Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 95, No. 5, October 1986, pp. 561–566.

Seasonal effect on certain developmental stages of *Tricholyga bombycis* Beck. (Diptera: Tachinidae)

PRADIP KUMAR and M S JOLLY
Central Sericultural Research and Training Institute, Mysore 570 008, India

MS received 18 November 1985; revised 9 April 1986

Abstract. Studies conducted for a period of one year (from April 1982 to March 1983) revealed that temperature and relative humidity play a significant role on incubation period, pupal period, emergence percentage, adult longevity and fecundity of uzi fly, *Tricholyga bombycis*. Correlation between temperature, humidity and certain developmental stages is also established.

Keywords. Seasonal effect; developmental stages; *Tricholyga bombycis*.

1. Introduction

Heavy infestation of uzi fly, *Tricholyga bombycis*, is recorded in the intensive sericultural regions of Karnataka and its spread has also been noticed in Andhra Pradesh and Tamil Nadu (Jolly 1981). Occurrence of this parasitic fly is also reported in many other countries of eastern Asia (Ghosh 1949). Although it is mainly a pest of mulberry silkworm, infestation of muga and eri worm by *T. bombycis* has been reported (Mukherjee 1919; Choudhury 1981).

The extent of damage recorded in Karnataka is sometimes upto 40% (Jolly and Kumar 1985). Every year considerable loss of silkworm crops due to uzi fly infestation is reported in West Bengal (Krishnaswami *et al* 1964).

A review of literature reveals that no studies have been made to find out the seasonal effect on the developmental stages of *T. bombycis* in Karnataka one of the most prosperous sericultural tracts of India.

The present investigation was undertaken with a view to understand the influence of temperature and humidity on certain developmental stages of uzi fly during different seasons which may enable us to evolve suitable control measures.

2. Materials and methods

T. bombycis maggots were collected from Ramanagaram area and cultured in the laboratory in netted cages (45 × 45 × 45 cm). The flies were reared on 10% glucose (Glaxo) solution on sterilized cotton wool (Sriharan *et al* 1980).

Silkworms (bivoltine races) were reared in a room (540W × 340L × 315H cm) having an ante-room. All the doors and windows of the room were fixed with wire mesh to ensure that no natural infestation takes place prior to the experimentation. Silkworms were reared as per the recommendations of CSRTI (Krishnaswami 1978). Fifth stadium silkworms from this population were used in this experiment.

Daily temperature and humidity was recorded at 6 h interval in the laboratory. Hatching percentage was obtained based on the number of scars and number of eggs laid. On recovery the maggots were allowed to pupate in loose sterilized soil kept in petridishes (10 cm diameter) till emergence. Silkworms were provided daily to mated female flies for egg laying. Four replications each of 5 pairs were maintained for studies on pupal period, emergence percentage, incubation period, hatching percentage, fecundity and longevity of female flies. Data were recorded once in a month for a period of one year starting from April 1982. Time taken for 50% of the flies to emerge from the day of pupation was considered as pupal period.

The effects of seasonal variations on the developmental stages recorded were statistically analysed (Fisher and Yates 1982) and the relationships existing amongst the various characters were obtained by the correlation coefficient.

3. Results and discussion

3.1 *Incubation period*

The average incubation period was found to be 42 h. The maximum period of 60 h was recorded during June and December and minimum of 30 h during March, April and May (table 1). The incubation period in many species of tachinids is determined as 2–3 days (Clausen 1940).

Statistical correlation of the data indicate negative and highly significant correlation with temperature and positive and non-significant correlation with humidity (table 3). The parameters like hatching percentage and fecundity were positively and non-significantly correlated whereas longevity was positively and highly significantly correlated with incubation period (table 2).

3.2 *Hatching percentage*

An average of 86·50% hatching was recorded. The hatching percentage was maximum (90·78) during August closely followed by 89·96, 89·19 and 89·05 during September, November and July, respectively. The minimum hatching percentage (77·01) was recorded during February (table 1).

The hatching percentage was negatively and non-significantly correlated with temperature and positively and non-significantly correlated with humidity (table 3). It is also positively and non-significantly correlated with longevity and fecundity (table 2).

3.3 *Pupal period*

The maximum pupal period (12 days) was observed during December and June followed by 11 days from July–November and January (table 1). The shortest pupal period (10 days) was recorded during April, May, February and March. The average pupal period was 10·83 days. This is in confirmation with the range given for tachinids by Clausen (1940).

Pupal period was found to be negatively and highly significantly correlated with temperature and positively and non-significantly correlated with humidity (table 3). It was also positively and significantly correlated with emergence percentage and positively and highly significantly correlated with incubation period and longevity. However, the pupal period was positively and non-significantly correlated with hatching percentage and fecundity (table 2).

Table 1. Data showing seasonal effects on certain developmental stages of uzi fly.

Month	Temp. (°C)	Humidity (%)	Incubation period (h)	Hatching (%)	Pupal period (days)	Emergence percentage	Fecundity	Longevity of ♀ (days)
April 1982	28·9	61·4	30	84·84	10	33·25	269·75	11·50
May	28·4	63·8	30	88·23	10	39·25	290·00	12·25
June	24·7	79·0	60	84·74	12	62·75	561·25	15·75
July	25·4	76·4	48	89·05	11	60·00	1020·50	19·00
August	25·8	80·9	48	90·78	11	82·25	621·75	16·75
September	26·1	71·3	40	89·96	11	78·75	428·75	15·25
October	26·2	68·9	40	84·77	11	82·00	398·25	16·00
November	26·1	66·8	40	89·19	11	71·75	482·25	16·75
December	24·4	56·6	60	87·32	12	59·50	373·00	18·25
January 1983	26·1	53·3	42	88·43	11	79·00	352·50	16·50
February	27·1	55·1	36	77·01	10	51·00	286·50	13·25
March	28·6	50·2	30	83·77	10	37·00	298·50	13·50

	Incubation period	Hatching (%)	Pupal period	Emergence	Fecundity	Longevity
SE ±	NS	NS	NS	1·91	25	0·7
CD at 5%	NS	NS	NS	5·49	71	2·0

Table 2. Data showing the correlation amongst certain developmental stages of uzi fly.

Parameters considered	Correlation coefficient
Pupal period/emergence percentage	+0·5940[a]
Pupal period/incubation period	+0·9458[b]
Pupal period/hatching percentage	+0·3754
Pupal period/fecundity	+0·4101
Emergence percentage/incubation period	+0·4681
Pupal period/longevity	+0·7763[b]
Emergence percentage/hatching percentage	+0·4551
Emergence percentage/fecundity	+0·2772
Emergence percentage/longevity	+0·6697[a]
Incubation period/hatching percentage	+0·2391
Incubation period/fecundity	+0·4938
Incubation period/longevity	+0·7614[b]
Hatching percentage/fecundity	+0·4338
Hatching percentage/longevity	+0·4889
Fecundity/longevity	+0·7096[a]

Levels of significance for correlation coefficient. [a]5%–0·58; [b]1%–0·71.

Table 3. Correlation between temperature, humidity and certain developmental stages of uzi fly.

Parameter	Average pupal period	Average emergence percentage	Average incubation period	Average hatching percentage	Average fecundity	Average longevity
Temperature	−0·9384[b]	−0·6923[a]	−0·9369[b]	−0·3114	−0·5476	−0·8764[b]
Humidity	+0·4360	+0·4610	+0·4489	+0·4666	+0·7053[a]	+0·3821

Levels of significance for correlation coefficient. [a]5%–0·58; [b]1%–0·71.

The pupal period in *Exorista mella* Walker (Diptera: Tachinidae) was reported to be of 27·4 days at 15°C whereas at 30°C it was only 7·8 days (Butler *et al* 1968). This is in confirmation with the present finding.

3.4 *Emergence percentage*

Emergence percentage was maximum during August (82·25), 82% during October, 33·25% during April, average being 61·37 (table 1). Emergence percentage was negatively and significantly correlated with temperature and positively and non-significantly correlated with humidity (table 3). This is in confirmation with the finding of Hefley (1928) on a tachinid *Winthemia quadripustulata* (Fabricius). It was also recorded to be positively and non-significantly correlated with parameters like incubation period, hatching percentage and fecundity whereas it was positively and significantly correlated with longevity (table 2).

3.5 *Longevity*

The average longevity of female flies recorded was 15·39 days. Maximum longevity

(19 days) was recorded during July and minimum (11·50 days) during April (table 1). Sriharan *et al* (1971) reported maximum longevity of female (20 days) in March and minimum (9 days) in October and November. This variation may be due to the difference in environmental conditions.

Longevity was negatively and highly significantly correlated with temperature. However, it was positively and non-significantly correlated with humidity (table 3). This finding is in agreement with the observations on the tachinid parasite *Lespesia archippivora* Riley; the longevity of female was less at higher temperature and more at lower temperature (Bryan *et al* 1969). Even female of *Archytas marmoratus* (Townsend) has the same trend (Patrick 1975).

3.6 *Fecundity*

An average of 448·58 eggs were laid per female fly. Maximum fecundity (1020·50) was in July 1982 and the minimum (269·75) in April (table 1). Fecundity was observed to be positively and significantly correlated with longevity (table 2). It was negatively and non-significantly correlated with temperature and positively and significantly correlated with humidity (table 3). Sriharan *et al* (1971) reported a maximum of 369·50 eggs per female during January and minimum of 69·50 during February and this may be attributed to difference in the experimental environment.

The average number of eggs in the parasite *Euphocera edwardii* (Diptera: Tachinidae) was 190 (Wilkinson and Biever 1974), 310 in case of a tachinid parasite of cabbage looper (Kent and Rabb 1970). In case of *Archytas marmor-atus* the number of eggs laid was more at higher temperature (27°C) than at lower temperature (21°C) (Patrick 1975) which is contradictory to the present finding which can be explained by the finding of Wigglesworth (1953) who states 'the rate of egg production like other processes of metabolism varies with temperature, it is accelerated up to a point and falls rapidly'.

Besides, many other factors are likely to influence the fecundity. These include factors that affect the probability of discovering the host and ovipositing, for example a very low probability of discovering the host would lead to low oviposition. Nutrition of parasitoid larvae and adults also influence fecundity (Bracken 1966; Leius 1961).

The present course of investigation reveals that the effect of temperature and humidity on certain developmental stages of uzi fly are in agreement with the general uniformity recorded in case of several parasites of family tachinidae (Hefley 1928; Clausen 1940; Butler *et al* 1968; Jackson *et al* 1969; Kent and Rabb 1970; Wilkinson and Biever 1974).

Acknowledgement

The authors are thankful to Mrs Kshama Giridhar for statistical analysis of the data.

References

Bracken G K 1966 Role of ten dietary vitamins on fecundity of the parasitoid *Exeristes comstockii* (cresson) (Hymenoptera: Ichneumonidae); *Can. Entomol.* **98** 918–922

Bryan D E, Jackson C G and Raymond Patana 1969 Effect of temperature on the progeny production and longevity of *Lespesia archippivora* (Diptera: Tachinidae) in the laboratory; *J. Econ. Entomol.* **62** 765–767

Butler G D, Bryan D E and Jackson C G 1968 Development of the salt-marsh caterpillar parasite *Exorista mella* at controlled constant and variable temperatures in the laboratory; *J. Econ. Entomol.* **61** 161–162

Choudhury S N 1981 *Muga silk industry* (Directorate of Sericulture and weaving, Government of Assam, India) p 78

Clausen C P 1940 *Entomophagous Insects* (New York, London: McGraw Hill Book Company Inc) pp 430–483

Fisher R A and Yates F 1982 *Statistical tables for biological agricultural and medical research*, 6th edition (England: Longman Press) pp 74–75

Ghosh C C 1949 *Silk production and weaving in India* (CSIR monograph, Delhi) pp 61–62

Hefley H M 1928 Differential effects of constant humidities on *Protoporce quinquemaculatus* Haworth and its parasite *Winthemia quadripustulata* Fabricius; *J. Econ. Entomol.* **21** 213–221

Jackson C G, Butler G D Jr and Bryan D E 1969 Time required for development of *Voria ruralis* and its host the cabbage looper at different temperatures; *J. Econ. Entomol.* **62** 69–70

Jolly M S 1981 *Uzi fly its identification prevention and control*, (Bulletin No. 4, CSRTI, Mysore) pp 1–7

Jolly M S and Kumar Pradip 1985 A three pronged approach to control uzi fly; *Indian Silk* Feb–March 5–9

Kent D E and Rabb R L 1970 Biology of *Voria ruralis* (Diptera: Tachinidae); *Annu. Entomol. Soc. Am.* **63** 216–222

Krishnaswami S 1978 *New Technology of silkworm rearing* (Bulletin No. 2, CSRTI, Mysore) pp 1–23

Krishnaswami S, Jolly M S and Dutta R K 1964 A study on the fly pest infestation of the larvaé and cocoons of *Bombyx mori* L; *Indian J. Sericulture* **3** 7–12

Leius K 1961 Influence of food on fecundity and longevity of adults of *Itoplectis conquisitor* (Say) (Hymenoptera: Ichneumonidae); *Can. Entomol.* **93** 771–800

Mukherjee N G 1919 *Handbook of sericulture* (Bengal Secretariat Book Depot, Calcutta) p 296

Patrick S H 1975 The biology of *Archytas marmoratus* (Townsend); *Annu. Entomol. Soc. Am.* **68** 759–767

Sriharan T P, Samson M V and Krishnaswami S 1980 Effect of glucose molasses honey and yeast on *Tricholyga bombycis* Beck; *Indian J. Sericulture* **19** 1–3

Sriharan T P, Samson M V, Krishnaswami S and Datta R K 1971 Laboratory investigation on uzi fly *Tricholyga bombycis* Beck. a tachinid parasite of silkworm (*Bombyx mori* L); *Indian J. Sericulture* **10** 14–22

Wigglesworth V B 1953 *The principles of insect physiology* (London: Methuen and Co. Ltd.) p 473

Wilkinson J D and Biever K D 1974 Biological studies of *Euphorocera edwarsii* (Diptera: Tachinidae) an endoparasite of *Pieris rapae*; *Annu. Entomol. Soc. Am.* **67** 285–286