Effect of Insect growth regulators on mortality deformity and longevity of the Lepidopterous pests

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Abstract

The administration of penfluron and diaino-furyl-s-triazine was done by feeding and residual technique to *Euproctis icilia* and *Euproctis fraterna* larvae, to see its interaction on the experimental insects. The effect of the chemical at lethal and sublethal levels was recorded. The parameter of study was mortality, deformity, development, food consumption, growth and weight loss during exposure period. The results obtained in different experiments on these parameters were processed and are presented in tabular form. In the present study the insect growth regulators, penfluron and diamino-furyl-s-triazine, suppressed the food intake and larvalgrowth of the treated insects, both in feeding as well as residual treatment Results obtained showed that diamino-furyl-s-triazine reduced the food intake capacity more than penfluron, in third instar larvae. Reduction in food consumption was greater in *Euproctis icilia* than in *E. fraternal* in feeding treatment and was almost the same in residual treatment with penfluron. Similar results were also seen by diamino-furyl-s-triazine.

Key Words: penfluron, *Euproctis icilia, Euproctis fraterna*, mortality, deformity and development.

Introduction:

Despite a host of weapons and vast annual expenditure, little progress was made in the age-old battle against the insect. Fecundity of these creatures is frightening. Many species lay hundreds or thousands of eggs after mating. Some pass through their entire life cycle, from egg to adult in a matter of days or week, producing dozens of generations a season, thus giving them enormous evolutionary advantages, as scientist have learnt to their dismay. With the discovery of synthesis insecticides in 1940, which was referred as first generation pesticide, it was believed that the pest population will easily be eliminated but the control of some of the pest even below economic injury level, could not achieves. Besides, they also created many side problems such as development of resistance, secondary pest outbreak, resurgence and pollution to ecosystem. The fecundity of the surviving adults avoiding sublethal dosage is also increased. (Knustson 1951 and Afifi and Knutson 1965). Such problems forced the economic entomologists to proceed further in search of safer methods of pest management and second and third generation of pesticides came into existence by using the chemoterilant, pheromones and juvenile hormones, etc., but the desired success could not be achieved by any of them. The insect growth regulator, a fourth generation pesticide, accidently came into existence in the Laboratory of Philips Duphar. The Netherlands, while preparing the herbicides. First insect growth regulator synthesized, was diflubenzuron, which was from Benzoyal phenyl urea group. Later, different groups of insect growth regulators, having chitin biosynthesis inhibiting property, were identified. The different groups of insects growth regulators, though differ in their chemical structure and mode of action, but have a common characteristic, i.e. they exhibit lethal action in juvenile stages and sterility in sexually mature adults, thus the pest population declines very rapidly. Besides, they also inhibit the food consumption and growth of individuals, which survive sub lethal treatments. This becomes an additional benefit in the field of pest management as surviving pest will consume less population by the use of insect growth regulators has already been achieved by many workers. (Flint et al., 1978; Zepp et al., 1979; Hopkins et al.,1982; Velcheva 1083; Lecheva 1985; etc.). The bioefficacy of insect growth regulators is generally noticed during ecdysis, as it disturbs the process of chitin deposition due to which the insect dies. It also results in failure to feed, due to displacement of mandibles and labrum or blockage of the gut. These substance also produce delayed symptoms, in which the adults fail to escape from pupal skin and therefore cannot fly, feed and mate. The chemicals used in the presents study belong to Benzoyl phenyl urea and triazine group. They are penfluron, (2,6-difluro-N-[[[4-(trifluromethyl) phenyl] amino] benjamide and diamino-furyl-s-triazine, (2,6-diamino-6-(2-furyl)-s-triazine). Respectively. Triazine was previously used as chemosterilant in 1960, with larvicidal action, but later on came to known as an insect growth regulator with chitin biosynthesis inhibiting property. The insect selected for the investigations belong to be the order Lepidoptera. The idea to select the lepidopterous pests is due to the fact that it damages large number of important crop plants and economically are of great importance. The lepidopterous pest which constitute majority of injurious species devour the foliage and shoots of trees and crops. Hence, is a major pest of the agro-ecosystem. The pest taken for bioassay assessment were *Euproctis icilia* stoll. and *Euproctis fraternal* Mo. Of the family Lymantriidae. They are commonly known as hairy caterpillars and feed on costor (*Ricinus communis L.*) an important oil seed crop. They are found almost everywhere in India. The larvae occur in abundance and feed voraciously, so much so, that they defoliate trees completely, leaving only stems and branches. The selected lepidopterous pests were administered that insect growth regulators, by feeding and residual technique. The objective behind the present work was to establish the interaction of the chemicals against experimental insect pest at lethal as well as sublethal levels. The parameter of study included mortality effect, at deformity, longevity, food consumption, growth and loss of weight during exposure period, at sublethal level of treatments further, efforts have also been made to pin point effect of insect growth regulatoconsumption of experimental insect pests as reduced feeding by the larvae which escape sublethal treatment during its field application minimizes damage to the crops and it may be considered as an additional mortality in pest management programme. The results obtained in different experiments on various parameters were proceed and analysed statistically.

Materials and Methods:

The materials that were used and the methods adopted for the proposed investigations of insect growth regulators with lepidopterous pests. The insects that were exposed to chemical for observation were the hairy caterpillars. The pests used *Euproctis icilia* stoll. and *Euproctis fraterna* Mo., the chemical taken Benzoyl phenyl urea (Penfluron) and Triazine (Diamino-furty-s-triazine). The eggs and larvae of the lepidopterous pests were collected from the farms and cultured in the laboratory on their natural diet. From these test insects of known as and stage were taken for different experimental work. The eggs that were collected were kept in between the leaves which served as food for the newly hatched larvae. The final moult of these larvae led to sexually dimorphic adults. The rearing of different lepidopterous pests taken for the proposed work was done. *Euproctis icilia* and *Euproctis fraterna* both insect pests we found on the same host plant, rearing was done in similar manner. The eggs and the larvae were collected from the custor plants (*Ricinus communis L.)* found on the farm of Kulbhaskar Ashram College and Agriculture Institute, Allahabad. The rearing was done in wooden insect cages with iron mesh on its sides. The cages were of 60×60×45 cm size. These were kept on elevated platform and the four stands were put on earthen pots filled with water, to prevent the ants and other insects from entering it and damaging and killing the insects. Every morning and evening the larvae were supplied with their natural diet (custor leaves) until population. The adults which emerged were provided with 10% honey mixed sugar solution soaked in cotton which was kept in small petridish. Fresh castor leaves were put in the wooden cages for the adults females to lay eggs on them, after pairing had taken place. Later, the eggs were collected and placed in between the green and succulent castor leaves which served as food for the newly hatched larvae. The laboratory temperature during rearing and experimental was 29 ±2^{0}C.

Probit analysis table and graphs:

Larval feeding treatment

Effect of Penfluron on the mortality of *Euproctis icilia* larvae in third instar larval feeding treatment

Concentration	Avg. no. of larvae treated	Avg. no. of larvae pupated	Avg. no. of adults emerged	Total avg. mortality	Mortality	Net mortality
(ppm)	(no.)	(no.)	(no.)	(no.)± S.E.	(%)	(%)
Control	15	14.5	14.0	1.0± 0.06	6.66	-
0.001	15	8.5	5.0	10.0±0.86	66.66	64.28
0.01	15	6.0	3.5	11.5±0.95	76.66	74.99
0.1	15	5.5	1.5	13.5±1.60	90.00	89.28
1.0	15	4.0	-	15.0±0.00	100.00	100.00

Effect of Penfluron on the deformity of *Euproctis icilia* larvae in third instar larval feeding treatment

Concentration	Avg. no. of larvae treated	Avg. no. of pupae deformed	Avg. no. of adults deformed	Total avg. deformity	Deformity	Net deformity
(ppm)	(no.)	(no.)	(no.)	(no.)± S.E.	(%)	(%)
Control	15	-	-	-	-	-
0.001	15	1.0	2.5	3.5±0.25	23.33	23.33
0.01	15	2.5	2.0	4.5±0.50	30.00	30.00
0.1	15	3.5	2.0	5.5±0.65	36.66	36.66
1.0	15	4.0	-	4.0±0.45	26.66	26.66
50.0	15	(all died)	-	-	-	-

Effect of Penfluron on the development of *Euproctis icilia* larvae in third instar larval feeding treatment

Concentration	Average larval longevity after treatment in days				Increase in larval longevity	
(ppm)	3rd instar	4th instar	5th instar	Total	(day)	(%)
Control	3.0	3.0	5.0	11.0	-	-
0.001	4.0	3.0	4.5	11.5	0.5	4.34
0.01	5.0	3.5	5.0	13.5	2.5	18.51
0.1	5.0	3.0	5.5	13.5	2.5	18.51
1.0	6.0	3.5	4.5	14.0	3.0	21.42
50.0	(all died after 3 days)					

Effect of Diamino-furly-s-triazine on the mortality of *Euproctis fraterna* larvae in third instar larval residual treatment						
Concentration	Avg. no. of larvae treated	Avg. no. of larvae pupated	Avg. no. of adults emerged	Total average mortality	Mortality	Net mortality
(µg/cm^2)	(no.)	(no.)	(no.)	(no.)± S.E.	(%)	(%)
Control	20	18.5	18.5	1.5±0.07	7.5	-
0.0000259	20	17.0	14.0	6.0± 1.20	30.00	24.32
0.000259	20	14.5	9.5	10.5±1.75	52.50	48.64
0.00259	20	11.5	8.0	12.5±1.80	60.00	56.75
0.0259	20	9.0	7.5	12.5±2.30	62.50	59.45
1.259	20	7.5	5.0	15.0±2.80	75.00	72.97

Effect of Diamino-furly-s-triazine deformity of *Euproctis fraterna* larvae in third instar larval residual treatment						
Concentration	Avg. no. of larvae treated	Avg. no. of pupae deformed	Avg. no. of adults deformed	Total average deformity	Deformity	Net Deformity
(µg/cm^2)	(no.)	(no.)	(no.)	(no.)± S.E.	(%)	(%)
Control	20	-	-	-	-	-
0.0000259	20	1.5	-	1.4± 0.20	7.50	7.50
0.000259	20	1.0	1.5	2.5±0.40	12.50	12.50
0.00259	20	2.5	1.5	4.0±0.35	20.00	20.00
0.0259	20	3.5	2.5	6.0±0.75	30.00	30.00
1.259	20	2.5	5.0	7.5±0.70	37.50	37.50

Effect of Diamino-furly-s-triazine on the development of *Euproctis fraterna* larvae in third instar larval residual treatment						
Concentration	Average larval longevity after treatment in days				Increase in larval longevity	
(µg/cm^2)	3rd instar	4th instar	5th instar	Total	(day)	(%)
Control	3.5	3.5	5.0	12.00	-	-
0.0000259	4.0	3.5	5.0	12.50	0.5	3.84
0.000259	4.5	3.5	5.0	13.00	1.0	7.69
0.00259	5.0	3.5	5.0	13.50	1.5	11.11
0.0259	5.5	3.5	5.0	14.00	2.0	14.28
1.259	6.5	4.0	5.5	16.00	4.0	25.00

Results and Discussion:

In larval feeding treatment, the mortality was increased with increase in the concentration level, which shows that mortality rate is directly proportional to the concentration. The result obtained shows complete mortality at 1 ppm. Because at this level none of the larvae that were treated were able to pupate and hence no adult emerged A minimum of 64.28% net mortality was also exhibityed even at 0.001 ppm level of concentration tested, which shows that pen fluron is toxic to *Euproctis icilia* larvae.

The compound caused significant deformities in the larvae, pupae and adult insects. Maximum deformity was recorded at the lower concentration level which was 36.66% at 0.1 ppm. Higher concentration produced complete lethal action or high mortality percentage. Deformity includes mostly larava-pupa intermediates, swelling at some regions of the body due to irregular deposition of chitin, and in adults, wings are mostly affected.

In general, the effect of the chemical on mortality of the experimental insects was much pronounced and lethal action was directly related to the increasing concentration. Similar results have also been reported by various workers in past with different chemicals and insects (Lipa,1976; Mokraousova, 1977; Chattoraj and Dwivedi, 1980; Madrid and Stewart, 1981; Rabindra and Balasubramanian, 1981, etc.). Hence the results obtained in the present work is in corroboration with the findings of these workers.

In the present study, deformity in different life stages of the experimental insects was observed, specially at lower levels of treatment. Earlier, some workers attempted to study the effect of the chemical on deformity of the test insects. Various workers have reported similar results (Bijloo, 1975; Urs and Narasimhan, 1977; Salma and El-Din, 1977; Flint et al., 1978; Khan and Srivastva, 1989; etc.). The deformity results observed by the author is in agreement with these workers.

Prolongation of larval period was also observed after treatment. It was noted that prolongation was mainly in the instar in which it was treated remaining instars were similar to control. Shaaya and Pisarev, 1986 and Khan and Srivastava, 1989 also studied the effect of insect growth regulator on larval period and reported prolongation of larval life. Hence the present finding is in collaboration with their results.

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