IMPACT OF LEAF-AGE ON ECONOMIC TRAITS OF MULBERRY SILKWORM (*Bombyxmori*L.)

ABSTRACT

Aims: This study aimed to investigate the impact of feeding mulberry leaves of different maturity stages—tender, medium, and coarse—on the economic traits of bivoltine silkworms (*Bombyx mori* L.), with the goal of enhancing sericulture practices by identifying the most beneficial leaf types for feeding.

Study Design: The experiment utilized seven treatments comprising various combinations of mulberry leaf ages: tender (T1), medium (T2), coarse (T3), and their combinations (T4-T7). Each treatment was replicated three times, following a randomized block design.

Place and Duration of Study: The experiment was conducted during the monsoon season of 2020-21 at the Department of Agricultural Entomology, College of Agriculture, Latur, under Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra.

Methodology: Disease-free layings of FC2 X FC1 bivoltine double hybrid silkworms were reared on different mulberry leaf combinations (variety V-1), and parameters such as larval weight, cocoon weight, single shell weight, cocoon shell ratio, cocoon yield, filament length, filament weight, denier, disease incidence, and effective rate of rearing were measured.

Results: Feeding silkworms tender leaves (T1) resulted in the highest values for larval weight (38.82 g), cocoon weight (1.94 g), single shell weight (0.37 g), cocoon shell ratio (19.21%), cocoon yield (18.68 kg per 10,000 larvae), filament length (922.33 m), filament weight (0.28 g), denier (2.76), effective rate of rearing (98.40%), and lower disease incidence (1.30%). Conversely, feeding coarse leaves (T3) led to the lowest values across these parameters.

Conclusion: The study highlights the significance of mulberry leaf quality, particularly tenderness and moisture content, in optimizing economic traits in sericulture. Tender leaves consistently supported superior economic traits compared to medium and coarse leaves. These findings suggest that managing leaf quality can significantly enhance silk production and quality in *Bombyx mori* L., highlighting the nutritional advantages of tender mulberry leaves. Future research could explore additional factors affecting leaf quality and their specific impacts on silkworm development and silk characteristics.

Keywords: Mulberry leaf maturity, *Bombyx mori*, sericulture, silk production, cocoon yield, filament length, leaf quality.

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INTRODUCTION

The silkworm *Bombyx mori* is essentially monophagous and relies exclusively on mulberry leaves (*Morus* spp.) for nutrition, which is crucial for its growth, development, and silk production. Mulberry is a highly heterozygous and vegetatively propagated species with a prolonged juvenile period. The quality and maturity of mulberry leaves are vital for the healthy growth of silkworms and maximizing cocoon production (Sarkar, 2020).

Bombyx mori exhibits a preference for mulberry leaves at various maturity levels—tender, medium, and mature—depending on its larval stage (Sarkar, 2020). Chemical analysis show significant differences in crude protein, total sugar, starch, reducing sugar, total carbohydrates, fiber, ash, and moisture content among these leaves (Rahmathulla et al., 2003). Studies indicate that silkworm larvae prefer leaves with high moisture content and lower dry matter (Benchamin and Jolly, 1986). Top tender leaves are nutritionally richer compared to medium, mature, and over-mature leaves and have less density of pubescence with a blunt tip (Rangaswami et al., 1976; Sinha et al., 1993; Bongale et al., 1997; Trivedi et al., 2008).

Feeding highly moisture content tender leaves may help farmers to harvest quality cocoon crops (Narayanan et al., 1967; Krishnaswami, 1970; Vage and Ashoka, 2000; Rahmathulla et al., 2003). The quantity and quality of these leaves play a pivotal role in silk productivity, with a direct correlation to environmental factors (Nagaraju, 2002). Matsumura et al. (1958) highlighted that mulberry leaf quality is the most critical factor for successful cocoon crops, accounting for 38.2% of the success, followed by climate, rearing techniques, silkworm race, silkworm eggs, and other factors. Nearly 70% of the silk protein produced by silkworms comes directly from the protein in mulberry leaves (Fukuda et al., 1959). Thus, selecting the right mulberry leaves, containing essential chemical constituents and favorable physical features, is crucial for sericulture (Rajan &Himantharaj, 2005).

Considering these factors, the present study was undertaken to understand the impact of leaf age on the economic traits of bivoltine silkworm (*Bombyx mori* L.).

MATERIALS AND METHODS

The experiment was conducted during monsoon 2020-21 at the Department of Agricultural Entomology, College of Agriculture, Latur under VasantraoNaikMarathwadaKrishiVidyapeeth, Parbhani, Maharashtra to study the effect of mulberry (Variety V-1) leaves of different ages on the biology and economic traits of bivoltine silkworm (*B. mori*L.).It was conducted in randomized block design with seven treatments and three replications using disease free layings of FC_2 X FC_1bivoltine double hybrid silkworm.Mulberry variety V-1 is identified as a one of the best mulberry varieties in this area.One hundred silkworm larvae were reared in each replication under environmental conditions of 28°C, 85 per cent Relative humidity the rearing room.For defining different age groups of leaves mulberry branches were 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 treatments included wereT_1 with the larval feed of tender leaves, T_2 with the larval feed of medium leaves, T_3 with the larval feed of coarse leaves, T_4 with the larval feed of tender + medium leaves, T_5 with the larval feed of tender + coarse leaves, T_6 with the larval feed of medium + coarse leaves, and T_7 is with the larval feed of tender + medium + coarse leaves.

The equipments which were used during rearing programme are listed below.

Rearing trays: The plastic trays having size 36" x 24" x 3"mainly used for keeping the silkworm larvae during rearing programme.

Rearing stand: The rearing stand made of the iron frames on which the rearing trays were placed.

Chopping board: The chopping board was made-up of soft wood of size 36.6" x 36.6" with thickness 3.0" and used for chopping the mulberry leaves during Chawki rearing of silkworms.

Chopping knife: The chopping knife was an iron blade knife of 6" size with wooden handle used for chopping the mulberry leaves.

Bamboo sticks: The bamboo sticks were sticks about 8"long, thin in diameter and tapering at one end; they were used for giving space to the worms in rearing bed and picking the young stage larvae.

Feather: Clean white bird feather was used for brushingnewly hatched worms and cleaning the beds in younger stages.

Cleaning nets: The cotton thread and nylon nets were used to clean the beds in different stages of worms.

Collapsable plastic mountages: The collapsible plastic mountages of size 2 x 0.95 sq m. were used to keep the ripe new worms for spinning the cocoons.
Paraffin papers: The paraffin papers were used to cover the bed from upper and lower side in order to maintain the required humidity in the rearing beds.
Foam pads: The foam pads were used for maintaining optimum humidity in the rearing beds.
Rearing method
The disease-free layings of the Double Hybrid silkworm (FC_2 X FC_1) were kept for hatching in the laboratory. Upon hatching, the chawki (the neonate) worms were brushed onto the rearing trays as per the treatments, each with three replications. The mulberry leaves as per the treatments were chopped and sprinkled over the worms. The size of the bed varies with the stage of the stage of the larva.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. The disinfectants used were formalin 2% solution, Bleaching Powder 0.3%, Lime Powder, and Vijetha Powder @ 4 kg/100 DFLs(1kg powder contains 100 gm vijetha forte powder and 900gms of lime powder).Based on the stage of the larvae, a predetermined uniform quantum of feed was provided to the larvae across the treatments.The chopped and whole mulberry leaves were fed to the chawkiwormsand mature larvae respectively, 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 larval instar. 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 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, which is uniform among all the treatments and replications. 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.
The maximum larval weight in gramswas recorded by taking the weight of 10 matured larvae just before the onset of spinning, the cocoon weight was recorded on the 6^{th} 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.Yield of cocoon/ 10,000 larvae brushed (kg) was calculated as:Randomly selected 100 cocoons were weighed and the cocoon yield per 10,000 larvae brushed was computed.The disease incidence was calculated as: Number of diseased larvae /Total number of larvae released X 100.The effective rate of rearing was calculated as: No. of cocoon harvested / No. of larvae releasedX 100.Ten cocoons were boiled in waterand reeled for measurement of cocoon filament length, using a scale.The filament weight was recorded by taking the weight of randomly selected 10 reeled silk filaments, expressed in grams.The denier (density of fibres)was calculated using the formula:Filament weight (g) / Filament length (m) X 9000(Kale et al.2017).

RESULTS AND DISCUSSION

Larval weight(g): Table 1 data reveals that feeding with tender leaves (T_1) resulted in the highest larval weight of 38.82 g, while coarse leaves (T_3) led to the lowest larval weight of 21.47 g (fig.1). Rahmathulla et al. (2006) documented that larvae fed tender leaves attained the highest larval weight of 13.42 g per ten larvae by the end of the 4^{th} instar, compared to 11.07 g for medium leaves, 10.24 g for coarse leaves, and 11.56 g for mixed feeding. By the end of the 5^{th} instar, larvae fed tender leaves reached the highest larval weight of 65.65 g, whereas those fed medium leaves weighed 54.86 g, coarse leaves 47.93 g, and mixed feeding resulted in 56.97 g. Sarkar et al. (2012) reported significantly higher larval weights for larvae fed tender leaves (50.02 g) compared to medium leaves (49.08 g), with over-mature leaves showing the lowest weight (45.16 g) for the N x NB_4D_2 race. Kale et al. (2017) observed that treatment T_1, exclusively fed tender leaves, resulted in the highest larval weight recorded (38.28 g), while treatment T_3, fed with coarse leaves only, showed the lowest weight (18.66 g). Furthermore, Sarkar et al. (2020) noted that larvae fed tender shoots exhibited the highest larval weight (53.29 g), whereas those fed mixed shoots during late larval instar exhibited the lowest weight (48.78 g). Overall, the consistent findings across these studies underscore the significant influence of leaf maturity on the larval weight and development of *Bombyx mori* L. larvae. Tender leaves consistently support higher larval weights compared to middle and mature leaves, indicating their nutritional superiority for larval growth and development. These results highlight the importance of leaf quality in optimizing the economic traits of *Bombyx mori* L.

Cocoon weight (g): Table 1 shows that larvae fed on tender leaves (T_1) achieved the highest single cocoon weight of 1.94 g, whereas larvae fed on coarse leaves (T_3) exhibited the lowest single cocoon weight of 1.29 g (fig.2). These findings are consistent with multiple previous studies. Krishnaprasad et al. (2003) recorded a higher cocoon weight of 13.31 g per 10 cocoons in silkworms fed tender leaves. Rahmathulla et al. (2003) reported cocoon weights of 2.50 g for tender leaves, 2.11 g for medium leaves, and 1.84 g for coarse leaves. Sarkar et al. (2012) found that larvae fed tender leaves including the apical bud had the highest cocoon weight (1.79 g), significantly higher than mature (1.54 g) and over-mature leaves (1.48 g) for the N x NB_4D_2 race. AdeduntanSA (2013) observed the highest cocoon weight of 1.33 g in larvae fed tender leaves, followed by middle leaves (1.22 g), and base leaves (1.16 g). Kale et al. (2017) also observed significantly higher single cocoon weight (1.90 g) in larvae fed tender leaves exclusively, compared to the lowest weight of 1.23 g in larvae fed coarse leaves. Krishnaswami (1971) similarly reported that succulent mulberry leaves, especially from tender twigs, resulted in superior cocoon weight. Li and Sang (1984) investigated that cocoon weight of mulberry silkworms increased when larvae were fed tender leaves during their larval stage. Sarkar et al. (2020) also noted the highest single cocoon weight (1.806 g) in larvae fed tender shoots during the late larval instar of the N x NB_4D_2 race. Quraiza et al. (2021) reported a maximum cocoon weight of 1120 ± 55.41 mg when *Bombyx mori* larvae were fed tender leaves.

These collective findings underscore the significant influence of leaf quality, particularly the tenderness of leaves, on enhancing cocoon weight in *Bombyx mori* L. larvae. Tender leaves consistently support higher cocoon weights compared to medium and coarse leaves, highlighting their nutritional superiority and the importance of leaf quality management in optimizing economic traits in sericulture.

Shell weight (g): Table 1 illustrates the influence of feeding different maturity leaves on the single shell weight of bivoltine silkworms. Larvae fed tender leaves (T_1) exhibited the highest single shell weight at 0.37 g, whereas those fed coarse leaves (T_3) showed the lowest at 0.22 g(fig.3). These findings are supported by previous studies. Krishnaprasad et al. (2003) noted higher shell weights of 1.82 g per 10 cocoons in silkworms fed tender leaves, and Rahmathulla et al. (2006) found a significant positive correlation between leaf moisture content and single shell weight, with larvae fed tender leaves achieving a peak shell weight of 0.36 g. However, Paramasiva et al. (2006) reported the highest shell weight of 0.39 g with medium mature leaves, contrasting with Sarkar et al. (2012), who recorded 0.32 g for larvae fed tender leaves. Kale et al. (2017) observed significantly higher single shell weights of 0.36 g in larvae exclusively fed tender leaves. Similarly, Sarkar et al. (2020) reported higher shell weights in larvae fed tender shoots throughout the 4th and 5th instars compared to those fed mature shoots without tender leaves. Quraiza et al. (2021) highlighted a maximum shell weight of 200 ± 18.66 mg when *Bombyx mori* larvae were fed tender leaves. These findings collectively underscore the significant impact of leaf maturity on single shell weight in *Bombyx mori* L. larvae, emphasizing the importance of optimizing leaf quality for enhanced economic traits in sericulture.

Cocoon shell ratio (%): Table 1 presents data on the cocoon shell ratio, ranging from 17.35% to 19.21%. The highest cocoon shell ratio of 19.21% was observed in treatment T1, where larvae were fed tender leaves, while the lowest ratio of 17.35% occurred in treatment T3 with larvae fed coarse leaves (fig.4). These results align consistently with previous research findings. Rahmathulla et al. (2003) demonstrated that tender leaves yielded a higher cocoon shell ratio of 26.82% compared to medium leaves (25.21%) and coarse leaves (23.39%). Elumalai et al. (2001) also noted increases in the cocoon shell ratio with medium and coarse leaves, albeit not to the extent seen with tender leaves. Talebi et al. (2002) emphasized the relationship between leaf moisture content and cocoon shell ratio, suggesting higher moisture levels enhance shell formation. Sarkar et al. (2012) found a higher cocoon shell ratio of 18.25% in larvae fed tender leaves compared to other leaf types, and Kale et al. (2017) reported significantly higher ratios (18.94%) in larvae fed exclusively tender leaves. Similarly, Sarkar et al. (2020) observed a peak cocoon shell ratio of 18.34% in larvae fed tender shoots during late instar stages. Quraiza et al. (2021) reported a maximum cocoon shell ratio of 17.85 ± 1.01% when *Bombyx mori* larvae were fed tender leaves. These findings collectively underscore the significant impact of leaf quality, particularly tenderness, on enhancing the cocoon shell ratio in

Bombyx mori L. larvae, highlighting the importance of optimizing leaf quality for maximizing economic traits in sericulture.

Cocoon yield (kg): Table 1 presents data on cocoon yield per 10,000 larvae, showing that treatment T1, with larvae fed tender leaves, achieved the highest yield of 18.68 kg, whereas treatment T3, fed coarse leaves, had the lowest yield of 12.80 kg(fig.5). These findings are consistent with previous research. Rahmathulla et al. (2003) reported a cocoon yield of 24.95 kg per 10,000 larvae for those fed tender leaves, which was higher compared to medium leaves (19.81 kg) and coarse leaves (17.05 kg). Kale et al. (2017) reported significantly the highest cocoon yield (18.52kg) was obtained in treatment T_1*i.e.* feeding the tender leaves only. The significantly lowest cocoon yield (12.39 kg) was obtained by treatment T_3 *i.e.* larvae fed on coarse leaves only. Sarkar et al. (2012) observed a cocoon yield of 55.72 kg when silkworms were fed tender leaves, while larvae fed over-mature leaves yielded 39.91 kg for the N x NB4D2 race. Similarly, Sarkar et al. (2020) reported the highest cocoon yield of 57.09 kg with tender leaves for the same race. These findings underscore the significant impact of leaf quality, particularly tender leaves, on maximizing cocoon yield in *Bombyx mori* L. larvae. Optimizing feeding practices with tender leaves can enhance economic outcomes in sericulture by maximizing cocoon production.

Mean filament length (m): Table 1 reveals that larvae fed tender leaves (T_1) produced the longest filaments, measuring 922.33 meters, whereas those fed coarse leaves (T_3) yielded the shortest filaments at 755 meters (fig.6). These results are consistent with prior studies indicating that tender leaves promote longer filament lengths. Rahmathulla et al. (2003) found that larvae fed tender leaves attained an average filament length of 1467 meters, surpassing medium leaves (1256 meters) and coarse leaves (946 meters), with moisture content in tender leaves correlating positively with filament length. Similarly, Sarkar et al. (2012) reported the longest average filament length of 748.83 meters in larvae fed tender leaves compared to medium leaves (688.52 meters) and mature leaves (550.76 meters). Kale et al. (2017) also observed longer filaments (898 meters) in larvae fed tender leaves. Sarkar et al. (2020) confirmed these findings, noting that tender shoot feeding throughout the fourth and fifth instar stages resulted in an average filament length of 774.27 meters. These findings collectively emphasize the critical role of leaf quality, specifically tenderness and moisture content, in maximizing filament length and thus enhancing silk quality and economic outcomes in *Bombyx mori* L. larvae for sericulture.

Mean filament weight(g): The data presented in Table 1 reveal that silkworms fed on tender leaves (T_1) had the highest filament weight, measuring 0.28 g. In contrast, silkworms fed on coarse leaves (T_3) exhibited the lowest filament weight at 0.21 g. Filament weights for treatments T_5 (medium + coarse leaves) and T_6 (tender + coarse leaves) were also similarly low, at 0.22 g(fig.7).These findings align with previous research. Rahmathulla et al. (2003) reported the highest filament weight of 0.472 g when larvae were fed tender leaves, compared to 0.385 g for medium leaves and 0.340 g for coarse leaves. Similarly, Kale et al. (2017) observed that tender leaf feeding resulted in the highest filament weight of 0.254 g, while medium and coarse leaves resulted in lower filament weights of 0.217 g and 0.198 g, respectively.The current study's results are consistent with these earlier observations, confirming that tender leaves lead to the highest filament weights in silkworms, while coarse leaves and mixed leaf diets result in lower filament weights.

Denier: The data in Table 1 show that the highest denier value (2.76) was observed in treatment T_1, where silkworms were fed on tender leaves. Rahmathulla et al. (2003) reported the highest denier value of 2.91 for silkworms fed on tender leaves, compared to 2.76 for medium leaves and 2.82 for coarse leaves. Sarkar et al. (2012) reported the highest denier value of 2.11 for silkworms fed tender leaves, compared to 2.08 for medium leaves and 2.02 for mature leaves. Similarly, Kale et al. (2017) observed a significantly higher denier value of 2.55 in larvae fed tender leaves.Sarkar et al. (2020) also noted a higher denier value of 2.16 in silkworms fed tender shoots during the late larval instar. The current study's findings are consistent with these earlier observations, indicating that feeding silkworms tender leaves results in the highest denier values, while a combination of tender and coarse leaves or coarse leaves alone results in lower denier values.

Disease incidence(%): Table 1 presents data on disease incidence of flacherie among *Bombyx mori* L. larvae, highlighting that treatment T_1, with larvae fed tender leaves, exhibited the significantly lowest incidence at 1.30%. Conversely, treatment T_3, fed with coarse leaves, showed the highest incidence at 5.07%, indicating a greater susceptibility to disease incidence (fig.9). These findings are consistent with previous research demonstrating the impact of leaf maturity on disease susceptibility. Hu Shi Ye et al. (2009) observed higher occurrence, disease, and mortality rates in silkworms fed old mulberry leaves compared to those fed leaves of appropriate maturity, with occurrence rates 1.85 times higher, disease rates 2.08 times higher, and mortality rates 1.81 times higher. Kale et al. (2017) similarly reported lower disease incidences in larvae fed tender leaves compared to medium and coarse leaves. However, Sarkar et al. (2012) suggested no significant relationship between feeding tender leaves and the occurrence of grasserie disease in silkworms during dry summers, contradicting earlier observations by Sivaprakasam (1996), Basarajappa and Savanurmath (1997), and Elumalai et al. (2001). These findings underscore the importance of leaf quality in disease management strategies for optimizing silk production in sericulture, highlighting tender leaves as beneficial for reducing disease incidence and promoting healthier larval development.

Effective rate of rearing (%): Table 1 presents data on the Effective Rate of Rearing (ERR) in *Bombyx mori* L. larvae, showing that treatment T_1, where larvae were fed tender leaves, achieved the highest ERR at 98.40%. This was closely followed by treatments T_2 (97.33%), T_4 (98.07%), and T_6 (97.27%) (fig.10). In contrast, treatment T_3, fed with coarse leaves, exhibited the lowest ERR at 94.57%, although statistically similar ERRs were observed in treatments T5 and T7 at 95.97%. These results are consistent with previous research indicating the influence of leaf quality on ERR. Rahmathulla et al. (2003) reported a significantly higher ERR of 98.49% in silkworms fed tender leaves compared to those fed medium (91.14%) and coarse leaves (92.19%). Similarly, Sarkar et al. (2012) found that ERR was highest in batches fed tender leaves (8276.33) for the N x NB_4D_2 race, contrasting with significantly lower ERRs in batches fed mature (7774.86) and over-mature leaves (7617.16). Sarkar et al. (2020) further supported these findings, reporting the highest ERR of 8347 in silkworms fed tender shoots throughout the 4^{th} and 5^{th} instar stages, while the lowest ERR of 7789 was recorded in those fed mature shoots without tender leaves throughout the same stages. These findings underscore the critical role of leaf tenderness and quality in maximizing ERR and optimizing sericulture outcomes, emphasizing the importance of selecting suitable leaves to enhance productivity and economic viability in silk production.

CONCLUSION

Based on the study's findings regarding the influence of mulberry leaf maturity on bivoltine double hybrid silkworms FC2 X FC1, it is evident that feeding tender mulberry leaves, specifically variety V-1, accelerates silkworm growth, reducing both larval and pupal durations while significantly improving economic traits such as larval weights, cocoon weights, shell weights, cocoon shell ratios, cocoon yields, filament lengths, filament weights, denier values, and effective rates of rearing compared to coarse leaf-fed larvae. These findings underscore the nutritional superiority of tender leaves, attributed to their higher moisture content and nutrient profile, which optimize silk production outcomes. The study recommends prioritizing the cultivation and management of tender and succulent mulberry leaves through frequent irrigation to sustainably enhance sericulture productivity and profitability. Efforts towards leaf quality management are crucial for advancing sustainable practices in the silk industry, ensuring efficient resource utilization and economic viability. Further research could explore additional factors influencing silk production and evaluate the scalability of these findings across diverse sericulture environments.

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

Treatment No.	Treatment details (Leaf age)	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	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	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	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 withmedium + 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

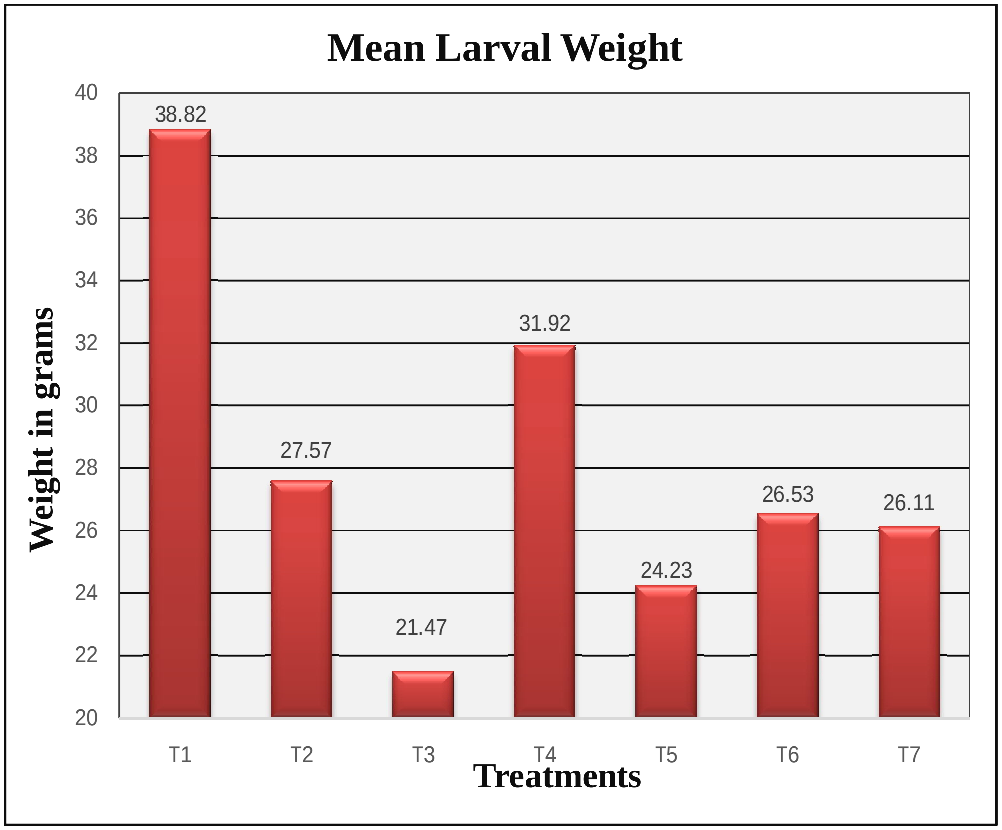

Fig.1: Impact of leaf-age on larvalweight of bivoltine silkworm(*Bombyx mori* L.).

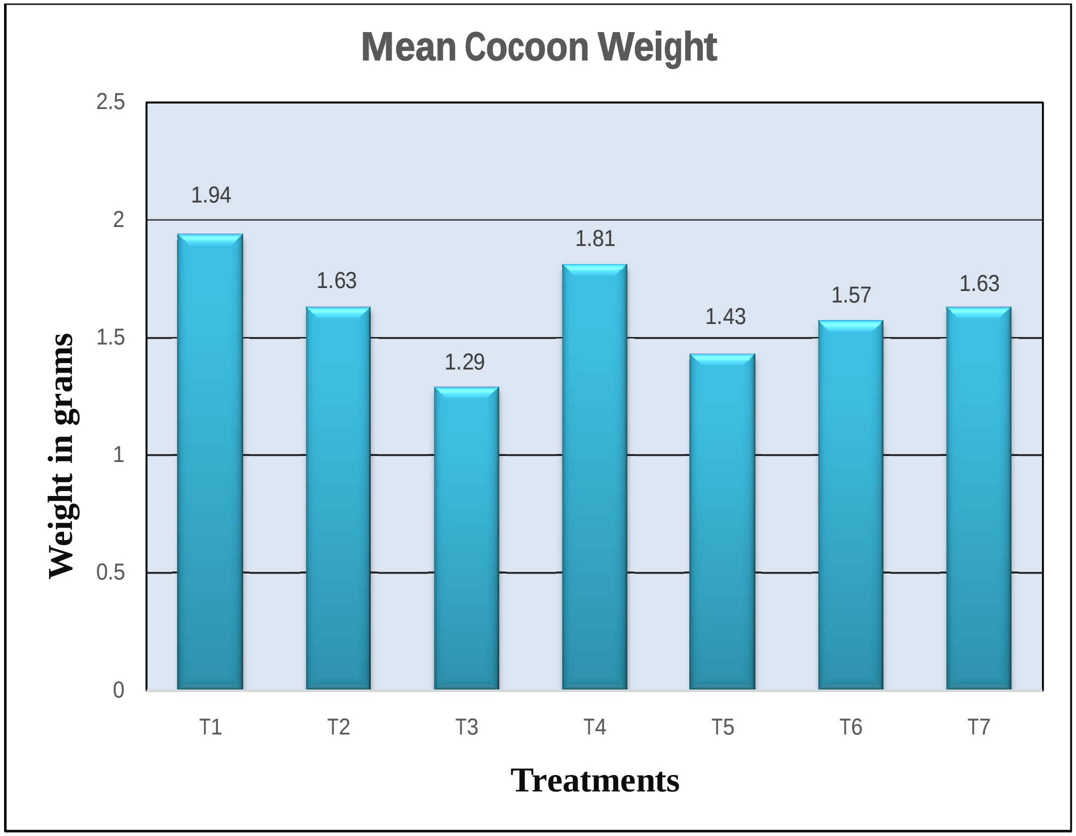

Fig.2: Impact of leaf-ageon single cocoonweight of bivoltine silkworm (*Bombyx mori* L.).

Fig.3: Impact of leaf-ageon shell weight ofbivoltine silkworm (*Bombyx mori* L.).

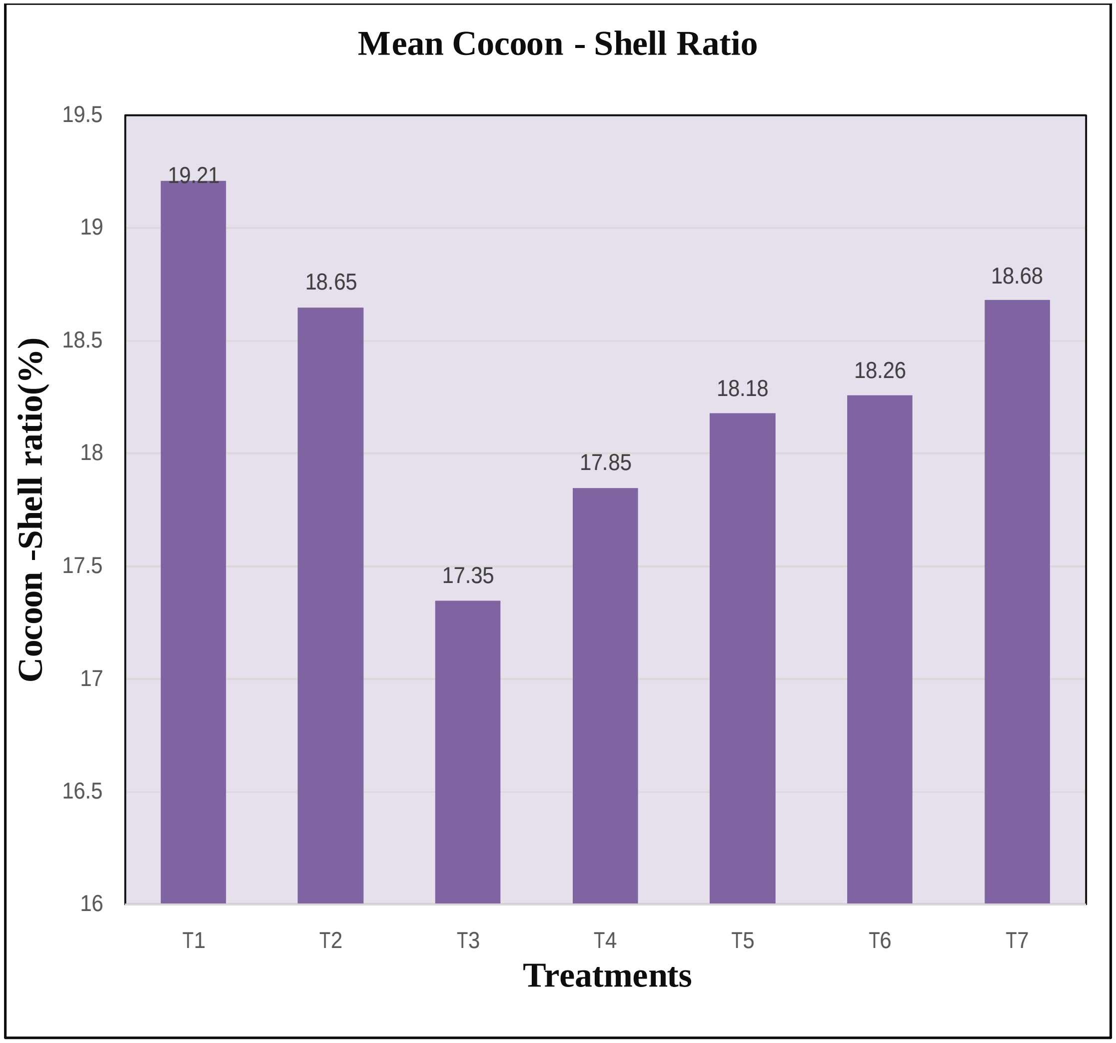

Fig.4: Impact of leaf-ageon cocoon shell ratio of bivoltine silkworm (*Bombyx mori* L.).

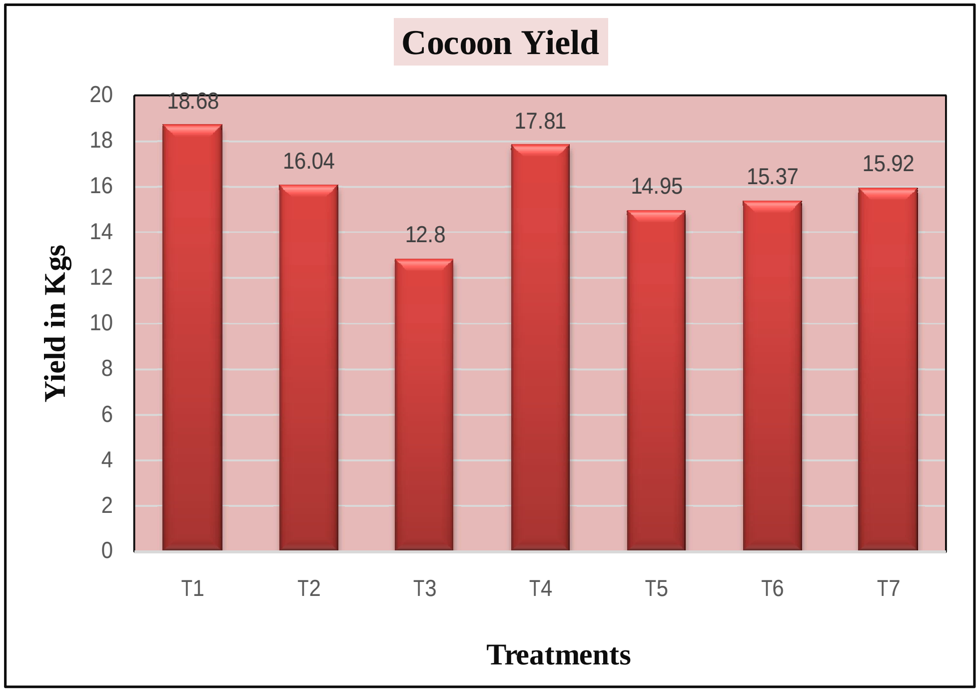

Fig.5: Impact of leaf-ageon cocoon yield per 10,000 larvae of bivoltine silkworm (*Bombyx mori* L.).

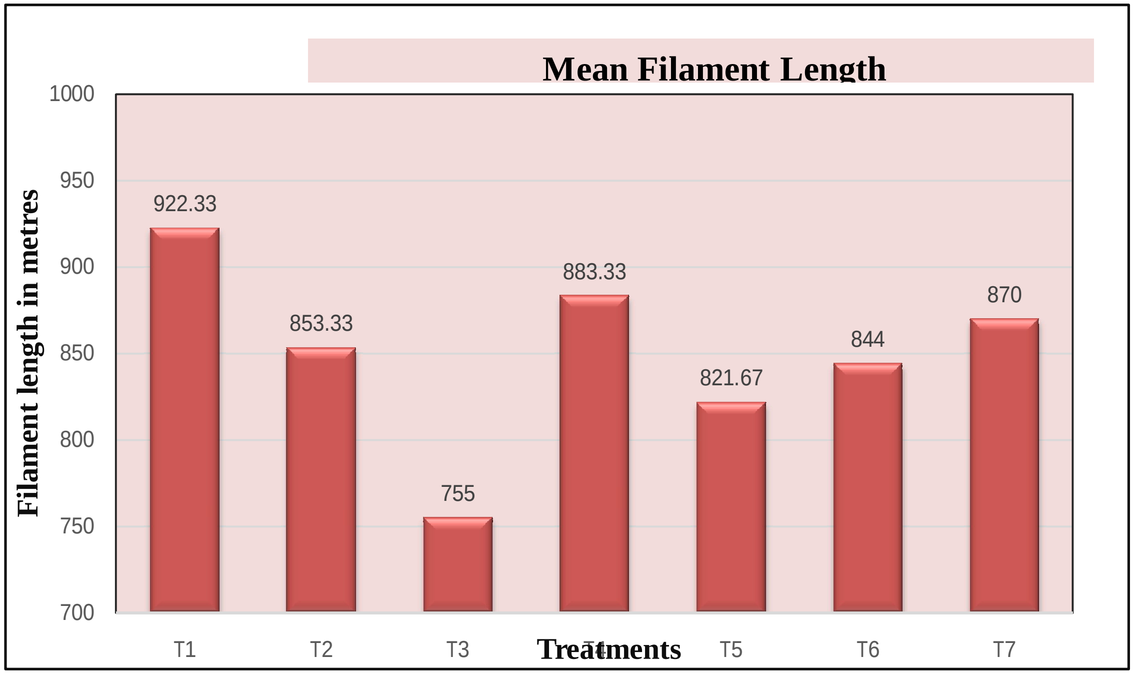

Fig. 6: Impact of leaf-ageon filament length of bivoltine silkworm (*Bombyx mori* L.).

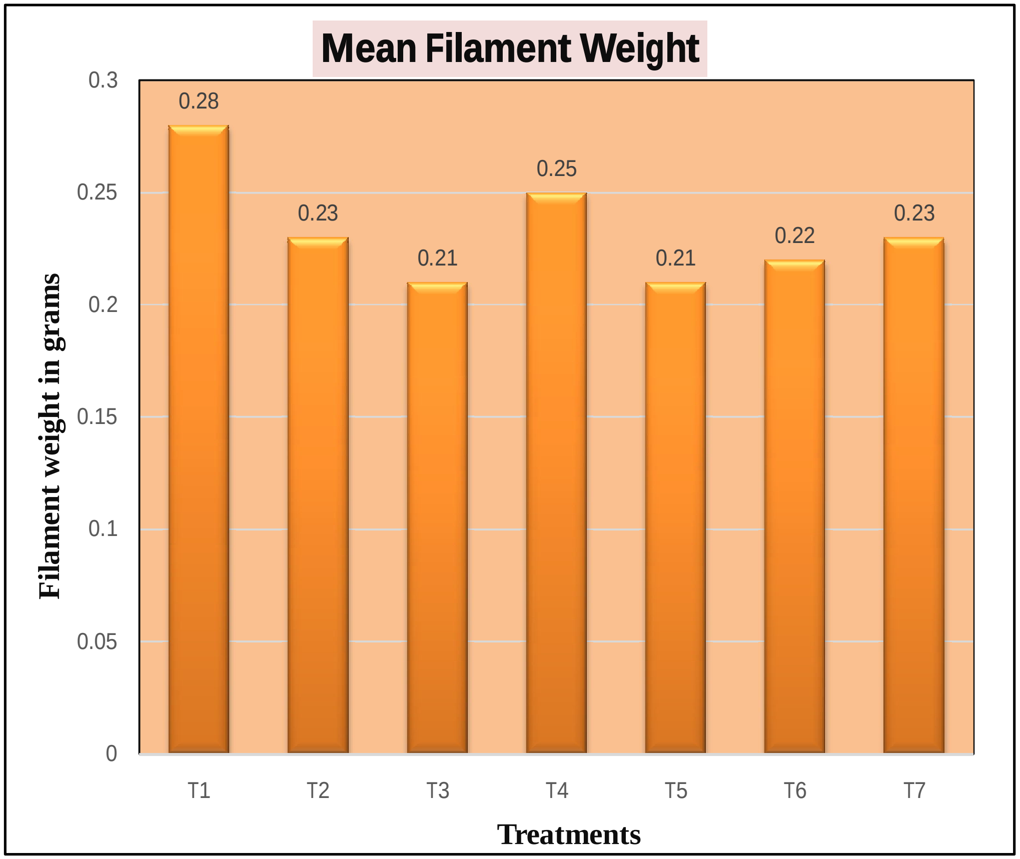

Fig.7: Impact of leaf-age on filament weight of bivoltine silkworm (*Bombyx mori* L.)

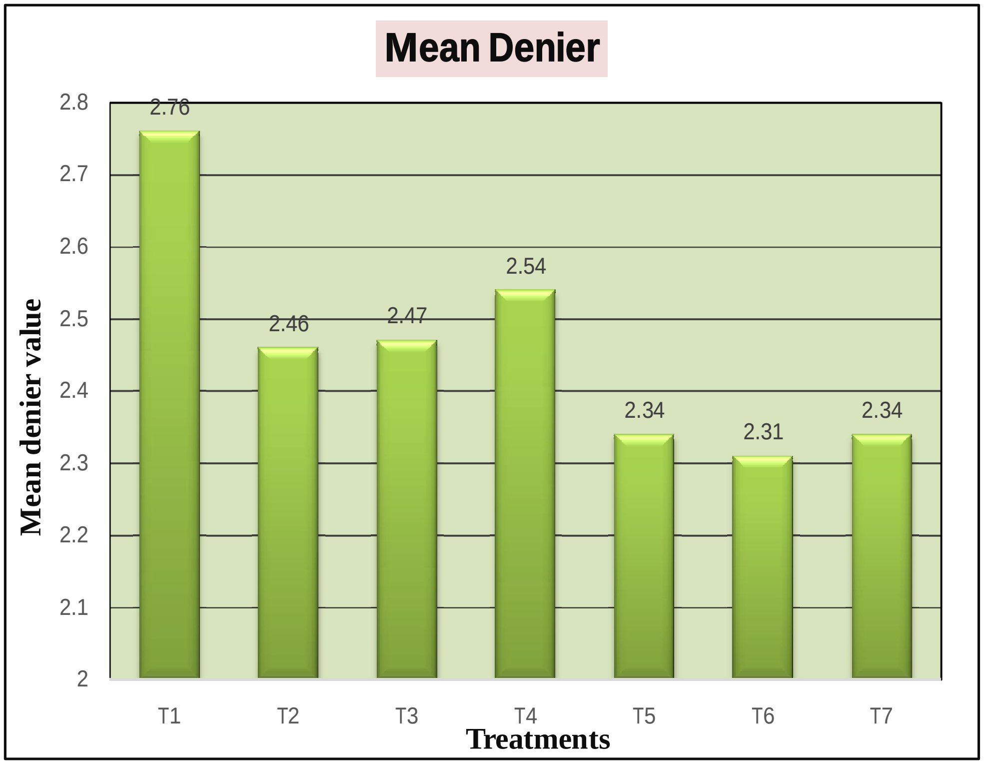

Fig.8: Impact of leaf-ageon denier of bivoltine silkworm (*Bombyx mori* L.).

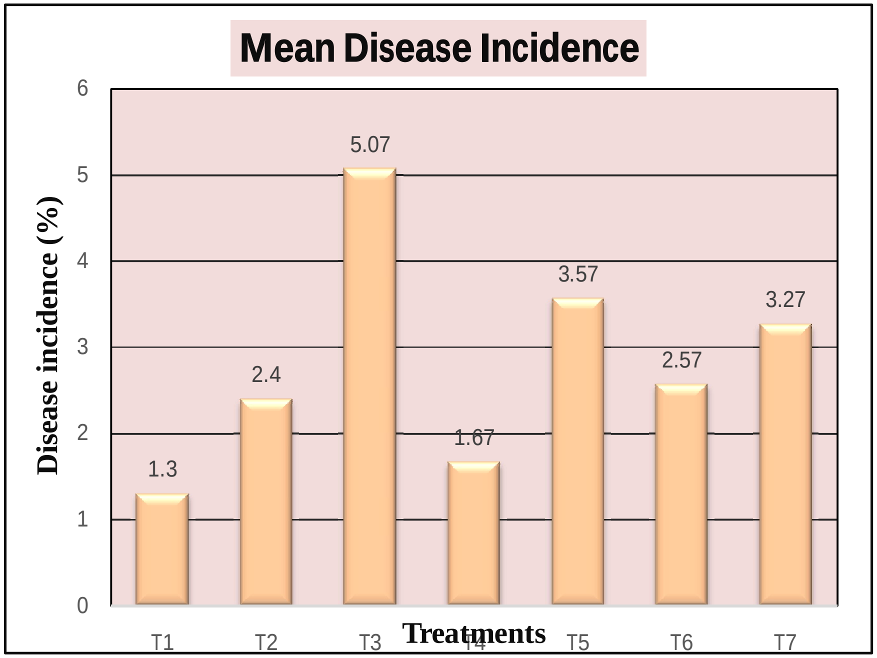

Fig. 9: Impact of leaf-ageon disease incidence of bivoltine silkworm (*Bombyx mori* L.).

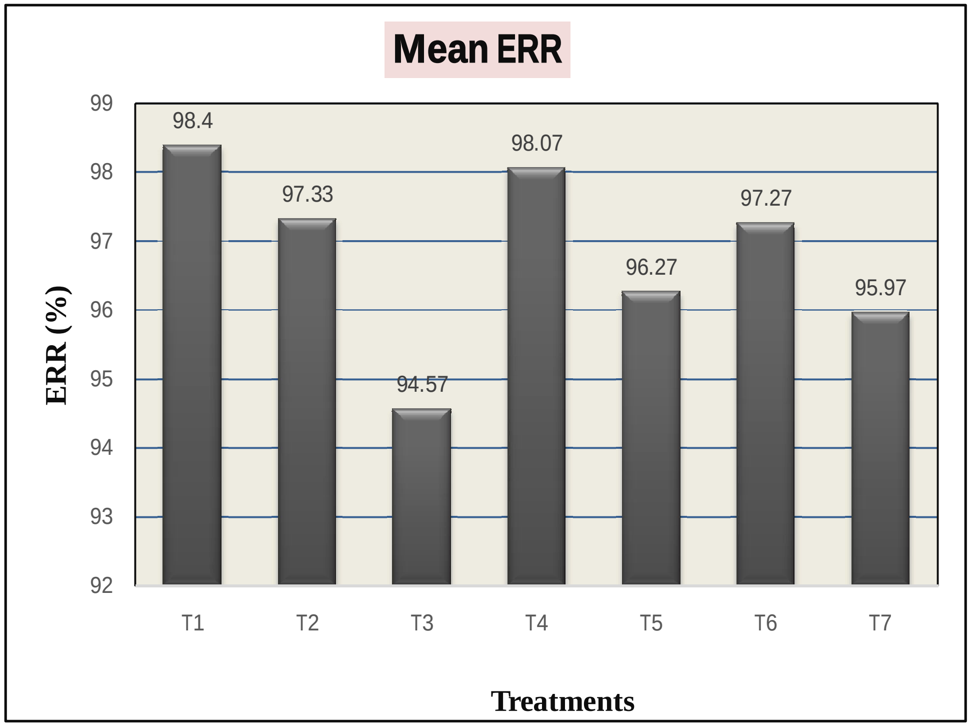

Fig. 10: Impact of leaf-ageon ERR of bivoltine silkworm (*Bombyx mori* L.)