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Feeding Effect of Chlorophyll content of different mulberry varieties on rearing performance of *Bombyx mori*

Ruchi Yadav, TarunYadav, Anju Singh and Harendra Kumar*

Department of Zoology, J.S.University, Shikohabad, Firozabad.

*Corresponding Author: k.harendra82@gmail.com

Abstract

Chlorophyll is an antioxidant which usually found in nature especially in green leafy plants .The chlorophyll content of four mulberry varieties (S_1, S_{13}, S_{146} and S_{1635}) and to check the effect on silkworm growth were studied. Total chlorophyll of all the varieties was extracted individually using acetone as solvent and detected using spectrophotometer at two wavelengths (645 nm and 663 nm). The highest total chlorophyll content was observed in S_{146} mulberry leaves and least chlorophyll content of mulberry leaves was observed in S_1 mulberry varieties. The silkworm fed with S_{146} mulberry leaves showed better rearing performance than the worms fed by leaves of other varieties. S_{146} fed larvae showed better cocoon performance effective rate of rearing (ERR %), cocoon weight, pupa weight, shell weight and filament length compared to other mulberry varieties. It shows the effect of chlorophyll content on rearing performance of *B.mori*.

Key words - Mulberry leaves, chlorophyll, rearing performance, silkworm growth.

Introduction

Sericulture is known as agro-based cottage industry. It plays an important role in improving the rural economy because it possesses high employment and income generation capability with minimum investment (Hiware, 2001). The Indian silk industry is a constant source of foreign exchange earnings and unique in producing all five types of silk varieties viz., Mulberry, Eri, Muga, tropical and temperate Tasar silks. However, mulberry silk is the most popular and of high demand which account 90 % of total silk production in the country. The mulberry silkworm, *B. mori* is an important economic insect and also a tool to convert leaf protein into silk. Mulberry is the exclusive food plant of *B. mori* cultivated both in tropical and temperate countries of the world. In India, the mulberry plants are cultivated mainly in Tamil Nadu, Andhra Pradesh, Jammu & Kashmir, Karnataka, Uttar Pradesh, West Bengal and northeastern states due to prevalence of favorable climatic conditions (Muthulakshmi *et al*., 2010). Mulberry leaves are the exclusive source of nutrition (e.g. protein, carbohydrates, vitamins, minerals etc) for growth and development of silkworms (Tang *et al*., 2003). The quality of leaves fed to silkworm is considered to be the prime factor for good cocoon production (Ravi Kumar, 1988). Mulberry leaves are rich in protein and amino acids. It is known that there is high correlation between leaf protein level and cocoon shell weight to the total amount of mulberry leaves consumed by silkworms (Mechii and Katagiri, 1991). There are three important factors which determine the quality of leaves, viz. good variety of mulberry, appropriate agronomic practices and plant protection measures (Qader *et al.*, 1992). Different species of mulberry leaves may have nutritive compositional differences and might lead to varying effects on growth and silk production The larval growth of silkworm is influenced by the nutritional level of different cultivars of mulberry which is ultimately reflect the economic traits namely larval weight, cocoon and shell weight, effective rate of rearing etc. Growth and dietary efficiency of mulberry silkworm was varied with nutritional and environmental conditions (Rahmathulla *et al*., 2004). The performance of any mulberry variety with respect to leaf quality and yield varies with agro-climatic conditions. Physical and chemical properties of leaves directly affect the amount of leaf consumed and digested by the silkworm (Das and Vijayaraghavan, 1990). Nutritional level of different mulberry varieties influence the larval growth and economic traits namely larval weight, cocoon, shell weight and effective rate of rearing (Ghosh *el al*., 2000; Zannoon *et al*., 2012). Keeping in view the above mentioned importance, the current study was conducted to investigate the effect of different mulberry varieties and rearing seasons on larval and economic traits of *Bombyx mori*.

Objective

To study the chlorophyll content of mulberry leaves and its effect on silkworm growth.

Materials and Method

The study was carried out in well-equipped rearing house of the Department of Zoology J.S. University, Shikohabad, Firozabad, Uttar Pradesh during spring (February- March), summer (March- April) season of year 2021 and 2022. Collected from the apical, middle and bottom portions of mulberry varieties viz. S_1, S_{13}, S_{146} and S_{1635} from mulberry germplasm of J.S.University. The plantation was taken 4 replication of each 8 mulberry varieties under the spacing 60x60 cm. The studies were observed the silkworm growth and cocoon characteristics of silkworm fed on different mulberry varieties were studied in Spring and summer seasons. 20 disease free laying (dfl's) in bivoltine hybrid race (CSR_2 X CSR_4) were produced from silkworm Seed Production Centre . Central Silk Board, Dehradun during 2021- 2022. The newly hatched out larvae were brushed on rearing trays a d offered chopped tender leaves to them Chawki rearing was carried out at mass level After 2nd instar, mulberry leaves of S_1, S_{13}, S_{146} and S_{1635} varieties were fed individually to larvae at four times in a day. Three rearing trays consist 300 larvae were maintained for each varieties of mulberry leaves. Fully ripened were picked manually and mounted on bamboo spinning tray. The humidity and temperature during the course of rearing were recorded. The total chlorophyll content of mulberry leaves quantified using the following formulae using 80% acetone, followed the method of Arnon (1949).

Chlorophyll –a mg / ml = (0.0127) x (O.D.663)- (0.00269) x (O.D. 645)

Chlorophyll –b mg / ml = (0.229) x (O.D.645) – (0.00468) x (O.D. 663)

Total Chlorophyll mg / ml = (0.0202) x (O.D.645)+ (0.00802) x (O.D. 663)

Larval weight –To study the feeding effect of mulberry leaves enriched with highest chl and lowest chl and also the diseased leaves among the eight mulberry variety ,on the larval growth, the weight of silkworm larvae 10worms/tray weighed after 2nd moult onwards till spinning using a digital balance.

$$\text{Body gain weight/gm/d} = \frac{\text{Wt larvae after moult} - \text{befor moult}}{\text{No. of taken larvae}}$$

d=day

Cocoon, pupa and shell weight-One week after pupation the cocoon were harvested and 10 cocoons in good condition were cut open from each replica and cocoon, pupa and shell weight were recorded.

Cocoon shell percentage- The shell percentage of each cocoon was calculated as

Effective rate of rearing percentage: the effective rate of rearing (ERR %) was calculated by following the formula of Joshi

$$\text{ERR\%} = \frac{\text{no.of cocoon harvested}}{\text{no.of larvae retained}} \text{ x } 100$$

Effect rate of rearing by weight: it is calculated by the following formula

$$\text{ERR by no} = \frac{\text{wt of harvested good cocoon}}{\text{of larvae retained}} \text{x100}$$

Denier of silk filament - it is calculated by the formula

$$\text{diner} = \frac{\text{weight of silk filament}}{\text{length of filament}} \text{x9000}$$

Table – 1. Chlorophyll contents of S_1

S.No.	Wavelength	Chlorophyll mg/g	Apical	Middle	Bottom
1	645	Chlorophyll A mg/g	5.52508	2.81701	2.71008
2	652	Chlorophyll B mg/g	9.75088	15.63446	13.85544
3	663	Total Chlorophyll mg/g	15.27058	18.44386	16.55874

Table–2. Chlorophyll contents of S_{13}

S.No.	Wavelength	Chlorophyll mg/g	Apical	Middle	Bottom
1	645	Chlorophyll A mg/g	1.24339	2.32354	5.33754
2	652	Chlorophyll B mg/g	5.65434	8.87124	22.00124
3	663	Total Chlorophyll mg/g	6.89494	11.19034	27.32784

Table–3. Chlorophyll contents of S_{146}

S.No.	Wavelength	Chlorophyll mg/g	Apical	Middle	Bottom
1	645	Chlorophyll A mg/g	9.6787	15.26554	15.02186
2	652	Chlorophyll B mg/g	3.66324	5.85476	5.5502
3	663	Total Chlorophyll mg/g	13.33864	21.11506	20.567

Table –4. Chlorophyll contents of S_{1635}

S.No.	Wavelength	Chlorophyll mg/g	Apical	Middle	Bottom
1	645	Chlorophyll A mg/g	8.25123	10.39986	10.02233
2	652	Chlorophyll B mg/g	3.81682	5.28164	9.73678
3	663	Total Chlorophyll mg/g	12.06492	15.67734	19.75298

Table- 5. Effect of S_1 mulberry variety on growth parameter

Effect of S_1 mulberry variety on growth parameter											
S. No.	**Instar**	**hatching percentage**	**replica**	**larval weight**	**larval length**	**larval width**	**feeding period**	**moulting period (hrs)**	**Larval period (day)**	**growth rate**	**body gain weight**
1	**3rd**	78.77	**R_1**	0.79	19.73	3.1	69		3	0.015	0.015
			R2	1.63	19.68	3.05	69	38	3	0.014	0.014
			R3	1.65	19.49	3.06	69		3	0.015	0.015
			MEAN	**0.81**	**19.63**	**3.07**	**69**		**3**	**0.014**	**0.014**
2	**4th**		**R_1**	5.39	36.77	5.89	70		4	0.388	0.388
			R2	5.4	36.23	5.88	70		4	0.397	0.397
			R3	5.27	36.04	5.88	70		4	0.385	0.385
			MEAN	**5.35**	**36.34**	**5.89**	**70**	37	**4**	**0.39**	**0.39**
3	**5th**		**R_1**	42.68	62.83	9.07	125		6	5.63	5.63
			R2	41.38	62.51	9.07	125	–	6	5.31	5.31
			R3	42.41	62.86	9.12	125		6	5.54	5.54
			MEAN	**27.69**	**62.73**	**9.08**	**125**		**6**	**5.49**	**5.49**

Table- 6. Effect of S_1 mulberry variety on silkworm growth parameter

S. No.	Instar	hatching percentage	replica	larval weight	larval length	larval width	feeding period	moulting period (hrs)	larval period (day)	growth rate	body gain weight
1	**3rd**	78.77	**R_1**	0.79	20.15	3.03	69	38	3	0.013	0.071
			R2	0.78	20.05	3.01	69		3	0.013	0.071
			R3	0.76	20.24	3.02	69		3	0.012	0.069
			MEAN	**0.77**	**20.15**	**3.02**	**69**		**3**	**0.012**	**0.07**
2	**4th**		**R_1**	5.39	36.66	5.89	70	37	4	0.424	0.168
			R2	5.4	37.03	5.96	70		4	0.444	0.143
			R3	5.28	36.98	5.97	**70**		**4**	0.427	0.167
			MEAN	**5.36**	**36.89**	**5.94**	70		**4**	**0.431**	**0.159**
3	**5th**		**R_1**	27.82	63.32	9.09	125		6	5.85	2.68
			R2	27.91	63.41	9	125		6	5.87	2.63
			R3	27.84	63.17	8.99	**125**		6	5.83	2.64
			MEAN	**27.85**	**63.3**	**9.02**	**125**		**6**	**5.85**	**2.65**

Table- 7. Effect on reeling parameters

S.NO	variety name		filament length(m)	Filament weight (gm)	Denier
1		**R_1**	**957.33**	**0.31**	**2.78**
2	**S_{146}**	**R_2**	**960**	**0.28**	**2.76**
3		**R_3**	**956.33**	**0.33**	**2.99**
		MEAN	**957.89**	**0.3**	**2.85**
1	**S_1**	**R_1**	**815**	**0.27**	**2.69**
2		**R_2**	**787**	**0.25**	**2.68**
3		**R_3**	**791.22**	**0.3**	**2.57**
		MEAN	**797.74**	**0.28**	**2.64**

Result and discussion

Leaf quality evaluation through analysis of chlorophyll content

The analysis of variance for chlorophyll content of four mulberry varieties given in table 1 to 4. The maximum total chlorophyll content observed in S_{146} and minimum in S_1, S_{1635}, S_{13} respectively but the most significant result observed that the total chlorophyll content all three type of mulberry varieties highest than their total chlorophyll content of mulberry leaves.

Leaf quality evaluation through rearing parameters of silkworm

Observation recorded in respect of selected parameter i.e. larval growth parameter, economic/cocoon parameter and reeling parameters.

Larval growth parameter- The body gain weight recorded maximum in larvae fed on S_{146} leaves (0.98gm/10larvae) followed by S_1 (0.96gm) and diseased fed larvae (0.83gm). Economic/Cocoon parameter-The single cocoon weight, Shell weight, Pupal weight, Shell percentage, Effective rate of rearing (ERR) by no. were recorded maximum in larvae fed on s_{146} variety leaves.

Reeling parameter-The filament weight, filament length and filament denier were also recorded highest in larvae fed on S_{146} leaves followed by S_1 and diseased leaves, (table-2).The present experiment revales that the silkworm fed on S_{146} variety leaves shows significantly better performance than S_1 and diseased leaves. All the larval growth parameter recorded maximum in larvae feed on S_{146}. In case of cocoon parameter except ERR by weight(41.49) which is recorded maximum in S_1fed larvae, all economic parameter i.e. ERR by no.(81.33), single cocoon weight(1.72gm), single shell weight(0.36) and shell ratio (26.64) recorded maximum in larvae fed with S_{146} leaves. All reeling parameter i.e. filament length (957.89m), filament weight (0.3gm), and filament denier (2.85) recorded maximum of filament produced by the larvae fed on S_{146} variety leaves. So for this study, it is clear that the S_{146} having the percentage of majority i.e. 12 of the 14 parameter under study i.e. larval weight, larval length, larval width, body gain weight, single cocoon weight, shell weight, pupal weight, shell ratio, ERR by no. ERR by weight, filament length, filament weight, filament denier. Thus, it can be concluded that most nutritive variety of mulberry inrespect of chlorophyll content is $S_{146.}$

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