RESEARCH ARTICLE

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Estimation of Food Consumption in *Antigastra catalaunalis* Duponchel under Stress of Insect Growth Regulators Chlorfluazuron and Novaluron

Vivek Kumar Verma
Department of Zoology, JMV, Ajitmal, Auraiya
Email: vermavk65@gmail.com

ABSTRACT

The advance in science and technology have helped the economic entomologists to reveal various approaches to control the insect pests and keeping their population below economic injury level. The emphasis on the use of insecticides in pest management has now become significantly important due to least toxicity to mammals. Many entomologists observed that different insecticides disturb the growth and development process in different insects.
***Key words**: Novaluron, Chlorfluazuron, Food consumption*

INTRODUCTION

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.

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: *Antigastra catalaunalis* Duponchel.

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 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. 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 food consumption 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 Food Consumption:

In the larval feeding treatment, the insect growth regulator suppressed the rate of food consumption in treated larvae at higher concentration level but at lower level (0.0001%), the insecticide was less effective in reduction of the food consumption. The maximum reduction in food consumption recorded was 43.40 per cent at 1.00 per cent concentration level and minimum being 20.95 per cent at 0.0001 per cent level in test. The food digested by the treated larvae was also reduced with the increase in concentration level and was recorded 67.75 per cent maximum at 0.0001 per cent, in comparison to control which showed food digestion of 70.93 per cent.

Effect of Chlorfluazuron on Food Consumption:

Under the larval feeding treatment, the used insect growth regulator suppressed the rate of food consumption in treated larvae at higher concentration level, but at lower level, the used insecticide was less effective in reducing the food consumption. The maximum reduction in food consumption was recorded as 45.20 per cent at 1.0 per cent concentration level in test. The food digested by treated larvae was reduced with the increase in concentration level and was recorded 36.17 per cent maximum at 0.0001 per cent concentration level, in comparison to control which showed food digestion of 70.93 per cent.

The data shows that the food intake was considerably reduced by the treated larvae at various concentration levels. At lower levels of concentration, the used insect growth regulator was also effective in reducing the food consumption. Food digested at 1.00 per cent was reduced by 29.69 per cent i.e. much reduced in comparison with control.

The results related to net mortality provide a clear picture of comparative efficiency of fourth generation insecticides. As per these results, the screened insect growth regulators may be arranged as novaluron and chlorfulazuron in descending order. Both insect growth regulators are equally effective under adult feeding method and in causing net mortality which is relatively high to that which results from residue film treatment.

In respect of the influence of tested fourth generation insecticides on the duration of larval life, the results clearly show that each strength of novaluron and chlorfluazuron prolong the larval period under both methods of treatment. Generally, at low concentration 0.0001 to 0.01 per cent the increase in larval period is about 3 to below 5 days but at higher concentrations, this increase is much more and insecticide specific; at 0.50% concentration, the novaluron and chlorfluazuron increase larval period by 13.40 to 13.50 days, and 5.80 to 6.00 days respectively under both modes of treatment and at one percent concentration, they increase this period by 19.82 to 21.36 days, 10.10 to 12.40 days, 10.90 to 12.40 days and 8.00 to 8.50 days respectively under both methods of their application. Usually the adult feeding method found more effective in prolonging the larval duration, cause more increase in this period as compared to application of an insect growth regulator as residue film. Further, the larval period increases generally with increasing concentrations but in some cases the prolonging influence is identical at 0.0001, 0.0001 and 0.01 per cent concentrations. As regards the virulence of the fourth generation insecticides in increasing the larval period, both chemicals may be arranged as novaluron and chlorfluazuron in descending order and both insect growth regulators are more effective under adult feeding method and the less effective when it is applied as residue film.

Table 1: Effect of Novaluron on food consumption and faecal matter of larvae in larval feeding treatment *Antigastra catalaunalis* Dup

Concentration .%	Larval periods In days	Total amount of food consumed (faecal matter) per larvae (g)	Reduction in food consumption (g)	Food Digested %
.0001	12.5	2.924 (0.933)	0.356	67.75
.001	13.8	2.674 (.856)	0.698	66.42
.01	14.6	2.396 (.824)	0.884	65.72
.10	15.2	2.335 (.823)	1.203	63.82
.50	15.7	3.133 (1.276)	1.203	31.30
1.00	17.0	1.448 (1.435)	2.377	29.41
Control	11.00	3.275 (0.951)	---	70.93

Table 2: Effect of Chlorfluazuron on food consumption and faecal matter of *Antigastra catalaunalis* Dup. larvae in larval feeding treatment

Concentration. %	Larval Period in days	Total amount of food consumed (faecal matter) per larvae (g)	Reduction in food consumption (g)	Food digested %
.0001	15.0	3.671 (2.343)	0.950	36.17
.001	16.0	3.0363 (2.338)	1.258	30.47
.01	16.5	3.226 (2.314)	1.358	28.27
.10	17.0	2.750 (1.961)	1.871	28.69
.50	17.5	2.378 (1.683)	1.681	29.41
1.00	18.5	2.714 (1.908)	1.903	29.69
Control	11.00	3.275 (0.951)	---	70.93

Barring 0.0001 per cent concentration, all other concentrations of both fourth generation insecticides used in this investigation prolong the pupal period which increases with the advancing concentration of insect growth regulator. At higher concentrations, such as 1.0 per cent the pupal period becomes more than 1.5 times to about 2.5 times of the pupal period under natural condition and this concentration becomes the more effective under

adult feeding method and less effective, if it is applied as residue film and the duration prolonging influence figures intermediate between these. As regards the comparative efficiency of the fourth generation insecticides in this context, based on the results of the higher concentrations, may be arranged as novaluron and chlorfluazuron in descending order.

Fig.1-Effect of Novaluron on food consumption and faecal matter of *Antigastra catalaunadis* Dup.larvae in larval feeding treatment.

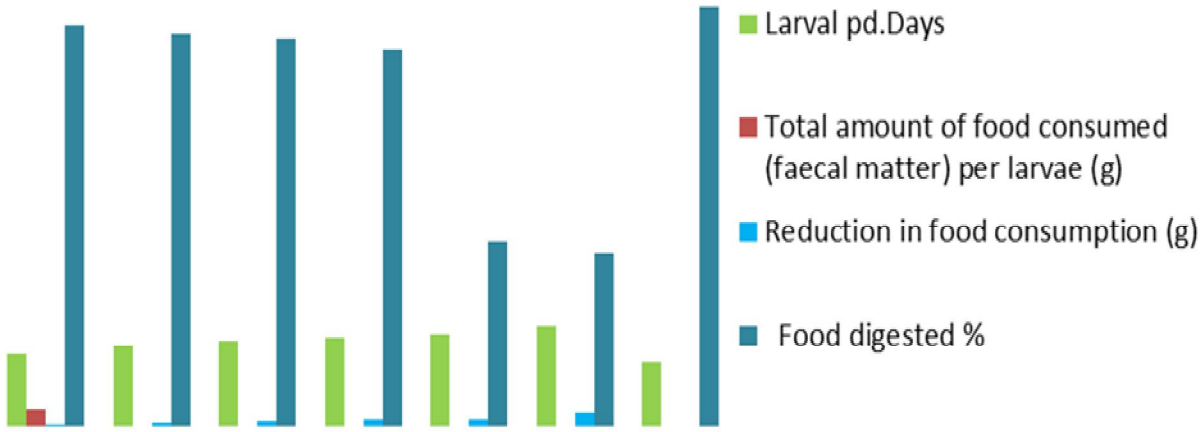
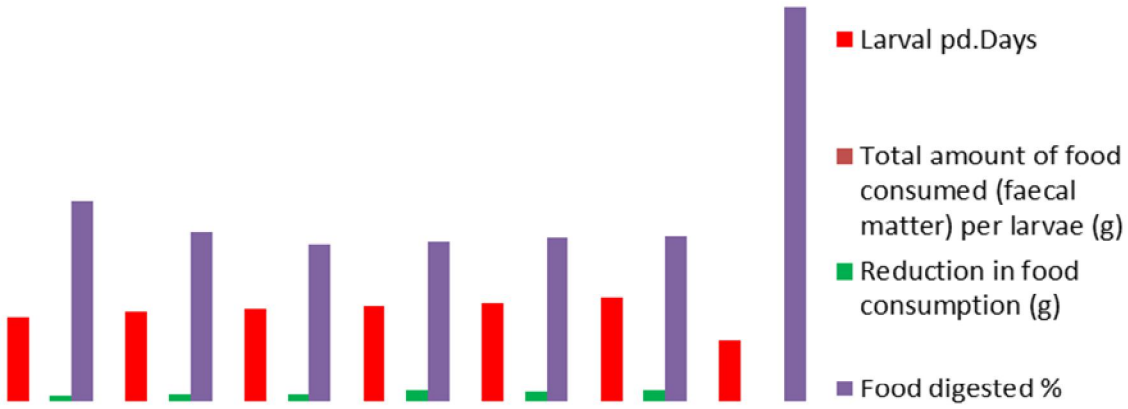


Fig.2-Effect of Chlorfluazuron on food consumption and faecal matter of *Antigastra catalaunalis* Dup. larvae in larval feeding treatment



Contrary to the larval and pupal periods, every concentration of both insect growth regulators reduces the longevity of both male and female adults and reduction in life-span of either sex increases with increase in concentration of insect growth regulators. At higher concentrations, such as 0.50 and 1.0 per cent the reduction in life-span of both male and female is much pronounced. At higher concentrations, the reduction in the male's longevity varies from 3.20 to 4.78 days, and from 5.02 to 8.04 days respectively, of course, depending on the kind of the fourth generation insecticide and the method of its application to the test moth. At one per cent concentration, the novaluron reduces the male's longevity to about one-third of the natural longevity of male. The results pertaining to male's longevity permit us distinctly to determine the comparative potential and comparative effectiveness of methods of treatment of the both fourth generation

insecticides. As per these results in the context of male's longevity reducing potential, the tested fourth generation insecticides may be arranged as novaluron and chlorfluazuron in declining sequence and both become moderately effective when applied by the adult feeding method and less effective when both chemicals administered as residue film.

Besides affecting the males longevity, the used insect growth regulators affect the life-span of the female too even at its lowest concentration and its longevity reducing potential progresses with the increasing concentration. In this respect, both used fourth generation insecticides are more effective under the adult feeding method as compared to its administration as the residue film. Hence, the oral administration produces more effect than the treatment with the residue film. Among its higher concentrations the used insecticides cause steep decline in the female life span. At its one per cent concentration, insecticides may reduce the female life-span to about one third of the natural longevity; some insecticides may reduce it to more than half the natural longevity. Depending on their longevity reducing potential, the tested insecticides may be arranged as novaluron and chlorfluazuron in descending order.

The insect growth regulators (Chemosterilants), as their name suggest are the potent compounds which affect sterility and consequently, aid in control of the pest population and the sterility is the manifestation of reduction of both the fecundity and fertility (viability of eggs laid by a female) and it depends on the stage of life cycle (eggs, larvae, pupae and adults). In this investigation, the young adults were selected to be treated. The selection of young stage is related to two facts - (1) The young stage is one in which critical gonadal development takes place and, (2) In many insects, the insect growth regulators applied at young stage have been successful in inducing sterility to a considerable extent (Bobaye and Carman, 1975; Codogon *et. al*., 1997; Chockalingam and Krishnan, 1984; Dhawan, 1991; Gupta *et.al*., 1994; Kadam *et. al*, 1995; Khan and Srivastava, 1988; Khan and Srivastaa, 1989; Masih, 1992; Saxena and Khattri 2000; Saxena *et.al*., 2001, Nokano and Romano 2002, Gupta *et.al*. 2005., Gupta *et.al*. 2006., Arya 2006., Ahirwar 2008 and Gupta & Khattri 2012).

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