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IDENTIFICATION OF SUPERIOR TAPIOCA (MANIHOT ESCULENTA) GENOTYPES FOR OPTIMIZING THE REARING PERFORMANCE AND ECONOMIC TRAITS OF THE ERI SILKWORM (*SAMIA CYNTHIA RICINI*)

Srinivas Raju K.V.[1*,4], K. M. Ponnuvel[1], Salamun D. E.[4], S. Manthira Moorthy[1], Harish Babu S.[2], Devendra Kumar Vishwakarma[3] and N. Mala[5]

[1]CSB-Institute of Seri-Biotechnological Research, Kodathi, Bangalore - 560035, India

[2]Department of Entomology, University of Agricultural Sciences, Raichur, Karnataka, India

[3]CSB-Eri Silkworm Seed Production Centre, Hosur, Tamil Nadu, India

[4]Department of Biotechnology, School of Sciences, Jain University, Bangalore - 560011, India

[5]CSB-Institute of Silkworm Seed Technology, Kodathi, Bangalore - 560035, India

[*]Corresponding author Email: srinivasrajuster@gmail.com

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ABSTRACT

The eri silkworm *(Philosamia cynthia ricini)* is traditionally reared on castor (*Ricinus communis*) leaves, which are not widely available in several regions of India. This study explored tapioca (*Manihot esculenta*) as an alternative host plant and evaluated the rearing performance of eri silkworms on seven tapioca genotypes. Proximate analysis revealed significant nutritional differences among genotypes, with G4 showing the highest crude protein (26.6%) and favorable moisture content. Silkworms fed on G4 produced the heaviest cocoons (2.85 g), greatest shell weight (0.38 g), and a high shell ratio (13.33%), all statistically comparable to those obtained from castor-fed larvae. The "Greenish Blue Plain" cocoon type reared on G4 demonstrated superior silk yield and consistency. These results indicate that G4 is a promising genotype for eri silkworm rearing, providing an efficient and sustainable alternative to castor. Adoption of G4-based rearing could enhance sericulture productivity while generating additional income for tapioca growers in southern India.

***Key words*: Eri silkworm, Tapioca, Manihot esculenta, Cocoon yield and Sericulture.**

Introduction

Sericulture encompasses the mass rearing of silkworms for commercial silk production, involving both the mulberry silkworm (*Bombyx mori*) and various vanya silk moths, including *Samia* spp. and *Antheraea* spp. In India, approximately 80% of the silk production is attributed to B. mori. *Samia cynthia ricini*, commonly known as the eri silkworm, holds significant economic importance in the northeastern region of India, with castor (*Ricinus communis*) traditionally serving as its primary food plant. Conversely, in the southern parts of India, tapioca (*Manihot esculenta*) is a significant tuber crop predominantly cultivated in states such as Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh.

Beyond castor (*Ricinus communis*), Eri silkworm rearing is also conducted using Kesseru (*Heteropanax fragrans* Roxb.) and tapioca (*Manihot esculenta*) leaves, depending on the specific region and availability. The utilization of tapioca in Eri silkworm rearing presents a promising avenue for feed diversification in South India. This alternative feed source offers a potential economic advantage to tapioca growers, as they can derive increased income through eri culture without additional investments or adverse effects on the yield of seeds or tubers (Sakthivel *et al*., 2010).

Plant genotypic differences significantly impact silkworm rearing outcomes. Consequently, effectively utilizing tapioca for eri rearing necessitates the

Table 1: Proximate analysis of tapioca genotype.

Sl. No.	Parameter	Results (mean wet weight in percentage)							
		G1	G2	G3	G4	G5	G6	G7	Control
1	Moisture	73.18	70.77	72.72	76.39	75.81	74.98	71.32	74.5
2	Total Ash	1.82	2.83	3.09	2.12	3.24	3.51	2.17	2.11
3	Protein	5.08	5.65	4.99	6.73	5.85	5.49	6.53	6.31
4	Charbohydrates	19.77	20.58	18.97	14.62	14.74	15.85	19.78	16.89
5	Total Sugar	4.56	4.97	4.84	4.88	4.4	4.78	4.11	3.31
6	Fat	0.15	0.16	0.23	0.14	0.36	0.17	0.21	0.19

identification and characterization of superior tapioca varieties capable of providing optimum eri silkworm rearing performance when fed tapioca leaves. The qualitative characteristics of silk are directly influenced by the quality of the feed and precise maintenance of rearing conditions, such as temperature and humidity. Nutritional management of tapioca varieties can be challenging compared to other crops, as their nutritional profiles tend to vary considerably from season to season.

The growth and development of silkworm larvae, and subsequently the quantity and quality of cocoon production, are profoundly influenced by the quality of the tapioca leaves provided. For successful cocoon crops and high-quality silk, Eri silkworms require abundant feeding on high-quality tapioca leaves. The present study investigated the effective performance of Eri silkworm rearing using various tapioca genotypic varieties, aiming to identify a potential replacement for castor leaves as a primary feed source for Eri silkworms.

Materials and Methods

Rearing of Silkworms and Host Plant Cultivation

Disease-free layings (DFLs) of the eri silkworm (*Samia cynthia ricini*) were procured from a certified grainage. The larvae were reared under standard laboratory conditions (25-28°C and 70-80% relative humidity). Seven tapioca genotypes (G1-Shrejaya, G2-Shree Vishakam, G3-Shree Harsha, G4-H97, G5-Shree Sahya, G6- Shree Prakasha and G7-Shree Sakthi Varieties for this study) were raised following the recommended package of practices (George *et al.*, 2000) in a dedicated plot to ensure a consistent supply of quality foliage. The control group was reared exclusively on castor leaves.

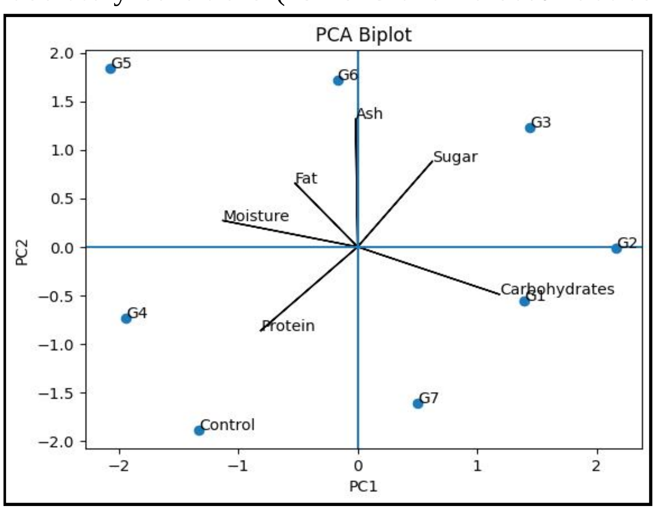

Fig. 1: PCA Biplot based on genotype means of proximate analysis.

Experimental Design

The experiment was designed with eight treatments, including one control (castor) and seven tapioca genotypes. For each treatment, three replicates of 100 larvae were maintained. The silkworms were initially reared on castor leaves (chawki rearing) until the third instar to ensure the initial larval health and vigor. From the beginning of the fourth instar to the spinning stage, the larvae were fed exclusively with leaves from their respective assigned tapioca genotypes or castor (control).

Proximate Analysis of Foliage

Leaf samples from each of the seven tapioca genotypes and the castor control were collected and dried. Standard biochemical procedures were used to conduct a proximate analysis to determine the percentage of moisture, crude protein, carbohydrates, crude fiber and

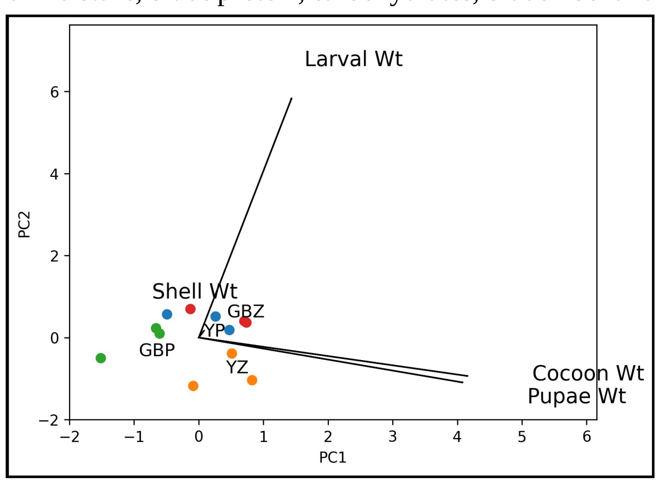

Fig. 2: (PCA) biplot depicting the distribution of genotypes (Yellow Plain, Yellow Zebra, Greenish Blue Plain, and Greenish Blue Zebra) based on larval, cocoon, pupal, and shell weights.

total mineral content.

Evaluation of Rearing and Cocoon Parameters

Data were systematically recorded for the key economic parameters.

- **Cocoon Weight (g):** The average weight of a single, fully formed cocoon.
- **Pupal Weight (g):** The average weight of the pupa after cutting open the cocoon was measured.
- **Shell Weight (g):** The average weight of the silk shell, calculated by subtracting the pupal weight from the cocoon weight.
- **Shell Ratio (%) =** Single Cocoon Weight (g) × 100/Single Shell Weight (g)

Statistical Analysis

The data collected from the replications were subjected to Analysis of Variance (ANOVA) to determine the statistical significance of the differences observed among the treatments.

Results and Discussion

Proximate Analysis of Host Plant Leaves

The nutritional composition of host plant leaves is paramount for silkworm growth. Proximate analysis (Table 1) revealed significant variations among the tapioca genotypes. Genotype G4 exhibited the highest crude protein content (6.73%), which is a critical factor for larval development and silk synthesis.

One-way ANOVA revealed significant differences ($p < 0.001$) among genotypes for all proximate parameters (Fig. 1). Tukey's HSD test indicated that G4 recorded the highest protein content, while G2 showed significantly higher carbohydrate and sugar content. PCA explained 85–90% of total variance, with PC1 associated with energy traits and PC2 with mineral and fat content, clearly separating genotypes into distinct nutritional clusters

Economic Parameters of Eri Cocoons on Different Tapioca Genotypes and morphology of cocoon

To understand the variation among the studied genotypes, multivariate statistical analysis was performed using principal component analysis (PCA). This approach reduces complex, interrelated variables into a few principal components, allowing visualization of patterns, relationships, and trait contributions. By incorporating larval, cocoon, pupal, and shell weights, PCA provides a comprehensive overview of how these traits collectively influence genotype performance (Fig. 2).

The principal component analysis (PCA) biplot revealed clear differentiation among the four genotypes based on growth and cocoon-related traits (Fig. 2). The first principal component (PC1), accounting for the majority of variation, was strongly associated with larval, cocoon, and pupal weights, indicating that these traits collectively represent overall biomass and productivity. Greenish Blue Zebra (GBZ) and Yellow Plain (YP) were positioned towards the positive side of PC1, reflecting superior growth performance, while Yellow Zebra (YZ) appeared on the lower side, indicating comparatively reduced larval and cocoon development. Greenish Blue Plain (GBP) was distinctly separated, influenced by relatively lower cocoon and pupal weights. The second principal component (PC2) was mainly driven by shell weight, which showed weaker correlation with other traits, suggesting its independent contribution to variability. Overall, the analysis highlights cocoon and pupal weights as key determinants for genotype differentiation and confirms GBZ as the most promising genotype in terms of productivity.

Conclusion

This study successfully demonstrated that tapioca (Manihot esculenta) can serve as a viable and effective alternative host plant for the eri silkworm, particularly in regions such as Southern India, where it is widely available. Among the seven genotypes evaluated, G4 emerged as the most promising for commercial eri rearing. The silkworms fed on G4 leaves exhibited cocoon weight, shell weight, and shell ratio that were statistically comparable to those of the traditional castor-fed control group. This superior performance is attributed to the high crude protein and moisture content in G4 leaves.

The adoption of G4 for Eri sericulture can provide a significant economic boost to tapioca farmers, creating a dual-income opportunity from both the tubers and the foliage. Further research should focus on the long-term effects of G4 on multiple generations of Eri silkworms and explore the gut microbiome adaptations to a tapioca-based diet to fully understand the physiological interactions.

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Authors' Contributions

Study, Conception and Design of the research work was contributed by Author 1

The protocol, statistical analysis and wrote the first draft of the manuscript. 'Author 2' Material preparation, data collection and analysis were performed by Author 3

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