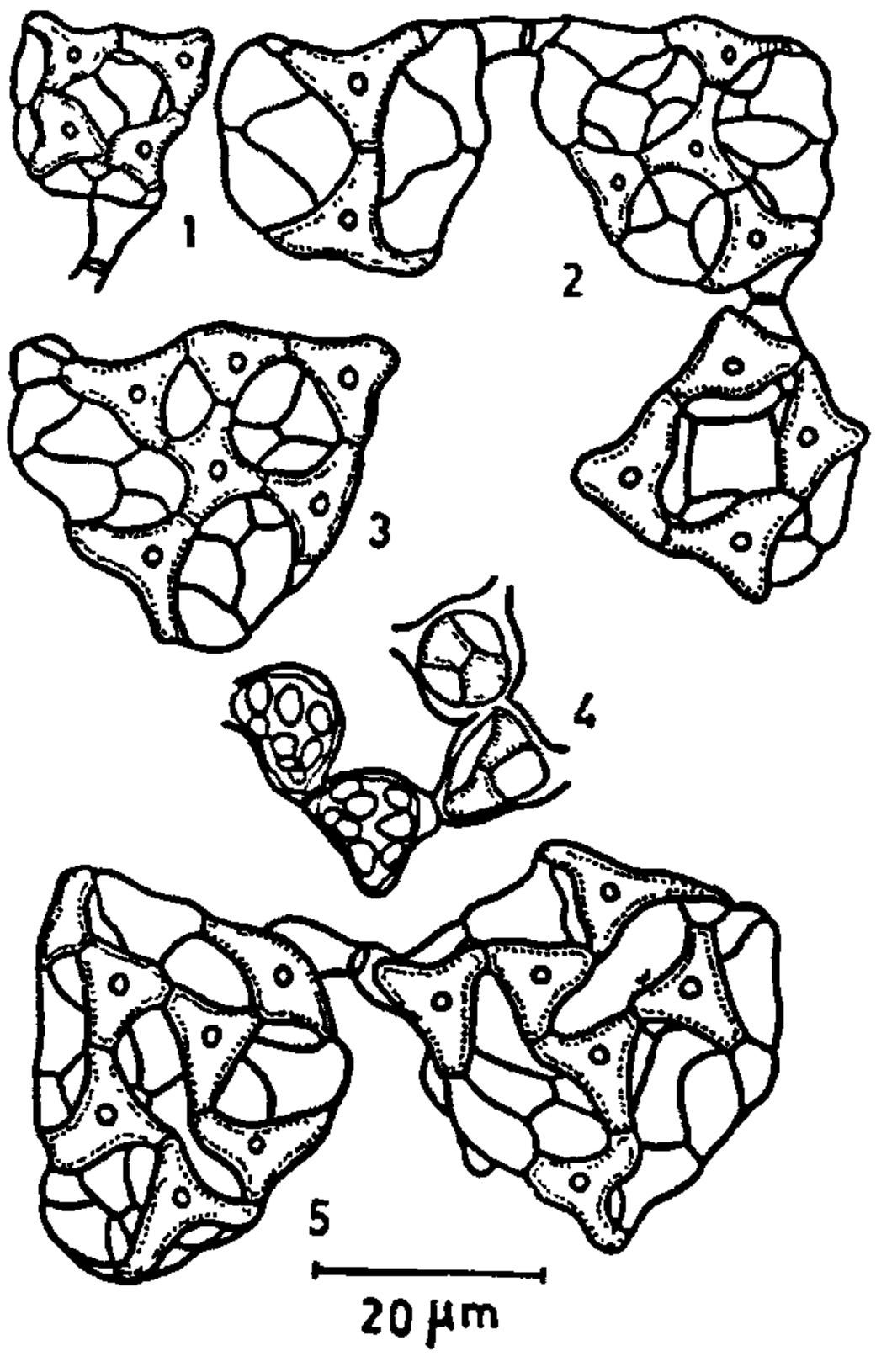

Figures 1–5. *Coelastrum compositum* G. S. West. **1.** 8-celled coenobium; **2** and **5.** Mature coenobia jointed together by parent cell connection; **3.** A coenobium showing cruciate-shaped cell in the centre; **4.** Autocolony formation in different stages.

According to Philipose[2] there are different opinions about this species. *C. compositum* has been considered to be a synonym of *C. proboscideum* Bohlin by Smith[3] and Prescott[4]. But Brunnthaler[5], Fritsch and Rich[6], Rich[7] and Philipose treated it as a distinct species. Here also it is treated as a distinct species following the above authors.

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STUDIES ON THE INHERITANCE OF TRIMOULTERS IN THE SILKWORM, *BOMBYX MORI*

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THE number of larval instars in a given species is genetically fixed[1]; however, studies[2, 3] have shown that larval instar in insects is influenced by low temperature, low humidity, starvation or population density. In silkworm, *Bombyx mori*, the number of larval moults has been shown to be reduced or increased by the combined effect of temperature, photoperiod and nutrition experienced during embryonic development and larval stages[4, 5]. Appearance of sex-linked trimoulters in silkworm has been reported by many workers[6, 7]. The present study is aimed at understanding the manifestation of trimoulters in hybrids of different parent combinations of the silkworm, *Bombyx mori*.

A three-way cross involving two bivoltines (NB_7 and NB_{18}) and one multivoltine (MHMP-W) was found giving spontaneous trimoulters of both sexes to an extent of 6 to 8%. This trimoulter line was used for the present study. Appearance of trimoulters in F_1 varied considerably depending upon the parent strains used either as male or female. The segregation of trimoulters and tetramoulters, their larval span and the percentage of trimoulters in each replication are given in table 1. In a cross involving females of NB_{18} (a Japanese type bivoltine which spins dumbbel cocoons) and trimoulter males, all the trimoulters segregated (9.5 to 35%) were invariably females. However, no trimoulters appeared in the reciprocal cross. Similar results have been reported[5] in the cross of univoltine × multivoltine or bivoltine

Table 1 *Appearance of sex-linked trimoulters among the offspring of different crosses of silkworm, Bombyx mori*

Combinations	Tetramoulters ♂♂ (No.)	Tetramoulters ♀♀ (No.)	Tetramoulters Larval Span days : hours	Trimoulters ♂♂ (No.)	Trimoulters ♀♀ (No.)	Trimoulters Larval Span days : hours	% of trimoulters
NB_{18} × trimoulter	140	109	20:00	00	27	17:00	9.7
–do–	166	47	22:00	00	115	17:20	35.0
	68	55	20:18	00	13	17:04	9.5
Trimoulter × NB_{18}	209	204	22:06	00	00	00	00
–do–	195	189	22:06	00	00	00	00
	186	185	21:20	00	00	00	00
KA × trimoulter	174	68	20:20	00	108	17:04	30.8
–do–	201	60	20:20	00	136	18:02	34.2
	185	64	20:20	00	117	17:04	31.9
Trimoulter × KA	197	191	22:06	00	00	00	00
–do–	147	145	21:20	00	00	00	00
	203	207	22:06	00	00	00	00

× multivoltine when the eggs were incubated at 18°C and reared at 25°C.

In another cross involving females of KA (A Chinese type bivoltine which spins oval cocoons) and trimoulter males, maximum (30.8 to 34.2%) trimoulters were observed. It was surprising to find that all the trimoulters appeared were exclusively females. Again, no trimoulters segregated in the reciprocal cross. The larval duration (17.12 days) of trimoulters was 4.3 days shorter than that (21.49 days) of tetramoulters. In a study[8], only 3.3 days difference of larval span was reported between trimoulters and tetramoulters segregated from F_1 hybrids between the dominant trimoulter and tetramoulter strain. Cocoons spun by trimoulters and tetramoulters larvae have been shown in figure 1. The comparative performance of quantitative characters between trimoulters and tetramoulters segregated from F_1 hybrids is given in table 2. The quantitative characters like cocoon weight, shell

Figure 1. Cocoons of tetramoulter and trimoulter silkworms.

Table 2 *Comparative performance of tetramoulters and trimoulters segregated from different crosses of the silkworm, Bombyx mori*

Combination	Type	Cocoon weight (g) ♂♂	Cocoon weight (g) ♀♀	Shell weight (g) ♂♂	Shell weight (g) ♀♀	Shell ratio (%) ♂♂	Shell ratio (%) ♀♀	Filament length (m)	Denier
NB_{18} × Trimoulter	Tetramoulter	1.580	1.362	0.355	0.254	22.4	18.6	733	2.6
	Trimoulter	—	1.053	—	0.174	—	16.5	675	2.0
Trimoulter × NB_{18}	Tetramoulter	1.485	1.770	0.311	0.327	20.9	18.4	901	2.1
	Trimoulter	—	—	—	—	—	—	—	—
KA × Trimoulter	Tetramoulter	1.519	1.450	0.325	0.277	21.3	19.1	804	2.3
	Trimoulter	—	0.896	—	0.137	—	15.2	588	1.7
Trimoulter × KA	Tetramoulter	1.385	1.687	0.299	0.304	21.5	18.0	873	2.4
	Trimoulter	—	—	—	—	—	—	—	—

weight and shell ratio showed distinct differences between trimoulters and tetramoulters.

Toyama[9] was the first to study the moultinism behaviour in silkworm. Later, several theories have been proposed to explain the appearance of trimoulters in different crosses such as two major genes and modifier gene[5], a recessive trimoulting gene on Z chromosome[6] and a two-gene hypothesis[7]. Our data demonstrate that there is no segregation of trimoulters in crosses involving trimoulter females and tetramoulter males. There is thus a possibility that the trimoulter used in this study is a weak and heterozygous strain.

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NEW RECORD OF HYPERPARASITOIDS ON *CAMPOLETIS CHLORIDAE* UCHIDA AND *EUCELATORIA BRYANI* SABROSKWY PARASITIZING *HELIOTHIS ARMIGERA* (HUBNER) ON TOMATO

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HELIOTHIS ARMIGERA (Hb.) is a key pest of tomato in India. It is attacked by several parasitoids in tomato ecosystem. *Campoletis chloridae* Uchida (Hymenoptera: Ichneumonidae) is an important indigenous parasitoid[1] and *Eucelatoria bryani* Sabroskwy (Diptera: Tachinidae), an exotic parasitoid was introduced in India from USA in 1978[2]. During field collection of *H. armigera*, these two parasitoids were observed to be attacked by hyperparasitoids, which may apparently reduce the efficiency of primary parasitoids under field condition. *E. bryani* was recovered from field after 3 years of last release in 1986. Mani and Krishnamoorthy[3], and Pawar *et al*[4] reported its establishment in tomato ecosystem.

Nesolynx? flavipes Ashmead (Hymenoptera: Eulopridae), a polyembryonic hyperparasitoid was recorded from *E. bryani* puparia collected from the field. Adults (10–28 in number) were observed emerging from one puparia. The total developmental period under laboratory condition was 14 days and the adult parasitoid lived for 21 days. Sixty per cent *E. bryani* puparia was observed to be parasitized. This is the first record of *Nesolynx? flavipes* Ashmead parasitizing tachinid parasitoid *E. bryani*. This species was earlier recorded from Philippines as a primary parasitoid of *Penthocrates* sp. by Cock *et al*[5] who reported it as facultatively hyperparasitic through *Apanteles* sp.

Field collected cocoons of *Campoletis chloridae* (which is a most important parasitoid of *H. armigera* throughout the country) were found to be hyperparasitized by *Tetrastichus? ayyari* Rhower. The specimens collected were slightly different from typical *ayyari* Rhower. *T. ayyari* is considered to be a primary pupal parasitoid of a number of pest species[6]. This is the first record of *T.? ayyari* as a hyperparasitoid of ichneumonid parasitoid, *C. chloridae* from India although *Tetrastichus* spp. are known to be hyperparasitoids of *Apanteles* spp. The total life cycle was 14 days and adults lived for 24 days.

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