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LARVAL PERIOD DURATION AND ITS RELATIONSHIP WITH KEY BIOLOGICAL TRAITS IN SILKWORMS (*BOMBYX MORI* L.)

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SUMMARY

This valuable study aimed to investigate the larval period duration and its relationship with other biological traits in different breeds and advanced lines of mulberry silkworm (*Bombyx mori* L.). The study observed a considerable reduction in the duration of larval transition from one instar to another. Thus, in the breeds Parvoz-1 and Parvoz-2, the duration of the transition from the second to third instar decreased by 3.7 hours, whereas in lines 500 and 501, the said duration decreased by 3.4 hours. The larval period shortening was most prominent on day 4 of the fourth instar and on the 7–8 days of the fifth instar. The relationship between the larval period duration and breeding traits revealed an increase in the larval period duration has the complementation of a decrease in phenotypic correlation coefficients (r_p = -0.645 to -0.957) among the proportion of non-viable eggs, egg hatchability, and larval survival. However, an increase in phenotypic correlation coefficients (r_p = 0.859-0.970) was evident between the number of viable eggs, the weight of healthy eggs, the level of larval infection, and cocoon productivity.

Keywords: Mulberry silkworm (*B. mori* L.), larval period duration, egg productivity, egg hatchability, larval survival, cocoon weight, phenotypic correlation

Key findings: Developing highly productive silkworm (*B. mori* L.) hybrids with shorter larval periods will contribute to the localization of egg production at the specialized enterprises in Uzbekistan. These measures will increase productivity and improve quality traits of the produced cocoons.

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INTRODUCTION

The mulberry silkworm (*Bombyx mori* L.) breeding development, characterized by the highest silk productivity and early maturity, gains motivation from the pressing need to increase profitability of the sericulture industry. The commercial hybrids mostly used in production have the quality of the highest silk productivity but late maturation, and achieving their productive potential necessitates significant labor, time, and feed resources. Furthermore, the hybrids' breeding with an extended developmental cycle and larval feeding and cocoon production also creates additional organizational and technological difficulties for both egg- and cocoon-producing enterprises (Kalpana *et al.,* 2005).

In silkworm breeds and hybrids, early maturity is a varied and an unstable trait, as it largely depends on the existing feeding and rearing conditions. Larval rearing at the elevated temperature and increasing feeding frequency generally accelerate the development of silk glands and increase silk accumulation. However, some existing breeds form cocoons earlier or later even with optimal feeding and rearing conditions. With standard silkworm-rearing conditions, the difference in growth and development rates among early-maturing elite breeds imported from China and local breeds averages 3–5 days. Still, under elevated-temperature conditions and intensive feeding, this difference could decrease to 1–2 days, while genotype remains with a decisive role (Bisht *et al*., 2025; Nguyen*,* 2026).

Several generations of two silkworm breeds characterized by the highest and lowest survival rates received rearing on an artificial diet. An extension in the larval period occurred, along with a decrease in cocoon productivity and deterioration in silk quality parameters (Gunchaeva *et al.,* 2017). In substantiating the silkworm rearing method with higher humidity (Sodisov, 2021), the testing of a modified rearing shelf structure adapted for maintaining elevated air humidity succeeded. The said past study comprised three experimental variants, viz., a) rearing under plastic film, b) rearing under moistened fabric, and c) an open, conventional rearing method. The results showed that in silkworms reared under conditions of high humidity, the duration of the larval period revealed a decline of 2.7–4.0 days compared with the conventional method.

Temperature plays a key role in the development of mulberry silkworms. Since the silkworm is an ectothermic organism, the ambient temperature directly influenced its physiological and biochemical processes occurring in the larval body. In general, the larvae with complete development and entering the pupation period at earlier stages showed characteristics of higher resistance to elevated temperature, which considerably contributes to their increased survival (Rahmathulla, 2012). During embryonic and postembryonic periods and the pupation stage, the temperature below the optimal level slowed down the larval development, prolonged the larval period, and subsequently decreased individual survival (Umarov *et al.,* 2020).

Indian researchers conducted a study to investigate the biological characteristics of the silkworm breed Mcon-1 under laboratory conditions. Their findings showed the duration of the third stage of embryonic development (the hatching period) averaged 8.6 days, the larval stage lasted in 23.7 days, the pre-pupal period lasted in 2.3 days, the pupal stage lasted about 10 days, and the adult (moth) stage lasted in 4.6–5.9 days (Gurjar *et al*., 2018).

Khudayberdieva *et al.* (2021) conducted a study on four lines and two breeds of the mulberry silkworm to determine the effect of adult lifespan on cocoon productivity. Their results enunciated that the lifespan of the emerged moths exhibited considerable variability, ranging from 5.12 to 8.02 days. However, the subsequent generation obtained from long-lived moths revealed a significant decrease in cocoon productivity and silk content. The above findings exhibited that studies on the dependence of silkworm life cycle duration on paratypic (exogenous) and genetic factors showed inconsistent results. With these perspectives, the promising study

aimed to focus on the detailed investigation of the larval period in different breeding lines and genotypes of the mulberry silkworm.

MATERIALS AND METHODS

Experimental procedure

The said studies transpired in the specialized silkworm (*B. mori* L.) rearing facilities of the Silkworm Breeding Laboratory at the Scientific Research Institute of Sericulture under optimal hygrothermal conditions. These also continued in accordance with the methodological guidelines 'Basic Methodological Rules for Mulberry Silkworm Rearing.' The breeding process involved the use of a technology for obtaining 24-hour-old eggs of the silkworm. The experimental breeding populations entailed feeding with mulberry leaves of cultivars Jararik, Oktyabr, Pioner, and SANIISH 33, collected from the institute's mulberry plantations and standardized for quality.

Characteristics of breeds and lines

The experimental studies involved mulberry silkworm breeds Parvoz-1 and Parvoz-2, as well as breeding lines 500 and 501. For comparative analysis, the use of control populations of each breed and line, as well as imported Japanese and Chinese silkworm breeds, also served as standard checks. The Parvoz-1 breed had an elongated cocoon shape with a constriction, whereas the Parvoz-2 breed typically produces oval-shaped cocoons. Both breeds form cocoons of medium density with fine white silk filament. The morphological traits of both breeds at different developmental stages are available in Figure 1. The breeding lines 500 and 501 displayed features of small, and oval-shaped white cocoons with fine silk filament (Figure 2). A distinctive feature of these silkworm lines was their ability to produce high-quality silk filament with a linear density of 4000 m/g (2.25 den) from their cocoons.

Figure 1. Mulberry silkworm breeds Parvoz 1 and Parvoz 2.

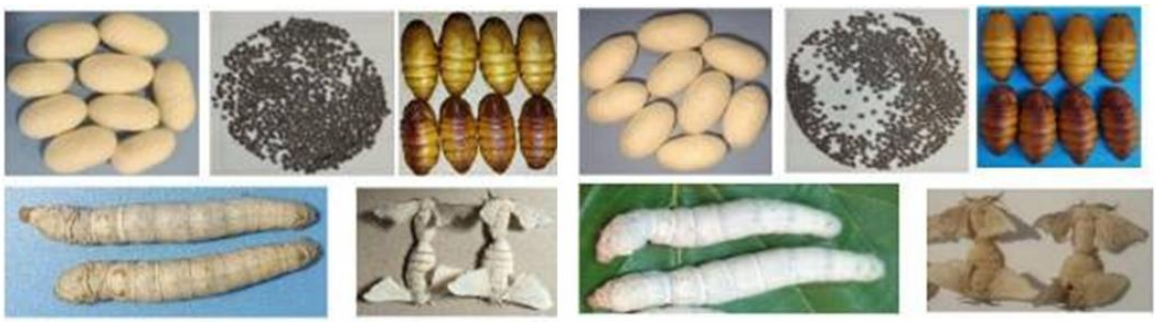

Figure 2. Mulberry silkworm lines 500 and 501.

Genotype selection

The biological activity of insects adapted to moderate temperature conditions increases with temperature, and relative humidity promotes the acceleration of metabolic processes in the larval body. Conversely, when temperature and humidity decrease below optimal levels, the physiological processes slow down in the larvae. According to this method, the initial keeping of mulberry silkworm (*B. mori* L.) eggs at an intermediate temperature of +13 °C–14 °C for 24 h preceded their being transferred to an incubator at a temperature of +24 °C and a relative humidity of 75%–80%. After the onset of the third stage of embryonic development (blastokinesis), characterized by the beginning of egg decolorization, increasing the temperature to +25 °C followed while maintaining the relative humidity at 75%–80%.

During the postembryonic development of the mulberry silkworm, sharp fluctuations in temperature and relative humidity significantly affected the duration of the feeding period and larval survival. For silkworm rearing, the optimal temperature varies, depending on the larval instar, which is as follows: +27 °C in the first instar, +26 °C in the second, +25 °C in the third, and +24 °C–25 °C in the fourth and fifth instars. The optimal relative humidity should remain within the range of 65%–80%. During the individual selection for a shortened life cycle among purebred silkworm families, characterized by the earliest onset of embryonic development after oviposition, the families within each breed underwent grouping into three categories.

In each category, larval development monitoring ensued throughout all developmental stages. Larvae that initiated cocoon formation earlier than others received individual numbering, after which analysis and individual selection proceeded based on economically important traits, including larval survival, cocoon productivity, and technological characteristics of the cocoons. For the next generation, the formation of mixed egg batches came from moths that began spinning cocoons earlier and were suitable for reproduction. In the subsequent experimental year, larvae obtained from Category 1 families further incurred subdivision into categories, with the selection performed according to the same criteria.

In the experimental treatment, selection took place under individual rearing conditions (one larva per unit). As comparative controls, the rearing of purebred populations and imported elite breeds was in three replications with 250 individuals each (Nasirillayev *et al.,* 2020). In both experimental and control variants, the larvae received the same amount of mulberry leaves over a five-year period. The obtained parameters for each category sustained comparison with those of the purebred population and imported breeds.

Degree of correlation

In populations of selected breeds and breeding lines of the mulberry silkworm (*B. mori* L.), genotypes characterized by the most rapid transition to pupation, intermediate rates of cocoon formation, and the slowest developmental rates underwent classification into three grades. Based on the duration of the larval period, the genotypes acquired either Grades I, II, or III. For each grade, the calculation of arithmetic mean values of reproductive traits included fecundity (the number of eggs per clutch), clutch weight, single egg weight, and the frequency of physiological defects. Based on the obtained data, calculating arithmetic mean values occurred for cocoon weight, cocoon shell weight, and the silk content. The study determined phenotypic correlation coefficients (r_p) between the duration of the larval period and the number of normal eggs per clutch (units), total egg mass per clutch (g), single egg weight (mg), egg viability (%), larval viability (%), single cocoon weight (g), cocoon shell weight (mg), and silk content (%). The evaluation of the correlation strength between the traits used the Bayesian Pearson correlation module of the JASP software package (version 0.95.2.0) (Figure 3).

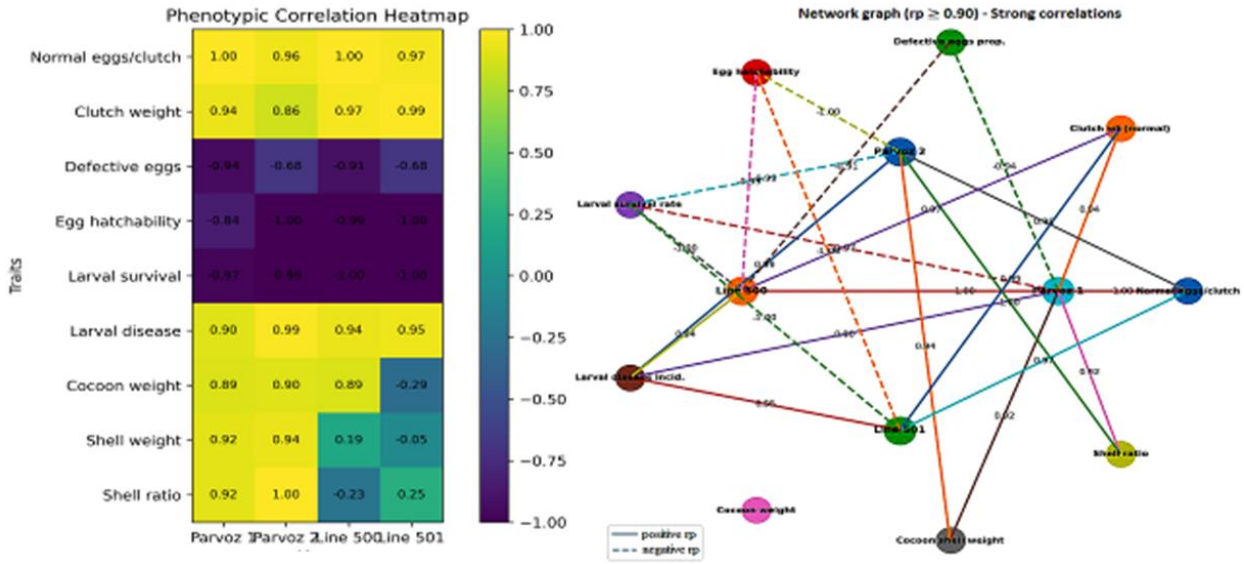

Figure 3. Correlation coefficients among the various traits of silkworm breeds and lines.

Statistical analysis

All the recorded experimental data underwent analysis using the JASP software package (version 0.95.2.0), with the calculation of the arithmetic mean (M) and the standard error of the mean (SE). The significance of differences (P) between the experimental Grade I and the control group received evaluation using the one-factor Bayesian one-sample t-test method. Reproducing the described selection scheme continued annually throughout the experimental period.

RESULTS

By studying the larval period in mulberry silkworms (*B. mori* L.), the primary aim was to develop the new breeds and hybrids with the integration of high cocoon productivity and a shortened period of cocoon formation. The silkworm breeds and hybrids characterized by the highest silk content with late maturation periods receive less usage since their cultivation requires considerable labor, time, and feed resources. In this context, the present experiments enabled evaluation of the silkworm breeds and breeding lines with developmental duration parameters reflecting growth and developmental rates of the organisms (Khudjamatov and Nasirillaev, 2022).

According to the data analysis, the differences in mean values between the experimental breeds and Grade I lines and the control breed population were highly significant ($p < 0.01$), whereas those between the foreign elite breeds were significant at a moderate level ($P < 0.05$) (Table 1). In the silkworm breeds Parvoz-1 and Parvoz-2, the total larval period was remarkably shorter in the experimental groups of Grade I compared with Grade III. In Grade I, the duration of the total larval period was 24.0–24.1 days. However, in individuals with a longer life cycle assigned to Grades II and III, the said parameter ranged from 24.9 to 25.3 and 24.7 to 25.0 days, respectively. In the non-selected control populations of both breeds, the total larval period ranged from 25.9 to 26.0 days, whereas in the foreign elite control group, the said range was 26.7–26.8 days.

Likewise, in the experimental groups of the breeding lines 500 and 501, the total larval period significantly differed among the various grades, with an obvious advantage of Grade I over Grade III. In Grade I, the total larval period in both advanced lines was 23.2–23.5 days. In Grades II and III, the corresponding

Table 1. Larval period duration of mulberry silkworm breeds and lines during 2021–2024.

Experimental breeds	Larval period I gradation M±SE (days)	Larval period II gradation M±SE (days)	Larval period III gradation M±SE (days)	Larval period of purebred population (control 1)* M±SE (days)	Larval period of foreign elite breeds (control 2)** M±SE (days)
Parvoz 1	24.1±0.42	24.9±0.53	25.3±0.76	25.9±0.41	26.8±0.98
Parvoz 2	24.0±0.27	24.7±0.48	25.0±0.62	26.0±0.35	26.7±1.97
Line 500	23.5±0.43	24.5±0.73	25.2±1.03	26.2±0.73	26.1±1.23
Line 501	23.2±0.60	24.1±0.85	24.9±1.06	26.3±0.69	26.3±1.46

values ranged from 24.5 to 25.2 and 24.1 to 24.9 days, respectively. However, in control populations of both lines, the total larval period was 26.2–26.3 days, while in the foreign elite control group, the total larval period ranged from 26.1 to 26.2 days. Thus, the selective breeding aimed at reducing the larval period in the breeds Parvoz 1 and Parvoz 2 resulted in a reduction of this parameter by 1.8 and 2.0 days, respectively. For the breeding lines 500 and 501, at-par results emerged, and the larval period duration decreased by 2.7–3.1 days. Selective breeding continued over five consecutive generations.

Larval period duration and biological indicators

The present study's relevance was recognizable given that in the development of local breeds and hybrids of the mulberry silkworm, primary emphasis centered on cocoon productivity and larval viability through breeding programs. However, the present requirements of the sericulture industry necessitate the development of breeds and hybrids with the highest productivity and cocoon quality, which should also include features of accelerated growth rates and reduced time to the onset of cocoon spinning. In this context, a comparative analysis of the larval period duration and key biological traits of the mulberry silkworm proceeded. The results on larval development duration and the main selection-related traits of the studied silkworm breeds and lines over the period of 2020–2024 appear in Table 2.

According to fecundity parameters, the highest reproductive performance resulted in the breeds Parvoz 1 and Parvoz 2 (Table 2). The females with average fecundity in these breeds occurred to be 647-660-665 and 643-649-649 eggs, respectively. In the breeding lines 500 and 501, the said trait ranged from 622-633-639 to 614-622-625 eggs, respectively (Khudjamatov *et al.,* 2025). For breeds Parvoz 1 and Parvoz 2, egg hatchability averaged 93.8%–95.0% in Grade I and 93.1%–94.3% and 89.5%–94.1% in Grades II and III, respectively. Meanwhile, in the breeding lines 500 and 501, the said trait was slightly higher, with an average of 95.4% in Grade I and 94.7%–94.8% and 93.2% in Grades II and III, respectively. In the selection of genotypes with a shortened larval period and accelerated pupation, larval viability in Grade I ranged from 91.4% to 93.5%, whereas in Grades II and III, this parameter was relatively lower, varying between 86.6% and 91.7%.

In the presented study, particular attention focused on cocoon productivity traits. In the breeds Parvoz 1 and Parvoz 2, the average cocoon weight was 1.75–1.83 g, the cocoon shell weight was 373–402 mg, and the silk ratio of fresh cocoons was 21.4%–22.0%. For breeding lines 500 and 501, cocoon weight ranged from 1.57 to 1.60 g, cocoon shell weight from 338 to 343 mg, and the silk ratio averaged 21.5%. The results revealed that in the breeds Parvoz 1 and Parvoz 2, the highest cocoon weight recorded appeared in Grade III, whereas in the breeding lines 500 and 501, the said trait remained nearly unchanged across the three grades. A similar pattern was also evident for the cocoon shell weight.

Phenotypic correlation

Unlike qualitative traits, quantitative traits generally do not follow classical Mendelian

Table 2. Larval period duration and key biological traits of mulberry silkworm breeds and lines during 2020–2024.

Grades	Total larval duration (instars I–V) (days)	Normal eggs per clutch	Clutch weight (mg)	Physiologically defective eggs (%)	Egg hatchability (%)	Larval survival rate (%)	Cocoon weight (g)	Cocoon shell weight (mg)	Shell ratio (%)
Parvoz 1									
1 gradation	24.1±0.42	647±3.10	365±3.6	1.6±0.1	93.8±1.7	93.4±0.7	1.75±0.05	373±11.2	21.4±0.1
2 gradation	24.9±0.53	647±3.10	375±5.3	1.3±0.1	93.1±1.8	91.7±0.8	1.82±0.06	409±21.9	22.7±0.6
3 gradation	25.3±0.76	647±3.10	375±3.7	1.3±1.1	89.0±1.2	91.5±0.8	1.81±0.05	406±16.5	22.6±0.5
Parvoz 2									
1 gradation	24.0±0.27	660±5.80	363±6.1	1.6±0.1	95.0±1.4	91.4±0.6	1.83±0.04	402±6.90	22.0±0.5
2 gradation	24.7±0.48	660±5.80	367±3.6	1.2±0.1	94.3±0.9	88.5±0.6	1.89±0.04	426±10.6	22.5±0.5
3 gradation	25.0±0.62	660±5.80	366±3.2	1.4±0.1	94.1±0.9	86.6±1.6	1.88±0.05	425±14.5	22.7±0.4
Line 500									
1 gradation	23.5±0.43	622±39.0	324±24.5	1.9±0.2	95.4±0.9	93.5±0.8	1.60±0.02	343±6.23	21.5±0.0
2 gradation	24.5±0.73	633±37.3	327±24.0	1.6±0.1	94.8±1.0	90.1±1.4	1.2±0.04	353±8.29	21.9±0.2
3 gradation	25.2±1.03	639±34.7	332±11.8	1.6±0.2	94.2±0.9	87.9±2.9	1.61±0.03	344±13.4	21.3±0.4
Line 501									
1 gradation	23.2±0.60	614±36.6	334±25.2	1.5±0.3	95.4±1.1	91.7±0.8	1.57±0.06	338±12.1	21.5±0.1
2 gradation	24.1±0.85	622±35.3	337±25.0	1.2±0.1	94.7±1.1	90.7±1.2	1.59±0.06	348±12.2	21.9±0.2
3 gradation	24.9±1.06	625±34.8	341±23.4	1.3±0.2	94.0±1.2	90.0±1.5	1.56±0.07	337±24.5	21.6±0.4

patterns of inheritance, as multiple genes manage their expression. Environmental conditions also exert a substantial influence on the expression of quantitative traits, resulting in considerable variability in fecundity, viability, and productivity in the mulberry silkworm (Nasirillayev *et al.,* 2019). Therefore, the variations in these traits largely depend on the environmental factors (Hemmatabadi *et al*., 2014). In the development of highly productive breeds, particular importance should focus on the phenotypic and genotypic correlations in the expression and inheritance of economically important traits (Seidavi, 2010). Hence, the correlation analysis of the studied traits has a considerable practical value.

In this study, for the first time, the relationships between the larval period duration and other biologically and selection-relevant traits of the mulberry silkworm succeeded in their analysis, which determined the strength of their correlations (Table 3). Analysis of the correlation coefficients revealed an increase in the larval period duration had an association with an enhancement in both the number and the total mass of viable eggs in a clutch. Quantitatively, the correlation coefficients ranged from r_p = 0.945 to 0.998 in the breeds Parvoz 1 and Parvoz 2 and from r_p = 0.970 to 0.998 in the breeding lines 500 and 501. The results indicated a significant positive phenotypic correlation between the larval period duration and fecundity-related traits. Another important reproductive parameter was the proportion of physiologically defective eggs in the clutch, revealing a negative relationship with the larval period duration. The correlation coefficients calculated during 2021–2024 (r_p = -0.680 to -0.945) enunciated an increase in the larval period duration accompanied by a decrease in the proportion of physiologically defective eggs. The results confirmed the trait-specific relationship between the larval period duration and the reproductive performance of the mulberry silkworm.

The results established that larval period duration showed a considerable correlation with the viability and productivity indicators of the mulberry silkworm. In this regard, it was primarily interesting to determine whether the correlation pattern between larval development duration, viability, and productivity also remained in new breeds and breeding lines with different genotypes. According to the 2020–2024 data presented in

Table 3. Correlation between the larval period duration and other biological traits during 2021–2024.

Interrelated traits	Phenotypic correlation coefficient (r_p)			
	Parvoz 1	Parvoz 2	Line 500	Line 501
Larval duration — number of normal eggs per clutch	0.998	0.956	0.998	0.975
Larval duration — clutch weight (normal eggs)	0.945	0.858	0.970	0.993
Larval duration — proportion of physiologically defective eggs	-0.945	-0.682	-0.912	-0.680
Larval duration — egg hatchability	-0.837	-0.997	-0.995	-0.999
Larval duration — larval survival rate	-0.972	-0.994	-1.000	-0.998
Larval duration — larval disease incidence	0.903	0.992	0.944	0.948
Larval duration — cocoon weight	0.893	0.899	0.885	-0.295
Larval duration — cocoon shell weight	0.918	0.945	0.191	-0.048
Larval duration — shell ratio	0.920	1.000	-0.230	0.253

Table 3, a robust negative correlation was noticeable between the larval period duration and egg viability: r_p = -0.837 in the breed Parvoz 1, r_p = -0.997 in the breed Parvoz 2, r_p = -0.995 in line 500, and r_p = -0.999 in line 501. The findings revealed a reduction in the larval period in the studied breeds, with lines considerably associated with an increased egg viability. A similar relationship emerged in the analysis of the correlation between larval period duration and larval viability.

The phenotypic correlation coefficients (r_p = -0.972 to -1.000) enunciated that a shorter larval development period coincides with a higher larval survival. Additionally, the study found that a decrease in the larval period duration with accelerated growth and development of the breeding material also proved in association with a reduced incidence of larval diseases. These results received robust support from the highest values of the phenotypic correlations between the larval period duration and disease incidence: r_p = 0.903 in the breed Parvoz 1, r_p = 0.992 in the breed Parvoz 2, r_p = 0.944 in line 500, and r_p = 0.948 in line 501.

The larval period duration and cocoon productivity were the most economically valuable traits in the silkworm. However, the breeding efforts aimed at improving one of these traits should not adversely affect other key performance indicators. The phenotypic correlation coefficients between larval period duration and cocoon weight (r_p = 0.893–0.899) determined a robust positive relationship for the breeds Parvoz 1 and Parvoz 2. The results confirmed an increase in larval period duration had connections with the formation of heavier cocoons (Figure 4).

DISCUSSION

Enzymes play a foundational role in the intensive physiological processes underlying the growth and development of the silkworm (*B. mori* L.). One of the most important enzymes is amylase, which contributes to the digestion and hydrolysis of carbohydrates contained in mulberry leaves, thereby accelerating metabolic processes in silkworm larvae (Seetharamulu *et al.,* 2022). Time-dependent variations in gene expression in the silk glands of last-instar larvae (days 0–7) have been apparently in close association with hormonal regulation (Masuoka *et al.,* 2024). The *Bmdimm* (Bombyx mori-derived dimmed) gene, acting through BmKr-h1, maintains the balance between larval growth and other developmental processes. In these genes, the suppression of activities results in a shortened larval period and reduced protein content in the silk glands, which leads to decreased cocoon productivity (Cao *et al.,* 2023). The *Period* (*CLK*) gene participates in the regulation of larval development and oviposition through photoperiodic mechanisms. However, some reports have stated that inhibition of the *Clock* gene affects the larval development, resulting in increased cocoon weight and silk yield (Brady *et al.,* 2025).

It was successful that shortening the silkworm life cycle and accelerating larval hatching primarily depend on the

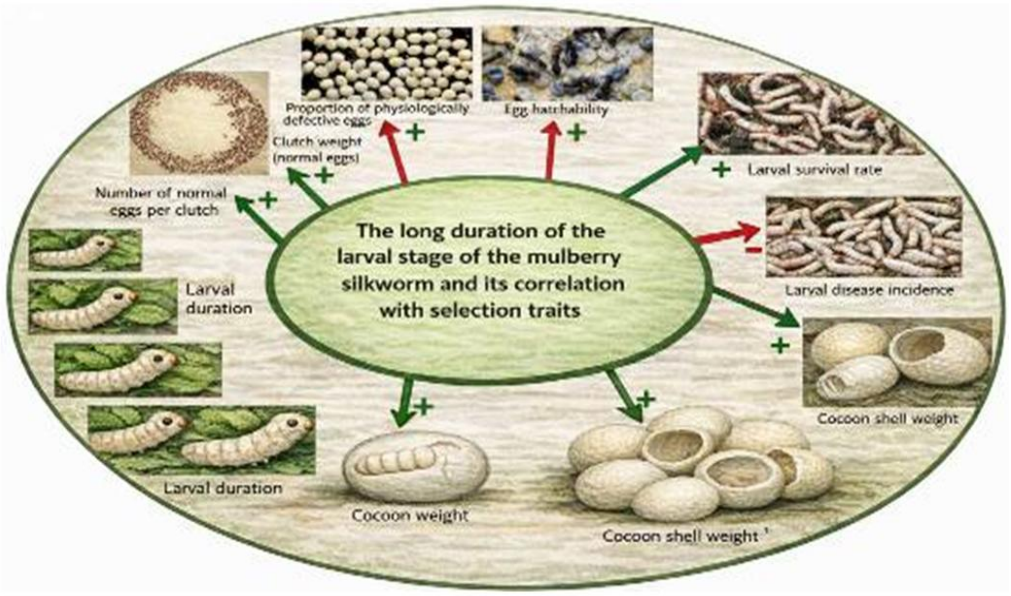

Figure 4. Graphical representation of the correlations between larval period duration and key biological traits of silkworm breeds and lines.

determination and optimization of the timing of embryonic development, particularly the hatching period. The response of newly hatched larvae to adverse stress factors, such as nutrient deficiency and extreme temperature conditions, primarily determines considerable variations in embryonic and post-embryonic viability (Nasirillayev *et al.,* 2019). Previous studies also reported the development of silkworm lines whose eggs are resistant to a critical temperature of +34 °C contributes to enhanced larval viability (Nasirillayev *et al.,* 2025). Backcrossing of monovoltine and bivoltine silkworm breeds has had reports of improving larval viability (Reddy *et al.,* 2009). However, the selection through inbreeding followed by selection in generations I_5–I_9 ensured the larval viability within the range of 60.9%–77.7% (Larkina and Yakubov*,* 2010).

The increase in productivity and cocoon yield, as well as reduction in the duration of the larval period, enabled proposing the silkworm larvae rearing with leaves of new mulberry cultivars. Under the Uzbekistan conditions, rearing 19 g of silkworm larvae on the mulberry cultivar Jarariq, five leaves resulted in a cocoon yield of 70.1–76.5 kg (Valiev *et al*., 2017). Juvenile hormone (JH) also plays a key role in regulating growth rate and controlling the transition of silkworms from one instar to the next. However, its action needs mediation through the Met receptor and the *Kr-h1* gene, which accelerates the developmental processes and could induce the onset of pupation as early as the fourth instar (Feyereisen and Jindra*,* 2012). The fifth-instar larvae treatment with JH at the concentration of 1.25 ppm for 48 hours resulted in an increase in cocoon weight (Sashindran *et al.,* 2013). Previous studies reported positive results in the development of high-quality silk-producing breeds and male hybrids (Kavaguchi *et al.,* 2009). Furthermore, Uzbek researchers, through reciprocal selection of the lines—Line 66, Line 28, Line 203, and Line 207—obtained the 100% male hybrid with a silk content of 27.2% (Abdukadirov and Nasirillayev*,* 2021).

The significant positive phenotypic correlations have been evident between the first-day oviposition intensity and reproductive (r_p = 0.654–0.988), viability (r_p = 0.859–0.999), and productivity traits (r_p = 0.692–0.999) (Khudjamatov *et al.,* 2023). The locomotor activity of male moths has emerged to be in a positive correlation with cocoon weight and negative association with cocoon

silk content (Larkina *et al.*, 2010). Reports have also detailed that female silkworms may exhibit both long and short life spans, while a pronounced negative correlation was noteworthy between the larval viability and cocoon productivity (r_p = -0.706 to -0.984). Moreover, a significant positive correlation has been apparent between the disease susceptibility and lifespan of adult moths (r_p = 0.900–0.985) (Khudayberdieva and Navruzov, 2019).

CONCLUSIONS

The results revealed that reduction in the larval period of the mulberry silkworm (*B. mori* L.) is a multifactorial task, affected by genetic, physiological, and technological factors. The studied breeds and lines differed in several economically important and biological traits; the selective breeding over five generations resulted in a consistent reduction in the larval period duration across the experimental variants. The correlation analysis showed larval period duration has a significant positive correlation with the number of eggs per clutch and clutch weight, while a negative association with the proportion of physiologically defective eggs. Furthermore, negative correlations were valid between larval period duration and egg hatchability and larval viability. The significant positive correlation between larval period duration and cocoon productivity of the breeds Parvoz 1 and Parvoz 2 revealed that a longer larval development period was in association with the formation of heavier cocoons.

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