EFFECT OF DIFFERENT MATURITY MULBERRY LEAVES ON ECONOMIC TRAITS OF BIVOLTINE SILKWORM (*Bombyx mori* L.)

ABSTRACT

Feeding the silkworm with tender mulberry leaves resulted in significantly higher values for cocoon shell ratio (19.21 per cent), single cocoon weight (1.94 g), single shell weight (0.37 g), highest larval weight of ten mature larvae (38.82 g), highest cocoon yield per 1000 larvae (18.68 kg), longest filament length (922.33 m), heaviest filament length (0.28 g), highest denier (2.76 g), lowest disease incidence (1.30 per cent) and the highest effective rate of rearing (98.40 per cent) than those silkworms reared on medium, coarse, and mixed leaves.

KEY WORDS:- Cocoon shell ratio, Single cocoon weight, Single shell weight, Larval weight, Cocoon yield, Filament length, Denier, Disease incidence, Effective rate of rearing.

INTRODUCTION

The development of silkworm larvae and the economic characteristics of cocoons are significantly influenced by the nutritional quality of the mulberry leaves they consume (Krishnaswami, 1978). *Bombyx mori* L. predominantly consumes mulberry leaves and exhibits a preference for leaves at various maturity levels, such as tender, medium, and mature, depending on its larval stage (Sarkar, 2020). Chemical analysis of these leaves reveals notable differences in terms of crude protein, total sugar, starch, reducing sugar, total carbohydrates, fiber, ash, and moisture content (Rahmathulla et al., 2003). Benchamin and Jolly (1986) noted that silkworm larvae show a preference for leaves with high moisture content and lower dry matter. Previous research has consistently highlighted the nutritional richness of top tender leaves compared to medium, matured, and over-matured leaves, emphasizing their lower pubescence density and blunt tip (Rangaswami et al., 1976; Sinha et al., 1993; Bongale et al., 1997; Trivedi et al., 2008).

The quantity and quality of these leaves play a pivotal role in silk productivity, with a direct correlation to environmental factors (Nagaraju, 2002). Mulberry leaves containing more water, total sugar, soluble carbohydrate, and less mineral are best relished by silkworms. Nutritive requirements of silkworm larvae vary with the maturity of leaves fed. Silkworms require leaves of high moisture content as it is easy to digest, while late-age silkworms require mature leaves with less moisture content as they have the strength to digest mature leaves (Koyuncu, 2004; Sabhat et al., 2016).

MATERIALS AND METHODS

The experiment was conducted during monsoon 2020-21 at Department of Agricultural Entomology, College of Agriculture, Latur under Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra to study the effect of different maturity mulberry leaves on economic traits of bivoltine silkworm (*B. mori* L.). It was conducted in randomized block design with seven treatments and three replications using FC_2 X FC_1 bivoltine double hybrid silkworm. Effect of different maturity mulberry leaves on biology and economic traits of bivoltine silkworm (*B. mori* L.) was studied. One hundred silkworm larvae were reared in each replication. The disease free layings were used to feed on the leaves of mulberry variety V-1. The mulberry branches divided into three regions, namely top tender (high moisture 75-80%), middle medium (moisture content 65-75%), and bottom coarse leaves (low moisture 60-65%).

The treatment details are as follows the treatment T_1 is feeding with tender leaves, the treatment T_2 is feeding with medium leaves, the treatment T_3 is feeding with coarse leaves, the treatment T_4 is feeding with tender + medium leaves, the treatment T_5 is feeding with tender + coarse leaves, the treatment T_6 is feeding with medium + coarse leaves, and the treatment T_7 is feeding with tender + medium + coarse leaves.

The disease-free layings of the Double Hybrid silkworm (FC_2 X FC_1) were kept for hatching in the laboratory. After hatching of the eggs, the chawki worms were brushed as per the treatments. They were separated into rearing trays into three replications as per treatments. The mulberry leaves as per the treatments were chopped and sprinkled over the worms. The bed was made in a uniform size as per space required for the worms. The improved technology of silkworm rearing described by Krishnaswami (1978) was followed in the present investigation. The quantity of food, spacing, and cleaning were done as per the stage of worms and their requirement. The disinfectants used were formalin 2% solution, Bleaching Powder 0.3%, Lime Powder, and Vijetha Powder. The equal quantity of food on the basis of weight as per treatment was given to the larvae for feeding. The chopped mulberry leaves were fed to the larvae three times a day at 8.00 am, 2.00 pm, and 6.00 pm. The size of the chopped leaves was regulated according to the condition and size of the worm. During moulting periods, the worms were not fed with any food and they were not disturbed. After the completion of each moult, a bed disinfectant Vijetha @ 4 kg/100 DFLs was dusted as per recommendation after passing every moult for the prevention of diseases and feed was given after half an hour. After each moulting, bed cleaning was done by removing waste material from the tray with the help of cleaning nets. The quantity of food was increased as per the growth of the silkworm. After the full development of the worms, they were released on mountages for spinning cocoons. Treatment-wise harvesting of cocoons was made on the fifth day of releasing worms on the mountages. Three lots of 10 cocoons from each treatment and replication were randomly selected and used for recording cocoon parameters. The first lot was used for recording cocoon weight. The second lot was used for determining the single filament length and the third lot was used to observe the emergence of moths and fecundity.

Chopped mulberry leaves were fed to the chawki worms, and whole leaf feeding was followed for mature larvae. The worms were fed three times a day at 8.00 am, 2.00 pm, and 6.00 pm.

The maximum larval weight was recorded by taking the weight of 10 matured larvae just before the onset of spinning, which was expressed in grams. The cocoon weight was recorded on the 6th day of spinning when the cocoon weights are assumed to be maximum. The average of 10 cocoons was taken as single cocoon weight and expressed in grams. The cocoons were cut open at one end, and the shell weight was recorded after removing the pupae. The average of 10 shells was taken as single shell weight and expressed in grams. The cocoon shell ratio was calculated using the formula: Cocoon shell weight / Cocoon weight X 100. Randomly selected 100 cocoons were weighed, and the cocoon yield per 10,000 larvae brushed was computed. The disease incidence was calculated as: No. of diseased larvae / Total no. of larvae observed X 100. The effective rate of rearing was calculated as: No. of cocoon harvested / No. of larvae retained X 100. Cocoon filament length was measured in meters by reeling 10 cocoons after boiling in water with the help of a scale. The filament weight was recorded by taking the weight of randomly selected 10 reeled silk filaments, expressed in grams. The denier was calculated using the formula: Filament weight (g) / Filament length (m) X 9000.

RESULTS AND DISCUSSION

The data in Table 1 revealed that the significantly highest larval weight (38.82 g) was recorded in treatment T_1, i.e., feeding with tender leaves. The significantly lowest larval weight (21.47 g) was recorded in treatment T_3, i.e., feeding with coarse leaves only. Several studies have indicated a significant impact of leaf type on the development and weight gain of silkworm larvae. Basu et al., (1992), Vage et al., (2000a), Vage et al., (2000b), Rahmathulla et al., (2003), Sarkar et al., (2008), Kundgar, (2015) supported this finding by reporting that larvae fed on tender leaves had the highest weight at the end of the 5th instar , compared to those fed on medium leaves , coarse leaves or a mixture of leaves .

The treatment T_1, involving larvae fed on tender leaves exhibited the highest single cocoon weight at 1.94 g, while treatment T_3, comprising larvae fed on coarse leaves exclusively, demonstrated the lowest single cocoon weight at 1.29 g (Table 1) . Rahmathulla et al., (2003) and Kundgar (2015) also reported the highest individual cocoon weight when silkworm larvae were exclusively fed tender leaves.

The single shell weight (Table 1) revealed that the treatment T_1 i.e. larvae fed on tender leaves, had the significantly highest shell weight (0.37 g) and the significantly lowest shell weight (0.22 g) was observed in treatment T_3 i.e. feeding with coarse leaves. Krishnaswami (1971), Talebi et al., (2002), Rahmathulla et al., (2003), Sarkar et al., (2008) and Kundgar (2015) reported higher cocoon shell weight in batches fed with tender leaves compared to those fed with medium leaves.

The data (Table 1) revealed that the significantly highest cocoon yield per 10,000 larvae brushed (18.68 kg) was recorded in treatment T_1, i.e., feeding with tender leaves, and the significantly lower cocoon yield (12.80 kg) was recorded in treatment T_3, i.e., larvae fed with coarse leaves. Gabriel and Rapusas (1976), Tayade (1984), Rahmathulla et al., (2003), Krishnaprasad et al., (2003), Kundgar (2015) reported higher cocoon yield with tender leaves compared to medium leaves and coarse leaves.

The treatment T_1, i.e., larvae fed on tender leaves, recorded the significantly longest filament length (922.33 meters) (Table 1) , while treatment T_3, i.e., larvae fed on coarse leaves, exhibited the significantly shortest cocoon filament length (755 meters). Basu et al., (1995), Rajashekharagouda and Lakshmikanth (1998), Vage and Ashoka (2000), Rahmathulla et al., (2003), Kundgar (2015) and Sarkar (2020) also support the above findings.

The silkworms fed on tender leaves (T_1) recorded the significantly highest filament weight (0.28 grams), while the lowest filament weight (0.21 grams) was found in T_3, i.e., silkworms fed on coarse leaves. Treatment T_5, i.e., feeding with medium + coarse leaves, and T6, i.e., feeding with tender + coarse leaves, also exhibited similarly low filament weights (0.22 grams). This finding is consistent with research by Rahmathulla et al., (2003), Kundgar (2015), and Sarkar (2020) all of which emphasize the favourable influence of tender leaves on filament weight.

The significantly higher value of denier (2.76) was recorded in treatment T_1, where silkworms were fed on tender leaves. Conversely, the lowest denier (2.31) was recorded in T6, where silkworms were fed with a combination of tender and coarse leaves. However, this value was at par with all other treatments except T_4, where silkworms were fed with a combination of tender and medium leaves (2.54). Rajashekharagouda and Lakshmikanth (1998), Vage and Ashoka (2000) and Rahmathulla et al., (2003) reported higher denier value recorded in larvae fed on tender leaves. Overall, these findings highlight the importance of incorporating tender leaves into the diet of silkworm larvae may contribute to enhancing silk quality and improving the overall characteristics of silk filaments.

The significantly lower disease incidence (1.30 per cent) was observed in treatment T_1 (Table 1), where larvae were fed tender leaves. Conversely, treatment T_3, where larvae were fed coarse leaves, recorded the significantly highest disease incidence (5.07 per cent). Barman (1992), Shivaprakasham et al., (1996) and Kundgar (2015) reported notably low disease incidences with tender leaf feeding. The findings suggest that the maturity of mulberry leaves significantly influences disease incidence in silkworms.

The highest ERR was observed in Treatment T_1, where larvae were fed with tender leaves (98.40 per cent). This result was consistent with treatments T_2 (feeding with medium leaves), T_4 (feeding with tender + medium leaves), and T_6 (feeding with tender + coarse leaves), which recorded ERRs of 97.33 per cent, 98.07 per cent, and 97.27 per cent, respectively. Conversely, the lowest ERR was recorded in T_3, where larvae were fed on coarse leaves (94.57 per cent), although it was at par with T_5 (feeding with medium + coarse leaves) and T_7 (feeding with tender + medium + coarse leaves), both recording ERRs of 95.97 per cent. Krishnaswami (1971) ,Rahmathulla et al., (2003) , Rahmathulla et al., (2006) , Sarkar et al., (2008) and Sarkar et al., (2012) also observed high ERR when silkworms fed with tender mulberry leaves.

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Table 1: **Effect of feeding different maturity leaves of mulberry on the economic traits of bivoltine silkworm (*Bombyx mori* L.).**

Treatment No.	Treatment details	Larval weight (g)	Cocoon weight (g)	Shell weight (g)	Cocoon shell ratio (%)	Cocoon yield (kg)	Mean filament length (m)	Mean Filament weight(g)	Mean denier	Mean disease incidence (%)	Mean ERR (%)
T_1	Feeding with tender leaves	38.82	1.94	0.37	19.21 (25.98)*	18.68	922.33	0.28	2.76	1.30 (6.54)*	98.40 (82.73)*
T_2	Feeding with medium leaves	27.57	1.63	0.30	18.65 (25.57)	16.04	853.33	0.23	2.46	2.40 (8.90)	97.33 (80.68)
T_3	Feeding with coarse leaves	21.47	1.29	0.22	17.35 (24.59)	12.80	755.00	0.21	2.47	5.07 (13.00)	94.57 (76.59)
T_4	Feeding with tender + medium leaves	31.92	1.81	0.32	17.85 (24.98)	17.81	883.33	0.25	2.54	1.67 (7.41)	98.07 (82.02)
T_5	Feeding with medium + coarse leaves	24.23	1.43	0.26	18.18 (25.22)	14.95	821.67	0.21	2.34	3.57 (10.88)	96.27 (78.85)
T_6	Feeding with tender + coarse leaves	26.53	1.57	0.28	18.26 (25.28)	15.37	844.00	0.22	2.31	2.57 (9.21)	97.27 (80.61)
T_7	Feeding with tender + medium + coarse leaves	26.11	1.63	0.30	18.68 (25.59)	15.92	870.67	0.23	0.30	3.27 (10.41)	95.97 (78.54)
	S.E. ±	0.374	0.020	0.005	0.231	0.210	9.694	0.005	0.051	0.123	0.929
	C.D. at 5%	1.152	0.062	0.014	0.719	0.647	29.869	0.015	0.157	0.378	2.896
	C.V. (%)	2.30	2.15	2.69	1.58	2.28	1.98	3.60	3.58	2.247	2.013

*figures in parentheses are angular transformed values