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ORIGINAL ARTICLE

Impact of Novaluron on Biomass Accumulation in *Antigastra catalaunalis* Duponchel Pupae and Adult

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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 cannot fly, feed and mate. These insecticides also induce the fertility and fecundity as observed by many entomologists.

***Key words**: Novaluron, Biomass, Pupae, Adult*

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INTRODUCTION

Crop protection has become an indispensable component in the latest technology of crop production and much emphasis has been given to chemical insecticides for the control of noxious crop pests. This has posed a burning and alarming situation due to the indiscriminate use of chemicals on various agricultural commodities, resulting resistance in insects to insecticides and adverse effects on beneficial insects and human beings through food chain.

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

Test Insect: *Antigartra catalaunalis* Duponchel.

Systematic Position:
Phylum-Arthropoda
Class-Insecta
Order-Lepidoptera
Family-Pyralidae
Genus-*Antigastra*
Species-*catalaunalis*

Sources:
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.

Laboratory Stock of the Insect:
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
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. Detail 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 biomass is estimated 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

Effect of Novaluron on Biomass Acquisition In Pupae And Adults Under AFM:
Untreated adults resulted in heavier pupa (153.62 mg) than the treated adults with any concentration of the novaluron under A.F.M. ($P<0.01$). Weight of the pupa varied from 69.57 to 142.02 mg. in response to different concentrations of the insect growth regulator under this method of treatment and it was detected to differ with the concentration ($P<0.01$) and decreased with the increasing concentration.
Like the pupa, obtained from the untreated adults, the male obtained from the untreated pair was heavier (104.43 mg.) than that obtained from the pupa treated with any concentration of the novaluron. Weight of the male varied from 48.36 to 94.32 mg.in response to the treatment by AFM with different concentrations of the novaluron and as per analysis of variance, the weight of the male moth depended on the concentration of the insect growth regulator ($P<0.01$) with a clear tendency of decrease with increasing concentration (Table-1).
Female obtained from untreated stock acquired more weight (110.12 mg.) than that obtained from the treated pair of moths with any concentration of the novaluron. Further, the weight of the female varied from 52.38 to 103.46 mg. in response to adult treatment with different concentrations of the novaluron and the statistical analysis revealed that it was dependent on the concentration of the insect growth regulator ($P<.01$) and it decreased with increase in the concentration.

Effect of Novaluron on Biomass Acquisition In Pupae And Adults Under R.F.M.:
The pupa obtained from the untreated adults acquired 153.62 mg. biomass which was considerably more than that of the pupa obtained from the adults treated with residue film of any concentrations of the novaluron ($P<0.01$). In response to residue film treatment of adults with different concentrations of this insect growth regulator, weight of the pupa varied from 72.14 to 144.44 mg. and it was detected to differ with the

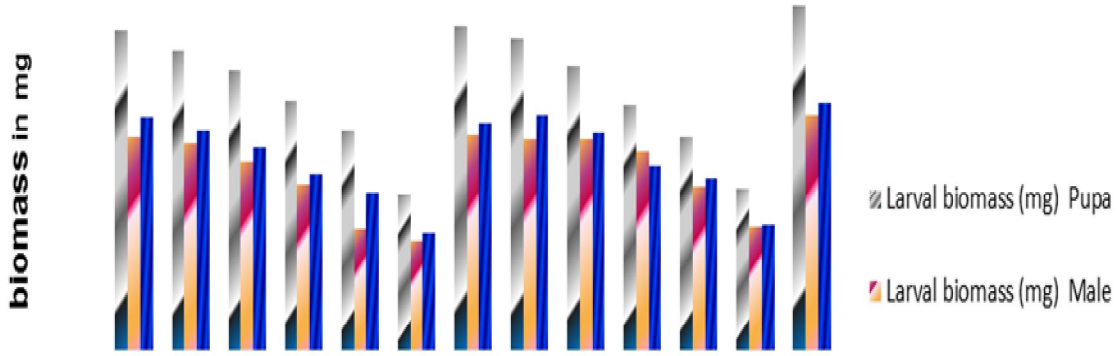
concentration of the insect growth regulator (P<0.01). In this respect, data revealed that the acquisition of the biomass in pupa declined with increasing concentrations.
The male obtained from adults, not treated with the residue film of the novaluron was heavier (104.43 mg.) than that obtained from adults exposed to residue film of any concentration of the novaluron. In response to exposure of its parents to residue film of different concentrations of this insect growth regulator, the weight of male varied between 54.64 to 95.12 mg. and it appeared to decease with increase in the concentration, but as per statistical analysis, concentrations from 0.0001 to 0.01 per cent affected almost identically the biomass acquisition in male (P<0.05) but those from 0.10 to 1.0 per cent affected differently (P<0.01) and in this range, the biomass of the male declined with the increasing concentration of chemical.

Table 1: Effect of Novaluron at different concentrations under different modes of treatment on biomass accumulation by pupa and adults in *Antigastra catalaunalis* Dup

(Values are means ± S.E.)

Mode of treatment	Concentration%	Larval biomass (mg) ± S.E. on		
		Pupa	Male	Female
AFM	.0001	142.02±0.44	94.32±0.44	103.46±0.82
	.001	133.52±0.64	92.11±0.48	97.10±0.82
	.01	124.85±0.32	83.45±0.32	90.10±0.92
	.10	110.63±0.64	73.83±0.52	78.12±1.04
	.50	97.24±1.02	54.14±1.93	70.24±1.25
	1.00	69.57±1.45	48.36 ±2.34	52.38±0.72
RFM	.0001	144.44±0.33	95.12±0.72	101.24±0.53
	.001	138.53±0.84	93.80±0.52	104.13±0.72
	.01	126.06±0.62	93.43±0.93	96.78±0.52
	.10	109.24±0.83	88.42±1.12	82.46±1.13
	.50	94.78±1.12	73.26±0.82	76.42±1.06
	1.00	72.14±1.14	54.64±0.93	55.74±1.12
	Control	153.62±0.92	104.43±1.22	110.12±0.94

Fig-1: Effect of Novaluron at different concentrations under both modes of treatment on biomass accumulation by pupa and adults in *Antigastra catalaunadis* Dup.



The female obtained from the untreated adults acquired more biomass (110.12 mg.) than that obtained from adults treated with residue film of any concentration of the novaluron ($P<0.010$. As regards the effect of the residue film of different concentrations of the novaluron, the biomass accumulated by the female varied from 55.74 to 101.24 mg, decreasing with the increasing concentration of the residue film and the analysis of variance test revealed it to be dependent on the concentration of the residue film ($P<0.01$).

In context of the efficiency of the insect growth regulators reducing the accumulation of the biomass in larvae, as per results of this investigation, considering concentrations from 0.0001 to 1.00 per cent the insect growth regulators screened under this investigation may be arranged as novaluron in descending order.

Like the accumulation of the biomass of the larva, the acquisition of biomass in pupa and adults is also reduced by both insect growth regulators under adult feeding and residue film methods of treatment but both methods are not identically effective in causing reduction in the biomass of the pupa and adults. Administering an insect growth regulator orally causes more reduction in the biomass of the above life-stages than the application of the same through the residual film method in *Antigastra catalaunalis*.

Further, the results in this context reveal that there is an indirect proportionality between the biomass of these stages of life cycle and concentration of insect growth regulators. As regards the pupal biomass reducing potential of the different insect growth regulators both can be arranged as novaluron in descending order. These facts suggest that the biomass curtailing influence of the chlorfluazuron in *Antigastra catalaunalis* depends on the sex.

Depending on their concentration, the fourth generation insecticides cause abnormal larval mortality, ranging from about 27 to 67 per cent, the mortality mostly increases with the increase in the concentration. The oral administration of insect growth regulator usually cause more larval mortality than its application through the residue film. As regards comparative effectiveness of the tested fourth generation insecticides, the results permit us to arrange them as novaluron in descending order.

Besides causing abnormal mortality of larvae, depending on its concentration, both insect growth regulators also inhibit emergence of adults to considerable extent, the inhibition of the emergence under the influence of an insect growth regulator may range from 33 to 53% as compared to inhibition of emergence under natural condition and it decreases with increase in concentration of the fourth generation insecticides. Usually the oral treatment with the insect growth regulator is more effective than its application through the residue film in context of the inhibition of the emergence of adults. As regards the efficacy of different fourth generation insecticides in inhibiting the emergence of adults, the results permit us to arrange them as novaluron in descending order.

The net mortality gives the correct estimate of the mortality at postembryonic stage (larvae and pupae) under the influence of the fourth generation insecticides because it is worked out after considering the natural mortality and therefore it clearly indicates the toxicity of such chemicals (Abbot, 1925). The novaluron applied through adult feeding method causes 52 to 94 per cent net mortality among its different concentrations; the mortality inducing potential of this insect growth regulator increases with the progressively increasing concentration. The different concentrations of this sterilizing compound under the oral administration cause mortalities at 0.0001% concentration. But when the different concentrations of novaluron are applied as the residue film to the adult, the percentage of net mortality is comparatively low at every level. The net mortalities caused by it are more at corresponding concentrations under adult feeding method but low when it is applied as residue film. However, under both methods of treatment the increase in its concentration increases net mortality.

Although sesame is attacked by many insect pests (Nayar *et.al*., 1976 and Ahuja and Bakhetia, 1995). Among the reported pest sesame leaf roller and capsule borer, *Antigastra*

calaunalis (Dup.) is the most destructive and causing heavy yield loss in India (Bhattacharaya *et.al.* (1977) and Lal, 1962). This capsule borer infests the crop at leaf, flower and capsule stage and cause yield loss upto 90% (Murli Baskaran and Thangavelu, 1990 and Ahirwal *et.al.,* 2008).

To increase the productivity of sesame, a large number of insecticides have been used for the control of *A. catalaunalis* (Desai and Patel, 1965, Jagtap *et.al.,* 1986; Mathur *et.al,* 1971; Patel and Bhalani, 1986; Singh and Grewal, 1989, 1991; Singh and Jakhmola, 1984; Mishra and Patnaik, 1994; Solanki *et.al.,* 2006; Ahirwar *et.al.,* 2008; Karuppaiah e*t.al.,* 2009 and Bharathimeena and Sudharma, 2009) reported promising results against this notorious pest.

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