

obovoid, obtuse at the apex, truncate at the base, 3-septate, pale-brown to brown, measure $25-32 \times 10-12 \mu\text{m}$.

Matrix: On dead twigs of *Syzygium cumini* (L.) Skeels (F. Myrtaceae), Leg. K.I.M.V., at Vithalwadi, Poona, on 28-8-1975. No. AMH 2884 (Holotypus), IMI Sub-numero 204510 (Isotypus).

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SOME OBSERVATIONS ON CANNIBALISM IN LARVAL BLOWFLIES (CALLIPHORIDAE: DIPTERA)

A COMPARATIVE study of cannibalism in four different species of blowflies is made to interpret principles of competition, production and succession.

Larvae of blowflies, *Chrysomia rufifacies* Macquart, *Chrysomia megacephala* Fabricius, *Lucilia cuprina* Weidemann and *Sarcophaga ruficornis* Fabricius were randomly selected from the stock culture for study. They were thoroughly washed with tap water to remove meat particles attached to their body. The larvae were then introduced in stoppered test-tubes ($6'' \times 1''$) kept horizontally in a wooden tray for observation. At a time, a batch of twenty larvae of an instar was studied to determine the age at which cannibalism is seen. Ten larvae of specific age and species were used in different combinations for studies regarding nature of cannibalism in different species.

Observations regarding the age at which cannibalistic tendency is noticed, percentage of cannibals and percentage of pupation in single as well as combinations of different species of blowflies are presented in Table I.

Cannibalism is maximum in *Chrysomia rufifacies* less in *Sarcophaga ruficornis* and absent in *Lucilia cuprina* and *Chrysomia megacephala*. Only third instar larvae of *C. rufifacies* and *S. ruficornis* showed cannibalism in the order of 3 day old > 4 day old > 5 day old > 6 day old. Differential predation

was a common feature even under experimental conditions. The tendency for early pupation was noticed only in the third instar larvae of all the species starting as early as in 3 day old larvae of *L. cuprina* and *C. megacephala* and 4 day old larvae of *C. rufifacies* and *S. ruficornis*, which gradually increased with advancing age. Thigmotactic behaviour was a common feature among the non-cannibalistic larvae.

Various reasons such as hydromania¹, deprivation of particular niches², non-availability of food³, differences in the developmental events⁴, competition between species for oviposition medium⁵ have been suggested to explain cannibalism. Each carcass on which the larvae feed represents an essentially restricted environment containing a limited quantity of suitable food which gradually changes in its quality as decomposition sets in⁴. Because of this, the available food remains attractive for a comparatively short time. In nature, cannibalism probably starts when the food is no more attractive.

Among the species studied, *C. rufifacies* presented a strongly marked predatory nature. The head of the larva of this species is markedly attenuated which allows easy penetration into the tissue of the prey⁶. Thus the larva of *C. rufifacies* has an edge over other species and this is probably responsible for its aggressive behaviour not only towards its own members but also towards the members of allied species.

Predatory tendencies were absent in 1st and 2nd instar larvae but percentage of cannibalism was found to be much greater in early third instar larvae of *C. rufifacies* and *S. ruficornis* as predation starts sufficiently early to reduce competition or density of population.⁴

In the absence of food the larvae of *L. cuprina* and *C. megacephala* were found to respond in a totally different way. They exhibit a strong thigmotactic behaviour probably to save water loss through respiration by creating a moist microclimate around them and show a marked preference for early pupation. Non-cannibalism has been regarded as tolerance for shortage of food.⁷ In the absence of cannibalistic tendency under laboratory conditions, these species formed viable pupae at much earlier age.

Growth plays a major part in determining the survival in any species. All the larvae in nature, probably start life with approximately equal chances of development and survival though they differ fundamentally in their developmental events. The larval stages studied were found to respond differently to the absence of food in the laboratory. Tendency for early pupation or cannibalism is then a reflection of basic differences in growth patterns of different species. The efficiency with which the developing larvae, in the absence of food, produce viable pupae would decide the success of species in survival.

TABLE I

Table showing the age at which cannibalistic tendency is seen (A), nature of cannibalistic tendency in different species when kept in different combinations (B), percentage of cannibalism and percentage of pupation (C) in the larvae of *Chrysomia rufifacies*, *Chrysomia megacephala*, *Lucilia cuprina* and *Sarcophaga ruficornis*:
(Values given are mean of five replicates)

Instars	I	II	III			
Age in days	1	2	3	4	5	6
(A)						
No. of larvae used	20	20	20	20	20	20
No. of larvae eaten :						
% cannibalism in 2 days						
<i>C. rufifacies</i>	X	X	17 : 85	11 : 55	5 : 25	2 : 10
<i>C. megacephala</i>	X	X	0	0	0	0
<i>L. cuprina</i>	X	X	0	0	0	0
<i>S. ruficornis</i>	X	X	X	3 : 15	2 : 10	0
(B)						
No. of larvae used	10/10	10/10	10/10	10/10	10/10	10/10
No. of larvae eaten :						
% cannibalism in two days						
<i>C. megacephala</i> * and	X	X	7 : 70	7 : 70	6 : 60	5 : 50
<i>C. rufifacies</i>	X	X	..	..	..	..
<i>C. megacephala</i> * and	X	X	2 : 20	1 : 10	0	0
<i>S. ruficornis</i>	X	X	..	..	..	..
<i>C. megacephala</i> and	X	X	..	..	..	..
<i>L. cuprina</i>	X	X	..	..	..	..
<i>C. rufifacies</i> and	X	X	..	..	..	..
<i>S. ruficornis</i> *	X	X	6 : 60	5 : 50	4 : 40	4 : 40
<i>C. rufifacies</i> and	X	X	..	..	..	..
<i>L. cuprina</i> *	X	X	6 : 60	6 : 60	5 : 50	5 : 50
<i>S. ruficornis</i> and	X	X	..	..	..	..
<i>L. cuprina</i> *	X	X	1 : 10	1 : 10	0	0
(C)						
No. of larvae used	20	20	20	20	20	20
No. of larvae pupated :						
% pupation						
<i>C. rufifacies</i>	..	..	0	9 : 45	13 : 65	18 : 90
<i>C. megacephala</i>	..	..	7 : 35	16 : 80	20 : 100	20 : 100
<i>L. cuprina</i>	..	..	8 : 40	17 : 85	20 : 100	20 : 100
<i>S. ruficornis</i>	..	..	0	9 : 45	14 : 70	17 : 85

Note : —These larvae died on their own.

*—These larvae fell victim to predation.

The suggestion that cannibalism can be a factor in reducing the blowfly population is a comparatively old one⁸. It is evident from the above discussion

that predation does not have much of a role in population control. It succeeds very little in controlling the emerging adult population in nature^{9,10}.

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ON THE TRACHEAL ORGANS OF SPIDER *OECOBIOUS PUTUS*

In spiders, there is a great diversity in respiratory organs¹. A survey of these organs by Levi² reveals that these animals are provided with book-lungs, tracheae or both. The presence of tracheal organs in some spiders has been completely overlooked. These were first reported in a Japanese liphistiid spider, *Heptathela kimurai* by Yoshikura³. Recently we have observed tracheal organs in an Indian spider, *Oecobius putus* collected from Ahmedabad. In this communication we intend to report our observations on tracheal organs of *Oecobius putus* carried out with the help of a Cambridge S4-10 scanning electron microscope as well as a binocular research microscope.

The tracheal organs are the pair of ovoid bodies located between two book lungs on either side of the midventral axis (Fig. 1). The basal portions of these organs form a common stalk called the pedicel. This in turn communicates to exterior through a single opening placed on the hind margin of second abdominal segment.

The scanning electron micrograph of tracheal organs reveals that, their broader fan-shaped free part presents uneven surface giving appearance of folds. But

this can never be compared with the lamellar components of a true book-lung. The cross-section passing through the tracheal organs on the other hand, indicates the presence of tubular elements which form the core of the tracheal organs (Fig. 2). Looking to the arrangement of these elements and the radial projection of their bristles towards the lumen of the organs, it is convincing to believe these organs arising from tracheal system. Thus our observations support the histological findings of Yoshikura that, the tracheal organs may be homologous with tracheal trunks of the true spiders and their functions may be tracheal. Moreover, like *Heptathela kimurai* which is a dipneumonus spider, *Oecobius* also possesses two book-lungs. Thus although phylogenetically *Oecobius putus* belongs to different taxonomic group than that of *Heptathela kimurai*, the presence of tracheal organs suggests the primitive status of *Oecobius putus* in its group.



FIG. 1. Stereomicrograph showing the tracheal organs and book-lung, $\times 2,000$.

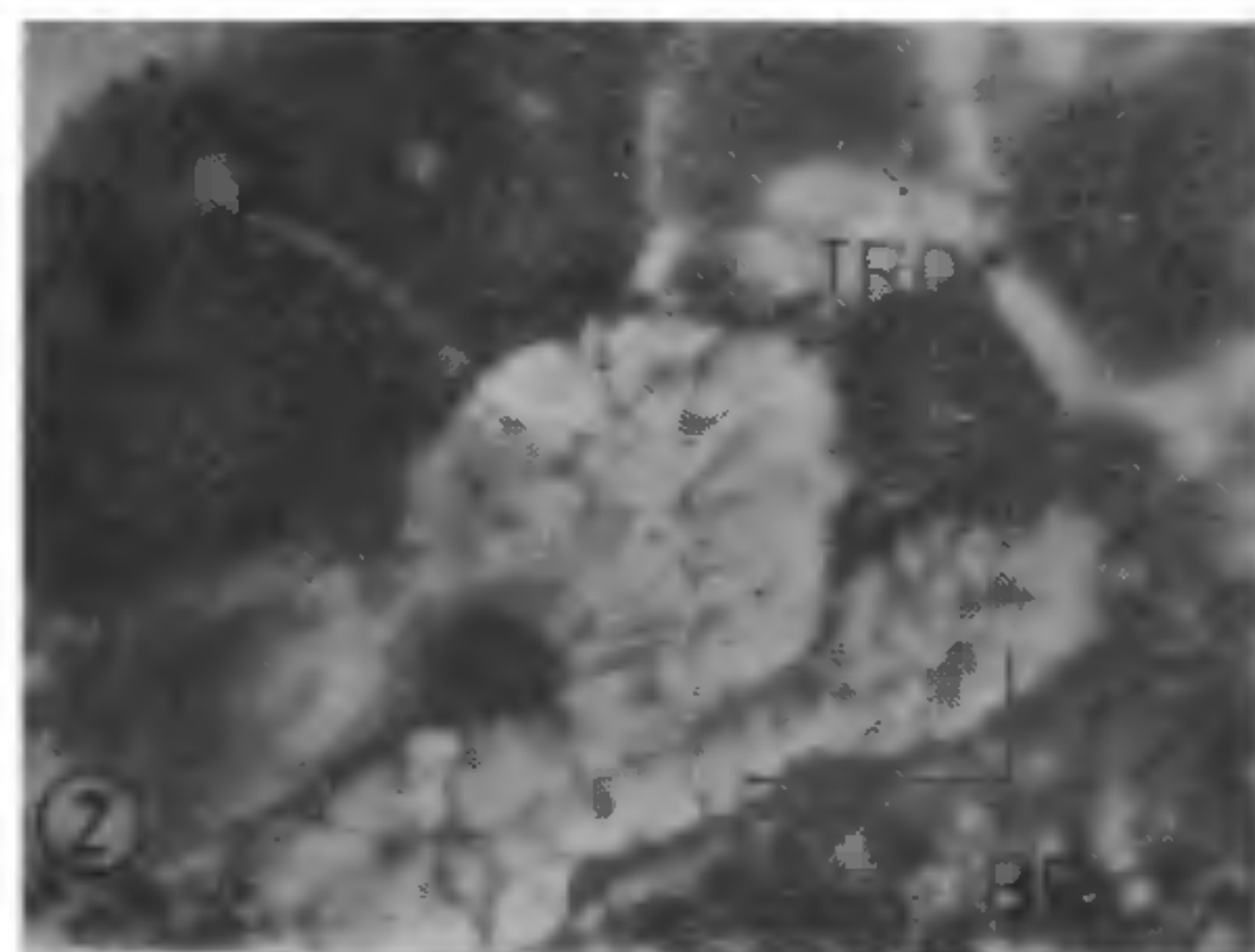


FIG. 2. Transverse section passing through the tracheal organs, $\times 1,000$.

Abbreviations used: B = book-lung; BR = bristles; P = pedicel; TRO = tracheal organ.