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Exploring *Ficus racemosa* (*L.*) (Family: *Moraceae*) and *Oroxylum Indicum* (*L.*) *(Benth. ex Kurz)* (Family: *Bignoniaceae*) as new host plants for *Samia ricini* in BTR, Assam

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Abstract
Samia ricini, a multivoltine species, can be reared on various food plants due to its polyphagous nature. The selection of suitable host plants is crucial for effective ericulture, as they significantly influence rearing parameters such as survival rates, larval duration, cocoon quality, and moth emergence. This study reports the use of *Oroxylum indicum* and *Ficus racemosa* as alternate host plants for rearing *S. ricini*, in addition to conventional host plants *Ricinus communis* and *Heteropanax fragrans*. These plants were found to provide sufficient leaves during summer (*O. indicum*), rainy (*F. racemosa*, *O. indicum*), and winter (*F. racemosa*) seasons. A satisfactory correlation was observed between growth parameters and the leaves of these two plants, with an overall effective rearing rate of 89.55±0.76% and 86±0.63% for *F. racemosa* and *O. indicum*, respectively. However, the knowledge of using these plants is currently limited, highlighting the need for broader dissemination to enhance productivity and silk yield.

Keywords: Kokrajhar, ericulture, nutrition, host plants, grainage parameters

Introduction

The availability of high-quality host plants plays a crucial role in the success of sericulture, particularly in the rearing of eri silkworms. The suitability of host plants significantly influences the number of rearing cycles per year and the number of silkworms or disease-free layings (DFLs) that can be reared per batch. [1, 2] Effective agronomic practices are essential for producing high-quality leaves, which in turn affect the growth, development, and productivity of silkworms. [3, 4] The selection of host plants by silkworms is largely mediated by the presence and distribution of secondary metabolites, which are chemicals that influence insect behavior and host-plant selection. [5, 6, 7] The quality and availability of host plant leaves have a profound impact on silkworm survival, food intake, digestion, and assimilation. [2, 8] The amount and quality of food intake by silkworm larvae influence various parameters, including growth rate, larval duration, survival rate, and reproductive potential. [9, 10] The quality of host plant leaves and the nutritive contents of the foliage have been shown to significantly impact silkworm growth and development, as well as overall silk production. [1, 11] *Samia ricini*, a non-mulberry silkworm species, is widely distributed in the north-eastern regions of India, particularly in Assam. The rearing of this species is an integral part of the cultural heritage of various ethnic communities in Assam. As a polyphagous species, *S. ricini* can be reared on a variety of host plants, including primary (*Ricinus communis*, *Heteropanax fragrans*), secondary (*Manihot esculenta*, *Evodia fraxinifolia*, *Ailanthus excelsa*, *Ailanthus grandis*), and tertiary (*Gmelina arborea*, *Plumeria rubra*, *Carica papaya*, *Ficus benghalensis*, *Jatropha curcas*) host plants. [2, 10, 12, 13, 14, 15, 31] The choice of host plant is influenced by the physiological makeup of the silkworm, as well as the availability of foliage during different seasons. The sericulture sector in India, particularly in Assam, faces several challenges, including seasonal scarcity of host plant leaves, which can make rearing difficult. [8] To address this issue, rearers must identify alternative host plants and ensure a steady supply of foliage. The selection of suitable host plants is crucial for effective sericulture, as it significantly impacts silkworms' growth, development, and productivity. [1]

Methodology

Study Location and Data Sampling: The present study was conducted in 15 villages of Kokrajhar district, Assam, situated near the Chakrashila Wildlife Sanctuary and Raimona National Park (Fig. 1). This region is characterized by a rich biodiversity, providing an ideal setting for exploring the host plant preferences of *S. ricini*. A total of 100 families were sampled using a scheduled survey method. The survey questionnaire was designed to gather information on the traditional knowledge and practices of sericulture in the region.

Plant Collection and Identification: The sampled plants were collected and herbaria of the plants were submitted to the Botany Department of Bodoland University for proper identification and accession numbers (Fig. 2-3).

Rearing of Silkworms: To investigate the efficiency of the food plants, two groups of silkworms with three replications (n=100/replication) were prepared and reared under indoor conditions for up to six consecutive generations. [10, 16] The rearing conditions were maintained at a temperature of 25°C-28°C and relative humidity of 75%-80% (Rao *et al*., 2015) [8]. Grainage parameters, *viz*, survival rate (%), average larval duration (in days), total cocoon spun (%), moth emergence (%), and effective rate of rearing (%) were recorded. The effective rate of rearing (ERR) after every complete generation was calculated by following the formula:

Effective Rate of Rearing (ERR)= (No. of cocoons harvested)/ (No. of initial population of larvae brushed) ×100%

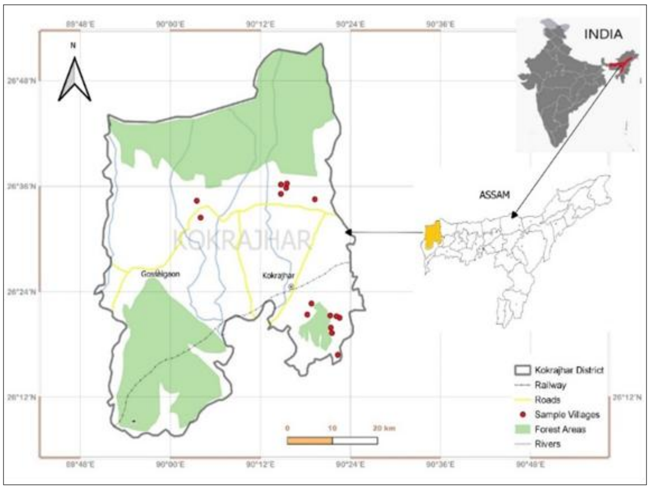

Fig 1: Map of Kokrajhar district showing sampled villages

Results

The plants selected for study were *Oroxylum indicum* and *Ficus racemosa*, with Bodoland University Botanical Herbarium (BUBH) accession numbers BUBH0000832 and BUBH0000837, respectively. Notably, both plant species were commonly employed by rearers in the sampled villages, highlighting their significance in local sericulture practices. Among the total rearers who interacted, 72% have used *F. racemosa*, while 63% have used *O. indicum* for ericulture (Fig. 2, 3). The silkworms reared on these plants demonstrated impressive effective rates of rearing, with *F. racemosa* yielding 89.55 ± 0.76% and *O. indicum* yielding 86 ± 0.63% (Fig. 4). The findings also indicate a shortened larval duration of *S. ricini* compared to those reared on conventionally used host plants. However, while silkworms reared on *O. indicum* had a larval duration of 27.17±0.30 days, those reared on *F. racemosa* showed a shorter larval duration of 25.67±0.49 days (Fig. 5).

Fig 2: Rearing of silkworm in *F. racemosa*

Fig 3: Rearing of silkworm in *O. indicum*

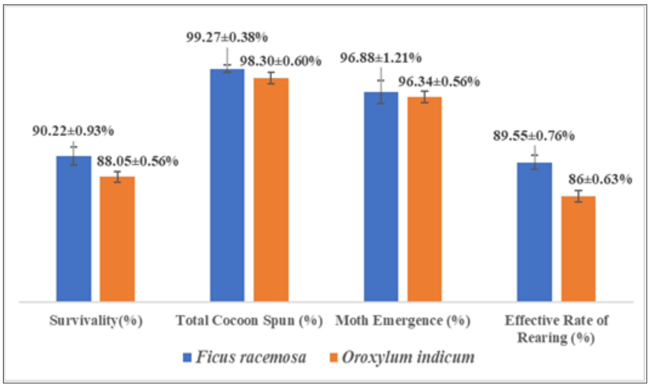

Fig. 4: Different grainage parameters of Eri silkworms reared on *F. racemosa* and *O. indicum*

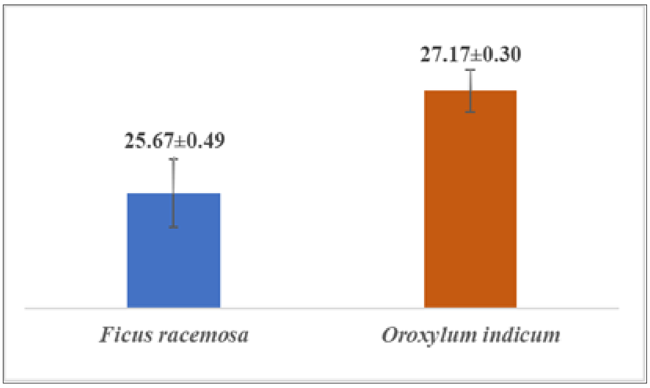

Fig 5: Larval duration (in days) of Eri silkworms reared on *F. racemosa* and *O. indicum*

Discussion

Eri silk production, or ericulture, faces the dual challenge of enhancing productivity while simultaneously minimizing production costs. One of the most critical factors influencing this balance is the quality and availability of host plant leaves, which serve as the primary source of nutrition for eri silkworms. The host plants significantly impact key biological functions in silkworms, including survival rate, food intake, digestion efficiency, and nutrient assimilation. These physiological processes directly affect the overall growth and development of the larvae, which in turn influence essential economic parameters such as cocoon yield and silk quality. [3, 9] The amount and quality of leaf intake by larvae are particularly vital, as they govern the growth rate, larval duration, survival, and reproductive potential of the silkworms. Nutritional adequacy not only supports optimal physiological functioning but also enhances the commercial viability of silk production by improving traits such as cocoon size, filament length, and silk content. The success of the sericulture industry is intricately linked to the nutritional composition of host plants, as it directly influences the economic and biological performance of the silkworms. [1] Further, it was also emphasized that nutrition, particularly ingesta and its digestibility, plays a pivotal role in shaping the physiological and commercial characteristics of *S. ricini*. [8] Therefore, selecting high-quality host plants and optimizing their cultivation is essential for the sustainable growth of the eri silk industry.

The present study reported the application of two host plants, *Ficus racemosa* and *Oroxylum indicum*, for eri silkworm rearing in various villages of Kokrajhar district, Assam. Although *O. indicum* has been previously documented as a host plant for eri silkworms in Jorhat district, Assam [17], *F. racemosa* represents a new addition to the list of host plants. Notably, *F. benghalensis* and *F. religiosa* have been identified as tertiary food plants for *S. ricini,* underscoring the potential of the genus Ficus (Family: Moraceae) as alternate host plants for effective ericulture. [2, 17, 18] Both *F. racemosa* and *O. indicum* are rich in nutrients, antioxidants, and secondary metabolites, including tannins, saponins, phenols, and flavonoids, which fulfill the dietary requirements of *S. ricini* during seasonal scarcity. [19, 20, 21, 22]

Recent research has documented 24-30 different types of host plants for *S. ricini*; [23, 24] however, the response of silkworms in terms of growth parameters warrants further exploration and discussion, as very few plants are scientifically documented and adopted as new alternatives. The polyphagous nature of *S. ricini* enables it to survive on diverse host plants, likely due to the presence of gustatory stimulants and nutritional content in the leaves. Conversely, non-acceptance of a host may be attributed to antifeedants, poor phagostimulants, olfactory stimulants, and the presence of alkaloids in the leaf, which can repel worms from the feeding site and exert physiological implications if consumed. [18] The interchangeability of host plants during rearing is crucial, particularly during leaf scarcity. Factors such as distribution, habitat, leaf collection, and plantation determine the adoption of new plants. Therefore, screening and selecting suitable alternative host plants is essential for successful ericulture, which impacts economic and grainage parameters, including survival rate, larval period, cocoon shell ratio, total cocoon spun, moth emergence, and effective rate of rearing (ERR).

Recent studies have explored various food plants beyond the conventionally used *Ricinus communis*, which luxuriously enhance the growth and development of eri silkworms. Alternative host plants, such as *Ficus bengalensis*, *Spathodea campanulata*, *Terminalia catappa*, *Daucus carota*, *Mikania micrantha*, *Oroxylum indicum*, *Ailanthus grandis*, and *Jatropha curcas* [16, 17, 18, 25, 26] have been found to positively impact survivability, feeding response, larvae, silk gland volume, silk gland ratio, larval duration, cocoon weight, larval weight, shell weight, effective rate of rearing, and pupal rate. The grainage parameters recorded after six consecutive generations can be correlated with those of some newly recorded food plants, resonating and highlighting the efficiency of the plants selected for this study. The effective rate of rearing (ERR%) of both the newly documented plants is satisfactory, underscoring the potential of both plants for effective ericulture. ERR 89.55±0.76% and 86±0.63% are recorded for *F. racemosa* and *O. indicum*, respectively, which are found almost similar to the ERR of Jatropha (86.50 ± 0.514%), Papaya (85.60 ± 0.539%), and Borpat (81.50±3.17%). [16, 26] However, *F. racemosa* had shown a higher ERR than its close relative, *F. benghalensis* (60%), [27] probably making it more suitable for ericulture.

The current study also recorded satisfying grainage parameters, *viz*, survivability (%), total cocoon spun (%), and moth emergence (%). The survivability primarily determines the suitability and feeding response of a host plant. In the present study, survivability of 90.22±0.93% (*F. racemosa*) and 88.05±0.56% (*O. indicum*) could present potential acceptance of these plants as food plants for better commercial yield. Likewise, enhanced rate of total cocoon spun (*F. racemosa*: 99.27±0.38%, *O. indicum*: 98.30±0.60%) and moth emergence (*F. racemosa*: 96.88±1.21%, *O. indicum*: 96.34±0.56%) also denoted promising effects of both these plants upon growth and development of *S. ricini* in future endeavours. In terms of average larval days, there was a slight difference between these two plants (*F. racemosa*: 25.67±0.49 days, *O. indicum*: 27.17±0.30 days). In case of *O. indicum*, the average larval days (23 days) were found almost similar to the earlier reports of Ahmed *et al*. (2012). [17] However, for *F. racemosa*, there is no such data available to compare the total larval days, but the results of the present study are found similar to the total larval days of Jatropha and Papaya (22.00 ± 0.5 days, both). [16] This may be due to the nutrient uptake, phytonutrient composition, availability, and proper supply of the newly adopted food plants.

The results of this study align with previous studies [16, 28], which reported favorable outcomes of castor-fed silkworms, including a higher moth emergence rate (75-89%), larval duration (19.25±0.25 days), and effective rate of rearing (ERR) (91.05±0.229%). Narzary and Brahma (2021) [30] also reported higher larval duration (21.89±0.699-35.78±1.534 days), ERR (82.93±4.258%-79.43±6.892%), and moth emergence (93.12±1.898%-90.349±4.263%) of *S. ricini*, thereby underscoring the effectiveness of *R. communis* as compared to other host plants. Similarly, Devi Borah *et al* (2020) [26] reported a larval duration of 24.88±0.55 days and an ERR of 76.75±1.70% for the Kokrajhar ecorace of *S. ricini* reared on *R. communis*. The present study, conducted on the Kokrajhar ecorace of *S. ricini*, also corroborates this literature and highlights the superiority of *F. racemosa* and *O. indicum* over *R. communis*, a widely accepted food plant for ericulture, given their significant ERR, larval duration, and other grainage parameters. This indicated that these new host plants have potential for enhancing ericulture productivity.

Interestingly, eri rearers in the sampled villages expressed satisfaction with using *F. racemosa* and *O. indicum*, particularly during the summer, rainy, and winter seasons when primary host plants (*R. communis* and *H. fragrans*) were less accessible. Most rearers in these villages were economically marginalized and lacked land for planting the conventionally used host plants. For them, both *F. racemosa* and *O. indicum* were easily accessible due to their availability in the surrounding areas. A significant proportion of rearers, 72% for *F. racemosa* and 63% for *O. indicum*, adopted these plants due to their easy accessibility, leaf availability, and satisfactory grain yield. Notably, while *O. indicum* sheds leaves during the winter season, *F. racemosa* retains its leaves, making it a more valuable alternate host plant for eri silkworms during the winter season up to spring in the sampled area. Similarly, *O. indicum* supports ericulture from monsoon to early winter. The present study observed that rearers employed both tray-rearing and bunch-feeding methods for chawki worms and late-stage larvae, respectively.

Some rearers have also adopted innovative techniques, such as fortification, which involves mixing leaves of *F. racemosa* and *O. indicum* with primary host plants (either *R. communis* or *H. fragrans*) in equal amounts. This approach enables rearers to maintain dietary requirements, mitigate seasonal crop fluctuations, and prevent malnutrition due to food scarcity. Such techniques are also reported earlier from the Karbi Anglong district of Assam, where invasive creeper *Mikania micrantha* leaves were mixed with *R. communis* in equal proportions, and fed to eri silkworms. [25] The study exhibited significant improvement in fecundity, ERR, moth emergence, and hatchability (370.70±0.32 eggs,98.03±0.31%, 99.84±0.03%, and97.01±0.16%, respectively) over control, i.e., *R. communis* (329.28±058 eggs, 98.02±0.32%, 99.66±0.16%, 96.71±0.20%, respectively). Similarly, another investigation reported increased cocoon weight (grams) and pupal weight (grams) in *S. ricini* fed with *R. communis* leaves and *Alpinia allughos* at equal combination (3.169-4.253 grams, 2.734-3.874 grams, respectively) as compared to those fed with only *R. communis* (2.96-3.84 grams, 0.31-3.15 grams, respectively) and *H. fragrans* (2.530-3.270 grams, 2.250-2.910 grams, respectively).[29] These findings validate the innovative techniques of the Eri farmers of Kokrajhar district, underscoring the suitability of *F. racemosa* and *O. indicum* as new host plants for eri silkworm rearing. This marks a significant development in the field of sericulture, offering a promising alternative to traditional host plants, ensuring a stable food supply, and promoting sustainable ericulture practices.

Conclusion

The present study weaves a compelling narrative around the significance of host plants in eri silkworm (*S. ricini*) rearing, with *F. racemosa* and *O. indicum* emerging as promising alternate host plants. Notably, these plants boast satisfactory effective rates of rearing (ERR%) and grainage parameters, rendering them well-suited for eri silkworm rearing. The study also sheds light on the resourcefulness of eri rearers in the region, who have successfully integrated these plants into their traditional rearing practices, particularly during seasons when primary host plants are scarce. Furthermore, the adoption of innovative techniques, such as fortification, by rearers has been instrumental in maintaining dietary requirements and controlling seasonal crops. Ultimately, the introduction of *F. Racemosa* and *O. indicum* as new host plants heralds a promising era for sustainable ericulture practices, ensuring a stable food supply and bolstering the resilience of sericulture industries.

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