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EVALUATION OF DIFLUBENZURON AGAINST CABBAGE SEMILOOPER, *THYSANOPLUSIA ORICHALCEA* (FAB.)

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ABSTRACT

Diflubenzuron was tested against eggs (0-24, 24-48 and 48-72 hours old), larvae (II & V instars) and pupae (0-2 days old) of cabbage semilooper, *Thysanoplusia orichalcea* (Fab.) Unhatched eggs ranged from 34.67-100.00, (0-24 h) 30.67-77.33 (24-48 h) and 28.00-73.33 (48-72 h) per cent when exposed to different concentrations (50, 100, 150, 200 and 250 ppm). The per cent larval mortality ranged from 28.00-58.00 and 28.00-50.00 for IInd and V instar larvae, respectively as against 14.00 and 12.00 per cent in untreated control, when exposed to concentrations of 50, 100, 200, 500 and 1000 ppm applied by feeding and ingestion methods. Tested compound showed prolonged larval duration, extended pupal period and decreased adult emergence of *T. orichalcea* through larval treatment. Similarly, pupal exposure to this compound resulted in prolonged pupal period and reduced adult emergence. Besides a number of morphological deformities were also observed in all treated juvenile stages (eggs, larvae and pupae).

Key words: Diflubenzuron, *Thysanoplusia orichalcea* (Fab.), deformities-juvenile stages.

INTRODUCTION

Cabbage semilooper, *Thysanoplusia orichalcea* (Fab.) is an important polyphagous insect pest, which causes tremendous losses to cauliflower, cabbage and many other vegetables from seeding to the harvesting stage. Besides, it has been recorded on pulses, oilseeds and tobacco, etc. (Atwal, 1986). Diflubenzuron, an insect growth regulator (IGR), interferes with chitin synthesis either by ingestion or contact, and its lethal effects are manifested at the subsequent ecdysis when death is caused by inhibiting the formation of new cuticle by preventing terminal polymerisation in chitin synthesis pathway (Mitsui *et al.*, 1984). Its insecticidal properties with characteristic mortality symptoms and effects on growth and development at the time of moulting have been described for several insects (Retnakaran *et al.*, 1985) which ultimately results into various morphogenetic deformities (Van Daalin *et al.*, 1972). Looking to its broad-spectrum effect, it has been tested against the cabbage semilooper in the present investigation.

MATERIALS AND METHODS

Culture of *Thysanoplusia orichalcea* (Fab.) was maintained in the laboratory on leaves of Japanese mint, *Mentha arvensis* in a BOD incubator maintained at 25±2°C temperature and 70-90 per cent relative humidity. Rearing was done collectively in sterilised rearing trays (60 × 30 cm) that were cleaned everyday to remove the excreta followed by provision of fresh food. After pupation they were transferred to separate sterilised specimen tubes and kept in incubator for adult emergence. The newly emerged moths were released in battery jars (46 × 22 cm diameter) containing a piece of filter paper for egg laying and cotton swabs soaked in 10 per cent honey solution as source of food, which were changed daily. The mouth of the jar was closed with a piece of muslin cloth tied with a rubber band. These jars were kept in an incubator for oviposition. The eggs laid were collected with a fine camel hairbrush and transferred to 5 cm diameter petridishes containing moist blotting papers at the bottom. Newly hatched larvae were transferred to 10 cm diameter petridishes containing fresh food, changed daily. Diflubenzuron was tested against egg, larval and pupal stages with six treatments and five replications in completely randomized design.

Treatment of eggs : Dipping method was adopted for determining ovicidal action of diflubenzuron. Fifteen eggs of 0-24, 24-48 and 48-72 h age were selected for this purpose and treated with suspension of diflubenzuron in distilled water at different concentrations *viz.*, 50, 100, 150, 200, 250 ppm (Rup and Chopra, 1987). The eggs were dipped for two minutes and air dried before putting into petridishes. Observations were recorded on per cent unhatched eggs.

Treatment of larvae : Ten second and fifth instar larvae were exposed separately to different concentrations of diflubenzuron *viz.*, 50, 100, 200, 500, 1000 ppm by dipping and ingestion methods. The observations in both sets were recorded regularly for different parameters *i.e.*, larval period, mortality after treatment, pupal period, per cent adult emergence, sex ratio and types of deformities.

Treatment of pupae : Inhibitory effect of diflubenzuron on pupae of *T. orichalcea* was determined by dipping method. Pupae (0-2 days old) were treated with different concentrations of the test compound (50, 100, 200, 500. 1000 ppm and control) as described by Sardana and Tiwari, (1987). Observations were recorded on pupal period, per cent adult emergence, sex ratio and types of deformities.

RESULTS AND DISCUSSION

Response of diflubenzuron on eggs : Diflubenzuron exhibited strong ovicidal action at different doses against *T. orichalcea* by dipping method (Table 1). Mean per cent unhatched eggs varied from 34.67-100.00 per cent as compared to 6.67 per cent in control for 0-24 h old eggs, 30.67-77.33 and 28.00-73.33 per cent for 24-48 h and 48-72 h old eggs, respectively. Diflubenzuron @ 200 and 250 ppm was superior than 50, 100 and 150 ppm at all the three stages of egg development. It was observed that newly laid eggs (0-24 h old) were more susceptible to diflubenzuron exposure as compared to older eggs (24-48 and 48-72 h old). Age of eggs was inversely related to ovicidal action of diflubenzuron and older eggs (24-48 and 48-72 h) were at par in their susceptibility. The abnormalities in these eggs were observed in the form of their blackening and drying ultimately.

Microscopic examination of eggs revealed that embryonic development proceeded upto larval formation, which could be seen through the chorion but the developing larva was unable to breakthrough. The failure in hatching of eggs may be attributed to the lack of deposition of chitin in cuticle of developing embryos, which failed to use their muscles to leave the eggshell due to lack of rigidity in their cuticle. The steady increase in hatchability of older eggs may be due to either advanced deposition cuticle or increased impermeability of chorion. Similar observations were recorded against cabbage borer, *Hellula undalis* (Fab.) (Sumalatha *et al.*, 1992), diamondback moth, *Plutella xylostella* Linn. and castor semilooper, *Achaea janata* (Linn.) (Kadam *et al.*, 1995a&b).

Response of diflubenzuron against larvae : Effect of diflubenzuron against II and V instar of *T. orichalcea* expressed in terms of their mortality, prolonged developmental period, fewer number of adult formation with no obvious effect on male to female ratio has been presented in Tables 2 and 3. Larval mortality due to exposure of diflubenzuron, applied through dipping and ingestion methods ranged between 28.00-58.00 and 28.00-50.00 per cent, respectively in early (II instar) and advanced (V instar) stage larvae. In all the cases, mortality increased with increase in dose and larval duration was prolonged in each treatment with more pronounced effects on early stage larvae.

Although pupal duration was extended, there was no difference between larvae exposed either at early or advanced stages. Few larvae could reach adulthood when exposed to diflubenzuron at early stage i.e., 52.00-72.38 per cent as compared to those at advanced stage 60.00-75.00 per cent. Sex ratio did not follow any definite trend. Of the two different combinations of diflubenzuron application to the larvae of *T. orichalcea* irrespective of age, the ingestion method was more effective where larvae were fed on treated food. These findings are to be an important indication of biological activity of diflubenzuron as foliar spray for various stages of the semilooper, if applied under field conditions.

Table 1. Effect of diflubenzuron on eggs of *T. orichalcea* by dipping method

Concentrations	Mean per cent unhatched eggs			Mean
(ppm)	0-24 h old	24-48 h old	48-72 h old	
250	100.00 (90.00)	77.33 (61.75)	73.33 (58.98)	83.55 (70.24)
200	82.67 (65.88)	64.00 (53.15)	61.33 (51.58)	69.33 (56.87)
150	74.67 (59.88)	58.67 (50.02)	56.00 (48.45)	63.11 (52.78)
100	62.67 (52.35)	56.00 (48.46)	54.67 (47.68)	57.78 (49.50)
50	34.67 (35.96)	30.67 (33.59)	28.00 (31.86)	31.11 (33.80)
Control	6.67 (11.56)	0.00 (0.00)	0.00 (0.00)	2.22 (3.85)
Mean	60.22 (52.61)	47.77 (41.16)	45.55 (39.76)	51.18 (44.51)

S.Em. CD (P=0.05) (2.52)
Among treatments: (2.86); Between period of application: (2.02); Treatment × period of application: (4.95)

Figures in parenthesis are arc sin values.

Table 2. Effect of diflubenzuron on IInd instar of *T. orichalcea*

Concentrations (ppm)	Larval period (days)		Larval mortality (%)		Pupal period (days)		Adult emergence (%)		Sex ratio (M:F)	
	Dipping method	Ingestion method	Dipping method	Ingestion method	Dipping method	Ingestion method	Dipping method	Ingestion method	Dipping method	Ingestion method
1000	23.10	23.34	54.00 (47.31)	58.00 (46.91)	17.37	17.07	56.00 (48.46)	52.00 (46.15)	1:0.85	1:1.20
500	21.85	22.42	48.00 (43.85)	48.00 (43.85)	16.95	17.02	61.33 (51.56)	61.33 (51.56)	1:1.28	1:0.78
200	21.41	22.11	42.00 (40.38)	42.00 (40.38)	16.03	16.72	62.00 (51.99)	62.00 (51.99)	1:1.57	1:1.25
100	20.74	22.04	34.00 (35.62)	42.00 (40.38)	15.35	16.59	69.53 (56.51)	68.67 (56.18)	1:2.28	1:2.28
50	21.06	21.50	28.00 (31.88)	34.00 (35.62)	15.27	16.08	72.14 (58.15)	72.38 (58.53)	1:1.17	1:0.73
Control	20.16	20.16	14.00 (21.69)	14.00 (21.69)	15.25	15.25	100.00 (90.00)	100.00 (90.00)	1:1.05	1:1.05
S.Em.	0.10	0.06	(1.45)	(1.38)	0.10	0.06	(1.08)	(1.73)	*	*
CD (P=0.05)	0.29	0.19	(4.22)	(4.03)	0.30	0.18	(3.16)	(5.04)	*	*

Figures in parentheses are arc sin values; * Data not analysed.

Table 3. Effect of diflubenzuron on Vth instar of *T. orichalcea*

Concentrations (ppm)	Larval period (days)		Larval mortality (%)		Pupal period (days)		Adult emergence (%)		Sex ratio (M:F)	
	Dipping method	Ingestion method	Dipping method	Ingestion method	Dipping method	Ingestion method	Dipping method	Ingestion method	Dipping method	Ingestion method
1000	20.93	21.20	48.00 (43.85)	50.00 (45.00)	16.47	16.33	58.00 (46.91)	60.00 (50.77)	1:1.14	1:0.88
500	20.75	20.93	44.00 (41.54)	44.00 (41.54)	16.35	16.12	60.67 (51.20)	60.67 (51.20)	1:1.43	1:1.25
200	20.60	20.34	40.00 (39.23)	42.00 (40.38)	16.20	15.79	66.67 (54.74)	68.67 (56.18)	1:1.22	1:2.33
100	20.23	19.90	38.00 (38.03)	40.00 (39.23)	15.93	15.52	70.48 (57.35)	70.00 (56.97)	1:1.20	1:1.62
50	19.78	19.76	28.00 (31.88)	32.00 (34.41)	15.77	15.44	75.00 (60.17)	73.81 (59.33)	1:2.00	1:1.27
Control	18.07	18.07	12.00 (20.06)	12.00 (20.06)	15.31	15.31	100.00 (90.00)	100.00 (90.00)	1:1.09	1:1.09
S.Em.	0.05	0.05	(1.24)	(1.11)	0.07	0.08	(1.60)	(1.70)	*	*
CD (P=0.05)	0.16	0.14	(3.61)	(3.25)	0.19	0.23	(4.64)	(4.97)	*	*

Figures in parentheses are arc sin values; * Data not analysed.

Table 4. Effect of diflubenzuron on pupae of *T. orichalcea* by dipping method

Concentrations	Diflubenzuron		
(ppm)	Adult emergence (%)	Pupal period (days)	Sex ratio (M:F)
1000	22.00 (27.89)	17.86	1:0.83
500	34.00 (35.62)	16.93	1:0.70
200	46.00 (42.69)	16.76	1:0.77
100	64.00 (53.17)	13.32	1:0.39
50	74.00 (59.45)	12.89	1:0.54
Control	100.00 (90.00)	12.44	1:0.92
S.E. (m)	(1.34)	0.17	*
CD (P=0.05)	(3.91)	0.48	*

It is obvious from preceding discussion on the results achieved with respect to the influence of diflubenzuron through various combinations against the larvae that the foliar application would be successful in controlling the larval population existing at that time, forth coming population after fresh egg hatch and migrations from surrounding fields. The present studies revealed that the mortality of treated larvae occurred only during the process of moulting and the body colour of effected larvae turned black. Pupae formed after the treatment to II and V instar larvae, established morphological deformities such as pupae with rough body surface, black in colour, normal anteriorly and curved posteriorly, and larval-pupal intermediates being the major ones. Same deformities were also observed in adults emerging from pupae after larval treatment *viz.,* adults with twisted wings, adults with crippled wings and the like. Similar observations against the larvae of *Achaea janata*, Linn were reported by Rao and Reddy (1984).

Response of diflubenzuron against pupae : Different concentrations of diflubenzuron tested against pupae of *T. orichalcea* have clearly demonstrated the effect on moth emergence by prolonging the pupal period (Table 4). It is also clear from the data that the test compound at all concentrations significantly delayed the pupal period from 12.89-17.86 days as compared to 12.44 days in control. Adult emergence decreased significantly (22.00-74.00%) as compared to 100.00 per cent in control. However, sex ratio in adults, after pupal treatments with different concentrations of diflubenzuron, indicated no pattern to draw definite inferences. Some deformities were observed in adults emerging from treated pupae. Adults with crippled wings were observed to be maximum. Similar observations were recorded against the pupae of diamondback moth, *Plutella xylostella* Linn. and castor semilooper, *Achaea janata* (Linn.) by Kadam *et al.* (1995 a&b).

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