

Some interesting observations on the parasitisation of *Danaus chrysippus* (Lepidoptera: Nymphalidae) by *Sturmia convergens* (Diptera: Tachinidae) from West Bengal, India

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Abstract

The tachinid fly, *Sturmia convergens* (Wiedemann, 1824) is one of the most important parasitoids, causing heavy mortality in *Danaus chrysippus* (Linnaeus, 1758). The present work documents for the first time, the gregarious behavior of *S. convergens* in the host larvae. The parasitoid can very well complete its development within the larval stage of the host. A single host larva is capable of provisioning the full development of up to 8 larvae of *S. convergens*. The study also reports them as true larval and larval-pupal parasitoids of *D. chrysippus* on *Calotropis gigantea* (Linnaeus) Dryand, 1811.

Keywords: Gregarious, *Sturmia convergens*, Tachinidae, *Danaus chrysippus*, parasitoid.

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Introduction

Insect parasitoids mainly belong to orders- Hymenoptera, Diptera, Coleoptera, Lepidoptera and Neuroptera and they have a significant role in regulating the population of their host groups. Though the majority of parasitoids are hymenopterans, 21 families, with about 16000 species in Diptera are known to be parasitoids (Eggleton and Belshaw, 1992; Feener and Brown, 1997), Tachinidae being one among them. Tachinid flies are a bit larger in size to houseflies and have more number of bristles. They mostly have Lepidoptera as their major hosts, though a few attack Coleopterans and Hymenopterans too (O' Hara, 2008). *Sturmia convergens* (Wiedemann, 1824) (Tachinidae: Exoristinae) (Fig. 1) is an endoparasitoid of the Nymphalid Plain Tiger butterfly, *Danaus chrysippus* (Linnaeus, 1758) (Ahmed *et al.*, 2014; Gupta *et al.*, 2015). They lay tiny black eggs on the leaf surface of the milkweed plant and are ingested by *D. chrysippus* caterpillars, along with the plant matter. The eggs hatch within the body of the caterpillar, and develop into larva. By the time

the host larva pupates, the fully grown tachinid maggot emerges out and readily pupates (Fig. 2) in soil or other suitable substratum and develops as an adult fly (Mathavan, 1975). The present work deals with some interesting aspects of parasitisation of *D. chrysippus* by *S. convergens* on *Calotropis gigantea* (Linnaeus) Dryand, 1811 in West Bengal. The work documents the gregarious behavior of the species for the first time and also reports *S. convergens* as both larval parasitoids and larval pupal parasitoids.

Materials and Methods

A total of 39 larvae of *D. chrysippus* were collected by hand picking from a profusely branched *C. gigantea* plant at Howrah district, West Bengal, (22°35'34.55" N, 88°17'57.35" E, 12 m elevation), during the period of November, 2017 to March, 2018. The larvae were reared individually in small petri dishes, providing fresh leaves and buds from the host plant. The experiment was carried out under the prevailing temperature and relative humidity as indicated in Table 1. The longevity of the host stages and

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parasitoids were recorded as in Table 3. Morphometrics of larval, pupal and adult stages of *S. convergens* were measured using ocular micrometer (Table 4). Host emergence and parasitoid emergence were observed and carefully documented (Fig. 2). Photographs were taken using digital camera, Panasonic DMC-FH2. The identity of the parasitoids was confirmed with the help of taxonomic expertise available at Zoological Survey of India, Kolkata.

Table 1: Climatic parameters

Month	Average temperature	Average humidity
November	34°C	70%
December	21°C	74%
January	18°C	68%
February	24°C	61%
March	29°C	61%

Observations and Results

The present study documents *S. convergens* as one of the most important natural enemy of *D. chrysippus*. Overall, from the 39 caterpillars observed, 35 maggots of the parasitoid emerged from the hosts (16 from caterpillars and 19 from pupae) and among them, 29 successfully developed into adult flies. *D. chrysippus* caterpillars were most abundant during mid December 2017 to mid January 2018, the peak winter time and were seen pupating not only on the host plants, but also on the boundary walls, piled bricks, and also stumps and poles in the backyard, within 10m radius of the host plant.

During the first half of November 2017, a single caterpillar of *D. chrysippus* was collected on *C. gigantea*, which successfully pupated and developed into an adult butterfly. No parasitisation could be documented.

Later during mid-November to mid December 2017, twenty caterpillars were collected, all of them successfully pupated and among the twenty pupae, only 3 developed into butterflies. From each of the remaining 17 pupae, a single maggot emerged making a hole

in the pupal case (Fig. 2). Of them 16 successfully developed into adult *S. convergens* flies.

From mid December 2017 to mid January 2018, twelve caterpillars were collected, 8 successfully pupated and 4 of them emerged into adult butterflies. From the remaining pupae, 4 maggots emerged, one per pupae and all the four maggots developed into adult parasitoid flies. However, in the second half of February 2018, only 2 caterpillars were collected. From each caterpillar, 4 maggots emerged, rupturing the body wall. In total 8 maggots successfully pupated and developed into adult flies.

During March, out of the 4 caterpillars collected, 2 died and one developed into an adult butterfly. From the remaining one caterpillar, 8 maggots emerged (Fig. 3) and almost 30 minutes were taken for the total emergence. Only 7 of them developed into adults.

The entire mortality caused by the *S. convergens* on *D. chrysippus* has been represented in Fig. 4. The larval mortality and pupal mortality of *D. chrysippus* by *S. convergens* have been 9.09% and 57.57% respectively.

Discussion

Parasitoids are generally classified on the basis of the stage of the hosts they attack. When the parasitoid deposits its eggs inside the larva of the host and if the progeny after completing development, emerge from the host larvae itself, the parasitoid is termed a true larval parasitoid. If the same progeny completes its development late and emerge only from the host pupa, then it is a larval-pupal parasitoid. The present study reports *S. convergens* as true larval parasitoids as well as larval-pupal parasitoids. The exit time of the parasitoid from the host is ruled by the nutritional condition of the host for tachinids, though ecological factors could also be relevant (Cho *et al.*, 2010). Since only a single maggot of *S. convergens* often emerged from the host pupa, they were documented widely as solitary parasitoids (Mathavan, 1975; Gupta *et al.*, 2015). The larvae usually exit the host body at the pupal stage of *D. chrysippus* since the parasitoid has to wait for that much time to get enough nutrition to complete its development

(Mathavan, 1975). But *S. convergens* at two instances in this study were gregarious in the host larvae, since multiple individuals (upto eight) emerged from a single host caterpillar (Table 2). This parasitoid can very well complete its development within the larval stage of the host and apparently, a single host larva is capable of provisioning the full development of up to 8 larvae of *S. convergens* (Fig. 3). However, such instances are very rare, because

compared to the early instars, usually the chances of the tachinid eggs getting ingested by the host caterpillar is more by the late larval instars, when they feed voraciously (Mathavan, 1975) and the development of the larvae in such cases is completed only in the host pupae. Further the early instars are often inadequate in providing enough nourishment to the developing parasitoid, even if the parasitoid eggs start developing in them.

Table 2: Sampling data from November 2017 to March 2018

Sampling period	No. of caterpillars collected	No. of butterfly pupae formed	No. of adult butterflies emerged	No. of maggots emerged from caterpillar	No. of maggots emerged from butterfly pupa	No. of adult parasitoid flies emerged
November, 2017 (First half)	1	1	1	0	0	0
Mid November 2017 to mid-December, 2018	20	20	3 (males)	0	17	16
Mid December, 2017 to mid-January, 2018	12	8	4 (3 males, 1 female)	0	2	2
Mid January and February, 2018	2	0	0	8 (4 maggots from each of the 2 caterpillars)	0	4
March, 2018	4	1	1	8 maggots from a single caterpillar	0	7

Table 3: Average duration of different stages and longevity (in starved condition) of *S. convergens*

Life stages	Average time duration (days)
Egg	Not assessed
Larva	0.58
Pupa	16.5
Adult	4.71

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Table 4: Average body size of different stages of *S. convergens*

Life stages	Length in mm (Average \pm SD)	Breadth in mm (Average \pm SD)
Egg	Not assessed	Not assessed
Larva	9.87 \pm 1.44	5.17 \pm 0.95
Pupa	7.66 \pm 1.32	4.81 \pm 1.06
Adult	9.55 \pm 1.23	3.84 \pm 0.41



Figs. 1-3: *Sturmia convergens* 1. Adult; 2. Pupa of *S. convergens* along with host pupa with emergence hole; 3. Emerged maggots and the host caterpillar.

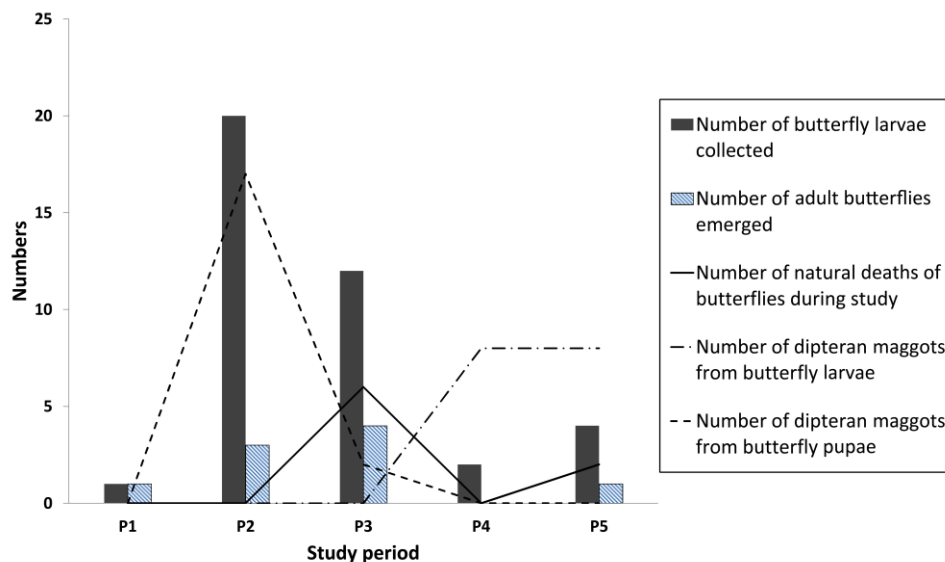


Fig. 4. Host-parasitoid interaction between *D. chrysippus* and *S. convergens*

Conclusion

With several flies emerging out of the host caterpillar, the tachinid endoparasitoid, *S. convergens* can be gregarious at larval stage of the host, and cause very high mortality to *D.chrysippus*.

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