Beitr. Ent. Berlin 41 (1991) 1, S. 271–275

Department of Entomology
Haryana Agricultural University
Hisar, India.

RAM SINGH and J. P. CHAUDHARY

Influence of female and male age and association periods of the adults of oriental armyworm (Lepidoptera: Noctuidae) on oviposition, egg hatch and longevity

1. Introduction

The oriental armyworm, *Mythimna separata* (WLK.) is a serious polyphagous pest of over 33 species of cereals and grasses in Asia and Australia (SHARMA and DAVIES 1983; SINGH et al. 1987). Larvae remain unnoticed till they reach final instars when maximum damage (over 96%) is caused to crops (RICE et al. 1982). To control this stage, higher doses of insecticides are required which may not be desirable in integrated pest control. Use of biocontrol agents and resistant plants has also not yielded promising results (SHARMA and DAVIES 1983). Continuing concern about the need for new approaches to control armyworm has resulted in research exploing the potential of light trap catches (PERSSON 1977) and mating disruption with the sex pheromones (SATO et al. 1980). These approaches focus on manipulation of the reproductive biology of insect to achieve population suppression and for their success, knowledge of reproductive behaviour and biology is an essential component. Reproductive potential of this armyworm is dependent upon several factors including mating, temperature and adult feeding (HIRAI and SANTA 1983; SINGH 1987). Consequently further studies were conducted to determine the effect of female and male age at mating and their association periods on the degree of oviposition, egg viability and longevity.

2. Methods

Experiments were conducted at prevailing temperature 17 ± 2 °C and relative humidity 71 ± 5% in economic entomology laboratory from mid-January to mid-March, 1986. These conditions are conducive for higher longevity, fecundity and hatching of this pest (DHALIWAL and BAINS 1978; SINGH 1987). Adults were used from the culture raised in laboratory by sexing and holding the pupae individually in glass vials. Emerging adults of known age were kept separately in glass jars (15 × 10 cm) and provided with 10% sucrose solution absorbed in cotton swab till used in the experiments. The females of different age groups **viz.**, 1, 5, 10, 15, 20 and 25 days old, were paired with newely emerged (0–12 h) males and vice-versa in glass jars (15 × 10 cm) which functioned both as mating and oviposition chambers. Dry sugarcane leaves were offered as oviposition substrate and sucrose 10% solution as adult diet in each chamber. In each age group 10 pairs (male + female) were tested individually. A male without female and reverse were also

DOI: 10.21248/contrib.entomol.41.1.271-275

kept as control to see the longevity. Observations were recorded daily on the number of eggs laid and the adult mortality if any. Eggs alongwith oviposition substrate were removed daily from oviposition chambers and confined to glass beakers (500 ml) to record hatching.

In another set of experiment, newly emerged adults were paired for different association periods **viz.**; 1, 2, 5, 10, 15, 20, 25 days and also till death. After the prescribed period, males were dissociated from mating chambers and kept separately in similer glass jars containing sucrose. At the time of adult release, mating chambers were provided with dry sugarcane leaves and 10% sucrose solution as described above and were replenished whenever required. Observations were recorded on adult longevity, egg deposition and hatching for each treatment.

The data were subjected to analysis of variance to know the significant differences among various treatment means (SNEDECOR and COCHRAN 1967).

3. Results

Results are summarised in Tables 1 to 3. The females of *Mythimna separata* lay eggs only after mating (SINGH 1987) and therefore, females which deposited eggs were assumed to have mated. As evident from Table 1, mating of females of different age groups with newly eclosed males affected preoviposition, oviposition, postoviposition durations, egg number and hatching significantly. Egg output (550 egg/female) of 10 days old females was significantly poor as compared to newly mated females (900 egg/female). Twenty five days old females died without laying eggs whereas 20 days old females laid fewer eggs (200 egg/female). Egg hatch for 1 to 15 days old females was almost similar (65–75%) but it was significantly poor (30%) when laid by 20 days old females. Variable age of adults at mating did not affect the longevity (27–29 d) of either sex.

Table 1:
Effect of differential age of the females of oriental armyworm when mated with newly emerged males (0–12 h) on longevity, egg deposition and hatching.[a]

Age of females (days after emergence)	Female longevity (days)				Male longevity (days)	Eggs (no./female)	Hatching (%)
	Preoviposition period	Oviposition period	Postoviposition period	Total			
1	7	20	2	29	27	900	75
5	7	19	3	29	29	750	73
10	11	14	3	28	27	550	76
15	16	12	1	29	28	350	65
20	21	6	1	28	29	200	30
25	–	–	–	27	28	0	0
1 (female without male)	–	–	–	29	–	–	–
SEm ±	2.1	2.5	0.5	1.4	1.4	90.0	12.0
CD (P = 0.05)	5.2	6.3	1.2	NS	NS	260.0	28.0

[a] Mean values based on 10 pairs (10 male + 10 female) in each age group.
NS = Non-significant differences.

DOI: 10.21248/contrib.entomol.41.1.271-275

Table 2:
Effect of newly emerged females (0–12 h) of the oriental armyworm when mated with males of different age groups on longevity, egg production and hatching[a]

Age of males (days after emergence)	Female longevity (days)				Male longevity (days)	Eggs (no./female)	Hatching (%)
	Preoviposition period	Oviposition period	Postoviposition period	Total			
5	7	19	2	28	29	875	76
10	8	19	1	28	28	845	72
15	7	18	3	28	27	425	45
20	7	14	5	26	28	410	40
25	—	—	—	26	29	—	—
1 (male without female)	—	—	—	—	30	—	—
SEm ±	0.5	1.6	0.9	1.3	1.5	80.0	13.0
CD (P = 0.05)	NS	3.9	2.7	NS	NS	240.0	40.0

[a] Mean values based on 10 pairs (10 male + 10 female) in each age group
NS = Non significant differences.

The age of males at mating (Table 2) with newly emerged females also affected reproductive parameters. Oviposition period (19d), egg deposition (845–875 egg/female) and hatching (72–76%) of newly eclosed females when mated with 5 and 10 days old males were almost similar but older males (15–20d) affected egg output and hatching adversely. Twenty five days old males could not induce females to lay eggs. However, age of males did not affect preoviposition period and total longevity of either sex.

Table 3:
Influence of different association periods of the newly emerged oriental armyworm males and females on adult longevity, egg production and hatching.[a]

Association period (days)	Female longevity (days)				Male longevity (days)	Eggs (no./female)	Hatching (%)
	Preoviposition period	Oviposition period	Postoviposition period	Total			
1	17	1	8	26	28	10	0
2	16	3	10	29	28	75	0
5	10	4	12	26	28	250	0
10	7	6	12	25	27	400	30
15	6	12	9	27	26	550	46
20	7	19	2	28	29	818	65
25	7	19	2	28	28	915	70
Till death	7	20	2	29	27	900	75
SE ±	2.0	3.1	2.1	1.4	1.1	95.0	15.0
CD (P = 0.05)	5.2	6.8	5.2	NS	NS	285.0	42.0

[a] Mean values based on 10 pairs (10 males + 10 female) in each association period.
NS = Non significant differences.

DOI: 10.21248/contrib.entomol.41.1.271-275

Oviposition period, rate of egg laying and hatching were directly proportional to association period of adults (Table 3). Longer the association period of both sexes after emergence higher was the reproductive potential of females. Females which were kept only for one night with males after emergence laid on an average 10 eggs while those remained with males till death deposited 900 eggs. Association period of less than 5 days led to fewer and unviable eggs.

4. Discussion

In majority of noctuid moths, mature eggs are produced during the later stage of pupal life as has been reported for *Bombyx mori* (MOKIA 1941), *Mamestra brassicae* (BONNEMAISON 1961) and several other noctuids (EIDMANN 1931). In all these cases mating is followed by immediate egg laying but in the oriental armyworm, there was no egg deposition till 7 days even when mating took place on first night after eclosion. This indicates that mating stimulates both oogenesis and oviposition. SINGH and RAI (1977) also observed mating as prerequisite for egg laying in this pest. Further, unlike several other noctuids, the oriental armyworm also requires carbohydrate solution in adult stage (SINGH 1987) which stimulates ovarion development (HIRAI and SANTA 1983). Therefore in addition to adult feeding on carbohydrate diet, mating and the continuous presence of males with mated females are essential factors for accelerating egg output and hatching in the oriental armyworm. KRISHNA et al. (1977) also reported similar findings in another noctuid *Earias fabia*.

Mating and maintenance of oviposition are under the control of sex pheromones which has been reported in over 38 species of noctuid moths (TAMAKI 1985) including the oriental armyworm (CLEARWATER 1972; SATO et al. 1980). Poor mating and egg laying performance in aged females of the oriental armyworm may be indirectly attributed to poor titre and biological activity of sex pheromones as was also observed for *Argyrotaenia velutinana* (MILLER and ROELOFS 1977). MOSCARDI et al. (1981) also observed higher fecundity and hatching in younger females as compared to older one in another noctuid *Anticarsia gemmatalis*.

Present findings suggest the trapping of armyworm adults in early period of their adult life either through light traps (PERSSON 1977) or sex pheromone traps (SATO et al. 1980). This may help in suppression of field population and subsequent generations.

Acknowledgements

Authors are thankful to the Head of the Department of Entomology, Haryana Agricultural University, Hisar, for providing necessary facilities.

References

BONNEMAISON, L.: Etude de quelques facteurs de 1961 la fecondite et de la fertilite chez la Noctuelle du chou (*Mamestra brassicae* L.) (Lep.). II Influence de la lumiere sur les imagos et sur laccoup lement. – In: Bull. Soc. Entomol. – Paris Fr. **66** (1961). – S. 62–70.

CLEARWATER, J. R.: Chemistry and function of a pheromone produced by the male of southern armyworm, *Pseudaletia separata*. – In: J. Insect. Physiol. – London **18** (1972). – S. 781–789.

DHALIWAL, Z. S., BAINS, S. S.: Effect of temperature on the development survival and the rate of increase of armyworm, *Mythimna separata* (WALKER) (Noctuidae: Lepidoptera). – In: Indian J. Ecol. – Ludhiana **5** (1978). – S. 240–249.

EIDMANN, H.: Morphologische and physiologische Untersuchungen am weiblichen genitalappatat der lipidopteran. II Physiologischer Teil. – In: Z. Angew. Entomol. Hamburg **18** (1931). – S. 57–112.

DOI: 10.21248/contrib.entomol.41.1.271-275

HIRAI, K. & SANTA, H.: Comparative Hamburg physioecological studies on the armyworms, *Pseudaletia separata* WALKER and *Leucania loreyi* DUPONCHEL (lepidoptera: Noctuidae). — In: Bull. Chugoku Natn. Agri. Exp. Sta. — In: **21** (1983). — S. 55—101.

KRISHNA, S. S., VISHWAPREMI, K. K. C. & SHAHI, K. P.: Studies on the reproduction in *Earias fabia* STOLL (Lepidoptera: Noctuidae): Oviposition in relation to adult nutrition, mating and some environmental factors. — In: Entomon. — Murnau, München **2** (1977). — S. 11—16.

MILLER, J. R. & ROELOFS, W. L.: Sex pheromone titre correlated with pheromone gland development and age in the redbanded leaf roller moth, *Argyrotaenia velutinana*. — In: Ann. Entomol. Soc. Am. — College Park **70** (1977). — S. 136—139.

MOKIA, G. G.: Contribution to the study of hormones in insects. — In: C.R. Acad. Sci. U.S.S.R. Moscou **30** (1941). — S. 371—373.

MOSCARDI, F., BARFIELD, C. S. & ALLEN, G. E.: Effects of temperature on adult velvetbean caterpillar oviposition, egg hatch and longevity. — In: Ann. Entomol. Soc. Am. — College Park **74** (1981). — S. 167—171.

PERSSON, B.: Distribution of catch in relation to emergence of adults in some noctuid pest species in south coastal Queensland. — In: Aust. J. Zool. — Melbourne **25** (1977). — S. 95—102.

RICE, S. E., GRIGARICK, A. A. & WAY, M. O.: Relationship of larval density and instars of *Pseudaletia unipuncta* to rice leaf feeding. — In: Environ. Entomol. College Park **11** (1982). — S. 648—651.

SATO, Y., TAKAHASHI, S., SAKAI, M. & KODAMA, T.: Attractiveness of synthetic sex pheromone to the males of the armyworm, *Leucania loreyi* DUPONCHEL (Lepidoptera: Noctuidae). — In: Appl. Entomol. Zool. — Tokyo **5** (1980). — S. 334—340.

SHARMA, H. C., DAVIES, J. C.: The Oriental armyworm, *Mythimna separata* (WLK.) distribution, biology and control: A literature review. — In: Miscellaneous Report. — Centre for Overseas Pest Research, London: (1983), No 59.

SINGH, R.: Effect of temperature, sustenance and mating on rice armyworm reproduction. — In: International Rice Res. Newsl. — Manila **12** (1987). — S. 26—27.

SINGH, R., MRIG, K. K. & CHAUDHARY, J. P.: Incidence and survival of *Mythimna* species on cereal crops in Hisar. — In: Indian J. Agric. Sci. — New Delhi **5** (1987). — S. 59—60.

SINGH, D. & RAI, L.: Bionomics of rice cutworm, *Mythimna separata* (WALKER). — In: Entomon. — Murnau, München. **2** (1977). — S. 144—146.

SNEDECOR, G. W. & COCHRAN, W. G.: Statistical Methods, Oxford and IBH Publishing Co. — New Delhi, (1967).

TAMAKI, Y.: Sex pheromones. In: Comprehensive Insect Physiology, Biochemistry and Pharmacology (Eds. KERKUT, G. A. and GILBERT, L. I.). Vol. 9. — New York: Pergamon Press, 1985, 735 S.

Zusammenfassung

Das unterschiedliche Alter (1, 5, 10, 15, 20, 25 Tage) der Weibchen und Männchen des orientalischen Heerwurms *Mythimna separata* (WLK.) bei der Paarung hatte einen signifikanten Einfluß auf Zeitraum und Umfang der Eiablage und auf das Schlüpfen bei Untersuchung unter Laborbedingungen (17 ± 2 °C, 71 ± 5% R.H., 10% Sucrose-Nahrung). Je jünger (10 Tage) die Adulten bei der Paarung waren, desto höher lagen die Raten der Eiablage und des Schlüpfens, aber sie wurden nur erreicht, wenn die Vereinigungszeit der Weibchen und Männchen mehr als 5 Tage hintereinander betrug. Vereinigungszeiten von 20 oder mehr Tagen erbrachten höhere Eizahlen (818—915 Eier pro Weibchen) im Vergleich zu solchen von 1 bis 5 Tagen (10—250 Eier pro Weibchen).

Summary

The differential age (1, 5, 10, 15, 20, 25 days old) of the oriental armyworm, *Mythimna separata* (WLK.) females and males at mating significantly influenced oviposition period, egg output and hatching when studied under laboratory conditions (17 ± 2 °C, 71 ± 5% R.H., 10% sucrose diet). Younger the adults (10d) at mating higher was the egg deposition and hatching but it was accomplished when association period of both females and males was more than 5 days at a stretch. Association period of 20 days or more yielded higher number of eggs (818—915 egg/female) as compared to 1—5 days (10—250 egg/female).

DOI: 10.21248/contrib.entomol.41.1.271-275