

Skill Enhancement courses (SEC)

PART II: SEMESTER 3

UNIT 1: INTRODUCTION TO SERICULTURE: DEFINITION, HISTORY AND PRESENT STATUS; SILK ROUTE, TYPES OF SILKWORMS, DISTRIBUTION AND RACES EXOTIC AND INDIGENOUS RACES MULBERRY AND NON-MULBERRY SERICULTURE

Sericulture, or **silk farming**, is the cultivation of silkworms to produce silk. Although there are several commercial species of silkworms, *Bombyx mori* (the caterpillar of the domestic silk moth) is the most widely used and intensively studied silkworm. Silk was believed to have first been produced in China as early as the Neolithic Period. Sericulture has become an important cottage industry in countries such as Brazil, China, France, India, Italy, Japan, Korea, and Russia. Today, China and India are the two main producers, with more than 60% of the world's annual production.

History of Silk

- ❑ A Chinese tale of the discovery of the silkworm's silk was by an ancient empress Lei Zu, the wife of the Emperor.
- ❑ She was drinking tea under a tree when a silk cocoon fell into her tea and the hot tea loosened the long strand of silk.
- ❑ As she picked it out and started to wrap the silk thread around her finger, she slowly felt a warm sensation.
- ❑ When the silk ran out, she saw a small larva. She realized that this caterpillar larva was the source of the silk.
- ❑ She taught this to the people and it became widespread.



Chinese Empress Drinking tea under a tree



Silkworm cocoon falls



Silk strand unravels and larva exposed

SERICULTURE: HISTORICAL PERSPECTIVE

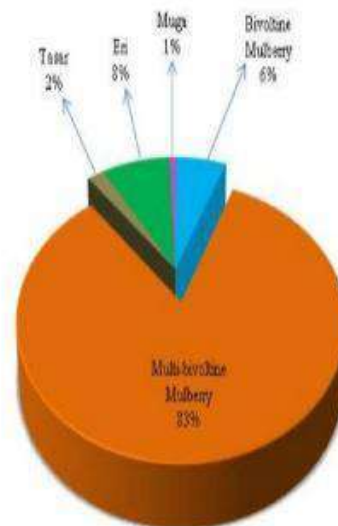
- A Chinese tale of the discovery of the silkworm's silk was by an ancient empress Lei Zu , the wife of the emperor.
- She was drinking tea under tree, when a silk cocoon fell into her tea cup and the hot tea loosened the long strand of silk
- As she it out, and started to wrap the silk thread around her flinger, she felt the warm sensation
- When silk ran out, an larva appeared. She realized that it was this larva that produces the silk
- Soon, she taught this to people and it became wide spread



PRESENT STATUS OF SERICULTURE

INDIAN SERICULTURE DEVELOPMENT: AN OVERVIEW

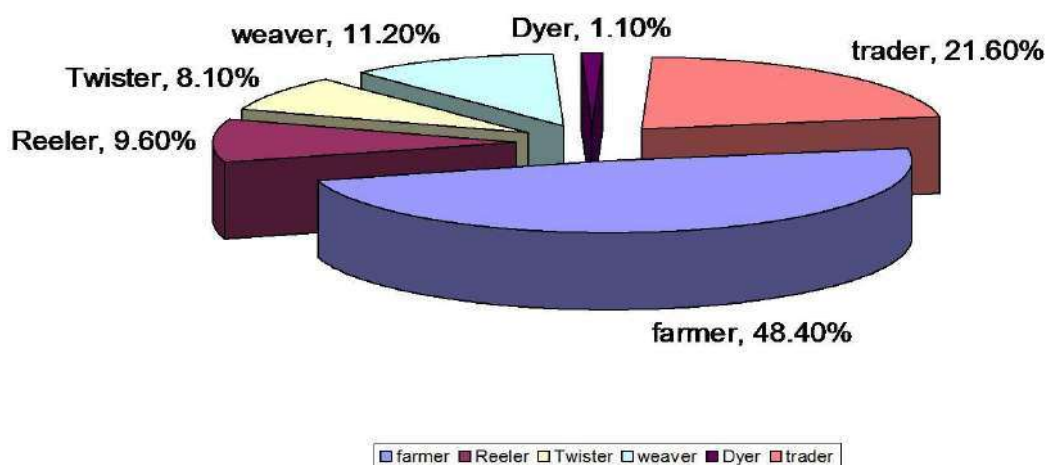
- Sericulture is both an art and science of raising silkworms for silk production.
- India is the second largest producer of raw silk after China
- Biggest consumer of raw silk and silk fabrics
- Trends in international silk production suggests that sericulture has better prospects for growth
- India has a distinct advantage of practicing sericulture all through the year, yielding a stream of about 4 – 6 crops as a result of its tropical climate.
- It is a farm-based, labor intensive and commercially attractive economic activity falling under the cottage and small-scale sector
- it requires low investment but, with potential for relatively higher returns.
- the domestic demand for silk, considering all varieties, is nearly 25,000 MTs
- being imported mainly from China
- basically driven by multivoltine mulberry silk.



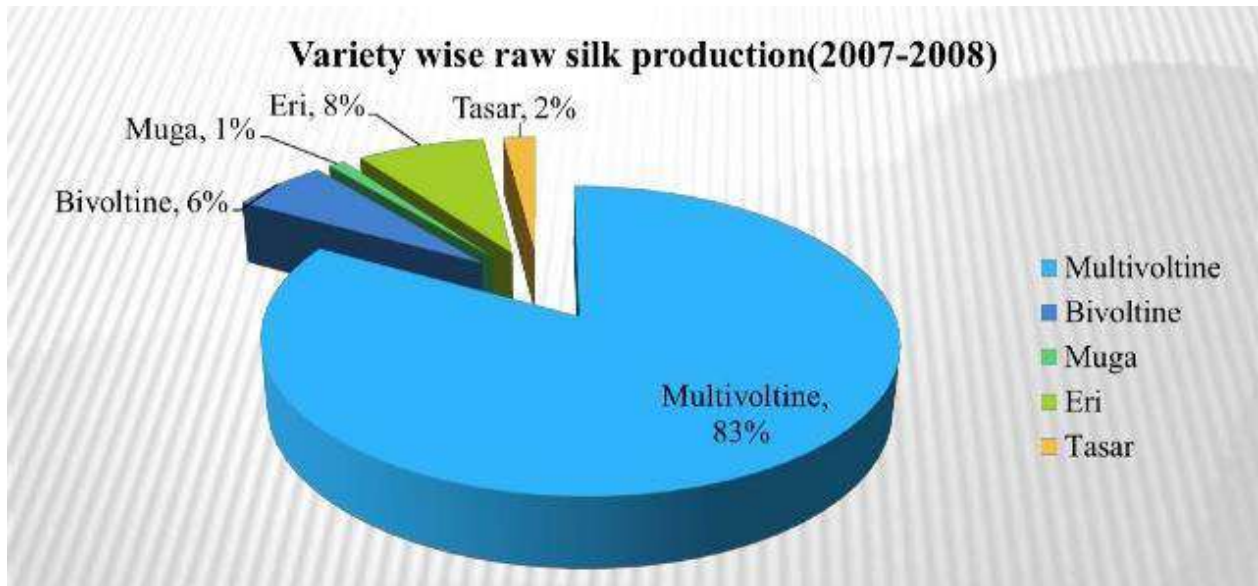
Present Status of Sericulture in the State

MULBERRY SECTOR	
Departmental Nurseries	173
Total area under Nurseries	963 Acres
Production capacity of Saplings/Year	30 Lac
Present Annual Sapling production in Departmental Nurseries	20 Lac
Total available mulberry tress in the State	100 Lac
SEED SECTOR	
Grainages	6
Basic Seed Stations	9
Annual DFL Production	17 Lac
Annual DFL Consumption	25 Lac ⁹

Price Spread in Sericulture



Surce: mattigatti (2000)



Global Silk Industry

The major silk producing countries in the world are; China, India, Uzbekistan, Brazil, Japan, Republic of Korea, Thailand, Vietnam, DPR Korea, Iran, etc. Few other countries are also engaged in the production of cocoons and raw silk in negligible quantities; Kenya, Botswana, Nigeria, Zambia, Zimbabwe, Bangladesh, Colombia, Egypt, Japan, Nepal, Bulgaria, Turkey, Uganda, Malaysia, Romania, Bolivia, etc.

The major silk consumers of the world are; USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany, UAE, Korea, Viet Nam, etc.

Even though silk has a small percentage of the global textile market - less than 0.2% (the precise global value is difficult to assess, since reliable data on finished silk products is lacking in most importing countries) - its production base is spread over 60 countries in the world. While the major producers are in Asia (90% of mulberry production and almost 100% of non-mulberry silk), sericulture industries have been lately established in Brazil, Bulgaria, Egypt and Madagascar as well. Sericulture is labour- intensive. About 1 million workers are employed in the silk sector in China. Silk Industry provides employment to 7.9 million people in India, and 20,000 weaving families in Thailand. China is the world's single biggest producer and chief supplier of silk to the world markets. India is the world's second largest producer. Sericulture can help keeping the rural population employed and to prevent migration to big cities and securing remunerative employment; it requires small investments while providing raw material for textile industries.

1. Global Silk Production (in Metric Tonnes)

#	Countries	2014	2015	2016	2017	2018
1	Bangladesh	44.5	44	44	41	41
2	Brazil	560	600	650	600	650
3	Bulgaria	8	8	9	10	10
4	China	1,46,000	1,70,000	1,58,400	1,42,000	1,20,000
5	Colombia	0.5	0.5	-	-	-
6	Egypt	0.8	0.8	1.2	1.1	1.25
7	India	28,708	28,523	30,348	31,906	35,261
8	Indonesia	10	8	4	2.5	2.5
9	Iran	110	120	125	120	110
10	Japan	30	30	32	20	20
11	North Korea	320	350	365	365	350
12	South Korea	1.2	1	1	1	1
13	Philippines	1.1	1.2	1.82	1.5	2
14	Syria	0.5	0.3	0.25	0.25	0.25
15	Thailand	692	698	712	680	680
16	Tunisia	4	3	2	2	2
17	Turkey	32	30	32	30	30
18	Uzbekistan	1,100	1,200	1,256	1,200	1,800
19	Vietnam	420	450	523	520	680
20	Madagascar	15	5	6	7	7
	Total	178057.62	202072.83	192512.27	177507.35	159648.00

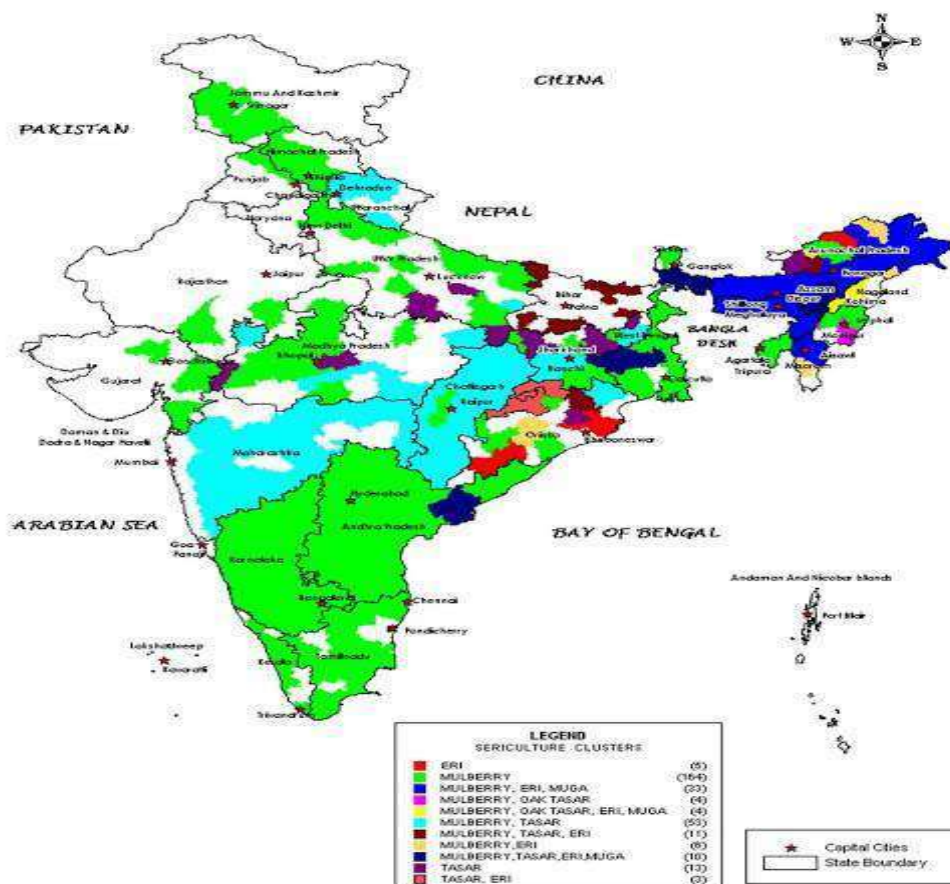
SERICULTURE IN INDIA

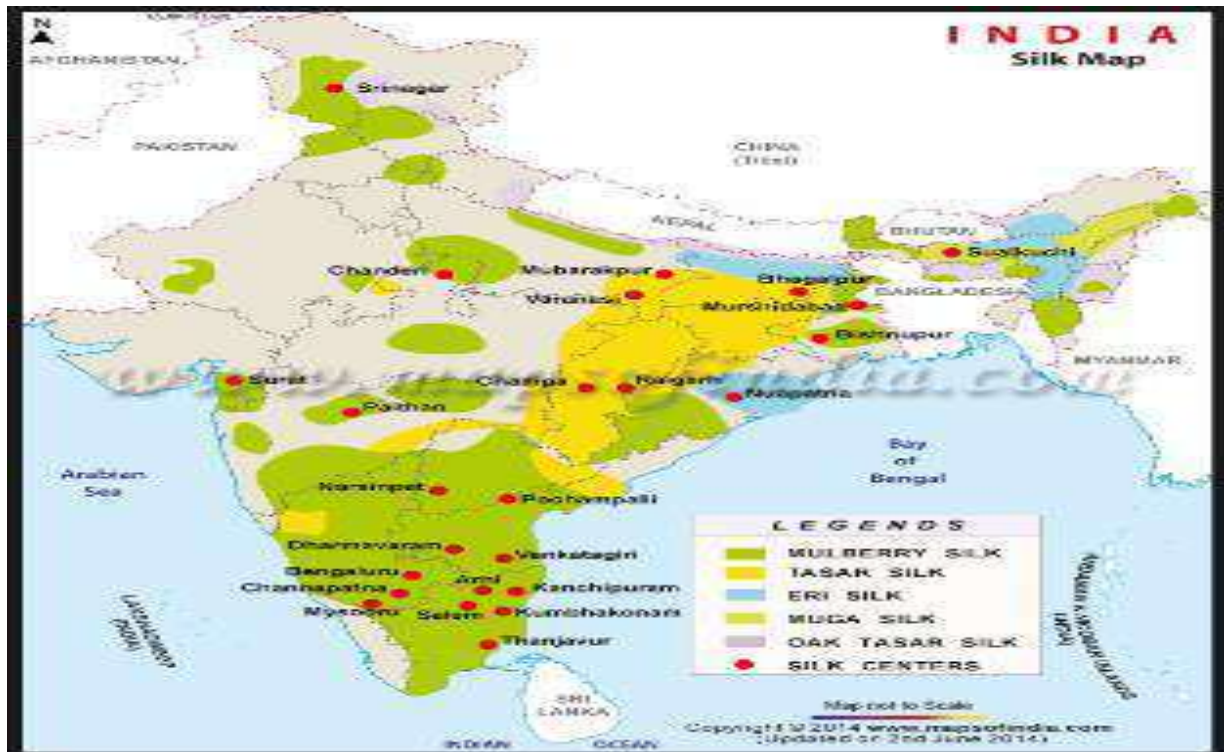
Sericulture and Silk Industry is an avocation in India at least the second century B.C. According to historians, raw silk was exported during the reign of Kanishka in 58 B.C. Some legend says that Chinese Buddhist monks smuggled in eggs of silkworms and seeds of the Mulberry tree in their hollow bamboo sticks. In its long history, silk industry has passed through periods of great prosperity as well as decline. The modern silk history dates back to the 15th Century, which was also famous for sculpture and paintings.

During the 18th, 19th and early 20th centuries sericulture flourished in the States of the then Bengal, Mysore and Kashmir. Indian silk industry has improved manifold since independence from the raw silk production level of 1437 MT during First Plan period (1969-74) to 23679 MTs by the end of March 2013. This has been possible due to the sustained efforts of Central Silk Board, Govt. of India, its research agencies, Provincial (State) sericulture departments and private stakeholders. Development and introduction of improved races of silkworm breeds, high yielding food plants, improvement in rearing practices, organized seed production network, technology up-gradation in reeling, weaving, wet processing, etc., along with the investment made by the governmental agencies have led to an overall improvement in productivity and quality.

India's silks are known for their finery and artistic designs and distinct colours. Today India is the second largest silk producer of raw silk and also has the distinction of being the world's largest consumer of pure silk. The country is known the world over for the exquisite brocade fabrics of Banaras, silks of Karnataka, tie-and -dye and Patola of Gujarat and Rajasthan, ikats from Orissa, fine Bandhej and temple silks of Kancheepuram and Tanjore, etc., are only a few of the myriad range of silk weaves, textures and patterns available in India. India is the only country in the world to produce all the four known varieties of silk including Mulberry, Eri, Tasar and Muga. Mulberry is the largest practiced sericulture industry accounting for almost 76 per cent of the entire silk production. The industry provides employment to more than 7.6 million people across 51,000 villages, who operate 328,627 handlooms and 45,867 power looms with 8,14,616 weavers. Its exports of silk are worth about US\$ 360 Million of which 70 per cent comprises natural silk yarn and fabrics, 13 per cent made-ups and 26 per cent garments. Domestic demand stands at 28800 MT compared to production of 23679 MT annually thanks to the growing demand for silk fabrics and sarees from Indian women. Aggressive promotion of the silk industry in India has attracted a large number of organized players to set up modern units for both apparel as well as home textile production.

SERICULTURE MAP OF INDIA





SILK ROUTE

The Silk Route was a historic trade route that dated from the second century B.C. until the 14th century A.D. It stretched from Asia to the Mediterranean, traversing China, India, Persia, Arabia, Greece, and Italy.

It was dubbed the Silk Route because of the heavy silk trading that took place during that period. This valuable fabric originated in China, which initially had a monopoly on silk production until the secrets of its creation spread. In addition to silk, the route facilitated the trade of other fabrics, spices, grains, fruits and vegetables, animal hides, wood and metal work, precious stones, and other items of value.

In 2013, China announced plans it would revive the Silk Route, connecting it with more than 60 countries in Asia, Europe, Africa, and the Middle East.

History of the Silk Route

The original Silk Route was established during the Han Dynasty by Zhang Qian, a Chinese official and diplomat. During a diplomatic mission, Qian was captured and detained for 13 years on his first expedition before escaping and pursuing other routes from China to Central Asia.

The Silk Route was popular during the Tang Dynasty, from 618 to 907 A.D. Travelers could choose among a number of land and sea paths to reach their destination. The routes evolved along with territorial boundaries and changes in national leadership.

The Silk Route was a means to exchange goods and cultures. It also served in the development of science, technology, literature, the arts, and other fields of study.

The Silk Route also helped missions by Buddhist and European monks and was instrumental in spreading Buddhism, Christianity, Islam, Hinduism, and other religions throughout the regions served by the routes.

Reviving the Silk Route

In 2013, China began to officially restore the historic Silk Route under president Xi Jinping with a \$900 billion strategy called "One Belt, One Road" (OBOR). The project was a way to improve China's interconnectivity with more than 60 other countries in Asia, Europe, and East Africa.

Also known as the Belt and Road Initiative (BRI), it traverses numerous land and sea routes. The Silk Road Economic Belt is primarily land-based to connect China with Central Asia, Eastern Europe, and Western Europe, while the 21st Century Maritime Silk Road is sea-based, connecting China's southern coast to the Mediterranean, Africa, South-East Asia, and Central Asia.

China views the venture as an important way to improve its domestic growth. It also serves as a way to open up new trade markets for Chinese goods, giving the country the cheapest and easiest way to export materials and goods.

China has passed several milestones related to the OBOR including the signing of hundreds of deals since 2016. In January 2017, a new rail service using the East Wind freight train was introduced from Beijing to London along the historic route, passing beneath the English Channel to reach London. The

16- to 18-day journey, travels nearly 7,500 miles and allows freight shippers an alternative to slow but relatively cheap water routes, and fast but relatively expensive air routes. Other key OBOR routes go from China to 14 major European cities.



DISTRIBUTION OF SILKWORMS

Distribution of Mulberry and Non-mulberry Sericulture (area, production and productivity across states), Cocoon Production

- Sericulture which has its origin in China is an age old industry in India.
- Silk route is one of the ancient internationally recognized route for global business for not only silk but also other important commodities.
- History reveals that silk is also used as an alternate currency (One of the important item to be exchanged in Barter System).
- India, silk has a prominent place since beginning and has glorious past and considered precious of great trading value. Indian sericulture plays a prominent role both at National & International level.
- At National level, it is important source of remunerative employment for around 6 million people, particularly in rural areas and the majority of which are from a socioeconomically weaker section of society and women folk.
- Besides, it contributes significantly in earning valuable and sizeable foreign exchange for the country through export of silk goods. Moreover, this industry ensures supply of Raw silk to the domestic market.

Production across states and India

- Indian silk industry has moved on with long strides and its production has increased to about 18,320 MTs in 2007-08.
- Mulberry silk currently accounts for over 88% in the production total of all varieties of silk.
- About 53,814 villages of India are involved in growing silk cocoons by bringing approximately 185 thousand hectares of land under silkworm food plant cultivation.
- The total annual production of mulberry raw silk in India is 16,245 MTs . as per statistics of silk production, the major states producing mulberry silk are Karnataka, Andhra Pradesh & Tamil Nadu in South India; West Bengal & Manipur in East India, Uttrakhand, Himachal Pradesh and J&K in the North.
- The traditional silk producing states (**Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and J&K**) together account for 98% of the total mulberry silk produced in the country

Mulberry Silk

- Bulk of the commercial silk produced in the world comes from this variety and often refers to mulberry silk. Mulberry silk comes from the silkworm, *Bombyx mori*L. which solely feeds on the leaves of mulberry plant.
- These silkworms are completely domesticated and reared indoors. The mulberry sector continues to be predominantly rural and small farmer-based, with post cocoon activities in the cottage and small industry sector.
- Mulberry silk contributes to around 80% of the silk production.
- In India, the major mulberry silk producing States are **Karnataka, Andhra Pradesh, West Bengal, Tamil Nadu and Jammu & Kashmir** which together contributes 97% of country's total mulberry raw silk production.

Non-Mulberry Silk

Tasar

- Tasar (Tussah) is copperish beige colour, coarse silk mainly used for furnishings and interiors. It is less lustrous than mulberry silk, but has its own feel and appeal.
- Tasar silk is generated by the silkworm, *Antheraea mylitta* which mainly thrive on the food plants of Asan and Arjun. The rearings are conducted outdoor in nature on the trees.
- In India, tasar silk is mainly produced in the States of **Jharkhand, Chhattisgarh and Odissa, besides Madhya Pradesh, Maharashtra, Bihar, West Bengal and Andhra Pradesh.**
- Tasar culture is the mainstay for many tribal communities in India.

ERI

- Also known as Endi or Errandi, Eri is a multivoltine silk spun from open-ended cocoons, unlike Other varieties of silk.
- Eri silk is the product of the semi domesticated silkworm, *Philosamia Ricini* that feeds mainly on castor leaves.
- Eri Silkworm being polyfagous has wide range of food Plants such as Tapioca/cassava, Papaya, Payam, Kessaru and Barkessuru etc.
- Eri-culture is a Household activity practiced mainly in North Eastern Region for protein rich pupae, a delicacy for the tribals in the region. Resultantly, the eri cocoons are open-mouthed and are spun.
- The silk was used indigenously for preparation of chaddars(wraps) for own use by the tribals. Eri silk fabric is a boon for those who practice absolute non-violence and do not use any product obtained by killing any living creature.
- Eri silk now popularized as "Ahinsa Silk".
- Now Eri silk is getting popular the world over due to the isothermal properties which make it suitable for eri shawls, jackets and blankets.
- In India, Eri culture is practiced mainly in the **NorthEastern States.**
- It is also getting popularized in **Bihar, West Bengal, Odisha, Uttar Pradesh and Andhra Pradesh.** Eri silk is suitable for knit products, under wears, kids wear, denim and other fashion garments.

Muga

- This golden yellow colour silk is prerogative of India and the pride of Assam State. It is obtained from the wild multivoltine silkworm, *Antheraea assamensis*.
- These silkworms feed on the aromatic leaves of Som and Soalu plants and are reared outdoor on trees similar to that of tasar.
- This fabric is one of the world treasures of fine silk fabrics, woven on foot-powered, hand operated looms, which creates a subtle unevenness.
- The natural shimmery golden colour of this rare, wild silk needs no dye to enhance its exquisite beauty.
- It is a high value product used in products like sarees, mekhalas, chaddars, etc.
- Muga culture is specific to **the State of Assam** and an integral part of the tradition and culture of that State.
- However, the muga culture is getting popularized to other States like **West Bengal, Meghalaya and Nagaland** due to the availability of Som and Soalu plants.
- Muga is now used to replace zariin sarees and for surface ornamentation is garments / apparels, etc.

RACES: EXOTIC AND INDIGENOUS RACES OF SILKWORM

BREED: A stock of animals or plants within a species having a distinctive appearance and typically having been developed by deliberate selection.

RACES: A population within a species that is distinct in some way, esp. a subspecies.

Indigenous originating in and characteristic of a particular region or country; native. Eg., Pure Mysore, Nistari.

Exotic plant or animal species introduced into an area where they do not occur naturally, nonnative species. Eg., E16, Daizo etc.,

CLASSIFICATION BASED ON GEOGRAPHIC DISTRIBUTION

1. **JAPANESE RACE** (ABORIGINAL IN JAPAN) Fecundity is higher ranging from 600-700. The larvae is very active & leaf cocoon ratio is less. Larval body size is small for long larval duration & is around 26 days and the larvae are marked. The shape of the cocoon is strangulated giving the appearance of pea nut shape. Almost all races produce white cocoons. Further, Percentage of double cocoons are more &

quality of silk is better. Larvae are susceptible to grasserie and flacherrie. There are Uni and Bivoltines races in this group.

2. **CHINESE RACE (ABORIGINAL IN CHINA):** In Chinese races the fecundity rate is higher ranging from 600- 650 eggs. The progress of the larval growth is quick & as a result of which the leaf cocoon ratio is less. Most of the Chinese races are plain without any markings. The shape of the cocoon is round/elliptical/few of them are spindle shaped. The Cocoon colour is white, golden yellow, flesh or red. The Silk filament is fine & reelability is good. The Chinese races are resistant to high temperature & humidity. Uni, Bi, Multivoltines falls under this group and ever trimoulters are noticed.

3. **EUROPEAN RACES (ABORIGINAL IN EUROPE AND CENTRAL ASIA):** The fecundity rate is medium ranging from 550- 600 & size of the eggs is large. The larval stage is long, the moulting period reduced by 1-2 h. The larvae are plain without any markings. The cocoons are big, long elliptical. Cocoons are either white/flesh coloured. The % of double cocoons is less. The filament length is long with good reelability. European races are weak against high temperature & humidity. All are Univoltines.

4. **SOUTH EAST ASIAN RACES (TROPICAL):** The fecundity rate is lower ranging from 400-500. Eggs are small. The larval length is short with few exceptions where the tropical races of India exhibit longer larval duration. The larval markings are not common in these races. Leaf cocoon ratio is high. The size of the larvae is small. The shape of the cocoon is spindle, flossy with less filament length. The common cocoon colour is green/pink/yellow/white. Denier of the silk filament is fine. These races are resistant to varied environmental conditions especially high temperature & humidity. Multivoltines/polyvoltine races are very common.

CLASSIFICATION OF SILKWORMS BASED ON VOLTINISM

Voltinism is a term used in biology to indicate the number of broods or generations of an organism in a year. or Number of generations per year under natural environmental conditions. Based on voltinism Bombyx mori is divided in to 3 types, namely

1. UNIVOLTINES,
2. BIVOLTINES and
3. MULTIVOLTINES.

1. **UNIVOLTINE RACES:** They produce ONE generation per year. The larval weight is comparatively higher and cocoons are heavy. Denier of the silk filament is above 2.3. They are not suitable for summer & winter rearings, since the larvae are weak

against unfavourable conditions especially to higher temperature. They lay only diapausing eggs. All European races are Univoltines eg., E16

2. BIVOLTINE RACES: They produce TWO generations per year. The length of the larval stage is short. The leaf consumption to cocoon production (cocoon ration) is less, and the quality of the cocoon's inferior to that of Univoltine races. Further, cocoon weight, shell weight, silk % & filament length lesser than uni/mono voltines. Most of the temperate races are bivoltines and lays both non hibernating and non-hibernating eggs eg., NB4D2, NB18, KA, NB7 etc.,

3. MULTIVOLTINE RACES: They produce more than 5-6 generations per year. The length of the larval duration is short. In most of the polyvoltine races the leaf cocoon ratio is high, cocoons are compact grained and cocoon layer is soft. The length of the filament is short (approximately 400 mts). However, the cocoon filament is fine and clean with little lousiness; but with more lustrous. The larvae are robust and can tolerate fluctuating environmental conditions and hence best suited for tropical climates. They lay only non-diapausing eggs. Eg., Pure Mysore, C. nichii, Hosa Mysore.

CLASSIFICATION BASED ON MOULTINISM

Moulting - Moulting or molting, also known as shedding, or ecdysis, is the manner in which an animal routinely casts off an outer layer or covering at specific points in its life cycle. Silkworms can be classified in to tri moulters, tetra moulters, penta moulters and hexa moulters (very rare)

1. TRIMOULTERS: This group includes silkworms which moult three times during larval period. The larval growth is limited, the larval duration short ranging from 15-18 days. Pupae & moths are small, cocoon weight is less, cocoon filament is fine & denier of the silk filament ranges from 1.6 to 1.7.

2. TETRAMOULTERS: This group moults four times during their larval stage. The length of the larval stage is medium ranging from 23-28 days. The larval growth and cocoon weight is medium. Denier is 2- 2.5. Tetra moulters are cosmopolitan in their distribution.

3. PENTAMOULTERS: This moults five times during their larval stage. The length of the larval stage is long, larval weight is high and cocoons are heavy, filament length is more. Denier of the silk filament denier is very high.

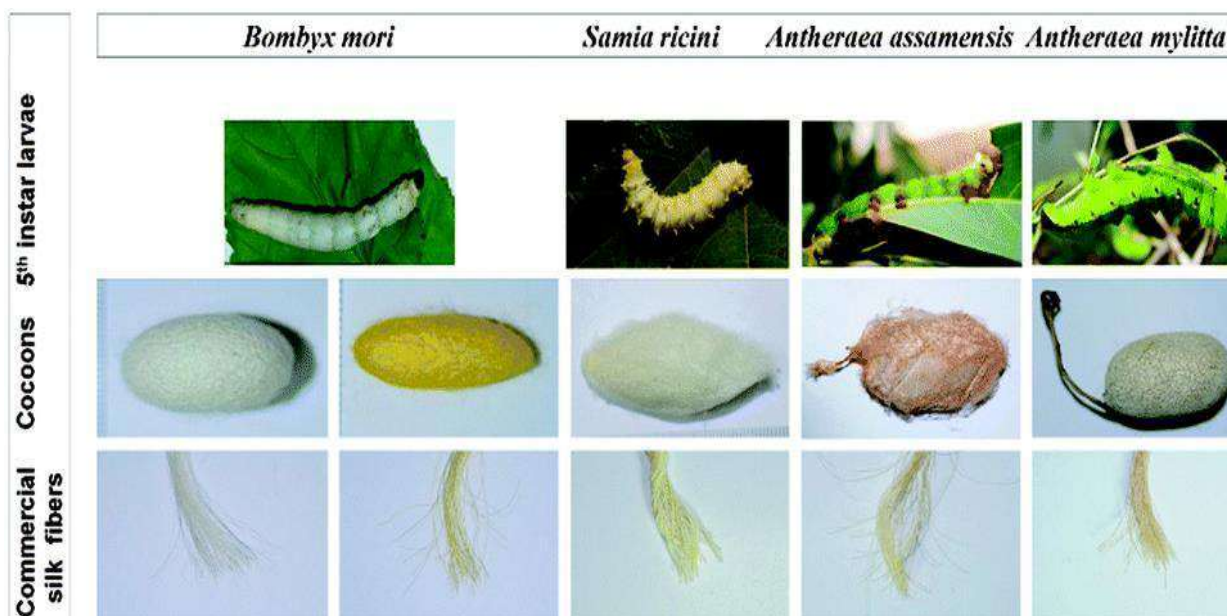
Characteristics of temperate and tropical voltine groups of silkworm:

Temperate Breeds

1. Temperate breeds are all either Uni/Bivoltines. They lay both hibernating and non hibernating eggs.
2. Temperate silkworm breeds are Susceptible to Fluctuating environmental conditions as well as poor quality leaves.
3. Temperate breeds are Good Yielders in general i.e., more cocoon weight, shell weight, filament length, denier etc., Eg. E16, Daizo etc.,

Tropical Breeds

1. Tropical breeds are all Multivoltines. They lay only non hibernating aggs.
2. Tropical silkworm breeds are resistant to fluctuating/ varied environmental conditions and poor quality leaves
3. Tropical breeds are Poor Yielders in general i.e., more cocoon weight, shell weight, filament length, denier etc., when compared to temperate breeds Eg., Pure Mysore, Nistari,



MULBERRY

1. low land holding capacity.
2. Investment is very high.
3. Economic return is very high.
4. Rearing house and rearing appliances should be used in mulberry sericulture.
5. Mainly indoor rearing.
6. Cultivation of mulberry-mori culture.
7. Mulberry silkworm-Bombyx mori
8. Mulberry silkworms are monophagous in nature.
9. Mainly found in Karnataka, TamilNadu, West Bengal
10. Foodplants of mulberry namely Morus alba
Morus indica
Morus serrata
Morus latifolia
11. Reeling conducted by different automatic and semi-automatic reeling machines namely
charka
cottage basin
multiend|reeling machine.

NONMULBERRY

1. high land holding capacity.
2. Investment is very low.
3. Economic return is very low.
4. Rearing house and appliances does not used.
5. Mainly outdoor rearing except eri (semi-indoor)
6. Cultivation-arboriculture.
7. Non mulberry silkworm-tasar, muga, eri
8. Non mulberry silkworms are polyphagous in nature.
9. Mainly found in Bihar, Madhy Pradesh, Nagaland, Assam.
10. Foodplants of Non mulberry namely
Tasar -Shorea robusta
Muga -Litsaea polyantha
Eri -Ricinus communis
11. Reeling is conducted by natwa bhir, trivedi type, das type, pedal operated reeling machine.

TYPES OF SILKWORMS

Moths belonging to families Saturniidae and Bombycidae of order lepidoptera and class Insecta produce silk of commerce. There are many species of silk-moth which can produce the silk of commerce, but only few have been exploited by man for the purpose. Mainly four

types of silk have been recognised which are secreted by different species of silk worms.

(i) Mulberry Silk:

This silk is supposed to be superior in quality to the other types due to its shining and creamy white colour. It is secreted by the caterpillar of *Bombyx mori* which feeds on mulberry leaves.

(ii) Tasar Silk:

It is secreted by caterpillars of *Antheraea mylitta*, *A. paphia*, *A. royeli*, *A. pernyi*, *A. proyeri* etc. This silk is of coppery colour. They feed on the leaves of Arjun, Asan, Sal, Oak and various other secondary food plants.

(iii) Eri Silk:

It is produced by caterpillars of *Attacus ricini* which feed on castor leaves. Its colour is also creamy white like mulberry silk, but is less shining than the latter.

(iv) Muga Silk:

It is obtained from caterpillars of *Antheraea assama* which feeds on Som, Champa and Moyankuri.

Different types of silk and their insects along with their particular food plants are given in the table below:

Type of silk	Type of Silk insects	Food plants
Mulberry	Bombyx mori	Morus alba (Mulberry)
	Antheraea mylitta	Terminalia arjuna (Arjun)
Tasar	Antheraea paphia	Terminalia tomentosa (Asan)
	Antheraea royeli	Shorea robusta (Sal)
	Antheraea pernyi	Ziziphus jujuba (Plum)
	Antheraea proyeli	etc.
Eri	Philosamia ricini	Ricinus communis (castor)
Muga	Antheraea assama	(Som) Michilus bombycina, Litsaea polyantha (soalu)

