CHAPTER II

REVIEW OF LITERATURE
2.1 Introduction:

The dictionary meaning of sericulture is silk warm breeding; it is derived from the word seric which means silken. The other meaning is Chinese which shows the Chinese origin of silk. “It history goes back to more then three thousand years before Christ. A cocoon had suddenly fallen into the tea cup of a Chinese emperor, when pulled out had unrolled itself yielding a long white filament. It is said that some Christian monk had stolen some silk eggs to Italy during the mid sixth century where the industry could compete with chinese silk in subsequent years”

2.2 Review of Literature:

History itself depicts that muga silk yarn produced by muga silkworm has been cultivated only in N.E. states of India and particularly by the states of Assam. Muga silk drapers which were used by the Assamese people at various point of time in history and in religious occasion and ceremonies have occupied a top level status amongst the skills in Assam and muga silk industry with the social evolution of Assam very closely interlinked with the evolution of the Assamese culture and traditions. “The art of sericulture was known in ancient Kamrup as early as epic age and the silk was known to be used as draper as early as vedic age. There was also reference of silk in the Indian epics of Balmiki’s “Ramayana” where Sita was stated to be eladed with “Katuza” meaning of strong silk, when she accompanied Ram to Banabash. It was

attributed in Kautilya's "Arthashastra" that the Prime Minister of King Chandragupta mentioned Kamrupa as Kingdom of cocoon rearers, meaning obviously the Kingdom of natural silk."1/

As muga culture was considered to be of local origin, it is not been found in any other place and therefore, the growth of muga culture in Assam valley should have been a part of recorded history. The muga worm culture has not known outside this region till the present day. The traditional muga culture was continued even before the time of British rule in Assam, as assamese people were mentioned in the old British history as the cocoon rearers.

Historically, although silk was known to be discovered in China during the reign of chinese emperor, Hwangti (2640 B.C) with the accidental drapping of a cocoon into a cup of his hot tea. Thus it was showed that silk was discovered in China and silkworm rearing historically started by the Chinese people and then the industry spread from there to other parts of the world, except the muga silk culture.

"The earlier authentic reference of silk was found in the chronicles of Chow-King (2200 B.C.) where silk figured prominently in public ceremonies, as a symbol of homage to the emperor. The silk industry, said to be originated in the province Chang-Tong and the secret was jealously gaurded by the Chinese people for about 300 years, when trade relation established between China and Persia and later with other countries the exports of raw silk and silk goods

assumed a great importance. In 555 A.D. two European monks while visiting
China managed to take out some eggs of silk worm along with mulberry seeds,
concealing the staff in their dress to Constantinopole. The silk culture thus
said to the spread to eastern parts of India along with the Brahmaputra valley.”

According to some historical sources the first country after China and
India to learn the silk culture secret was Korea, where Chinese immigrants
strated sericulture in 1200 B.C. in that country. The industry later spread to
Japan. According to another historical version, the instrumental to bringing the
silk industry to Japan during the 3rd Century B.C. was ‘Semiramus’ a general
in the army of Empress-Singo-Kongo, who invaded and concured Korea.
Among his prisoners were some sericulturists who were brought back to Japan.
During the later part of 19th century, Japan gave serious attention to the
development of the silk industry, introducing the use of modern machinery and
improved techniques of rearing and carried out intensive research on sericulture.
The industry was said to have been spread to Tibet, when a Chinese Prince
carrying silk worm eggs and mulberry tree seeds in her head dress.

(According to the some Indian scholars, the silk worms were first
domesticated in the foot hills of Himalayas and according to others it was reared
initially in the Eastern Himalayas, from where it went to China. There was also
evidence in the ancient Sanskrit literature that certain kinds of wild silks were
cultivated in Assam since time immemorial. Assam has a reputation equal to

that of China in sericulture and the tradition have been continued to the present time. The antiquity of silk rearing in Assam, as part time profession was certain and a proven fact. Stake (1884) considered that it was first imported to the Brahmaputra valley from China. However, Dling (500 B.C.) in his superficial comment stated that initially Chinese silk trade with India was carried out within and through Assam state. But Mohammedan historians namely Abul-Fajal land Abul-Faizin (1600 A.D.) stated clearly that silk product of Assam were indigenous, excellent and resemble the quality of China. 'Tavernier (1890, voyages in India) wrote that “Assam silk was produced on trees” and added that “the cloth made of them were very brilliant like China. However, this interpretation proved that silk rearing in Assam was present since antiquity and Assam is possitively the homeland of muga silk as no muga silk ever known to be produced in China, whatever the historical information might be. Gait (3rd edition in 1963, Barua, 1951) reported that Assam enjoyed a high reputation for producing natural silk of fine texture. They proved that Assam is the homeland for muga silk and no muga silk ever known to be produced in China. They mentioned that muga was stouter and more durable fabric's than pat silk. Assam silk specially muga silk was very much demanded in Europe, and it formed a trade of the East-India Company during the 18th through early 19th centuries.”

Barua (1951) in his book “The cultural history of Assam” stated that Bhaskarverma sent to Harshabardhan through Hamsabhega about thirteen

hundred years ago. Silk cloths, white as autumn moonlight, loin cloths smooths as the birch bark, which included all the specimens of eri, pat and muga silk.

In his “Arthasastra” Kautilya mentioned that several regions of ancient Kamrupa (Assam) had produced three varieties of silk fabrics viz, Dakula, khauma and patorna. Historians have identified Dakula as Muga (Antheraea assama) Khauma as eri (philosamia ricini) and patorna as pat (mulberry).

Some chronicles of the Ahom period have also made references to silk products woven by a Tanti caste-weaver in the 17th century. Ample references are, however, available in English literature of the 19th century. According to “An Account of Assam” by francis Hamilton, Assam’s annual exports of muga yarn and fabrics to Bengal during 1808-1814 were 65 Mounds (24.26 quts) and 75 Mounds (nearly 28 qunts) respectively. William Robinson wrote in 1841 that while plantation of mulberry was done only by some families for their own use for the members of the royal families and the grandees, every cultivator had a patch of land in his homestead, full of Ricinus communis for rearing rearing eri-the fabric of the common. Muga culture was also widespread and its dress was considered rich and valuable Eri and Muga fabrics were also popular among the Bhutanees and Tibetans. Sericulture in Assam, though practised since centuries, has remained a subsidiary avocation of a section of the farmers mainly due to technological stagnation at the stage of reeling, spinning and weaving. Muga and Eri cultures are practised widely in Assam, while mulberry is negligible and tasar is a recent introduction.
“Kautilya also referred to the varieties of silk garments known as patrorna and remarked that the textile commodities produced in the county Suvarnakudya (Assam) were the best. All three varieties of silks, pat silk, eri silk and muga silk were specially associated with Assam and Assamese culture and tradition. There was also reference of exporting mung silk thread from Assam. Gait (1897) mentioned that the custom house at Harida opposite Goalpara, fixed a duty of 10 percent according to the terms of commercial treaty executed with Gaurinath Singh by captain welsh on behalf of East India company in 1793 A.D. He reported that 224 mounds of muga silk thread were exported and the value was placed at Rs. 53,899.00 during that period.”

Schoff (1912) on the basis of peripals stated that the silk industry originated in China and travelled to Assam and other parts of India. But in the opinion of watt (1893) it was originated in Manipur. He also added that this place was the home of silk worms, the real mulberry silk-insect originated in Manipur and from there it went to China. Chondhury (1959) stated that Assam had a world wide reputation like China for manufacture of varieties of silk cloths and had a profitable foreign trade. The evidence from the Arthasastra, Harsacharita and other classical writings proved that the art of rearing of silk cocoons and weaving of the finest silk textiles, the weavers of Kamrup had a reputation equals to those of China. This tradition has been continued. It is likely that the art of Sericulture, weaving etc. was originated

41
in Assam at an early period by the Bodo (plain Tribes) and its allied tribes. In Arthashastra, also there was mention about the names of place like Joriga, Doriga etc. associated with the industrial products of Kamrupa which have Bodo origin. Whether in the art of weaving or in the rearing of silkworm and manufacture of dyed cloth, the tribes like Khasis, Nagas, and Manipuri's and Bodo in general have a great deal to contribute towards the development of silk industry in Assam.

The first official records of *muga* worms and *muga* silk culture appeared in 1662. The culture of silkworm could be traced out from the notes of great writer, Shihabuddin Talish, who was accompanied by Mirjumala at the time of invasion of Assam (Guwahati was occupied on 4th Feb. 1662). There was mention in his description on the dresses, the people of Assam used. The official records of 1662 was the silk are good but the people produce little more than they require for use. It attributed to famous traveller Jean Josheph Taveernier, who made special mention of silkworm variety of Assam that remained on trees all the year round. When British came to India, they found a flourishing silk trade prospects. The East- India Company exploited the industry and developed silk centres in many parts of the country for their benefits. The company exported large quantities of row-silk produced in west-Bengal to England. But companies monopoly was abolished in 1836 and the entire silk trade turned over to private enterprises which at that time was not properly organised and as a result the silk industry of Bengal declined. In the
mean-time, other silk producing centres namely-Mysore, Jammu & Kashmir took steps to develop the industry.

Sericulture declined during British regime, because Som plantation areas were assessed for taxation. During the last part of the 18th Century 18,000 crores out of 34,000 crores of host plantations were assessed which yielded a revenue of Rs. 28,000.00. Earlier British Pioneers were enthusiastic enough to explore and exploit it as an industry. Buchanan Hamilton, Stack, Jenkins, Hugon, Wardle, Geoghegain et. al. are among these pioneers. Though these pioneers failed to sustain Muga culture on a industrial scale, yet records left by them remained the source of valuable information. Since then, the industry has come to stay as a cottage industry at the instance of the rural folk of the state of Assam.

"Textile materials, according to the kalika purana, are devided into the following four classes; Karpasa (Cotton), Kambala (wool), Balka (bark) and kasaja (silk from cocoons). Cotton cloth was extensively use, and there was a special class of weavers (tantyvayas). Kambala was a texture of the fine wools (sheep's wool or goat's hair), most probably it was imported from Bhutan to Tibet."1

According to the commentator, Kulluka (15th Century A.D.), Ksauma was a cloth made at atasi fibre, From reference in both the epics, we gather that ksauma was either regarded as specially fit to be worn on festive occasion;

or was itself so finely woven that it was a fit raiment for queens. That ksauma was highly valued in ancient days, evident from the Mahabharate, in which it was stated that Arjuna brought away valuable ksauma cloths from his conquest of Uttarakuru beyond the Himalayas on the west. Bhaskarvarman sent as presents to Harsa ksauma cloths 'pure as the autumn moon light.

The present-day scientific name of the muga silk worm (Antheraea assama) denotes its peculiar connection with Assam, and it is, in fact, found in no other parts of India except Dehra-Dun, where it occurs sparingly. "There a variety of muga called compa muga; its worms feeds on the leaves of the compa tree (Michelia champaka). Walts reported that this was the fine white silk worm by the Ahom Kings and nobles of Assam in former times. Another kind of muga is known as Mejankari, the worm feeding on Mejankari silk as reported by Hamilton, constituted the dress of the higher ranks, most of it being dyed red with black."1

Silk was known in China as early as the shang period (1523-1027 B.C.). Hence, It is very difficult to determine the exact period from which the Assamese people used to produced silk, but it can be assumed that it was known to the Assamese people as early as the period of the Arthasasthra and the Ramayana. Some scholars are of the opinion that the silk industry in Assam flourished alongwith the migration of Tibeto-Burmese people. But the production of muga silk has been mainly confined to Assam only.

The silk industry had to face stiff competition from artificial cheap silk and cotton cloths during the British period. Even in such an un-favourable situation Assam's silk industry had not lost its past glories and unique position in respect of two indigenous silk fibres viz, *Muga* and *Eri*. As a whole, silk industry could not make a headway during British rule due to their colonial policy. But at the dawn of independence rearing, weaving of silk fibres, and its use in every household irrespective of caste and creed increased gradually. The caste prejudice which was prevailing up to 1940 began to wane when some of the high caste hindus decided to practise rearing of pat silk worm. Of course, in recent years, the majority of the rural people have been paying more attention to the culture of *eri* and *muga* which can easily be done.”

There is no authentic historical record about the origin of silk Industry. The silk Industry of Assam attained its excellence during the Ahom regime (1228 A.D-1826 A.D), but under British rule, it suffered set back due to want of patronage by the rulers. The growth potentiality of this industry is high due to some inherent qualities. In recent years, this industry is gaining popularity in the different corners of the globe.

The present state of silk industry in Assam is not satisfactory due to lack of proper planning and organisational negligence in executing the various schemes by the government departments and the rearers.

---

In brief, no extensive, systematic and scientific plantation of silk worms food plants is by and large not noticeable. Generally, rearers are dependent on naturally grown silk worms food plants.

Till today there is no detailed study covering income and employment aspects of the Muga Silk Industry of Assam. Of course, the sericulture and weaving department of Assam conducted a survey during 1975-76 in 598 Gaon Panchayats of the plains districts of Assam to assess the position of the silk industry relating to production, employment etc., and the 'Agro-Economic Research Centere' for North East India, AAU, Jorhat, Assam also conducted a study in the style of "Economic of silk production in Assam" (A study in Sibsagar District), which gives a brief note about the aforesaid district. A part from these, A few emperical research studies have been conducted in the field of biological aspects of the Muga silk worm.

The production of silk is quite a natural activity of the silkworm. Silk, the richest of all the fibres of the textile industry is a proteinaceous substance produced by the worm after synthesizing from a pair of specialised organs known as the silk-glands. The silk glands are nothing but modified labial (Antheraea-assama, West wood) is well known for the production of the golden silk thread. The pattern of morphogenesis in the life cycle of the insect represent one of the most important aspect in the study of the developmental activity. The developmental process, however, draws the attention of many workers scientists and sericulturists during the last century (Ueda's and Suzuki, K; 1967, Bhatta and Bhattacharya, 1976, K. L. Joshi, 1985.)
Muga, the semidomesticated multivoltine silkworm represents a rare endemic silkworm species found only in the North-Eastern-Region of India and not any where in the world. The studies and literature in this field is also very limited, but the developmental process of some other groups of insects of similar lepidopterans have been widely discussed and studied throughout the country and the world (Uchial, 1962, Bardaiyer, 1972, Chapman 1963;)

Among all other silkworm culture, the muga culture is closely associated with the life and culture of the people of Assam from time immemorial. The actual history and literature of producing silkworm products dates as far back as 3000 years ago and the discovery that silk filament could get from the insect species was quite accidental. Muga culture produces the golden thread are unique, excellent and resembled a high quality fabric not found any where in the world, was also stated clearly by historians like Abul Fazl and Abul Faizi (1600 A.D.). It was estimated that the global production of raw silk was 48,500 metrictons of which India's production being 3473 M.tons of mulberry and 612 metrictons of non-mulberry silk. The Assam's non-mulberry silks are eri, muga and tassar and Assam takes the fifth position among the silk producing states of India.

The developmental biology of different silk producing worm including Bombyx-mori and Philosomia-ricini are described by Helm (1876), Brachet (1957), Yokohoma (1963), Gallop (1966), Choudhury (1967), Garrel and Keith (1977), Singh and Singh (1978) and that of Antheraea-pernyi by Sahota and
Mansingh (1970). The Bio-Chemical information in relation to the growth in insects are generally found a little other than the muga silkworm, *Antheraea-assama*.

(The muga culture is the monopoly of Assam since then and it has got deep relation with the cultural life of Assamese people, beside the socio-economic development of Assam. Assam produced 55,000 Kilogram of muga raw silk in 1984-85 and the maximum production was 95,000 K.g. produced during the year 1957. But the production of muga silk indicates declining trend although the first official record was made since the 17\textsuperscript{th} century.)

In Assam, the art of sericulture was known in ancient Kamrup as early as epic age and this culture has taken the place of cottage industry during the early twentieth century. Assam with all its favourable climatic conditions and rich evergreen plantation that abandoned with wild multivoltine silkworm species and various food plants specially in Brahmaputra valley. Chen (1958) and Agrell (1964) worked out some aspects of the physiological and biochemical changes during the insects development. Church and Robertson (1966) suggested about the ascending growth of the larvae. According to Engstar, M.S. (1976) sufficient work is done at ultra structural level of lepidopteran Larvae.

Ueda, S. and Suzuki, K. (1967) reported on the growth of silkworm, Bombyx-mori and K.L. Joshi (1985) reported on the studies of growth indices of *Eri* Silkworm, philosomia-ricini Hutt (lepidoptera : Saturnidae) Sericologia 25 (3) : 313-319; In 1975 Takeshita H; Suto, M; Kumata, K; S. Matsumara : and

A.D. Imms (1925) worked out on the Silkglands of insects and he emphasized that the Silkglands are the most conspicuous appendoges of the digestive system which are generally largest in the families of saturnidae and Bombicidae. Thus in *Antheraea-assama* they measure about 7 times the length of the body and are completely folded while in *B. mori* it is four times the body length. In this regard Dr. S. N. Choudhury (1967) also put forward the similar description and stated that these are the second largest organ of the body and open it the same spinnerate. Moreover very little information have been available regarding the development of the silkgland in different insects and in different stages of morphogenesis (Tieges, 1972; Ueda et. al 1976). The silkgland and its development in different silk producing worm including *Bombyx-mori* and philosomia-ricini are described by Helm, 1876; Bracht 1957; Yoko yama, 1963; and silkgland of *Antheraea* pernji is described by sahata and Man Singh (1970)

According to Gallop, in *Bombyx-Mori*, the hatching of larvae from the egg donot disturb the cells of the silkglands and hence the cells of the gland merely increase in size without undergoing division. He stated that the silkgland begins to enlarge considerably after the fourth moult thereby entering the fifth inster larval stage.
Nagraj et-al (1984) were able to obtain 77 percent hatched larvae from the hybrid J 106 x cambodge by giving pest activation care at 17°c for 96 hours followed by HCl acid treatment (at 40°c for 2 minutes) and incubating the eggs at 24°c till hatching (S. N. Choudhury, 1989). Therefore the activation by variable temperature seemed to trigger the percent of hatching.

Taedo yokoyama (1972) described the content of the silk from the Japanese silkworm and suggested that the growth of the gland during morphogenesis showed generally two magnitudes, one immediately after hatching and the other at the early part of the fifth instar. He emphasised that there was a relativity between the growth and size of the gland and the amount of silk products as well as protein metabolism during different stages of metamorphosis. Most of the required amino acids for the silk production and secretion are derived from the body protein (Allen, 1989). According to Dr. J. S. Chandra and H. Sekar Babu haemolymph showed very minimal level of protein compared to other tissues (1.4 mg/100 mg. wet weight).

There is a paucity of literature in the field of income and employment generation of muga culture. In insects growth is generally disharmonic, heterogenic allotmetric i.e., the parts grow at rates peculiar to themselves, higher or lower than the growth rate of body as a whole. Rate of growth is mechanised primarily by moulting hormones (wiggles worth, 1972). It was also been observed that growth rate is related to the capacity of food intake (Kaufman et. al. 1972 on oryzo latipes; Rogers et. al. 1977 on shrub steeps).
In early nutritional experiments (Arai and Ito 1964) where use of 10 p.c amino acid diet resulted in deletion of proline that leads to a marked suppression of growth but later it was found use of 20 percent amino acid mixture has improved the larval growth.

The additional amount of protein in the silk worm nutrition is highly essential. Hence best growth of silkworm can be obtained when the diet is included with additional food supplement like protein, Kirimura (1962) made a quantitative analysis of the amino acid intake from the mulberry leaves of the silkworm.

Rearing of silkworm on artificial diet was first initiated in Russia in 1943, where Bombyx-mori was grown on a diet of mulberry leaves to which succhrose element had been added artificially. The diet was reported to increase the size of the larvae and yield of silk as well as induced greater degree of fertility, later on, several entomologists have tried including Dr. W. R. Smith (1972) the spraying of food plants leaves with a mixture of dextrose, potassium nitrate, brewer's yeast and water for the successful growth of Samia-cynthia and Antheraea-pernyi.

Much of the work on artificial diet for silkworm was carried out in Japan. The first attempt was made in 1983 to raise eri silkworm on artificial diet by obtaining eggs from India. Ito his co-worker in 1950 first applied the basal artificial diet on Bombyx-mori which was published in 1961. The diet was composed of 1.2 gm. starch, 0.9 gm. sucrose, 1.5 gm. cellulose powder and
0.06 gm. salt. The application of this diet has reduced the larval development from 24-25 days. Hamamura (1959) has observed that silkworm can thrive on agar containing food for 2-3 days. Yoshida et-al succeeded in rearing silkworm on artificial diet from hatching to the fourth days of the fifth instar. However it was Fukuda (1960) who first succeeded in rearing Bombyx-mori up to spinning on artificial diet. The diet was composed of starch, protein and casein and small amount of vitamin and mineral dissolved in distilled water.

Since 1950, more than 50 papers have presented with modification of the artificial diet for rearing of silkworm and production of silk. The effect of nutritional supplementation on insects other than silkworm like Dragonfly and locust have been described by Mishra (1962), Sidhu and Mishra (1980) and on philosomia-ricini by Joshi and Mishra (1979). Faye et-al (1975) reported that injection of bacteria in saturnid pupae induced the synthesis of a set of new proteins and they appeared in the haemolymph six hours after injection.

However, the effect of artificial diet on muga silkworm, antheraea-assama has not yet been studied as no literature is available regarding the effect of food supplement of the development, growth cocoon harvest and silk production of the species. The natural food of muga silkworm is the som leaves (Machilus-bombyciana). The culture and rearing of this species strictly confined to the Brahmaputra valley of Assam only using the three varieties of food plants namely Som (Machilus-bombyciana), Soalu (Litsea-polyantha) and mejankari (Litsea-citrata). Without using any artificial diet up to now or any other type of food plants (Thangavelu, 1986).
The recent declining trend in the muga culture and silk production has demanded to introduce some new technique in rearing of silkworm if possible by means of artificial diet. Therefore like *Bombyx-mori* is described by Fukuda, Ito et-al (1979) the application of basal artificial diet with the *som* leaves have been attempted in Barua’s experimental project to evaluate the triggering effect of such diet (composition as described in material and method, ‘Santana Barua’) on the growth and morphogenesis as well as the silk production of silkworm.

The quality and quantity of the *muga* silk production varies widely in different seasons of the year which is represented by five different broods in different seasons of the year. The cocoons produced in different seasons are not uniform in commercial character. Moreover, the cocoons and the shell weight varies to a marked extent as well as the amount of silk produced along with a marked variation in silk filament length was observed (choudhury, 1981).

Moreover, higher leaf moisture content is known to increase the amount of ingestion and digestion capacity of silkworm (Yokoyama, 1974) because moisture acts as an olfactory and gustatory stimulate (Ito, 1963) Mosumare (1975) reported that the appetite of silkworm was decreased when withered leaves were fed. Hence, multivoltine, *Antheraea assama* can never be reared indoor or domesticated.

Silkworm’s natural growth and development can never be attained in artificial conditions by rearing on torn out leaves. The moisture content of the leaves play an important role in the growth and development (Sen Gupta et. al, 1971) of silkworms. S. Barua worked out that application of folior spray of nutritional food supplement enhance the moisture content of the leaves alongwith the nutritional status of the food plant leaves. Barua also attempted to evaluate the beneficial effect of the food supplement on the quality and quantity of muga silk production irrespective of the seasonal variation. Although, there is no literature available up till now in this field concerning the topic. Yet the result of this project is expected to contribute substantial evidence on income and employment generation of *Muga* culture. *Muga* fabric has a great demand both inside and outside the state; but outdoor rearing of *muga* cocoons and shortage of seed cocoons are posing problems for taking up large scale production. In fact, up till now no research work has been successfully evolving a hybrid seed for indoor rearing. Prof. J. N. Talukdar of Institute
of Advance Study in Science and Technology, Guwahati, working on indoor rearing of the natural seed worm, holds that if the larvae can be reared up to third moult by feeding plucked leaves, they can easily be reared up to the last stage of fifth moult by supplying leaves four or five times a day. The larvae have a tendency to escape to the wilderness in search for food after hatching. This tendency can be checked by a sand barrier on the trays. The farmers of Boko and Karanga areas of Kamrup and Jorhat districts have shown keen interest in the new method of rearing. It minimises not only the loss due to mortality of the larvae, but also the labour involved.

The Institute of Advanced Studies on Science & Technology, Guwahati, has been engaged in the study of the transfer of indoor rearing technique from the laboratory to the field. They have also proposed to train up several persons for effective indoor rearing from the commercial point of view (DST Govt. of India Funded).

The Zoology Department, Gauhati University has recently been working on the impact of indoor rearing of muga silkworm on its nutrition, Carbohydrate and protein parts of leaves during indoor rearing have been estimated.

The Biochemistry Department of R.R.L., Jorhat, has undertaken the determination of muga silk chemistry and the effect of juvenile hormone analogues on the silk synthesis both in vivo and vitro.

The Plant Pathology Department, R.R.L., Jorhat has initiated to study the
pathological state of Som and Solau leaves on the growth of muga silkworm.

The Biotechnology Department of Asam Agriculture University has been engaged in the micropropagation of the muga host plant.

The National Institute of Immunology, New Delhi, is also working on molecular biological studies of genes of non-mulberry silk-worm Antheraea assama.

The Regional Muga Research Station (RMRS), Boko, has considerably been engaged on the quality seed production and the propagation of the host plants.

Bordoloi & Hazarika (1992) reported the changes in body water content, lipid reserve, Blood Volume (B.V.) and haemocytes of Antheraea assama at different seasons. They noticed that during summer and spring, the larvae contained low lipid reserves but concomitantly high water content in the fifth instar of this particular Lepidopteran. Further, stein & Fell (1992) recorded seasonal comparison of weight, energy reserve in the queens of Dolichovespula maculata and suggested that most queens that survive the winter and successfully initiate nest are associated with similar quantities of energy reserve. The effect of environmental temperature on the metabolism of insects could also be supported by the findings of Gilbert (1967) and Hoffmann (1984) which stated that decrease in rearing temperature increases the neutral fat content and lipid reserve of insects.
Shapiro (1979) reviewed that the body water content of insects is also effected by fluctuation in the environmental temperature, which in turn directly influenced the B. V. and haemocytes population. In this context the influence of many other factors like temperature (Rao, 1963), moulting status (Mc winne et. al, 1972), developmental stages (Firling, 1977), diet (Riley, 1980 Joshi, 1992) and photoperiod (Unni & pant, 1985) can be cited.

Parenti et. al (1985) observed that only two natural amino acids with threonine, aspartate, glutamate and their amides are taken up by the silkgland directly from the haemolymph for the biosynthesis of protein, whereas the basic amino acids are involved in the regulation of haemolymph osmotic pressure (Florkin & Jeuniaux, 1974) Biswas et. al (1992) observed that a disease caused by phyllactina corylea is markedly influenced by both diuranal variation and climatic condition. Conideal dispersal in cloudy rainy day condition (Temperature 23-33°c, R. H. 73-93%, average rainfall per day 5.17 mm) was more than that of bright sunny day (Temperature 21-31°c, R. H. 59-81%, no rainfall). The effect of environmental factors in the liberation of conidia was also reviewed by Adams et. al (1986).

According to Fujii (1936), the metabolic rate in the silkworm body is increased with the rise of the rearing temperature in the range from 22°c to 33°c, that is, the amount of nutrients preserved in the body, the uric-acid excreted and the carbohydrate consumed per 100 g.m. of body weight in 10 hours are
increased with the rise of the rearing temperature mentioned above. Matsumura (1975) reported that the activity of the amylase in gastric fluid was increased with the rise of temperature from 20°c–60°c; tyrosinase is most active at 24°c and its activity decrease with the lowering and rising of temperature; catalase activity is strong at 15°c–25°c and it decrease with the rise of the temperature.

Therefore, we would like to stress upon the integrated approach to develop this natural golden silk production as a subsidiary or professional economic activity to increase earning of the producers and for absorbing more and more people in this muga culture activity.

2.3 Conclusion:

Among the various traditional cottage industries the silk industry occupies an important place. It is equally popular among the people of developed as well as underdeveloped countries of the world. The industry provides fruitful, part time employment to a large section of the people of the globe.

In Assam also, silk industry has occupied a place of pride in the socio-economic and cultural life of the people of the State. Since hoary past, people of other regions of the country know about the excellence of muga silk fabrics of Assam.

There is no authentic historical record about the origin of Muga silk industry. Some scholars say that Assam is the original home of silk. In recent
years, this industry is gaining popularity in the different corners of the globe.

The present state of *muga* silk industry in Assam is not satisfactory due to lack of proper planning and organisational negligence in executing the various schemes by the government departments concerned. But it has got large scope for its development, provided the difference schemes of the government are implemented properly.

In the next chapter, Present position of *Muga* Culture in Assam would be carried on.