Genome Analysis in Eukaryotes: Developmental and evolutionary aspects
R.N. Chatterjee and L. Sánchez (Eds)

4. Developmental Aspects of Mulberry and Nonmulberry Silkworm Species: A comparative study

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I. Silkworms: An Experimental Model System

The mulberry silkworm, *Bombyx mori* has been exploited by man for more than 4000 years, for the production of the exotic silk yarn used in making fabric. The silk fibre, proteinaceous in nature synthesised by *B. mori* larvae, is unmatched in beauty and elegance by any of the man made fibres. The silk industry is reported to have its origin in China dating back to 2600 B.C. and found its way to India over the Himalayas. According to the recorded history, a young Chinese Empress by name Si Ling-Chi has been accredited with the development and exploitation of the silk cocoon for the production of exotic silk fibre. The silk industry spread widely in Europe in the sixth and seventh centuries A.D.

There are many different races and strains of silkworm exploited for silk production. About 90% of the silk produced in the world is from the mulberry silkworms and the remaining 10% originates from the nonmulberry silkworms such as Eri (*Philosomia cynthia ricini*), Muga (*Antheraea assama*) and Tasar (*Antheraea mylitta*) which feed on host plants other than mulberry. India is the second largest producer of silk in the world and has the unique distinction of producing all four varieties of silk.

The mulberry silkworm has been a target of intensive scientific investigations right from the ancient times. Genetic breeding to get better yielding varieties of silkworms has been practiced for a long time. The genetic legacy of this organism, dates back even earlier to that of the fruitfly *Drosophila*, the Cinderella of modern genetics. The achievements in *B. mori* genetics, however, have been very different from that of *Drosophila* because the attempts have been mainly directed towards economic benefits to improve the quality and yield of silk. In the following sections we have provided a detailed review on the developmental biology of *B. mori* with occasional references to the nonmulberry species wherever possible.

Bombyx mori belongs to Phyllum: Invertebrata; Class: Arthropoda; Order: Lepidoptera; Suborder: Heterocoera; Family: Bombycidae.

In the past decade, basic studies on the developmental biology, genetics and molecular biology of the silkworm have been intensified (Willis *et al.*, 1995). The central aim of developmental biology is to elucidate the mechanism of generation of the highly complex metameric adult from a single celled embryo. *B. mori is* now coming up as an important model system because more than 200 Mendelian mutations affecting a wide range of developmental, morphological and biochemical traits have been already mapped (Doira, 1992). Besides, many practical breeding strains of *B. mori* that differ in complex polygenic traits affecting qualitative and quantitative characters such as silk yield, disease resistance and feeding behaviour are also available although the underlying genetic basis of these phenomena is not very clear.

Members of the order Lepidoptera are eumetabolous and their body is covered with overlapping flat scales (Mani, 1968). The integument is coloured cryptically and is densely clothed with setae and flat overlapping scales. The head is small and is associated with long slender antennae with numerous segments, often clevate, pectinate or hooked apically or plumose in males. Generally Lepidopteran larvae are plant feeders except a few which are predaceous and scavengers, or feed on stored products. Most of them feed externally on foliage while a fair number of the minute species mine through leaves or leaf petioles, stems, trunks and roots.

B. mori is a member of *Bombycidae*, a family of 15 species of small dull moths having bipectinate antennae. The proboscis is absent and the legs are hairy and without spurs. The larval body is elongated with dorsal hinges or a terminal horn and is hairless. *B. mori* is supposed to have originated in the southern districts of China and has been differentiated from *Bombyx (Theophila) mandarina. B. mori* strains have been classified into various categories on the basis of colour, size, shape of the egg, cocoon and other morphological characteristics. The most commonly used classification is on the basis of the number of broods or voltinisms (Tazima, 1979), namely:

(i) Univoltine or One Brooded Silkworms: This category includes most of the improved races which go for a single brood in a year. The worms are sensitive to irregular environment, especially high temperatures. Eggs of univoltine insects hatch after an elaborate and graduated storage in cold. The weight of the cocoon, weight of the shell, ratio of the shell to cocoon and weight of slime are high.

(ii) Bivoltine or Two Brooded Silkworms: They are characterized by two broods in a year. Rearing period is short and the consumption of leaves is less as compared to the univoltines. The worms are strong and the weight of the cocoon, weight of the shell, ratio of shell to cocoon and weight of slime are less than univoltine but more than multivoltines. The members of