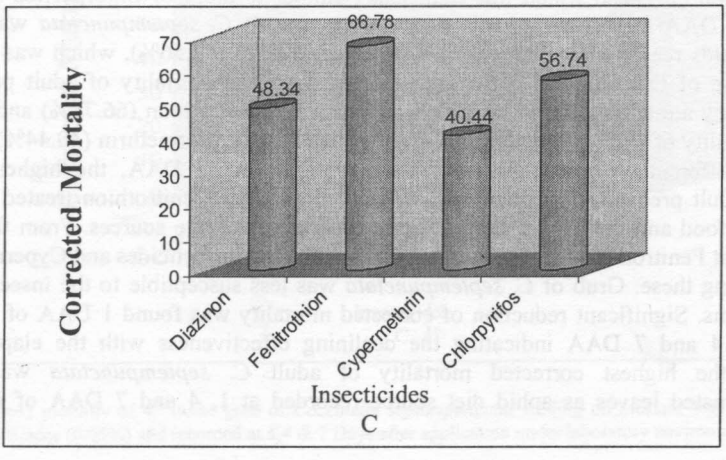

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Fig 2. Corrected mortally of adult *Coccinella septempunctata* feeding on mustard leaves treated with four selected insecticides (0.05%) and recorded at 1.4 & 7 Days after application under laboratory environment.

These findings have similarity with the present findings. Almost similar result was obtained with the application of Fenitrothion against *C. septempuncata* by Sharma and Adlakhal, 1986. It is evident from the study that Cypermethrin would be an appropriate choice for controlling the mustard aphid with minimum toxic affect on LBB.

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