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ORIGINAL ARTICLE

Analysis of Sterility Effect of Chlorfluazuron and Novaluron in *Antigastra catalaunalis* Duponchel

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ABSTRACT

The bio efficacy of insect growth regulators is generally manifested during ecdysis as it disturbs the process of chitin deposition, thus effecting growth and development of the insects. It also results in failure to feed, due to displacement of mandibles, maxillae and labrum and blockage of the gut. These insect growth regulators also produce delayed symptoms, in which the adults fail to escape from pupal skin and therefore can not fly, feed and mate. These insecticides also induce the fertility and fecundity as observed by many entomologists.

***Key words**: Novaluron, Chlorfluazuron, Reproductive success, Sterility*

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INTRODUCTION

Several insect growth regulators have been found effective in suppressing the population of *Euprocits icilia, Euproctis fraterna, Musca domestica, Pieris, brassicae, Spodoptera, litura, Pectinophora gossypiella, Earias insulana, Leptinotarsa decemlinata, Achoea janata, Oxya japonica, Tenebrio monitor, Utetheisa pulchella* and many other insects.

These chemicals particularly penfluron, diflubezuron, cholorfluzuron, diamino fruly-S-triazine, diofenolan, cyromazine, esflumuron, novaluron, keyouniao, buprofezin, triflumuron, fenoxycarb, tebufenozide, teflubenzorun, lufenufron and fenoxiculve have been found effective without any obvious effects, mating ability and life span of the insect. The possible use of insect growth regulators present an intriguing and exciting area for research. In view of already proved efficacy of insect growth regulators as control measure in good number of insects and the notoriety of *Antigastra catalaunalis*. It was thought desirable to apply Novaluron and Chlorfluazuron against this pest hence this investigation. The work embodies the results relating to two insecticides (insect growth regulators) with reference to their effects on growth, development, longevity and reproduction of *Antigastra catalaunalis*

MATERIALS AND METHODS

Male and Female, *Antigastra catalaunalis* Dup. were collected in second week of July, 2009 from sesame field. Their large population and swarms may be seen during rainy season (July-September). To collect the larvae the sesame crop was inspected time to time.

The insect was reared and maintained in the laboratory in order to ensure regular supply of the insect and its developmental stages during whole tenure of the present investigation as described below. To begin with, the stock was established with the help of field collected moths. These moths were maintained on 10 per cent sugar solution in

glass chimneys with tender sesame leaves (*Sesamum indicum*). Eggs obtained from them were kept as such for hatching. Larvae hatched from eggs were transferred on tender sesame leaves in petridishes (15 cm dia) and reared on them till pupation. The food supply to larvae was renewed twice a day in view of evaporation of water, which proceeds fast when leaves are detached from plants. The sesame leaves were treated with KM_nO_4 solution for five minutes followed by washing in running water. These leaves were dried under shade and provided to the experimental larvae. The larval period lasted for about 15.25 days. All possible precautions were taken to save larvae from bacterial and fungal infections. The first and second instars were reared in pertidishes but from third instar to pupations they were reared in pneumatic troughs (25 cm dia.) in small groups. When larvae acquired full growth and stopped feeding, they were transferred in separate pneumatic troughs having 6 inches thick moist soil layer on their bottoms. The larvae pupated in leaves made coverings. Pupae, thus obtained were kept as such for eclosion. Moths emerged from pupae were reared in pneumatic troughs as described above. In this way the progeny of moths of succeeding generations were reared generation after generation continuously till the tenure of the investigation. The laboratory reared insects and larvae were maintained throughout the tenure of investigation into the Department of Zoology, D.V. (P.G.) College, Orai, Jalaun by the technique described above with slight modifications as when found necessary.

Insect Growth Regulators Used and application: The following fourth generation insecticides whose efficacy as insecticides has already been proved in different crop pests employed against *Antigastra catalaunalis* in this investigation- Novaluron and Chlorfluazuron

The different concentrations of insect growth regulators mentioned above were applied against *A. catalaunalis*. The concentrations considered in this work included 0.0001, 0.001, 0.01, 0.10, 0.50 and 1.00 per cent. These concentrations were obtained by dissolving the desired quantity of insect growth regulator in acetone or methanol.

The insect was treated with different concentrations of insect growth regulators used in this investigation by two methods namely- Adult feeding method and Residue film method. Details of both methods are mentioned below:

(i) Residue Film Method (RFM): In this method of treatment 1 to 2hr old adults were exposes to a thin film of residue of a concentration of a particular insect growth regulator. For obtaining the thin film of the chemical as residue, about 10 ml of a concentration of a chemical was poured in a petridish (10 cm dia.) and the petridish was tilted in different ways to spread the chemical on the whole floor area of the petridish and its raised periphery. Thereafter, the petridish was kept in the air for the evaporation of the solvent. This led to the formation of a thin film of a concentration of a insect growth regulator in the petridish as residue. Adults were left in petridishes having thin film of the insect growth regulator for 24 hours. The petridishes were covered by thin muslin cloth to prevent the escape of the adults. Such treated adults were employed in the different experiments as described later on. This method of treatment will be designated as RFM in the text from here onwards.

(ii) Adult Feeding Method (AFM): In this method of treatment a concentration of a particular insect growth regulator was mixed in 20 per cent sugar solution which was supplied to adults for feeding. From here onwards this method of treatment will be referred as AFM in the text.

The sterility is examined as per standard laboratory methods and guidelines. The data obtained from the studies were subjected to statistical analysis. Various statistical techniques mentioned below have been applied to study the nature and relationship between variables to know the reliability and precision test the significant difference between the observed and corresponding expected values and to predict the estimated values of effectiveness for a given value of concentration.

RESULTS AND DISCUSSION

Sterility Effect of Novaluron on Male and Female *Antigastra catalaunalis* Dup.:

The mating between the female of the untreated adult parent and male of the treated parent, induced far reduced fecundity (89.2 eggs/female) as compared the mating between the male and female of the untreated parents (358 eggs/female) and, it caused 53.41 per cent net sterility, while the cross between the female of the treated parent moth and male of the untreated parent moth inducing almost similar fecundity (90.4 eggs/female) to that of the above mentioned mating but it caused comparative less reduction in the net sterility (50.44%). However, the mating when allowed between the male and female of the earlier treated parents by feeding method, there was further reduction in fecundity (77.4 eggs/female) without significance but the net sterility (63.41%) increased by 10 to 13 per cent as compared the above crosses.

Table 1: Percent reduction in fecundity, percent net sterility and percent control over reproduction in *Antigastra catalaunalis* Dup. caused by Novaluron under different modes of treatment

(Values are means ± S.E.)				
Mode of treatment	**Concentration %**	**% reduction in fecundity**	**% net sterility**	**% control over reproduction**
AFM	.0001	36.52	5.26	39.88
	.001	36.85	6.37	40.96
	.01	.37.84	8.57	43.80
	.10	53.32	24.34	64.97
	.50	66.32	29.34	76.20
	1.00	78.26	63.41	92.03
RFM	.0001	36.77	4.95	39.90
	.001	37.19	4.84	40.93
	.01	37.64	11.65	44.91
	.10	44.33	26.04	58.83
	.50	59.66	33.85	73.33
	1.00	69.88	57.8	86.88

Table 2: Percent reduction in fecundity, percent net sterility and percent control over reproduction in *Antigastra Catalaunalis* Dup. caused by Chlorfluazuron under different modes of treatment

(Values are means ± S.E.)				
Mode of treatment	**Concentration %**	**% reduction in fecundity**	**% net sterility**	**% control over reproduction**
AFM	.0001	26.32	13.52	36.30
	.001	32.50	21.76	45.43
	.01	35.23	28.24	53.52
	.10	4.034	33.63	60.40
	.50	52.11	50.33	76.20
	1.00	69.66	65.93	86.67
RFM	.0001	27.72	13.40	37.41
	.001	31.07	21.54	45.93
	.01	43.46	27.14	58.80
	.10	48.74	31.54	64.91
	.50	59.66	52.42	80.80
	1.00	69.02	62.20	88.30

Sterility Effect of Chlorfluazuron on Male and Female *Antigastra catalaunalis* Dup.: The treated male's mating with the female of the untreated stock caused great reduction in the fecundity (175.6 eggs/female) as compared the mating of the male and female of the untreated stock (3.65 ggs/female) and induced 30.77 per cent sterility but mating between the earlier treated female and untreated male caused more fecundity (190.6 eggs/female) and induced more sterility (31.11 per cent). However, the mating between the male and female of the treated adults caused more decline in the fecundity (108 eggs/ female) and induced far more sterility (57.14 per cent).

Table 3: Sex specific effect of Novaluron reproduction in *Antigastra catalaunalis* Dup.

(1 per cent Novaluron applied by AFM for 1 minute only)				
TR = Treatment; UNT = Untreated; F = Female and M = Male				
Mating between	**No. Eggs laid (Mean ±S.E.)**	**No. Eggs hatched (Mean ±S.E.)**	**Hatching (%)**	**% Net sterility**
UNT F x TRM	89.2±5.78	37.91±2.80	42.4	53.41
TRF x UNTM	90.4±3.46	41.22±2.36	45.6	50.44
TRF x TRM	77.4±6.81	25.8±1.12	33.3	63.41
UNT F x UNTM	358±5.46	324±4.32	91.0	-
(Control)				

Table 4: Sex specific effect of Chlorfluazuron on reproduction in *Antigastra catalaunalis* Dup.

(1 per cent chlorfluazuron by AFM for 1 minute only)				
TR = Treatment; UNT = Untreated; F = Female and M = Male				
Mating between	**No. Eggs laid (mean ±S.E.)**	**No. Eggs hatched (mean ±S.E.)**	**Hatching (%)**	**% net Sterility**
UNT x TRM	175.6±5.32	109.93±4.10	62.6	30.77
TRF x UNTM	1.90.6±4.88	138.38±3.68	72.6	31.11
TRF x TRM	108.0±2.22	43.20±2.60	40.0	57.14
UNT F x UNTM	358±5.46	324+4.34	91.0	-
(Control)				

Fig.1-Percent reduction in fecundity, percent net sterility and percent control over reproduction in *Antigastra catalaunalis* Dup. caused by Novaluron under both modes of treatment

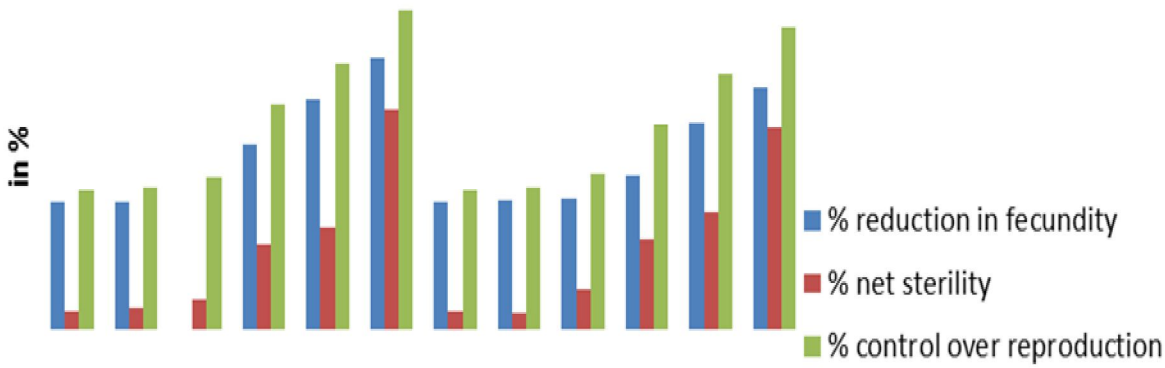


Fig.2- Per cent reduction in fecundity, percent net sterility and percent control over reproduction in *Antigastra catalaunalis* Dup. caused by Chlorfluazuron under both modes of treatment.

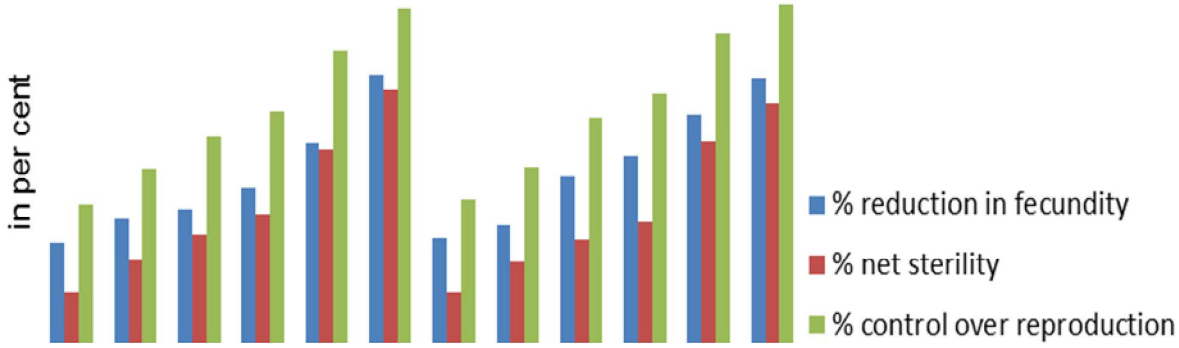


Fig.3-Sex specific effect of Novaluron on reproduction in *Antigastra catalaunalis* Dup.

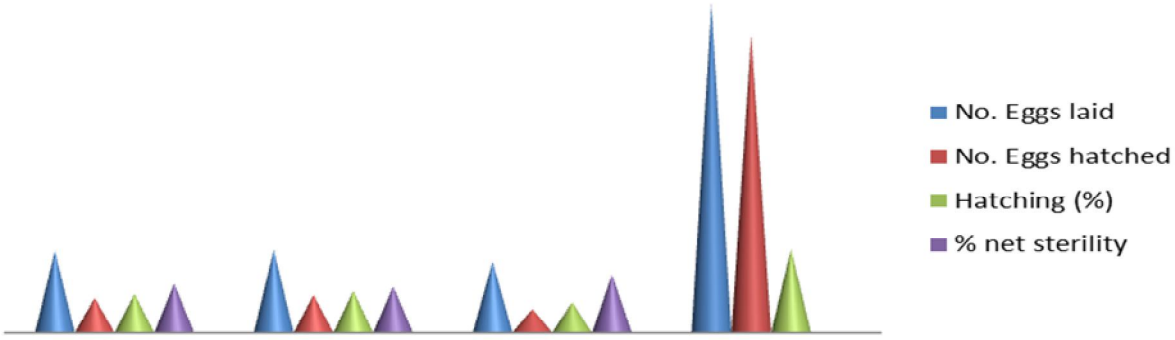
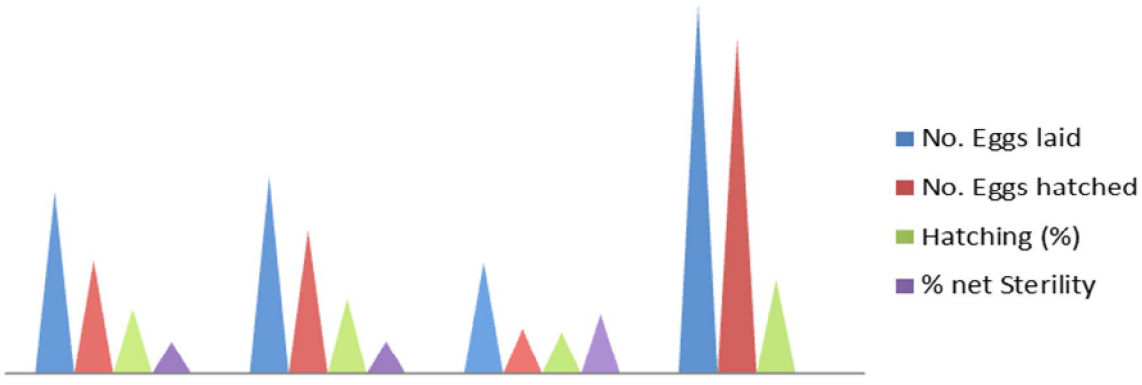


Fig.4-Sex specific effect of Chlorfluazuron on reproduction in *Antigastra catalaunalis* Dup.



The residue film method causes less sterility as compared to adult feeding method but chlorfluazuron is equally effective with adult feeding methods than when it is applied as residue film to the adults. As regards the sterilizing potential of the both insect growth regulators used in this investigation when applied to adults through oral administration, the results clearly reveal that the chlorfluazuron which causes about 66 per cent sterility, and novaluron induce more than 70% sterility and in the context of their sterilizing

efficiency in *Antigastra catalaunalis*, the insect growth regulators screened against this insect may be arranged as novaluron (83.73%) and chlorfluazuron (65.71%) in descending order.

In insects, the sex oriented sterilizing influence of the insect growth regulators has been reported by a good number of workers (Sharma, 1993; Saxena & Khattri 2000, Cloyd, 2003; Gupta *et.al*., 2005; and Gupta and Khattri 2012). This investigation also reveals the sex specific sterilizing influence of both insect growth regulators too. The results pertaining to the sterility of *Antigastra catalaunalis* obtained from the cross between the treated male and the untreated female, between the untreated male and treated female and between the treated male and the treated female are suggestive of three facts : (1) Both insect growth regulators induce sterility in both the sexes, (2) the cross between the treated male and female induces more sterility than that of a cross in which only one sex is treated and (3) in inducing sterility, the insect growth regulators are differently effective in male and female. The novaluron and chlorfluazuron induce more sterility in male than in female. The chlorfluazuron induces about 11 per cent sterility in the male as compared to female and the remaining insect growth regulators induce about 3 to 8 per cent more sterility in the male in comparison to their sterilizing influence in the famale *Antigastra catalaunalis*. Apparently, both insect growth regulators are male specific in this insect as reported in other too (Sharma, 1993; Arora *et. al*., 1996; Cadogam, *et.al*., 1997; Ishaaya *et.al*., 2002; Cloyd, 2003; Gupta *et.al.,* 2005; Arya *et.al*. ,2006. and Gupta and Khattri 2012.

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