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RESEARCH ARTICLE

EFFECT OF MORINGA ON LARVAL DEVELOPMENT AND COCOON PARAMETERS OF MULBERRY SILKWORM, BOMBYX MORI (L.)

Simi Simon , Lalitha H.M, PoojaKiran P.K, Monisha S.R and Aishwarya N

1. Department of Zoology, University College of Science, Tumakuru, Karnataka, 52103.

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Abstract

Sericulture is the epitome of a cottage enterprise. Combining industry and agriculture, it is one of the most labour-intensive sectors of the Indian economy. The silkworm, a larva of the silk moth, is the main source of silk. The quality and nutritional components of mulberry leaves have a significant impact on the growth rate and development of silkworm larvae and the subsequent production of silk. All genetic qualities, including the weight of larvae and cocoons, the amount of raw silk produced, pupation, and reproductive characteristics, are directly impacted by the nutritional requirements of food consumption. The current investigation was conducted at Zoology Research Lab, University College of Science, Tumkur University. For the studies, FC1×FC2 mulberry silkworms were selected. The work's objective is to investigate how moringa influences the silkworm Bombyx mori' economic characteristicssuch asLarval parameters [Larval weight, Larval duration,Growth Index], Cocoon Parameters [Cocoon weight, Effective rate of rearing, Shell weight,Pupa weight, Shell ratio, Silk productivity].

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Introduction:-

Bombyx mori, a vital economic insect, is utilized as a tool to transform the mulberry leaf protein into silk (Simi Simon et al., 2024a). Numerous species of silkworms differ in their nutritional value, metabolic and physiological processes (Ravikiranet al., 2024).Compared to single hybrid bivoltine, the FC1×FC2 double hybrid bivoltine can withstand unfavourable weather conditions and perform better in crop balancing (Simi Simon et al., 2024b).Mulberry is the only host plant for the silkworm Bombyx mori. The quality and nutritional content of mulberry leaves have a significant impact on the growth rate and development of silkworm larvae, as well as future silk production (Krishnaswamiet al., 1973). To improve economic qualities, silkworms are fed nutrients in addition to mulberry leaves (Jayapaul, 2003; Sheeba, 2006). Moringa, commonly known as the "Miracle Tree," is a nutritional powerhouse that contains vital amino acids, protein, minerals (e.g. calcium, potassium, iron), and vitamins A, C, E, and B-complex (Islam et al., 2021). Moreover, it contains phytochemicals that stimulate growth and antioxidants that enhance metabolic and immunological functions. Moringa has been shown to boost feed efficiency, growth rate, and physiological performance for insects and animals (Anushaet al., 2025). Fortification of moringa solutions at different concentrations (2.5%, 5%, and 7.5%) on V1 mulberry leaves and feeding them to

Corresponding Author:- Simi Simon
Address:- Department of Zoology,University College of Science, Tumakuru, Karnataka, 52103.

FC1×FC2 larvae during the fourth and fifth instars the optimum period for high metabolism and silk production was the method applied. In besides supplying vital nutrients, the combination diet enhances the silkworm's biochemical profiles, specifically the protein and carbohydrate in its fat body, silk glands, and haemolymph (Anushaet al., 2025). Because they directly affect the profitability and efficiency of sericulture activities, commercial standards are important in the production of silkworms (Simi Simon et al., 2024c).It has been demonstrated that this biofortification technique significantly improves commercial traits as silk yield, larval weight, cocoon weight, shell weight, and shell ratio (Mahantaet al., 2023). It also provides an inexpensive, eco-friendly substitute for chemical additives, which is ideal for the goals of sustainable sericulture. This study examines how moringaenriched V1 mulberry leaves affect the biochemical composition and commercial properties of FC1×FC2 silkworms, with the goal of increasing productivity through natural food improvement. This study proposes using moringa leaf powder to supplement V1 mulberry leaves, potentially improving the biochemical composition and commercial qualities of FC1×FC2 silkworms. The goal is to design and develop a sustainable, organic process that encompasses larval health, cocoon development, and silk yield, which will benefit both sustainable sericulture and small-scale farmers.

Materials and Methods:-

Silkworm Rearing:-

Prior to conducting the research, the lab was sterilized using limestone powder. The study was carried out at Zoology Research Lab, University College of Science, Tumkur University, Tumakuru. DFL silkworms (II instar larvae) of the FC1×FC2 breed were procured from the Chawki rearing centre in Honnudike , Tumakuru, and raised in a lab with a temperature 25±3°C, 72±2% relative humidity. The larvae were randomly divided up into three groups, each comprised of twenty larvae. The larvae were reared under standard rearing conditions (Krishnaswami.,1973).

Supplementation of Moringa: Commercially available Moringa powder was made into different concentrations (2.5%, 5%, and 7.5%), and treated with V1 mulberry leaves and fed to silkworms twice a day from fourth instar first day till they reached spinning stage.

Economic parameter: The commercial characteristics of the Bombyx mori species FC1×FC2 were determined based on the subsequent parameters: Larval parameters [Larval weight, Larval duration, and Growth Index], Cocoon Parameters [Cocoon weight, Shell weight, Pupa weight, Shell ratioand Silk productivity].

Biostatical Analysis:A commercially accessible statistical program (Graph Pad Prism 8 for Windows) was used to evaluate the provided data using two-way analysis of variance (ANOVA) and Dunnett's Multiple Comparisons test. The findings were displayed as Mean±SD. Statistical significance was defined as P values < 0.001.

Table 1: Effect of different concentrations of Moringa on Larval development in FC1×FC2 race of Bombyx mori. L. The values are expressed in grams for larval weight and Growth index and days for larval duration during IV instar and V instar.

Characteristics	Larval weight (g)		Larval Duration (days)		Growth Index (g)
	IV Instar	V Instar	IV Instar	V Instar	
Control	6.6±0.11	13.40±0.28	6.1±0.2	8.1±0.5	1.03±12
2.5% Moringa	7.29±0.03	14.23±0.4	5.5±0.3	7.5±0.28	0.95±0.23
5% Moringa	7.75±0.45	14.61±0.11	5.1±0.12	7.2±0.11	0.88±0.17
7.5% Moringa	8.21±0.2	14.92±0.5	4.8±0.11	6.5±0.7	0.81±0.21

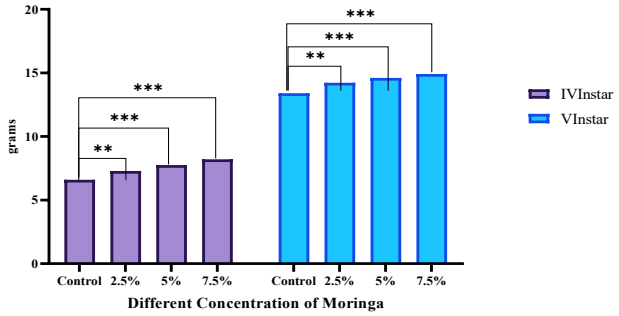

Fig 1(a)

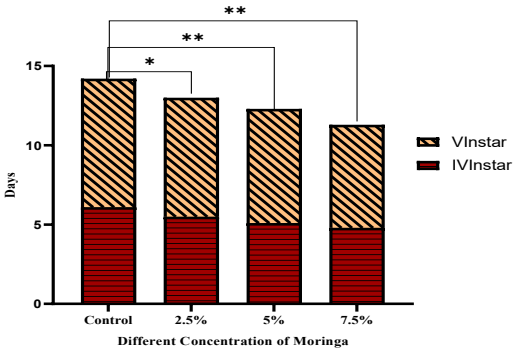

Fig 1(b)

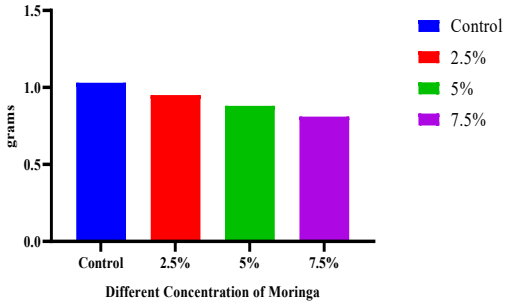

Fig 1(c)

Fig 1(a), (b), (c): Larval weight, Larval duration and Growth index in FC1×FC2 race of Bombyx mori. L fed V1 mulberry leaves treatment of Moringa during IV instar and V instar.

Table 2:Effect of different concentrations of Moringa on cocoon parameters in FC1×FC2 race of Bombyx mori. L. The values are expressed in grams for cocoon weight, shell weight and pupa weight and percentage for ERR, shell ratio and Cg/day for Silk productivity.

Characteristics	Control	2.5% Moringa	5% Moringa	7.5% Moringa
Cocoon weight (g)	5.2±0.02	5.62±0.12	6.04±0.01	6.77±0.02
Shell weight (g)	0.5±0.03	0.61±0.02	0.83±0.02	1.12±0.03
Pupa weight (g)	4.7±0.01	5.01±0.2	5.21±0.02	5.65±0.3
Shell ratio (%)	9.61±0.2	10.85±0.2	13.74±0.1	16.54±0.2
Silk productivity (Cg/day)	0.06±0.02	0.08±0.02	0.11±0.01	0.17±0.03

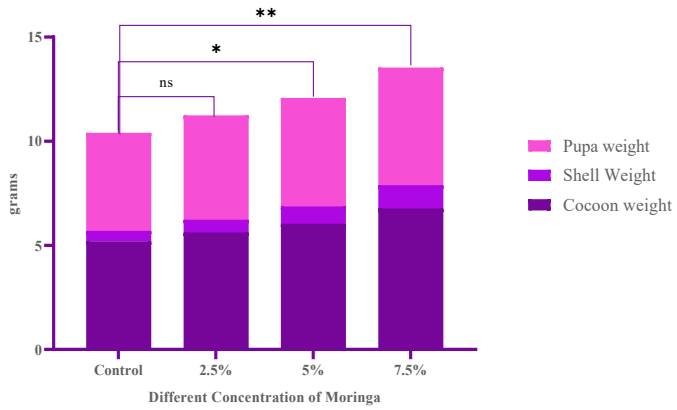

Fig 2(a)

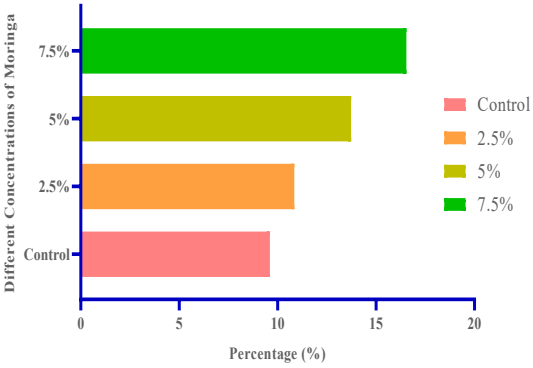

Fig 2(b)

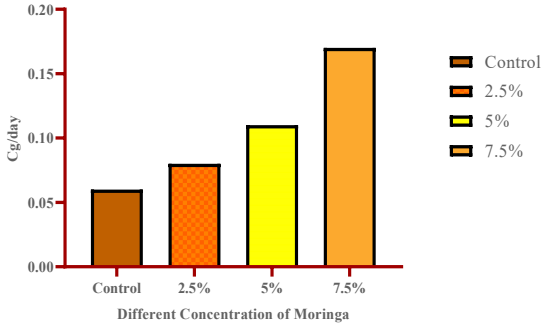

Fig 2(c)

Fig 2(a), (b), (c):Cocoon weight, Pupa weight, Shell weight, Shell ratio and Silk productivity in FC1×FC2 race of Bombyx mori. L fed V1 mulberry leaves treatment of Moringa.

Result:-

The economic parameter was observed in FC1×FC2 breed of silkworm under study which includes larval weight, larval duration, growth index, cocoon weight, pupa weight, shell weight, shell ratio and silk production ratio. The economic parameter of FC1×FC2 breed of silkworm from 4th and 5th instar are given in Table 1, & 2 and figure 1 &2. The table 1 and figure 1(a) summarizes larval weight gained by silkworms treated with 7.5% moringa shows high value in 4th and 5th instar larvae and least in control. Figure 1(b) shows the larval duration of FC1×FC2 breed of silkworm feeding on mulberry leaves supplemented with moringa. Larval duration shows reduced in both 4th and 5th instar larvae treated with 7.5% moringa and the high in control. The Growth index gained by silkworms treated with 7.5% moringa shows low value in and high in control. Data presented in table 2 and figure 2(a) indicates the cocoon weight shows highest in silkworms treated with 7.5% moringa and least in control. Pupa weight is highest in silkworms treated with 7.5% moringa least in control. Shell weight is highest in silkworms treated with 7.5% moringa least in control. The figure 2(b) summarizes the shell ratio shows maximum in 7.5% moringa treated and least in control and figure 2(c) indicates Silk production maximum in 7.5% moringa treated and least in control.

Discussion:-

The study found that incorporating moringa to V1 mulberry leaves for silkworm Bombyx mori FC1×FC2 had a significant impact on economic parameters such as larval development (larval duration, weight, and growth index) and cocoon parameters (cocoon weight, shell weight, pupa weight, shell ratio, and silk productivity). This finding demonstrates that mulberry leaves supplemented with moringa produce a better outcome in every stage of silkworm development. The nutritional value of V1 mulberry leaves and supplements had a significant impact on larval parameters. Mulberry leaves supplemented with 7.5% moringa demonstrate increased larval weight than the control, which could be owing to moringa's high protein, amino acid, and mineral content (Islam et al., 2021). The highest larval weight results in better silk production (Venugopal Reddy Bovilla, 2015). When mulberry leaves were supplemented with moringa, larval duration was significantly shorter, implying that the worms' nutritive requirements were met in a shorter period of time due to feed supplementation, as compared to unsupplemented mulberry leaves (Roy Choudharyet al., 1994; Vijakumaret al., 2016). Cocoon weight, shell weight, and pupa weight all indicate enhanced nutrition digestion and overall silkworm health (Anushaet al., 2025). The shell ratio indicates the ideal cocoon to shell mass ratio at a moderate enrichment level; silk production is determined by the rearing conditions, quality, nutritive elements, and quantity of mulberry leaves supplied during rearing; the higher the weight, the approximate quantity of raw silk output (Simi Simon et al., 2024c). Moringa'sproteinaceous supply can increase cocoon and shell weight (Anushaet al., 2025). The current study supports earlier studies on the use of moringa in sericulture, demonstrating that feeding silkworms'moringa improved silkworm growth and cocoon qualities (Pareeket al., 2023; Abbas, 2013).

Conclusion:-

The study found that the V instar larvae of silkworm Bombyx mori FC1×FC2 exhibit good yield in economic indicators such as larval weight, duration, growth index, cocoon weight, pupa weight, shell weight, silk production, and shell ratio. FC1×FC2, a bivoltine double hybrid breed, excels in seed crop output, recovery, and stability. The current study examines the effect of Moringa supplementation on silkworm economic characteristics.

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