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Tapioca: An Ideal Host for the Eri Silkworm

Harishkumar J[1]* and Yeruva Thirupathaiah[2]
[1]Resarch Scholar, Department of Studies in Sericulture Sciences, Manasagangothri Mysuru.
[2]Scientist C, Central Sericultural Research Training Institute, Mysuru

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Introduction

Eri silkworm (*Samia ricinii*) is one of the important non-mulberry silks, mainly produced in northeastern India and Assam. It is also present in Bihar, Tamil Nadu, Andhra Pradesh, Arunachal Pradesh, West Bengal, Sikkim, Uttar Pradesh, and Odisha. Assam is the origin of eri silk since the oldest record was found there in 1779. Based on scanning electron microscopy studies, the Chanhu Darrow culture was assumed to be the oldest record of silk reeling.Consequently, it has been adopted as the best occupation for the inclusive development of rural residents, particularly the weaker groups, such as the tribal populations in North East India (Elumalai, 2021). The output of eri silk (spun silk production) has grown significantly in recent years, from 1,089 metric tons in 2001-02 to 7,364 metric tons in 2020-21, representing a CAGR of 10.03% over the past two decades. Although the eri silkworm is a polyphagous non-mulberry silkworm that consumes more than 30 different host plants, the castor bean (*Ricinus communis* L.) is its main food source. But castor leaves are not available throughout the country, as it is primarily an annual plant and must be freshly planted every six months. Therefore, finding alternative host plants available in the region for the continuous rearing of eri silkworms is essential (Bukhari, et al., 2019). One such alternative source is Tapioca (*Manihot Utilissima*) a tuber crop widely used by tribal peoples. Due to their tolerance to unfavorable climatic conditions, these plants are abundant in all the states of northeastern India. The best way to use tapioca for raising eri silkworms is thus explored in this article.

Tapioca leaves suitability for eri silkworms.

The most significant element affecting larval development and the quality of silkworm cocoons is the leaves. Consequently, understanding the shape of leaves and their nutritional quality becomes crucial. Tapioca leaves are almost palmate (fan-shaped), similar to the related castor plant, but are more deeply divided into five to nine lobes. The leaves are

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lanceolate, acuminate, and completely pale green in color, leaves are deeply lobed, with palmate veins, these leaves have an alternate arrangement and have a phyllotaxy of 2/5. The length of the petiole ranges from 5 to 40 cm. The upper surface of the leaf is covered with a thin, shiny waxy cuticle, which silkworms prefer. The leaf area was in the range of 32.45 to 203.77cm2, the internodal distance was 2.62 to 3.32cm, leaf moisture content was 74.8–81.0% leaf moisture retention was 43.9%, and the leaf biomass/plant/harvest 161.2-193.6 (g). By keeping this, it can be estimated that the feeding capacity of eri silkworms would require approximately 800 kg of leaves to feed 100 dfls of eri silkworms (Jayaraj et al., 2004). The biochemical makeup of leaves had an impact on the eri silkworm's ERR (Sarmah et al., 2011).

Fig 1. Cassava plant

Cassava leaves retain 24-30% of carbohydrates, 17.85% of crude fiber, 16.7-39.9% of total protein, 9-14% of minerals and nitrogen, phosphorus, and potassium, and 6.02-14.78% of total minerals. Furthermore, by using cassava flour as a food plant, silkworms continued to maintain low levels of anti-nutrient components such as tannins 2.80 - 4.23% and HCN 310 - 402 mg/kg, which would improve the sustainability and cost-effectiveness of silkworm rearing.

Tapioca leaf influence on Silkworm nutrition

Although tapioca leaves continue to provide high leaf nutrition, understanding how they affect silkworm health becomes of utmost importance. In this regard, Tungjitwitayakul and Tatun (2017) reported that eri-silkworms reared on tapioca leaves showed a total blood cell count of 2.45 ± 0.33 × in 3rd-day-old and 5-instar silkworms 104cells/ml, total hemolymph protein concentration 30.27±5.87μg/μl, α-amylase activity 1.77±0.92 grams of starch hydrolyzed/μg of protein/h and total lipid content in the pupa was 67.73 ± 6.88 mg/g.

Fig 2. Cassava leaf feeding Eri silkworm

Eri silkworm is a wild silkworm moth that produces silk in commercial quantities and uses it for food in different parts of the world. Now, the scope of feeding silkworms with tapioca leaves to produce nutrient-rich silkworm pupae has a wider scope. In this contest, research carried eri larvae by feeding with tapioca leaf showed that larvae and pupae contained high amounts of protein, about 66 percent, which is higher than mulberry silkworm (53-54 percent) and very low content of hydrocyanic acid (6.21-50.47 mg/kg DM) (Sirimungkararat et al., 2004). According to a recent study, tapioca leaf-fed silkworm oil had higher free fatty acid (FFA) content than castor-fed silkworm oil, ranging from 0.11 to 0.17%, a phosphorus content of 0 ppm, and a peroxide value of 2.5. (Ravinder et al., 2016). Dinata et al. (2019) showed that the Samia caterpillar gained 1 gram of body weight by feeding 1.344 grams of tapioca leaves to the eri silkworm. They also reported that the caterpillar's digestibility coefficient was superior to that of other hosts at 77.23%. Because of this, feeding tapioca leaves to Samia cynthia ricini caterpillars results in normal development and nutrient digestion, making it an excellent alternative meal for eri caterpillars.

Influence of tapioca varieties on economic traits of Eri Silkworm

The eri silkworm is a holometabolous insect that completes the egg stage in 8 to 11 days as they lay their eggs in the larval stage from moths fed on tapioca leaves. The eri silkworms go through 4 molts and 5 instars to reach adulthood (days). The number of days for the larvae to develop was 21 to 22 days, with the first instar lasting 4 to 5 days, the second instar 4 to 5 days, the third instar 2.5 days, the fourth instar 2.5 to 3.0 days, and the fifth instar 8.32 to 8.5 days. Similarly to castor-fed silkworms, the pupal life span is completed by 16 to 18 days when fed tapioca leaves. Similarly, silkworm larvae weigh 6.5-6.80 (g), ERR (%) 80.0-88.0, pupation rate 77.0-82.0%, cocoon weight 3.25-3.22g, pupa weight 2.75-2.78g,78g, the shell weight of 0.46 and 0.44g, and shell ratio of 13.66-14% has been reported on feeding tapioca leaves (Kumar et al., 2010). Likewise, the color of the cocoon is one of the important economical parameters, and its color depends on the pigments absorbed from the leaves of the host plant. The color is a racial characteristic due to the presence of pigments in the sericin layer of the shell. Chutia et al. (2014) reported that cassava-fed cocoons were white, followed by castor and Kesseru. Good quality cocoons are firm, compact, and slightly elastic, the study revealed that the tapioca leaves reared Eri silkworms spun more moderate cocoons than castor-feed cocoons as the moth emergence in tapioca was (86.79 %), fecundity was (302.95 eggs/female), the incubation period was 9.02-10.40 days, the hatching percentage of eggs was (96.71 %), female adult longevity was 7.99 and the male longevity was 6.01 days, the total life cycle was 59.71 days have been reported (Birari et al., 2019). Sakthivel (2016) reported a cost-benefit ratio of 1:1.78 for integrated silkworm culture using cassava flour under irrigated conditions and 1:1.72 under rainfed conditions. This parameter indicates that tapioca plants are one of the most numerous hosts available for commercial cultivation of castor in non-sericulture regions of India which is on par with the castor plant productivity.

Tapioca plant varieties in India for ericulture:

Tapioca, *Manihot esculenta* Crantz, does not grow wild. However, about 98 species belonging to the genus Tapioca are known, ranging from subshrubs, and shrubs, to trees. Many research institutions have screened out some popular varieties, namely CO2, CO3, and CO(TP) 4. H165, H226, Kello, Qulle, Mulluvadi (MVD1), and Kunguma Rose (Sakthivel, N.

2018). The recent research by Rama Rao et al., (2005) revealed that 25% utilization of tapioca leaf for eri silkworm rearing, without affecting the tuber yield. Integrating tuber production and beekeeping farmers will reap guaranteed benefits.

Conclusion:

The production of tubers is one of the most well-established industries in India, and the cultivation of eri silkworms is rapidly gaining importance. Hence, combining the two sectors can increase farmer income while also ensuring both sector's sustainability

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