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Ericulture rearing practice in Nanded

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Abstract
The silkworm (*Bombyx mori*) is the larva or caterpillar of the *Bombyx mori*moth. Ericulture (Eri silkworm farming) is an agro-based traditional activity that has played an important role in generating income and employment for people living in rural areas. It is ideal for rural areas as it requires low capital, is labor intensive thus creates jobs and it is commercially attractive. This type of sericulture, has shown significant promise, after moriculture, which has been the leading source of world silk. In Nanded district, several types of silk exist, although only *Bombyx mori* (*B. mori*) has been commercialized. Ericulture has recently aroused interest among some silkworm farmers and is gradually gaining popularity due to its ease of rearing when compared to *B. mori* silkworm. This paper therefore focuses on the state of Ericulture by looking into the regions practicing this form of sericulture and the rearing practices. This aims boosting sericulture industry and creating awareness of Ericulture. It also aims to arouse interest in Ericulture research that will aid in improving Eri silk rearing in the region.

Keywords: Ericulture, silkworm, silk rearing

Introduction
Eri silk comes from the caterpillar of *Samia cynthia ricini*, found in northeast India and some parts of China, Japan. Ericulture, or silk farming, is the cultivation of silkworms to produce silk. Although there are several commercial species of silkworms, this moth (the caterpillar of the domesticated 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. Despite the efforts to boost silk production, it has not realized a significant growth ever since it was first introduced in the country and there has been low cocoon volumes produced annually [3]. Yet with the relevant studies in the country, directed towards *Bombyx mori (B. mori)* silk, its production still remains low, making silk processing in textile industries negligibly low. This is so because Mulberry silk (B. *mori)*, the dominant silkworm being reared in Nanded, requires a lot of care and sanitation, since they are susceptible to diseases. The quality and yield of mulberry leaves produced, which is the primary food for *B. mori* silkworm, depends on agricultural practices during cultivation and therefore requires a lot of skill in its cultivation. Thus silk farmers tend to shy away from rearing *B. mori* silkworm due to their strict rearing conditions and resource constraint associated with cultivation of mulberry [2, 4]. This variety is yet to be commercialized due to difficulty in domestication. Recently, Eri silkworm rearing has emerged to be a potential alternate to mulberry silkworm rearing as it is gaining favor with the Indian silk farmers. This is because Eri silkworm *(Philosamia cynthia ricini)* are more resilient to diseases, therefore are not very sensitive thus require less care. Eri silk has a unique appearance since it has wool like finish, has the look of cotton and has the softness of silk, rendering it an alternate fiber to wool. It also has excellent blending properties (since it is open-mouthed) both with synthetics and cotton and the resulting fabrics are usually more durable and resistant to dust and perspiration. Eri silkworms' primary food is castor oil plant leaves, which is readily available and grows naturally in the wild in semi-arid areas, making silkworm rearing possible even in semi-arid regions.

In the absence of Castor, Eri can also feed on cassava leaves, kasseru and other types of host plants, making it more flexible as compared to mulberry silk. Apart from textile purposes, Eri silkworm also has other uses in cosmetics, medicine and animal food processing. [7-9] It is not only in Nanded that Ericulture is increase becoming popular but other countries like India and China who are the leading producers of silk have also embraced Ericulture. Addition, African countries like Ethiopia have also increased research in Ericulture due to its potential in income generation and creation of employment.

This paper therefore focuses on the state of Ericulture by looking at the regions practicing this form of sericulture and the rearing practices in Nanded.

Methodology

Relevant field data was collected from different regions through interviews, newspaper articles, journals, published articles and research articles. Data was collected from Mukhed, Bhokar and Himayat Nagar regions of Nanded district. Eri silkworms are being reared for commercial purpose. This study was conducted during the period May and June, 2016.

Results

Rearing practices

An experienced silkworm farmer from selected area, who then obtain silkworms eggs from their grainages for rearing.

Host Plant

Leaves of castor oil plant *(Ricinus communis),* KC-9 variety, is used by the farmers as diet for the Eri silkworm larvae. This castor plant is abundant in Bhokar, Mukhed and usually grows naturally in the wild, therefore farmers pluck them in the wild. This eliminates the need for the farmers to grow the host plant. Leaves are usually washed with tap water and dried using an absorbent material before being fed to the larvae.

Rearing Method

Eri silkworm species being reared was found to be *Synthia ricini*. Fertilized Eri silkworm eggs obtained from Textiles grainages are placed in a rearing box and castor leaf placed on top of the eggs as shown in figure 1. This ensures that as soon as the eggs are hatched, the larvae can grab onto the host plant and start feeding. The rearing is done in semi-permanent mud houses under room temperature. This is because it is difficult for the local farmers to control temperature and humidity, which would be an expensive undertaking for them.

Fig 1: Castor leaf placed next to fertilized Eri silkworm eggs

Hatched 1st instar larvae are then transferred to a separate rearing box and fed on chopped tender leaves twice a day as shown in figure 2. The farmers report that the 1st instar takes three days while molting then takes one day and no feeding is done during this period. The 2nd instar larvae are also reared in boxes and are also fed on chopped more mature leaves. They are fed twice a day and it takes three days for the larvae to go through the second instar and one day to molt. During molting, the farmers sprinkle lime powder onto the larvae to ensure uniform molting and to keep the rearing beds dry.

Fig 2: Chopped tender leaves being fed to 1st instar Eri silkworm larvae

3rd instar larvae are fed on whole soft leaves and are fed thrice a day. They take three days during this stage and one day during molting. The 4th and 5th instar larvae are fed on whole mature castor leaves and are fed thrice a day and are reared in trays. The 4th instar larvae take three days in that stage with one day for molting. In the 5th instar, the worms take three days and after the farmers spot the worms change color from white to transparent yellow, they are then transferred to cocooning trays. Five worms are wrapped in one newspaper and left for four days to cocoon. 5th instar larvae and wrapped worms during cocooning.

After cocooning, the Eri silkworm cocoons are harvested by the farmers and then stifled by exposure to sunlight for 12 hours. The cocoons are weighed and sold per kilogram

Farmers only deal with Eri silk rearing for cocoon production, thus do not let the worm grow into a full moth. They constantly obtain new eggs from Tosheka Textiles who have grainages where worms are left to grow into a full moth for egg production. Figure 5 shows a fully grown male and female Eri silk moth that was used for egg production. The female moths are bigger in size when compared to the male moths.

Fig 3: Eri silkworm cocoons harvested by a farmer in Mukhed

Figure 3 shows Eri silkworm cocoons harvested by a farmer in Mukhed. Eri silkworm farmers in Nanded region don't have formal training on degumming, and therefore after they harvest cocoons, they are sent to Textiles industry. This organization then degums the cocoons and combs the silk fibers for the farmers, before returning to the floss to the farmers for hand spinning.

The procedure used for degumming involves the use sodium carbonate and liquid soap. About 8gm of sodium carbonate and 5ml of soap is then added to a liter of boiled water. The

cocoon shells are then added to the bathe and left to boil for 30 minutes until they form balls of wet floss. The floss is then rinsed twice with cold water and then hanged under a shade to dry.

Fig 4: Female and male Eri silk moth used for egg production

It was also noted that some farmers covered the leaves and feeding larvae using a clear polypropylene paper to reduce drying and loss of moisture of the leaves. It also regulate the changes in temperature and humidity that occur during the day. The farmers are also keen to ensure that the spacing between the worms during feeding is sufficient to avoid crowding that may cause competition. Bed cleaning is done once a day throughout the duration of rearing. Farmers also observed sanitation by ensuring hands are washed thoroughly with soap and latex gloves used prior to handling the worms. Netting is also done on spaces on the rearing house to prevent predators from attacking the worms.

Eri silk processing Degumming process

Fig 5: Degummed Eri silk fibers using soap

Spinning process

The degummed silk floss is then carded using a hand card (Strauch Fiber equipment Co.) shown in figure 6. The hand card consists of a single large roller surrounded by a small roller, with all the rollers covered in small spikes. Carding process separates the fibers by removing tangled clumps and locks and orients the fibers thus parallelizing them. During this process, the impurities in silk fibers are also eliminated.

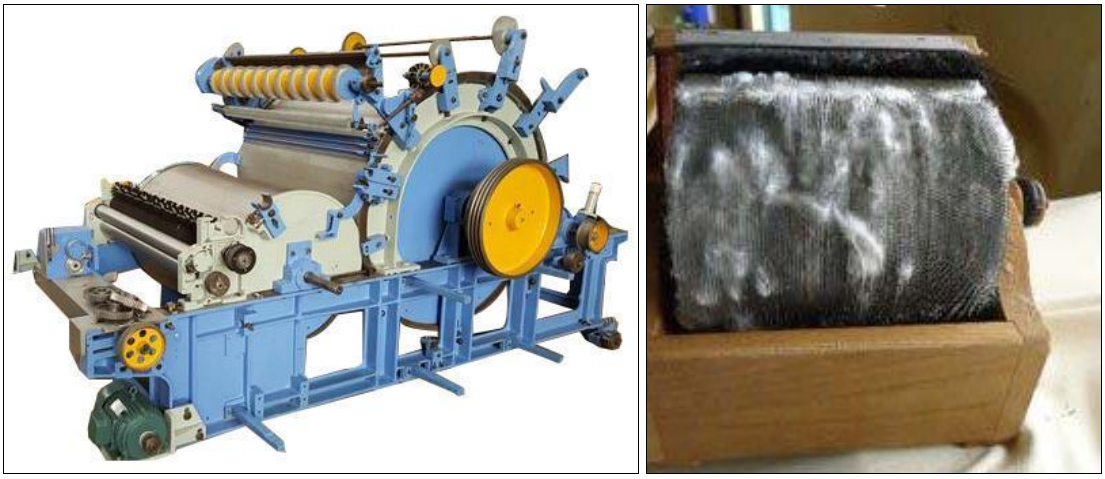

Fig 6: Hard carding machine

After the carding, the silk fibers are then combed using hand brushes shown in figure 8. This process further straightens and parallelizes the fibers as well as remove of short fibers. Impurities are also further removed during the brushing action.

Fig 7: Hand brushes used for combing

Fig 8: Hand spinning machine used by local farmers

After combing, the silk fibers are then distributed back to the silk worm farmers for yarn spinning which is done using a hand spinning machine shown in figure 8.

Eri silk yarns spun by the silk farmers is shown in figure 9. The evenness of the yarns produced usually depends on the experience of the spinner.

Fig 9: Eri silk yarns hand spun by farmers

Eri silk weaving enough strength, these yarns are usually used as the weft

The hand spun yarn is then used by the farmers to weave yarn. High strength yarns like polyester or cotton is usually various products. Weaving is done using a hand loom as used by the farmers as the warp yarns. shown in figure 10. Since the hand spun Eri silk yarns lack.

Fig 10: Hand looms used by Eri silk farmers in Mukhed to weave fabrics

Woven fabrics are the marketed and sold by Textile industry to various local buyers. The company also exports its products to the United States. In this way, the company empowers the local farmers, who are mostly women by creating employment for them and a source of income. The company has future plans of expanding to different counties within the country, with the aim of providing a source of income and creating employment.

Discussion

Various studies on Eri silkworm has been reported in different regions in marathwada with the aim of improving Eri silk production and processing. This is because like other silkworms, Eri silkworm rearing is dependent on ambient temperatures which affect its growth and silk quality and consequently the fabrics woven from the silk. [14] From the rearing data collected from the Eri silkworm farmers in Nanded, it is prudent that various studies be conducted to ensure that the rearing conditions in various parts of the country are optimized to improve silk quality produced and increase rearing efficiency. Since the Eri silkworm rearing is still in early stages in Nanded, the rearing practices used are governed by locally available materials. Better cocooning methods and rearing rooms need to be designed to ensure that quality silk is produced.

The degumming process used is also not optimized for the Nanded Eri silk. It is known that different degumming methods produce different quality of silk. [15] Therefore, an optimized degumming process needs to be investigated. It was a noted during the study that Eri silkworm farmers face a lot of challenges during rearing. Some of the challenges

included lack of enough skilled personnel to conduct proper and intense training to the farmers, change in climate that in turn affected the silkworm growth since they cannot afford conditioned rearing rooms, lack of funds to enable expansion of the rearing, Eri silkworm diseases and lack of quality castor seeds and Eri silkworm eggs. Our research group in collaboration with Textile industry, are currently undertaking joint research to aid in improving their rearing efficiency to enable production of quality eggs, quality silk and promote awareness of Ericulture as an alternative silk production in Nanded.

Conclusion

Nanded has various regions with the potential for Ericulture. Since Eri silk rearing is still at its infant stages, more research needs to be done in order to ensure that the rearing practices are optimized to each regions climatic condition which will enable production of quality silk. There is need for enhanced training of farmers to enable them understand the best rearing practices. More funds should also be allocated by the national government for sensitizing Nanded farmers on the advantages of Eri silkworm rearing and also for development of the Ericulture sector through purchase of modern technologies. The farmers are receptive to this kind of Sericulture due to its simplicity in rearing and therefore there is a very bright future for Ericulture in Nanded. If properly steered, Ericulture can boost Nanded silk production tremendously.

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