Correlation between the larval period of silkworm bombxy mori l. and egg production

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Abstract. In this work a correlation between the duration of larval period and signs of eggs laying of 6 races and 4 selectional lines of silkworm was studied. Races and lines were divided into gradations according to the speed of development and a comparative evaluation of indexes in gradations was made. According to the analysis of obtained results a negative correlation between the speed of larval period and reproductive characteristics was defined.

1 Introduction

Currently, there are 5 breeding and 12 seed-growing enterprises operating in Uzbekistan. The capacity of breeding enterprises for seed production does not allow providing local seed-growing enterprises with a sufficient amount of elite seeds. As a result, local seed companies are forced to import breeding seeds from abroad. Elite and industrial seeds imported from abroad are superior to local varieties and hybrids in terms of quality, hatchability, biological and technological indicators, and most importantly, the short larval period of caterpillars. Therefore, reducing the larval period and creating highly productive varieties and hybrids are topical tasks in sericulture. Scientists believe that populations with a long life cycle experience an increase in productive indicators. However, foreign experience shows that by using special selection methods it is possible to create fast-growing and developing, as well as highly productive breeds and hybrids. Based on this, at the current stage of development of the silkworm industry, the creation and introduction into production of breeds with a short life cycle and rapid cocoon mounting is a priority task for genetic and breeding researchers [1-6].

The growth and development of silkworms is influenced by various factors. In this regard, researchers and scientists have made the following comments. The silkworm is a poikilothermic insect; when it is exposed to unfavourable conditions, its development slows down and all economically important indicators decrease. At the Central Sericulture Research Centre in Mysore, Indian and Japanese scientists studied the effect of temperature and humidity on the growth and development of the well-known Indian bivoltine hybrid «CSR2 × CSR4». In this study, it was noted that when silkworms were reared at temperature 25°C

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and 70% humidity, the fifth instar of larval development lasted 8 days. During their research, the scientists determined how much the amount of silk in the silk gland changes from the 1st to the 7th day of the 5th instar in silkworm larvae. In the framework of their research, the scientists bred larvae of industrial silkworm hybrids “Ipakchi 1 x Ipakchi 2” with mulberry of new selection numbers. According to the researchers, the larval period of silkworms fed on varietal mulberry leaves was reduced by 1–4 days compared to the control variant fed on common mulberry leaves.

During their research, the scientists studied the growth dynamics of silkworm larvae depending on their instar. In this case, the silkworm breeding systems were fed with leaves of the mulberry varieties Zhararik 12, Marhamat-2017, Mustakillik-2018. The larval stage of the systems was observed by the increase in weight of the caterpillars on the first day of the 3rd stage, on the first day of the 4th stage and on the first day of the 5th stage. As a result, it was convincingly proven, that the growth dynamics of the caterpillars of the selection systems, fed with varietal mulberry leaves, accelerates.

Enzymes are of great importance in the intensive passing of physiological processes in the growth and development of the silkworm. One of them is the enzyme amylase. The enzyme amylase is involved in digestion and breaks down carbohydrates contained in mulberry leaves, which speeds up metabolism. Scientists have determined the activity of the amylase enzyme in the hemolymph of silkworm breeds such as “Pure Mysore”, “APS45” and “SLFC 27”. As a result of the study, the SLFC 27 breed, which was sex-marked at the cocoon stage, showed relatively high amylase enzyme activity, and the larval stage of the caterpillars was shortened compared to the other two breeds, and they began to mount cocoons. The viability of the caterpillars was 97.2%, and the percent cocoon shell was 21.8%. The researchers continued their work and found amylase inactivity in the hemolymph of the local common silkworm breed «Pure Mysore», which is most commonly reared on cocoon farms in India. It has been established that the larval period of caterpillars of this species is 26 days, the viability of caterpillars is 95.0%, and the percent live cocoon shell is only 15.4%.

Scientists have long been interested in silkworm breeds that mount cocoons early. In particular, in Uzbekistan, as a result of selection work carried out by scientists (N.Shurshchikova, Scientific research institute of sericulture, 1965) on early maturing and early yielding breeds of silkworm, SANISH 17 and SANISH 21 breeds were obtained.

The results obtained in the creation of breeds with a short life cycle are presented in the following data.

From the brief information presented above, it is clear that studies on the dependence of the life cycle duration of the silkworm on paratypic or genetic factors have led to different conclusions. Based on this, we focused our research on a detailed study of the larval stage of silkworm breeds and systems with different genotypes.

2 Materials and methods

In order to study the larval stage development of silkworm breeds and lines with different characteristics, based on the planned research program for 2020-2024, large-cocoon "Guzal", "Marvarid", medium-cocoon "Gulshan", "Nafis", fine-fiber "Parvoz 1", "Parvoz 2" breeds, as well as medium-cocoon "Line 42", "Line 101/1" and small-cocoon fine-fiber "Line 500", "Line 501" breeding lines were involved in the experiments. The study analyzed the extent to which egg productivity can influence the speed of caterpillar development. The experiments were conducted based on the main methodological rules of selection work and the 24-hour technology for obtaining seeds.

3 Research results

The silkworm was divided into three gradations depending on the rate of egg hatching and larval development within each breed.

In the first gradation are the most rapidly developing and early-mounting caterpillars;

In the II gradation are caterpillars have an average rate of development;

In the III gradation are the slowest developing caterpillars; the larvae were classified according to the rate of growth and development. The fertility of breeds and lines in the experiment was analyzed individually for each gradation, that is, the total number of eggs in a laying, the number of healthy eggs in a laying, the weight of healthy eggs in a laying, the weight of one egg and the percentage of physiologically unhealthy eggs. To determine the weight of eggs in the experiment, electronic scales PX224 were used. In studies since 2020, we have divided experimental breeds and linis into gradations depending on the rate of caterpillar development during their feeding season, and from each of these gradations, egg layings of F_1, F_2 and F_3 generations were prepared. After analyzing the obtained egg layings, each gradation egg layings were individually hatched. Then the caterpillars of the first gradation were divided into gradations again and egg layings of the F_4 generation were prepared. The results obtained are presented in Tables 1 and 2.

Table 1. Larval lifespan and fecundity of selection breeds and lines (2020-2024)

Breeds and systems	Duration of the larval period, in days			Number of normal eggs in a laying (in pieces)		
	I gradation	II gradation	III gradation	I gradation	II gradation *	III gradation **
Guzal	26.1±1.05	26.5±1.00	27.1±0.87	662±21.44	666±20.65	669±20.10
Marvarid	25.5±0.75	26.0±0.49	26.7±0.70	661±22.95	667±23.79	670±20.54
Gulshan	25.8±0.75	26.6±0.92	26.7±0.90	582±8.92	586±8.45	587±7.77
Nafis	24.2±0.71	25.4±0.89	25.6±0.67	651±5.05	663±6.21	663±6.56
Parvoz 1	24.4±0.41	25.3±0.59	25.8±0.56	647±3.10	660±5.80	665±5.04
Parvoz 2	24.4±0.53	25.1±0.61	25.4±1.25	643±1.89	649±1.82	649±2.66
Line 42	23.9±0.42	24.9±0.85	25.7±1.08	558±28.27	564±27.10	568±26.21
Line 101/1	24.9±0.88	25.4±0.44	26.0±0.91	587±12.24	590±11.46	593±10.71
Line 500	23.8±0.97	25.0±1.15	25.8±0.86	622±39.09	633±37.37	639±34.77
Line 501	23.5±0.79	24.6±0.80	25.5±1.04	614±36.66	622±35.35	625±34.82

If we consider the most productive breeds according to fertility indicators presented in tables 1 and 2, we can note Guzal and Marvarid breeds (662-666-669 pcs.); (661-667-670 pcs.). At the same time, the fact that Parvoz 1 and Parvoz 2 breeds lay 651–663 and 647–660–665 eggs, respectively, is the basis for including these breeds in the list of prolific

breeds. Among the selection lines, Line 500 and Line 501 lines are in the lead, with their figures being 622-633-639 and 614-622-625 pieces.

Table 2. Egg weight and indicators of physiological defects in egg clutches of selection breeds and lines (2020-2024)

Breeds and systems	Oviposition mass, mg			Physiological defect, %		
	I gradation	II gradation	III gradation	I gradation	II gradation *	III Gradation **
Guzal	408±10.62	411±8.67	415±8.81	1.4±0.28	1.1±0.19	1.1±0.19
Marvarid	409±18.15	412±17.51	414±16.82	1.3±0.24	1.2±0.19	1.1±0.17
Gulshan	337±12.11	341±10.77	341±10.99	1.6±0.31	1.2±0.23	1.3±0.24
Nafis	365±6.44	382±4.06	384±4.06	1.6±0.27	1.4±0.15	1.3±0.70
Parvoz 1	365±3.61	375±5.34	375±3.71	1.6±0.17	1.3±0.16	1.3±1.18
Parvoz 2	363±6.13	367±3.66	366±3.24	1.6±0.16	1.2±0.18	1.4±0.19
Line 42	312±21.55	318±19.92	322±19.17	2.0±0.10	1.6±0.12	1.4±0.23
Line 101/1	346±10.57	350±9.59	353±8.81	1.5±0.09	1.3±0.16	1.3±0.15
Line 500	324±24.52	327±24.04	332±11.87	1.9±0.29	1.6±0.15	1.6±0.25
Line 501	334±25.23	337±25.09	341±23.49	1.5±0.32	1.2±0.10	1.3±0.26

The main objective of our study was to determine to what extent the duration of the silkworm larval stage influences egg production. Analyzing the obtained results, we can conclude that Guzal and Marvarid breeds have large cocoons and are distinguished by high egg production and weight. However, the duration of the larval period was also significantly longer than in other breeds and systems. It is evident that there is no significant difference in egg production between the first and second gradations (Pd=0.077-0.154; Pd=0.154-0.229).

In the medium-cocoon and fine-fibered varieties “Parvoz 1” and “Parvoz 2”, the larval period of caterpillar development was 24.4 days in gradation I, and 25.4–25.8 days in gradation II, which indicates a significant difference in egg productivity (high reliability of the difference Pd=0.910–0.985; Pd=0.953–0.910). That is, it was observed that if the larval period is short, the number of eggs decreases, and the number of physiologically unhealthy eggs increases.

According to the data given in Table 2, the most productive breeds in terms of the number of eggs include the local breeds Guzal (681-795 pcs.) and Marvarid (665-776 pcs.). In the foreign breeds “Japanese” and “Chinese” the number of eggs in the laying made 484-674 pieces. Hybrid combinations involving domestic breeds Parvoz 1 and Parvoz 2 and foreign breeds also showed high fertility rates (639-731 units). One of the most important indicators of egg laying quality, analysis of the physiological defect index, shows that the percentage of dry and unfertilized seeds in our local breeds and foreign breeds is very low, and as a result of synthetic selection with foreign breeds, this figure was 0.52-1%.

4 Conclusion

In conclusion, it should be noted that the analysis of the egg productivity of silkworm breeds and lines with 10 different silkworm genotypes shows that acceleration of the larval stage leads to a decrease in the number of healthy eggs in the laying, a decrease in the weight of eggs in the laying and an increase in the proportion of physiologically damaged eggs. These indicators prove that there is a negative correlation between these features.

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