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THE EFFECT OF MULBERRY LEAF MATURITY ON SILKWORM REARING OUTCOMES IN AZERBAIJAN'S ECOLOGICAL CONDITIONS

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Abstract. Sericulture in Azerbaijan boasts an ancient 1,500-year history and rich traditions. This industry has deep-rooted significance for the country and has long been a part of its heritage. Azerbaijan's natural silk is renowned for its consistently high quality. It is well known that the domestic silk moth is a monophage, feeding exclusively on mulberry leaves. Therefore, the development of sericulture begins with establishing a strong forage base. In Azerbaijan, this base primarily consists of specialized plantations and linear mulberry plantings. The quality of mulberry leaves is crucial for feeding silkworm caterpillars, as it directly impacts their growth and silk production. Mulberry varieties vary significantly in chemical composition and leaf quality, which in turn affects the feeding outcomes of the silkworm. These qualities are influenced by various factors, including soil composition, plant age, varietal characteristics, agricultural practices, exploitation methods, planting types and leaf maturity. Considering these factors, we conducted a pioneering experiment on local species (Mayak-1) to determine how leaf maturity influences caterpillar feeding.

Keywords: *Sericulture, silkworm, leaf, silk, feeding.*

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1. Introduction

According to Kafian (1970) the nutritional value of mulberry leaves is closely linked to their palatability and overall nutrient content. Silk, a natural and environmentally friendly fabric, is derived from the delicate threads of silkworm cocoons. The fiber's thickness ranges from 20 to 30 micrometers and a single cocoon can produce a silk thread measuring between 400 and 1500 meters or more. Composed of 97% protein and 3% fats and amino acids, silk is lightweight, hypoallergenic and beneficial for the skin. Its protein structure effectively retains moisture, while the fabric's adaptability to body temperature ensures cooling or warming effects based on external conditions. Since the 12th century, Azerbaijani silk has been exported to European and Asian markets via the Great Silk Road, earning widespread recognition and acclaim (Saidov & Abbasov, 2012).

The development of sericulture begins with establishing a reliable forage base. In Azerbaijan, this base primarily consists of specialized plantations and linear mulberry plantings. The quality of forage plays a critical role in feeding silkworm caterpillars, as it directly impacts their growth and productivity. Mulberry varieties vary significantly in chemical composition and leaf quality, influencing the overall success of silkworm

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cultivation. The chemical composition and physical properties of mulberry leaves undergo considerable changes depending on various factors, with leaf maturity being a key determinant. As mulberry leaves mature, their moisture content and protein levels decrease, while the concentrations of fats, ash, fiber and nitrogen-free extractive substances increase (Sadykhov, 1992; Emmanuilov, 1960; Klimova, 1990; Lazarev, 1991).

Experiments conducted by various scientists (Demyanovsky, S.Ya., Rozhdestvenskaya, V.A., Gigauri, E.A., Yakushkina, E., Poyarkov, E.F., Lazarev, A.V., Milyaev, A.P., Shcherbakov, I.A., Rzaev, I.M., Iskandarov, Sh.M. et al.) have demonstrated that feeding silkworm caterpillars with younger mulberry leaves positively influences their development. Conversely, delaying the start of feeding can reduce cocoon yield by up to 20%.

2. Materials and methods

The experiments were conducted from 2020 to 2024 at the Azerbaijan Scientific Research Institute of Animal Husbandry (ASRIAH). For the first time, we investigated the effect of mulberry leaf maturity on silkworm feeding outcomes under the ecological conditions of Azerbaijan's western region. The object of the study was local breeds of silkworms (Mayak-1) (Abbasov *et al*., 2004), which were fed leaves from local mulberry varieties. The experiments adhered to the general agronomic practices established in sericulture (Saidov *et al*., 2012). Silkworm feeding took place in specialized facilities at the institute, designed specifically for breeding purposes. A plantation of diverse mulberry varieties was established on the institute's grounds, serving as the primary source of leaves for feeding the silkworm (Sadykhov, 2014). In this study, we examined silkworm breeds to local conditions and explored ways to enhance their productivity. Advanced feeding technologies utilizing leaves from local mulberry varieties were applied to optimize results.

3. Results and discussion

To assess the impact of mulberry leaf maturity on the feeding of introduced silkworm breeds (Mayak-1), we conducted an experiment to determine the optimal stage at which silkworm feeding should commence.

The experiments were carried out during the spring feeding period, following the scheme below:

1) Individual Feeding. 200 caterpillars of the Mayak-1 silkworm breed were individually fed with leaves from the Zerif-tut mulberry tree at the stages when 1, 3, 5, 7 and 9 leaves had emerged.

2) Individual Feeding. 200 caterpillars of the Mayak-1 silkworm breed were individually fed with leaves from the Azeri-tut mulberry tree at the stages when 1, 3, 5, 7 and 9 leaves had emerged.

3) Mass Feeding. Caterpillars were mass-fed with leaves from both mulberry tree varieties at the stages when 5 and 9 leaves had emerged.

In the first experiment, caterpillars were fed upon the emergence of the corresponding leaf stages outlined in the scheme. The required number of leaves was collected before each feeding, with separate preparations for each repetition of the experiment. The experiment was conducted twice, with 200 caterpillars involved in each

repetition. A dedicated mulberry tree was assigned to each repetition to ensure consistency.

This experimental design adheres to the principle of feeding caterpillars exclusively with leaves from a single tree, maximizing accuracy and reflecting the specific qualitative properties of the leaves. To determine the influence of leaf maturity, it was essential to identify differences in feeding outcomes based on the timing of feeding initiation. This variation highlights the impact of both younger and older leaves on silkworm development. Feedings that began with the emergence of the first pair of leaflets provided younger leaves, whereas those initiated at the appearance of the five or seven leaf involved more mature foliage.

The results detailing the feeding duration based on mulberry variety are presented in Table 1.

Table 1. The duration of the caterpillar stage depending on the start of feeding

Start of the feeding, depending on the stage of leaf growth	Duration of feeding of Mayak-1 caterpillars in days when feeding on with tree leaves	
	Zerif-tut	Azeri-tut
1	27,4	27,5
3	27,2	27,3
5	26,3	27,5
7	28,1	29,2
9	30,4	31,1

The data reveal a clear trend indicating that the duration of feeding increases once caterpillars begin feeding at the appearance of the 7th leaf, consistently for both tree varieties and from the 5th leaf for feedings conducted on Azeri-tut.

Experiments demonstrate that the overall feeding duration extends even under temperature conditions that promote accelerated caterpillar development.

Leaf maturity and the timing of feeding also influence caterpillar viability.

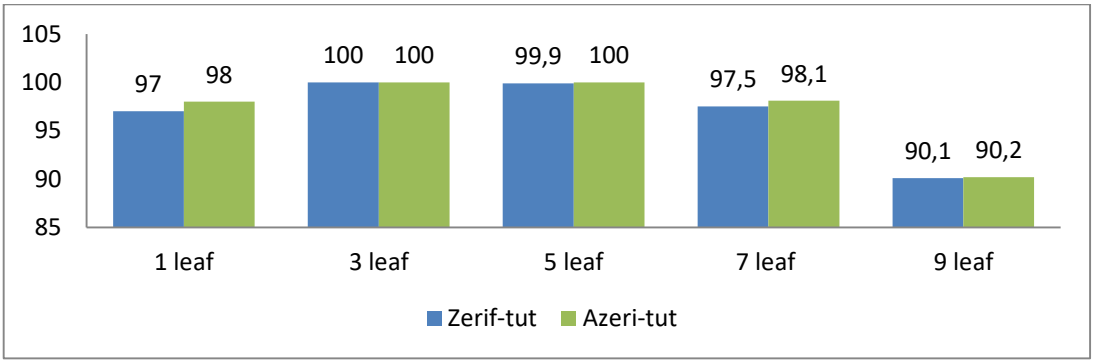

Diagram 1. Viability of caterpillars Mayak-1

The data (Diagram 1) indicate that feeding caterpillars with leaves from the studied trees leads to a significant decline in caterpillar viability in experimental cases where feeding begins at the appearance of the 7th leaflet. Therefore, to maintain caterpillar viability, feeding should commence no later than the appearance of the 5th leaflet.

To assess the influence of mulberry leaf maturity on the results of silkworm nutrition in the ecological conditions of our region, the average cocoon weight was also measured. The results are presented in Diagram 2.

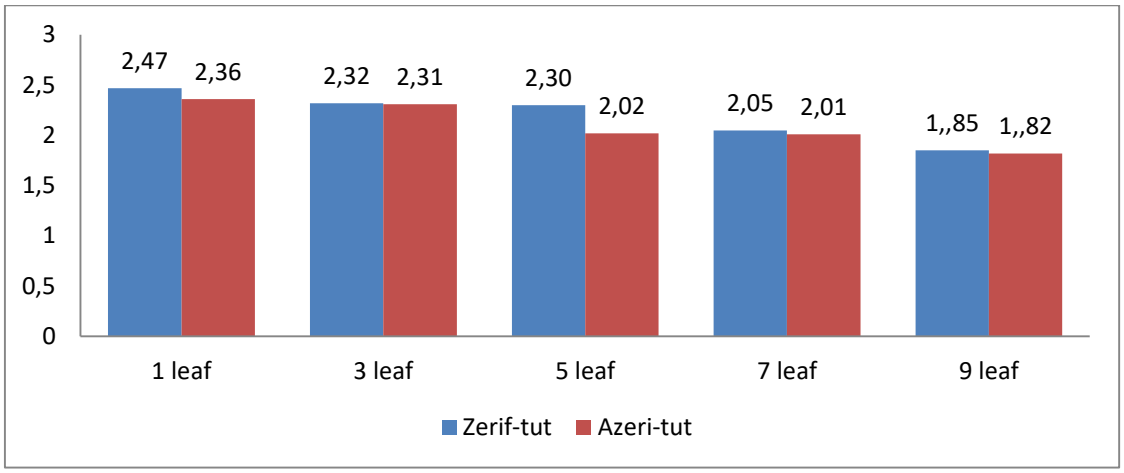

Diagram 2. Data characterizing the average weight of the cocoon

Diagram 2 clearly shows that the average weight of a live cocoon is directly influenced by feeding and decreases as the number of leaves on the tree increases at the start of feeding.

This trend is consistently observed in experiments involving both trees. A notable reduction in the average cocoon weight occurs in experimental cases where feeding begins at the appearance of the 9th leaf.

The feeding regime of silkworm caterpillars influences both the technological parameters and the egg production of the butterfly. The results are presented in Table 2.

Table 2. Technological indicators, depending on the start of feeding

Start of the feeding depending on the occurrence of the certain leaf	During the feeding of silk moth Mayak-1 with leaves of Zerif-tut mulberry tree		During the feeding of silk moth Mayak-1 with leaves of Azeri-tut	
	% shells in a raw cocoon	The weight of the shell, g	% shells in a raw cocoon	The weight of the shell, g
1	15,3	0,42	14,5	0,43
3	14,2	0,40	13,7	0,38
5	14,1	0,38	13,8	0,34
7	14,0	0,35	13,5	0,31
9	13,8	0,31	13,0	0,29

Table 2 demonstrates that egg production and the technological indicators of silkworm decline significantly when caterpillar feeding begins later. While the percentage of the shell in the raw cocoon does not clearly reflect the impact of feeding initiation, the shell weight distinctly decreases as feeding begins at a stage with a greater number of leaves.

In the study of how mulberry leaf maturity affects the feeding outcomes of introduced silkworm breeds, the shell weight was also measured. The results obtained are presented in Diagram 3.

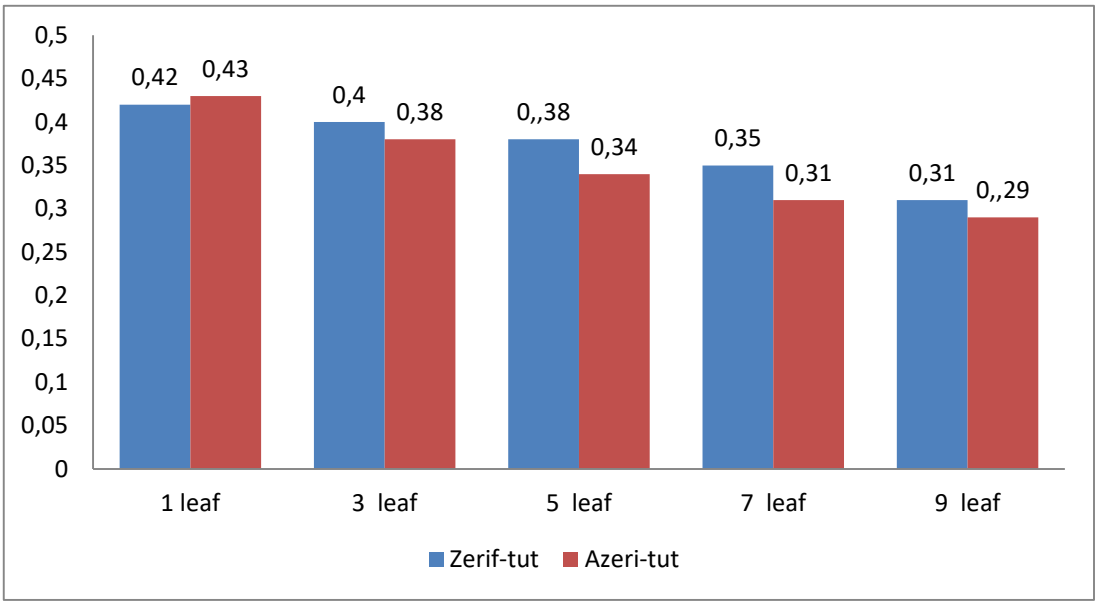

Diagram 3. The shell weight (g)

Diagram 3 clearly shows that shell weight is influenced by feeding and decreases as the number of leaves on the tree increases at the start of feeding.

This highlights the significant role that initial growth conditions play in developing the primary forms.

Experiments have shown that the Mayak-1 silkworm breed, when fed with leaves of the Zerif-tut mulberry variety, gives good results. However, even a single-season change in the silkworm's living conditions led to noticeable effects on the next generation, reflecting the influence of previous environmental factors. Therefore, if these feeding conditions persist for several consecutive seasons, the emerging trend is likely to intensify, resulting in a decline in the beneficial traits of the silkworm.

4. Conclusions

To determine the optimal time for the start of elite feeding, it was found that there is no need to begin feeding on the day the first mulberry leaves appear. Rather, relatively early timing is preferred, with feeding ideally starting at the appearance of the 3rd to 5th mulberry leaves. Additionally, it was observed that the later feeding begins - such as with the appearance of the 9th mulberry leaf - the more negatively impacted nearly all biological, breeding and technological indicators of caterpillars, cocoons and grana.

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