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EFFICACY OF EGG PARASITOID (*TRICHOGRAMMA CHILONIS* ISHII) AND PUPAL PARASITOIDS (*NESOLYNX THYMUS* GIRAULT *AND TETRASTICHUS HOWARDII* OLIFF) AGAINST *DIAPHANIA PULVERULENTALIS* (HAMPSON) (LEPIDOPTERA : PYRALIDAE), A PEST OF MULBERRY

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The parasitization potential of egg parasitoid, *Trichogramma chilonis* Ishii and two pupal parasitoids, *Tetrastichus howardii* Oliff and *Nesolynx thymus* Girault were evaluated against *Diaphania pulverulentalis* (Hampson) under laboratory conditions. The exposure of one, two and three day old eggs of *D. pulverulentalis* to adults of *T. chilonis* resulted in parasitization rate of 90.84±1.18, 90.00±0.00 and 72.50±5.90 per cent, respectively. The pre-pupae and pupae in the age group ranging between one to eight days were exposed to the adults of *T. howardii* under laboratory conditions and the rates of the pupal parasitization were recorded. The results revealed that at pre-pupal stage, the parasitization was maximum (86.67%), however, it decreased as the age of exposure of pupae to the parasitoid was increased. Thus, maximum rates of parasitization was observed when pupal age at exposure to parasitoid was 1, 2, 3 and 4 days, whereas the parasitoid did not parasitize the pest when 7 and 8 day old pupae were exposed. In case of *N. thymus,* when pre-pupae were exposed to the parasitoid, the parasitization was 13.33±0.00 per cent. However, pupae exposed to *N. thymus* at 6, 7 and 8 days of age recorded no parasitization. Among the parasitoids tested, *T. chilonis* recorded highest parasitization. Between the two pupal parasitoids, *T. howardii* was superior than *N. thymus* under laboratory conditions.

Key words : *Diaphania pulverulentalis, Trichogramma chilonis, Tetrastichus howardii, Nesolynx thymus.*

INTRODUCTION

Sericulture has been one of the main facets of agriculture in Asian countries for hundreds of years. The main input for sericulture is mulberry, which is often attacked by several pests. Among the defoliating pests of mulberry, the leaf roller, *Diaphania pulverulentalis* (Hampson) (Lepidoptera : Pyralidae) inflicts considerable reduction in mulberry leaf yield resulting in economic loss to sericulturists (Geethabai *et al.*, 1997). The incidence of leaf-roller and mulberry leaf yield loss are reported to be in the tune of 70 and 30 per cent, respectively (Muthuswami *et al.*, 2009). The pest appears during June and persists upto February and the disappearance of this pest from March to May is attributed to the possible pupal diapause (Rajadurai *et al.*, 1999). Several natural enemies such as parasitoids, predators and pathogens have been found to regulate the pest population under natural mulberry ecosystem (Manjunath Gowda *et al.*, 2009). Biological suppression of mulberry pests is the safest and most eco-friendly option, particularly *Trichogramma chilonis* Ishii, *Tetrastichus howardii* Oliff and *Nesolynx thymus* Girault have been identified as potential bio-control agents of *D. pulverulentalis*. The egg parasitoid, *T. chilonis* was found to parasitise the eggs of *D. pulverulentalis* upto 77.83 to 80.33 per cent under laboratory conditions (Rajadurai *et al.*, 1999 & 2002).

MATERIALS AND METHODS

One egg parasitoid, *T. chilonis* and two pupal parasitoids, *T. howardii* and *N. thymus* were evaluated against *D. pulverulentalis* under laboratory conditions during 2012-2013 at Department of Sericulture, University of Agricultural Sciences, GKVK, Bengaluru. The materials used and methodology adopted for this study are as described hereunder.

Laboratory evaluation of egg parasitoid, T. chilonis : The "tricho-cards" containing *T. chilonis* were procured from National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru. The cards were cut at the perforated edges into small bits of 1 x 3 cm and placed into the test tube (15 cm height and 2.2 cm diameter) and mouth of the test tube was covered with muslin cloth. After their emergence, the adults (*T. chilonis*) were gently transferred separately into another test tube. Mulberry leaves containing mulberry leaf-roller eggs, cut into small leaf bits (containing 20 eggs), were stapled to the paper disc and transferred into the test tube which contained 10 adults of *T. chilonis*. The parasitized leaf roller eggs turned black at fifth day after parasitization. After the 10^{th} or 11^{th} day, the *T. chilonis* adults emerged from the leaf roller eggs.

The observations on number of leaf-roller eggs exposed to the parasitoid, number of eggs hatched, number of eggs parasitized and time taken for emergence of adults of *T. chilonis* were recorded. The day-wise change in egg colour due to parasitization was also recorded. The rate of parasitization of eggs of *D. pulverulentalis* was calculated by exposing 24, 48 and 72 h old eggs of *D. pulverulentalis* to adults of *T. chilonis*.

Laboratory evaluation of pupal parasitoids : Two eulophid endopupal parasitoids, *N. thymus* and *T. howardii* were mass multiplied under the laboratory conditions on the puparia of uzi fly, *Exorista bombycis* (Louis) (Diptera : Tachinidae) as per the procedure suggested by Katiyar & Datta (2001).

Pre-pupae and pupae of *D. pulverulentalis*, which were 1 to 8 days old, were placed into different test tubes (15 cm height and 2.2 cm diameter) separately. The adults of *N. thymus* and *T. howardii* at the ratio of 10 adults per 20 pupae were transferred to different test tubes containing 1 to 8 day old pre-pupae and pupae. The rates of parasitization (day-wise) were recorded in both the cases.

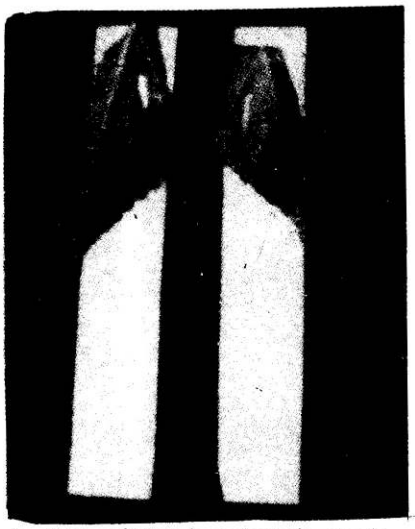
RESULTS AND DISCUSSION

The results pertaining to the evaluation of an egg and two pupal parasitoids against *D. pulverulentalis* under laboratory conditions are as described hereunder.

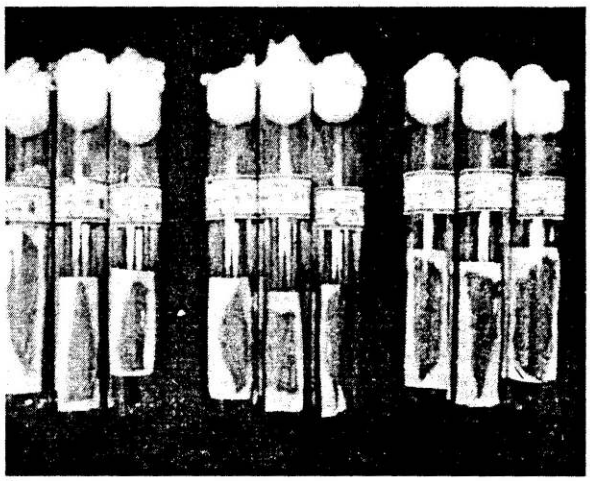
Egg parasitoid

The exposure of one, two and three day old eggs of *D. pulverulentalis* to adults of *T. chilonis* resulted in parasitization of 90.84±1.18, 90.00±0.00 and 72.50±5.90 per cent, respectively in the eggs of *D. pulverulentalis*. Though the differences between the parasitization rates observed in the one and two day old eggs was marginal, the rate of parasitization was reduced when three day old host eggs were exposed to parasitization (72.50±5.89 per cent). The present results clearly indicated that *T. chilonis* was more effective in parasitizing *D. pulverulentalis*, when eggs of this pest were exposed to the

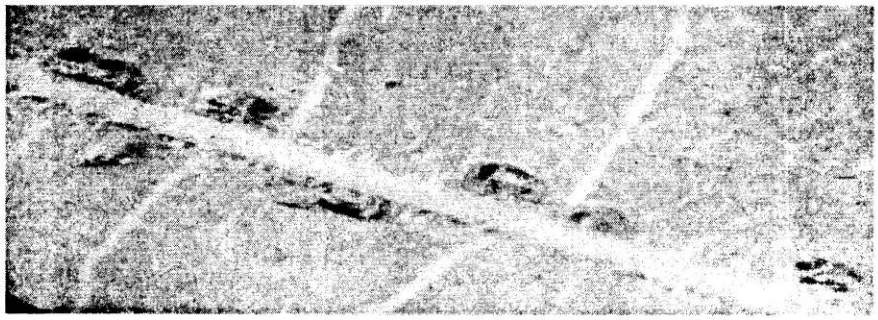
adult female parasitoid at one and two days of age, rather than exposing the eggs at three days of age (Table I; Plate 1 and Fig. 1). Rajadurai *et al.* (1999) reported upto 80.33 per cent *T. chilonis* parasitization on the eggs of leaf webber of mulberry. The parasitized host eggs turned black after three days of parasitization. The parasitoid adults emerged out from the leaf roller eggs after 8 to 9 days (Rajadurai *et al.*, 2002).



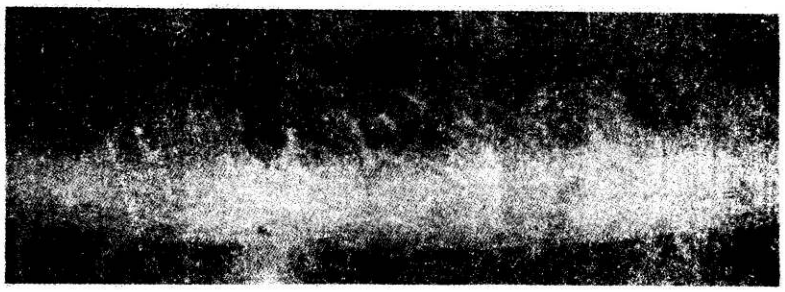
A. Eggs of *D pulverulentalis* staple to paper bits.



B. The eggs of *D. pulverulentalis* exposed to *T. chilonis*



C. *T. chilonis* parasitizing eggs of *D. pulverulentalis*



D. Darkening of eggs of *D. pulverulentalis due to* parasitization by *T. chilonis*

Plate 1 : Laboratory evaluation of egg parasitoid (*T. chilonis*) against *D. pulverulentalis*

Table 1: Parasitization by *T. chilonis* when *D. pulverulentalis* eggs of different age groups were exposed to parasitization.

Age of eggs	No. of eggs of *D. pulverulentalis* parasitized *(Mean ±SD)	No. of eggs of *D. pulverulentalis* hatched *(Mean ±SD)	Parasitization (%) *(Mean ±SD)
Day-1	18.17±0.23	1.83±0.23	90.84±1.18
Day-2	18.00±0.00	2.00±0.00	90.00±0.00
Day-3	14.50±1.17	5.50±1.17	72.50±5.90

*Mean of two replications, n=20 eggs each.

Pupal parasitoids

The pre-pupae of and pupae *D. pulverulentalis* at one to eight day old age were exposed to the adults of *T. howardii* under laboratory conditions and the rates of parasitization were recorded. The results revealed that at pre-pupal stage of *D. pulverulentalis*, the parasitization was 86.67 per cent, which was reduced to 83.34±4.71, 80.00±4.70, 76.67±0.00, 25.00±2.36, 3.33±0.00 and 1.67±2.35 per cent in the subsequent pupal stage, when one, two, three, four, five and six day old pupae of *D. pulverulentalis* were exposed to adults of *T. howardii*. Higher rates of parasitization was recorded at initial stages of the pupal period, whereas the parasitoid did not parasitize the *D. pulverulentalis* pupae when 7 and 8 day old pupae were exposed to parasitization. During pre-pupal stage the soft and membranous integument probably facilitated higher parasitization rates as compared to one day to six day old pupae. As the age of the pupa advanced, the integument became harder and rates of parasitization decreased (Table II). Rajadurai *et al.* (1999) observed parasitization rates of 75.67 per cent in case of *T. howardii* on *D. pulverulentalis* under laboratory conditions. Similarly, Vinod Kumar *et al.* (2011) recommended *T. howardii* as a successful biological control agent against *D. pulverulentalis*.

Table II : Parasitization by *T. howardii* when *D.pulverulentalis* pupae of different age groups were exposed to parasitization.

Age of pupae	No. of pupae of *D. pulverulentalis* parasitized *(Mean ±SD)	No. of adults of *D. pulverulentalis* emerged *(Mean ±SD)	Parasitization (%) *(Mean ±SD)
Pre-pupa	8.67±0.00	1.33±0.00	86.67±0.00
Day-1	8.34±0.47	1.65±0.47	83.34±4.71
Day-2	8.00±0.46	1.99±0.46	80.00±4.70
Day-3	7.67±0.00	2.33±0.00	76.67±0.00
Day-4	2.50±0.24	7.50±0.24	25.00±2.36
Day-5	0.33±0.00	9.67±0.00	3.33±0.00
Day-6	0.17±0.23	9.84±0.23	1.67±2.35
Day-7	0.00	10.00±0.00	0.00
Day-8	0.00	10.00±0.00	0.00

*Mean of two replications, n=10 pupae each.

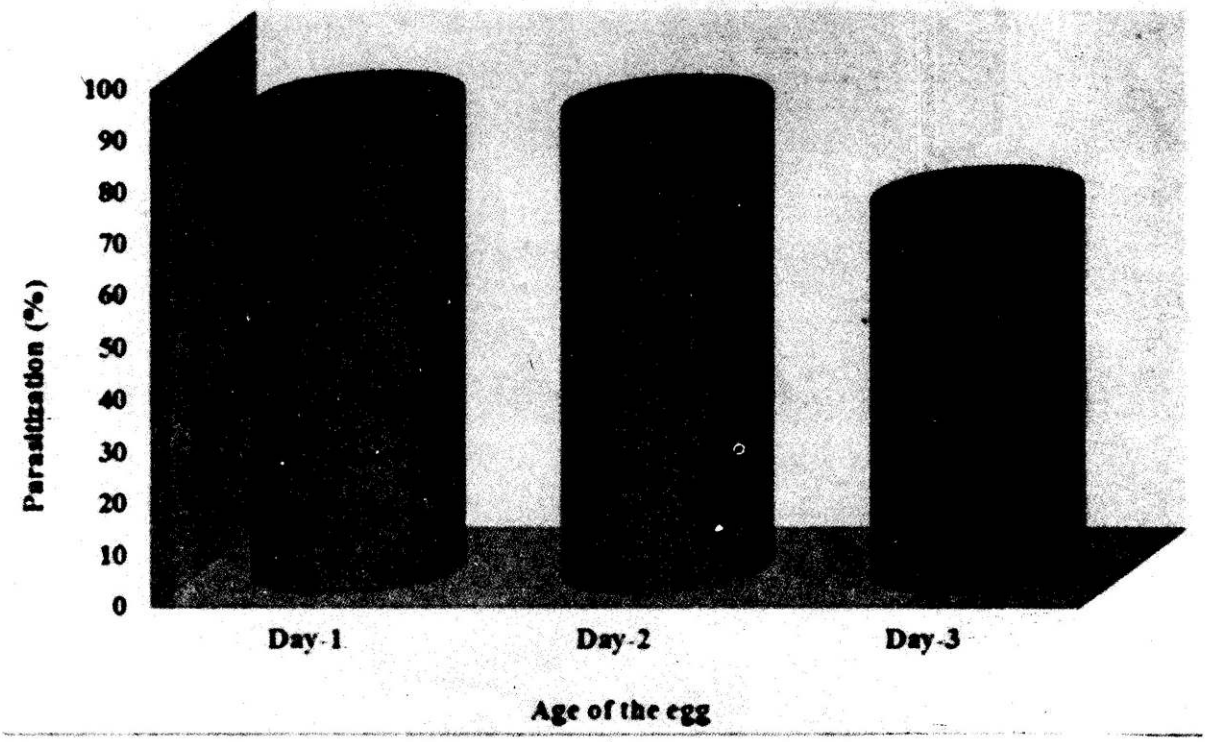
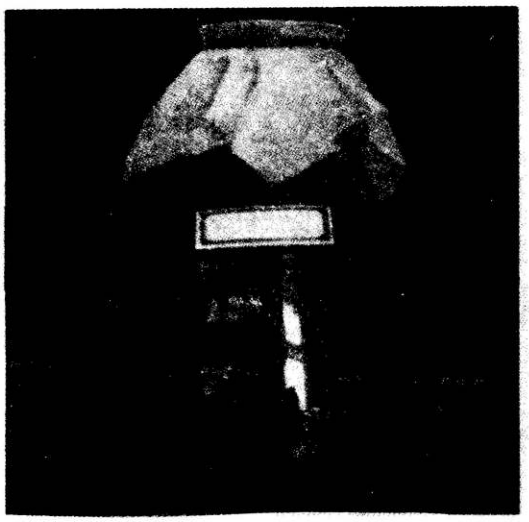
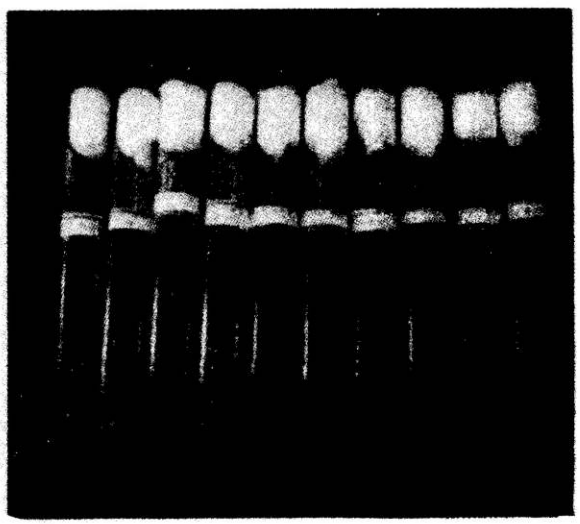


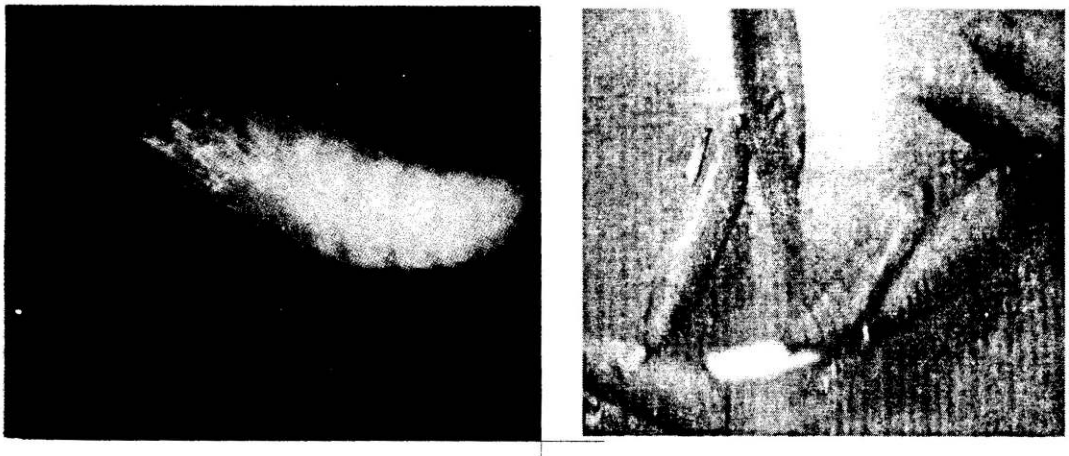
Fig. 1: Rate of parasitization of *T. chilonis* on eggs of *D. pulverulentalis.*



A. Uzifly puparia enclosed for mass culturing pupal parasitoids



B. Pre-pupae and pupae of *D.pulverulentalis* (1 to 8 day old) enclosed for parasitization



C. Close up view of prepupa of *D. pulverulentalis*

D. Close up view of parasitization Process

Plate II : Laboratory multiplication and evaluation of pupal parasitoids against *D. pulverulentalis*

In case of *N. thymus,* when pre-pupae of *D. pulverulentalis* were exposed to the parasitoid, the parasitization was 13.33±0.00 per cent. However, the rates of parasitization was 8.34±2.40, 1.67±2.33, 1.67±2.34, 1.67±2.36 and 1.67±2.36 per cent, respectively when one, two, three, four and five day old pupae of *D. pulverulentalis* were exposed to the adults of *N. thymus,* respectively. However, no parasitization was observed when pupae of *D. pulverulentalis* were exposed to *N. thymus* at 6, 7 and 8 days of age (Table III).

Table III : Parasitization by *N. thymus* when *D. pulverulentalis* pupae of different age groups were exposed to parasitization.

Age of pupae	No. of pupae of *D. pulverulentalis* parasitized *(Mean ±SD)	No. of adults of *D. pulverulentalis* emerged *(Mean±SD)	Parasitization (%) *(Mean ±SD)
Pre-pupa	1.33±0.00	8.67±0.00	13.33±0.00
Day-1	0.83±0.24	9.17±0.23	8.34±2.40
Day-2	0.17±0.23	9.84±0.24	1.67±2.35
Day-3	0.17±0.23	9.84±0.22	1.67±2.34
Day-4	0.17±0.23	9.84±0.25	1.67±2.36
Day-5	0.17±0.23	9.84±0.21	1.67±2.36
Day-6	0.00	10.00±0.00	0.00
Day-7	0.00	10.00±0.00	0.00
Day-8	0.00	10.00±0.00	0.00

* : Mean of two replications, n=10 pupae each.

The comparison of results revealed that as far as *D. pulverulentalis* is concerned, the egg parasitoid, *T. chilonis* was the most potential as compared to pupal parasitoids, *T. howardii* and *N. thymus*. However, *T. howardii* was comparatively, a more efficient pupal parasitoid than *N. thymus*. Hence, the egg parasitoid, *T. chilonis* could be the better biocontrol agent for the management of *D. pulverulentalis*.

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REFERENCES

GEETHABAI, M., MARIMADAIAH, B., NARAYANASWAMY, K.C. & RAJAGOPAL, D. 1997. An outbreak of leaf roller pest *Diaphania* (=*Margaronia*) *pulverulentalis* (Hampson) on mulbery in Karnataka. *Geobios News Reports.* **16**(2) : 73-79.

MANJUNATH GOWDA & NARAYANASWAMY, K.C. 2009. Determination of larval instars in mulberry leaf roller, *Diaphania pulverulentalis* (Hampson) (Lepidoptera : Pyralidae). *Entomon.* **34**(2) : 103-105.

MUTHUSWAMI, M., MURUGESH, K.A., KRISHNAN, R. & DEVI, G. 2009. Mulberry leaf webber, *Diaphania pulverulentalis* (Hampson) (Lepidoptera : Pyralidae) and it management practices in India. Department of Sericulture, Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore, India, pp. 169-179.

RAJADURAI, S., MANJUNATH, D., KATIYAR, R.L., PRASAD, K.S., SEN, A.K., SHEKAR, M.A., AHSAN, M.M. & DATTA, R.K. 1999. Leaf roller - a serious pest of mulberry. *Indian Silk.* **37**(12) : 9-12.

RAJADURAI, S., SEN, A.K., MANJUNATH, D. & DATTA, R.K. 2002. Natural enemy fauna of mulberry leaf roller, *Diaphania pulverulentalis* (Hampson) (Lepidoptera : Pyralidae) and its potential. *Progress of Research on Disease and Pest Management in Sericulture*, Sericulture College, UAS, Chintamani. pp. 50.

VINOD KUMAR, KIRAN MALHOTHRA & MARRISON, M.N. 2011. Rearing of *Tetrastichus howardii,* a pupal parasitoid of the leaf roller, *Diaphania pulverulentalis* on laboratory reared house fly pupa. Central Sericulture Research and Training Institute, Mysuru - Golden Jubilee Conference, pp. 103.

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