PRELIMINARY STUDIES ON THE BIOLOGY OF GREASY CUTWORM *AGROTIS YPSILON* ROTT. AND ITS SUSCEPTIBILITY TO GRANULOSIS VIRUS OF *A. SEGETUM* D & S. FROM DENMARK

by
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Abstract. *Studies on the biology of* A. ypsilon *Rott. were conducted in laboratory at Peshawar. The first generation starting with moths caught at light in early April completed in May. The subsequent* 3 *generations completed in June, August and September and the last hibernated during winter. The average durations of pre-oviposition, oviposition, incubation, larvae and pupae were* 2.3, 3.95, 3.6, 22.16 *and* 10.54 *days, respectively.*

In susceptibility test of A. ypsilon *and* A. segetum *to G.V. from Denmark conducted in laboratory,* 100% *mortality of cutworms of both species was observed due to virus infection while* 62% *and* 53% *larvae of* A. segetum *and* A. ypsilon. *respectively pupated successfully in check treatment.*

Introduction. Cutworms are notorious pests of agricultural crops and forest nurseries throughout the world. Their damage to tobacco, potatoes, vegetables, wheat, rice, mustard, gram and cotton seedlings is well known in Pakistan. They are also serious pests of forest nurseries especially coniferous seedlings and new plantings in hills.

Metcalf and Flint (1962) classified cutworms into four categories on the basis of their habits: solitary or surface, climbing, army, and subterranean. The greasy cutworm, *Agrotis ypsilon* is a solitary or surface cutworm and is most common in north western parts of Pakistan. The caterpillars of the pest remain hidden in the soil during day time and feed during the night.

Rehman (1940) reported *A. ypsilon. A. flammatra, A. segetum* and *A. spinifera* from Punjab. Beeson (1941) reported *A. ypsilon* as a serious pest of forest nurseries in India. Many species of cutworms were recorded on several host plants in north western areas of Pakistan by Alam *et al* (1969). Among these *A. ypsilon* was found to be the most abundant and widely distributed species feeding on great variety of host plants. On its migration, there is controversy: According to Wood House and Dutt (1913) it aestivates in Himalayas during hot weather Singh (1949) is of the view that the pest does not migrate to hilly areas but survive in small numbers in the plains of Bihar province, during summer. Sen (1952) supported Singh but Vinkatraman (1954) did not rule out the possibility of migration of cutworms to Himalayas in summer months. Alam *et al* (1969) accepts both possibilities

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because the pest suddenly disappears from Rawalpindi in the end of May and reappears in next March but a few pupae are found in the winter months.

John (1952), Faulkner (1954), Kamel and Soheb (1959), Begg and Horris (1961) Nirula (1963) and Harris (1969) conducted experiments on the chemical control of cutworms and recommended Endrin, Heptachlor, Aldrin, DDT, Toxaphene and BHC in different doses for its control.

Due to persistant action and hazarduous effect on environment the chlorinated hydrocarbon insecticides are being banned the world over. Instead greater stress is being laid on insect control methods other than chemical to avoid environmental pollution caused by extensive use of toxic chemicals. Biological means of insect control is receiving greater attention and more recently disease causing pathogens such as virus, bacteria, fungi and protozoa are being investigated for insect control.

Bacillus thuringiensis, a bacterial species, is now commercially produced and used against lepidopterous pests. More than three hundred viruses infecting insects were known in 1971 which belonged to three groups: Nuclear Polyhedrosis Viruses (NPV), Cytoplasmic Polyhedrosis Viruses (CPV), and Granulosis Virus (GV). All these have proved promising for insect control. Sider (1965), Zarin (1971), and Smirnoff (1973) have found these viruses quite effective against pests such as *Pygaera anastomosis*, *Stilpnotia salicis*, *Leucoma salicis*, *Lymantria dispar*, *Melacosoma neustria* etc.

Material and method. Moths of *A. ypsilon* Rott. were caught in light traps at the Pakistan Forest Institute, Peshawar in the first week of April, 1975. Pairs were released in glass chimneys for mating and oviposition. Sugar solution was provided to the moths. Eggs laid on blotting paper and leaves of host plants were daily separated for counting and further observations. Newly hatched larvae were fed on persian clover leaves in glass chimneys and later each caterpillar was kept in a separate plastic cup having sand for shelter, because of their carnivorous habit. Fresh leaves were provided daily in the cups.

For study of natural diseases of the pest and trial of *A. segetum* GV, cutworms were reared on artificial diet which was prepared once a week and kept in a freezer. Small pieces of artificial diet were cut and placed in plastic cups and larva released in each cup. The Granulosis Virus from *A. segetum* D & S provided by Ole Zethner of Zoology Institute, Copenhagen, Denmark was used for the trial against *A. ypsilon* and *A. segetum* conducted during May, 1975. Artificial diet was cut into pieces and placed in petri dishes was sprayed with diluted suspension of GV of *A. segetum*. After complete evaporation of water, 100 second Instar larvae of *A. ypsilon* were released on virus infected diet in petri dishes and allowed to feed on it for a day. These larvae were transfered to plastic cups containing uninfected diet the next day. Hundred larvae of the same age were fed on uninfected artificial diet in a separate laboratory with similar conditions to note natural mortality of larvae. A similar test was conducted with *A. segetum* keeping 50 larvae in each treatment. Observations were taken daily on the mortality of larvae in infected and untreated lots, till emergence of moths took place.

The larvae and pupae which died during these experiments were kept in a freezer and sent to Dr. Ole Zethner in Denmark for identification of diseases.

Results and Discussion. *Biology.* Observations on biology of greasy cutworm were recorded in the laboratory at the Pakistan Forest Institute, Peshawar and are given below:

Generations	I		II		III		IV		V	
Months.	April-May		May-June		June-July		July-August		September	
Different stages of the pest	Range	Aver.	Range	Aver.	Range	Aver.	Range	Aver.	Range	Aver.
	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days
Pre-oviposition period.	1—2	1.5	1—4	2.5	2—3	2.4	2—3	2.25	1—2	1.5
Oviposition period.	4—5	4.5	2—7	4.5	2—3	2.4	1—5	3.38	4—6	5.0
Incubation period.	4—6	5.0	3—6	4.16	2—3	2.25	2—4	3.0	—	—
Larval period	23—25	24	18—22	20.16	18—35	23.75	20—21	20.75	—	—
Pupal period	10—12	11	7—12	10.16	9—12	10.5	9—12	10.5	—	—
Longevity of male.	7—9	8	4—7	6.5	2—10	6.6	3—10	4.75	9—10	9.5
Longevity of female.	9—12	10	3—9	7.16	5—11	8.0	3—7	5.25	11—15	13.0
Total life cycle.	42—50	46	31—51	41.48	33—56	40.57	40—45	39.88	—	—
Fecundity (number of eggs)	1200—1800	1500	287—910	526	410—1050	765	85—1936	788	500—510	505

The first generation of the pest started in the first week of April in laboratory with moths of over wintering generation caught at light. Moths are nocturnal in habit, hide under plant debris during day and become active at night. In laboratory mating and egg laying occurred at night. Pre-oviposition period on an average in five generations was 2.3 days with range of 1 to 4 days. Oviposition period was on an average 3.95 days ranging from 1 to 7 days. Number of eggs laid by a female ranged from 85 to 1936 eggs in laboratory. Maximum number of eggs were laid by females of Ist and 4th generation in April and August. Average minimum number of 505 eggs per female were laid by females of 5th generation.

The females reared during June to August laid less number of eggs (526-765) eggs per female. Incubation period on an average was 3.6 days ranging from 2 to 6. Average longevity of male moths was 7.7 days ranging from 2 to 10, and that of female moths was 8.68 days ranging from 3 to 11. Average larval period spread over 5 instars was 22.2 days ranging from 18 to 35. Mean pupal duration was 10.5 days ranging from 7 to 12. An average life cycle of the pest was spread over 42 days. The successive 5 generations were completed in 46 days in May, 41.5 days in June, 40.6 days in August, 39.9 days in September and last generation over wintered.

Susceptibility of *A. ypsilon* and *A. segetum* to *A. segetum*—GV from Denmark.

Observations on the mortality of cutworm fed on infected and untreated food are given below:—

Agrotis species	Treatment	% Mortality of larvae after				Total	Pupation
		4 days	5 days	6 days	7 days		
Agrotis ypsilon	GV. infection	0	37	45	17	99	1
	Control	0	0	0	47	47	53
Agrotis segetum	GV. infection	20	62	16	2	100	0
	Control	0	0	0	38	38	62

It may be seen that all larvae of *A. segetum* fed on virus infected food died within 6 days without pupating, while 62 larvae released on untreated artificial diet kept as control successfully pupated and 20% moths emerged out of them. In case of *A. ypsilon*, larvae released on GV infected diet 99% died within 7 days with only one pupation and no emergence in check. From these results it is quite evident that *A. segetum*—GV (Denmark) is an effective disease causing virus against *A. ypsilon* and *A. segetum* and can be used for the control of these cutworms in Pakistan. Field scale trials are necessary for implementing these results on large scale.

Acknowledgement. The authors are highly grateful to Dr. Ole Zethner of Zoology Institute, the Royal Veterinary and Agriculture University, Copenhagen, Denmark for encouragement and guidance to initiate the study and providing a sample of *A. segetum* GV. for trial.

References

1. ALAM, M.M., M.N. BEG; R.A. SYED; I.A. HAFIZ and S. SHAH. 1969. "Survey of Parasites of Insect pests of cultivated useful plants and survey of parasites". CIBC Pakistan Station, Rawalpindi. Publication pp. 223-225.
2. BEESON, C.F.C. 1941. "Ecology and control of Forest Insects of India and neighbouring countries". pp. 645.
3. BEGG, J.A. and C.R. HORRIS. 1961. "Preliminary report on control of black cutworm *A. ypsilon* with Aldrin incorporated into the soil in various ways. Rev. appl. Ent. 49:396.
4. FAULKNER, L.R. 1954. "Effect of certain insecticides upon unhatched larvae of Pale western cutworm in the laboratory. J. Econ. Ent. 47(5): 929-930.
5. JOHN, L.H. 1953. "Soil treatement test for the control of Pale Western cutworm. J. Econ. Ent. 46(2): 1097.
6. KAMEL, A.A.M. and A. SOHAB. 1959. "Chemical control of greasy cutworm". Rev. Appl. Ent. 47(11): 409.

7. METCALF, C.L. and W.F. FLINT. 1962. "Destructive and useful insects". pp: 1087 Mc Graw Hill Book Co. Inc. New York, London.

8. REHMAN, K.A. 1940. "Insect Pest Number, Punjab Agriculture College. May 7(5-7): 25-27.

9. SINGH, M.P. 1949. "On the possibility of *A. ypsilon* Rott. Passing the summer months in the plains of Bihar breeding on alternate host plants. Ind. J. Ent. 14(1): 38.

10. SEN, A.C. 1952. "Alternate host plants of greasy cutworm in the plains of Bihar". Ind. J. Ent. 14(1): 38.

11. SIDER, C. 1952. "Alternate host plants of greasy cutworms in the plains of Bihar". Ind. J. Ent. 14(1): 38.

12. SMIRNOFF, W.A. 1974. "Three years Aerial field experiment with *Bacillus thuringiensis* and Chitinase formulation against the spruce bud-worm. J. Invertebr. Pathol. 24:344-348.

13. VANKATRAMAN, T.V. 1954. "A note on the possibility of *A. ypsilon* Rott migrating from plains to the hills during summer months in the plains of India. Ind. J. Ent. 16(2) 187-198.

14. ZARIN, P. and KALNGNYA. 1971. "Effect of temperature on the development of nuclear polyhedrosis in Melacosoma neustria" Trady LSHA (Lafvijas Lanksoimniecibes Akadeunijas Pasksbi) No. 40, 42, 47.