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# THE DURATION OF THE LARVAL PERIOD OF THE SILKWORMBOMBYX MORI L. AND ITS INFLUENCE ON THE FEED CONSUMPTION

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**Annotation.**This article presents the results of the research on study the duration of larval period, as well as feed consumption in the silkworm.Among the breeding traits of breeds and lines, the duration of the larval period is practically unexplored. Therefore, in our experiments, where 2 breeds and 2 lines participated, such populations where the duration of the larval period without moulting was reduced to 19.6-19.9 dayswere identified.These indexes indicate that by selecting fast-developing individuals over several breeding generations, it is possible to shorten the larval period of silkworm life.The creation of highly productive breeds with a short life cycle will reduce the cost of fodder mulberry leaves, as well as labor. In the feeding for the larval period, 250 larvae will require 6430.1 g of leaves.In our experiments, it was found that fast-growing caterpillars consumed food for 4.02-8.2% less than the maximum norm.The obtained digital data on the speed of larvaedevelopment indicate the possibility of reducing feed consumption based on the creation of breeds with a short life cycle.At the same time, during the study, it was revealed that with the shortening of the life cycle of caterpillars, a decrease in the weight of the cocoon was observed.In the populations of the breeds "Parvoz 1" and "Line 500" cocoons weight in the I-gradation, where the caterpillars developed rapidly, amounted to 1.68 g and 1.58 g, and in the III-gradation this figure was 1.78 g and 1.67 g. According to the preliminary data obtained, it can be concluded that the method of individual selection of fast-growing genotypes can be used to develop new breeding lines, and in the future, breeds that will save mulberry leaves and labor costs in production.

**Key words:** silkworm, mulberry leaf, cocoon, larva, silk, breeding line.

**Introduction.**

Until the 2000s, there was a high demand in the Republic of Uzbekistan for breeding large cocoon silkworm breeds, and because of this, the selection process was focused on creating highly productive hybrids with their participation.In large cocoon breeds, the content of raw silk is somewhat less, but cocoons are distinguished by their increased weight. At the same time, the consumption of fodder mulberry leaves given to larvae is quite high. As a result, from 1000 to 1200 kg of mulberry leaves were spent on a box of silkworm larvae.

Many researchers have found that a decrease in the volume of feeding of the silkworm negatively affects the biological and productive properties of large cocoon breeds.In the genetics of the silkworm, it has been proven that high rates of percent cocoon shell and fine silkiness depend on the breed composition.

Professor U.N.Nasirillaev (1978), as a result of his many years scientific research, proved that there is a negative relationship between the mass of the cocoon and the thickness of the cocoon filament.

B.U.Nasirillaev (2017) in his breeding research in the direction of obtaining industrial hybrids with high technological parameters, which is of great interest to the silk industry, created reciprocal hybrid combinations with the participation of breeding lines - Line 27, Line 28.

Environmental factors can influence the growth and development of silkworms and the quantity and quality of mulberry leaves.Some research works on feeding larvae at high temperatures and increasing the frequency of feeding have been carried out. N. Chernetsova (1966) and N.G.Bogoutdinov (1981) in their studies found that maintaining optimal temperature and relative humidity when feeding the silkworm and caterpillars 7 times a day, 2 times at night can accelerate the growth of larvae and increase cocoon productivity.

In N.Akhmedov's monograph "Ecology and agrotechnics of feeding the silkworm" there are references to such information, where it is noted that feeding the silkworm with varietal leaves has a positive effect on viability and productivity.At the same time, it is indicated that the larval period of the silkworm fed with varietal leaves of the mulberry tree makes 21.6-23.0 days (N.Akhmedov, S.Murodov 2004; H.Alipanakh, 2020).

In the studies of R.Gunchaev (2017), it was proved that as a result of the selection of two breeds of silkworms with low and high viability, the new generation was fed with artificial feed, in which an increase in the larval period of silkworms and a decrease in quality, as well as silk productivity were observed.

In the studies of Mirzakhodzhaev A., Mirzakhodzhaev B. (2016), Mirzakhodzhaev A., Mirzakhodzhaev A., Umarov Sh.R. (2019) Mirzakhodzhaev A., Mirzakhodzhaev A., Umarov Sh.R., B.T. Soipov (2021), D. Sodikov (2021) to justify the method of silkworm rearing in the conditions of high humidity, a new design of racks was tested, which provided an increased level of humidity during the rearing of the silkworm.Three different experiments were carried out on this design of racks The first method is feeding the caterpillars under the film, the second - under the moistened material, the third - the simple method (open).In larvae fed in theconditions of high humidity, a shortening of the larval period by 2.7-4.0 days was observed in comparison with the traditional open method.

Temperature plays an important role in the growth and development of the silkworm. Since the silkworm belongs to poikilothermic insects, the temperature directly affects various physiological processes in the body of the larvae.In general, fast-developing caterpillars that mount cocoons early are resistant to high temperatures, which also improves the quality of their life.According to V.K.Rahmatullaev (2012); Sh.R.Umarov, B.U.Nasirillaev (2020) when silkworm larvae are kept at low temperatures, the development of caterpillars slows down and the process of cocoon mounting is prolonged.

Indian researchers conducted laboratory research to study the biology of the silkworm belonging to the Mcon-1 breed.In this connection, the following indicators were revealed: the third stage of embryonic development (incubation) 8.6 days, the larval stage 23.7 days, the mounting of the cocoon 2.3 days, the pupal stage 10 days, the life expectancy of moths 4.6-5.9 days. It was found that females live longer than males (S. Gurjar, 2018).

U.Khudoiberdiyeva (2021) conducted a research to study the effect of life expectancy of silkworm moths on cocoon productivity in 4 lines and 2 populations of breeds with different genotypes.The life span of moths ranged from 5.12 to 8.02 days. In the next generation of long-lived moths, a significant decrease in cocoon productivity was observed.

S.Kh.Khujamatov (2021); (2022) published the results of the first studies on the shortening of the larval period in silkworm breeds and lines, with different genotypes.According to preliminary data, the duration of the larval period in families with a short growth rate in breeding lines was 20.0-21.7 days, and the moulting period was 4.2-4.3 days.At the same time, the silk productivity of breeds and lines with a short larvae growth rate was compared.

Scientists from the Meisuri Institute of India and Zhejiang University of China K. Sashindran Nari, Miao Yun-gen, S. Niral Kumar (2005) observed the effect of phytoecdysteroid on the acceleration of metabolic processes during the development of the silkworm.In this case, the famous Chinese silkworm hybrids Xinhang x Keming were exposed to phytoecdysteroid substances in two different periods, using the Hu Sang 197 mulberry variety.At the fifth instars larval were used at a dose of 2 μM at 14 hours, 48 hours and 72 hours, i.e. fed together with mulberry leaves.This impact had an influence on the duration of the larval period, as well as on the growth and development and mounting of the cocoon.The intensity of the effect of this substance depends on the time of application, and all the biological and technological properties of the silkworms improve when applied after 48 hours.When used after 72 hours, these figures were much lower. In this connection, the total duration of the larval stage of caterpillars was reduced to 24 hours.

P.A.Botikar, S.S.Dzhadhav, Yu.A.Shindelar studied the influence of varietal mulberry leaves on the growth and development of the silkworm Bombyx mori L. during 2009-2014.In silkworms feeding on mulberry varieties B-1, C-1635 and M-5, a shortening of the larval period of caterpillars was observed.For example, the larval stage of the silkworm fed with varieties B-1 and C-1635 was 25.02-25.26 days, while feeding with the leaves of variety M-5 27.04 days. When fed with the leaves of these varieties, the silkworms had a body length and width from 5.65 to 39.0 mm and a body weight of 873 mg.

Based on the above scientific sources, various conclusions can be drawn about the effect of the amount of feed, consumed by the silkworm in the larval period, on their cocoon productivity, as well as on other economically valuable traits.

**Material and methodologyof theresearch.**

In the process of feeding the silkworm, several factors influence on the production of high-quality cocoons, as well as on thegrowth and development of larvae.For example: air temperature, relative humidity, feeding area and most importantly the amount of nutrients.Since the silkworm is a monophagous insect, i.e. feeds only on the leaves of mulberry tree, the mulberry leaf and its quality are of great importance.Therefore, the first breeding work on the creation of breeds and hybrids, that consume much less leaves, we started by reducing the larval period during caterpillars rearing.Initially, the breeding material according to the growth dynamics of the silkworm was divided into 3 gradations.During the incubation period, we classified the earliest hatched insects in terms of growth and development as rapidly developing genotypes and relegated them to the 1-gradation, insects with moderate growth rates to the 2-gradation, and insects with very slow growth to the 3-gradation.However, all gradations were kept under identical hygrothermal conditions.First of all, the amount of food needed for 250 silkworms was determined. At a young instar, the silkworms were fed 7 times a day. At older instars, mulberry leaves were given 5 times a day.Each time the feed which was given to the breeding lines, was weighed on a scale and then fed to the caterpillars.The duration of the larval stage of the silkworms was measured in days and hours.During the experiment, the productivity of cocoons in each gradation was determined individually by dividing by sex into ♂25 and ♀25.The results obtained were processed by biological and statistical methods.

**Research results and discussion.**

Our experiments are aimed at creating highly productive breeds of silkworms with a short life cycle, which will reduce the cost of mulberry leaves and labor.The experimental breeds were fed in two different variants, using feed of the same quality and hygrothermal regime.

Variant 1 - based on the gradation of larvae with a short, medium and long larval period according to the life cycle in the larval stage.

Variant 2 - purebred population and foreign elite breed, which served as control options.

In the experimental variant, the caterpillars were fed individually and the rates of feed consumption by the instars were determined.Both experiments received the same number of mulberry leaves during 5 instars. The results of the study are presented in the following tables (Tables 1-3).

**Table 1.**

**The rate of feed consumption of mulberry leaves by instars**

| Larvae instars | Number of feeds per day | Leaf consumption per 1 box of larvae (45000 pcs), g | Leaf consumption per 250 larvae, g | Leaf consumption per 1 larva, g |
|---|---|---|---|---|
| 1-instar | 7 | 2700 | 15,0 | 0,06 |
| 2-instar | 7 | 8550 | 47,5 | 0,19 |
| 3-instar | 7 | 30370 | 168,7 | 0,67 |
| 4-instar | 5 | 183800 | 1021,1 | 4,08 |
| 5-instar | 5 | 932000 | 5177,8 | 20,7 |

| | | | | |
|---|---|---|---|---|
| Totally | 31 | 1157420 | 6430,1 | 25,7 |

According to table 1 data, the feed consumption of the silkworm, i.e. the amount of leaves used by ages was calculated on the recommendation of S.Zinkina, A.Maksimova (1966) and A.Mirzakhodzhaev (2001).Experimental and control caterpillars were fed a total of 31 times, including seven times a day at younger instars and five times at older instars.Table 2 shows indicators of the amount of feed by instars in breeding lines in comparison with control breeds.

**Table 2.**

**The amount of feed given to the selection breeds and lines of silkworm by instars (per 250 larvae) 2021**

| Gradations | 1-instar | 2-instar | 3-instar | 4-instar | 5-instar | Totally |
|---|---|---|---|---|---|---|
| **Parvoz 1 and Parvoz 2** | | | | | | |
| I-gradation | 15,7 | 47,5 | 169,0 | 821,1 | 4850,0 | 5903,3 |
| II-gradation | 15,7 | 47,5 | 169,0 | 893,3 | 5605,4 | 6730,9 |
| III-gradation | 15,7 | 47,5 | 169,0 | 1012,2 | 5867,7 | 7112,1 |
| Control population of pure breeds (Control 1) | 15,7 | 47,5 | 169,0 | 980,0 | 5805,4 | 7017,6 |
| Foreign elite (Control 2) | 15,7 | 47,5 | 169,0 | 1010,0 | 4717,7 | 5959,9 |
| **Line 500 and Line 501** | | | | | | |
| I- gradation | 15,7 | 47,5 | 169,0 | 920,0 | 5020,0 | 6172,2 |
| II- gradation | 15,7 | 47,5 | 169,0 | 970,0 | 5617,7 | 6819,9 |
| III- gradation | 15,7 | 47,5 | 169,0 | 1010,0 | 5697,7 | 6939,9 |
| Control population of pure breeds (Control 1) | 15,7 | 47,5 | 169,0 | 1031,1 | 5997,7 | 7261,0 |
| Foreign elite (Control 2) | 15,7 | 47,5 | 169,0 | 1010,0 | 4717,7 | 5959,9 |

**Table 3.**

**Larval instar and food consumption in breeding lines Line 500 and Line 501 (2021)**

| Gradations | Duration of larval instar (without molting), days | Actual feed consumption for 250 larvae, g | Feed consumption rate for 250 larvae, g |
|---|---|---|---|
| **Line 500** | | | |
| I-gradation | 19,9±1,38 | 5903,3 | 6430,1 |
| II- gradation | 21,3±1,89 | 6730,9 | |
| III- gradation | 22,5±2,23 | 7112,1 | |
| Control population of pure breeds (Control 1) | 22,5±3,56 | 7017,6 | |
| Foreign elite (Control 2) | 20,6±2,61 | 5959,9 | |
| **Line 501** | | | |
| I- gradation | 19,6±1,58 | 6172,2 | 6430,1 |
| II- gradation | 20,9±1,39 | 6819,9 | |
| III- gradation | 21,6±2,91 | 6939,9 | |

| | | | |
|---|---|---|---|
| Control population of pure breeds (Control 1) | 22,5±3,25 | 7261,0 | |
| Foreign elite (Control 2) | 20,6±2,61 | 5959,9 | |

The results of table 3 show that the waking period of the silkworms in gradation 1 is 19.9 days.In total, 5903.3 g of mulberry leaves were eaten for 1-5 instars. In the 2nd gradation, the waking period of caterpillars was 21.3 days, and in the 3rd gradation, the waking period made 22.5 days, and 6730.9-7261.0 g of mulberry leaves were consumed for the entire feeding period.In proportion to this, a control variant was observed, in which the waking period of silkworms in the purebred population was 22.5 days, in totalduring 1-5 instars the caterpillars consumed 7017.6-7261.0 g of mulberry leaves, and in the foreign elite breed these figures were 20.6 days and respectively 5959.9 g.

Normally, for the larval period of the silkworm, the amount of food consumed for 1-5 instars is set at 6430.1 g per 250 caterpillars.According to the results of our experiments, it can be seen that in the 1st gradation, the caterpillars consumed the leaves by 4.02-8.20% less than the maximum norm.At the same time, in the 2-3 gradations, where the duration of the larval period was somewhat longer, leaf consumption also increased by 4.67-6.06%.A similar upward trend in leaf consumption was observed in the purebred control (9.1-12.9%), while in the foreign elite comparable breed the leaf consumption decreased by 7.32%.The results obtained on the growth and development of silkworms prove the possibility of reducing feed intake on the base of creating breeds with a short life cycle in the larval period.

In order to properly organize selection and breeding work and create breeds and hybrids with high quality properties of cocoon products for production, individual selection of genotypes with a short larval period was carried out.In our study, individuals with the strongest genotype from families of2 selection breeds and2 breeding lines were divided into gradations and analyzed comparatively in terms of cocoon productivity.

The results of two-year and spring experiments are presented in table 4.

**Table 4.**

**Indicators of silk production of breeds "Parvoz 1" and "Parvoz 2" (2021-2022)**

| Breeds | With duration of the larval period | Cocoons females and males | Weight of the cocoon $\overline{X}$ ±S $\overline{x}$ , г | Weight of cocoon shell $\overline{X}$ ±S $\overline{x}$ , мг | Percent cocoon shell $\overline{X}$ ±S $\overline{x}$ , % |
|---|---|---|---|---|---|
| **PARVOZ-1** | I gradation (24.6 days) | ♀+♂ **aver.** | 1.70±0.04 | 357±13.860 | 21.0±0.41 |
| | IIgradation (25.0days) | ♀+♂ **aver.** | 1.74±0.02 | 367±8.87 | 21.1±0.29 |
| | III gradation (25.4days) | ♀+♂ **aver.** | 1.72±0.01 | 365±7.13 | 21.1±0.42 |
| Control population of pure breeds (Control 1)* (26.7 days) | | ♀+♂ **aver.** | 2.08±0.02 | 477±7.0 | 22.9±0.15 |
| Foreign elite (Control 2)** (25.7 days) | | ♀+♂ **aver.** | 1.55±0.02 | 347±3.57 | 22.4±0.10 |
| **PARVOZ-2** | Igradation (24.4days) | ♀+♂ **aver.** | 1.83±0.02 | 433±4.94 | 23.9±0.29 |
| | IIgradation(25.0days) | ♀+♂ **aver.** | 1.83±0.03 | 453±6.96 | 25.1±0.31 |
| | III gradation (25.1days) | ♀+♂ **aver.** | 1.88±0.01 | 472±12.417 | 25.4±0.43 |
| Control population of pure breeds (Control 1)* (26.9 days) | | ♀+♂ **aver.** | 1.90±0.01 | 446±11.512 | 23.3±0.68 |

| | | | | |
|---|---|---|---|---|
| Foreign elite (Control 2)** (24.2 days) | ♀+♂ **aver.** | 1.46±0.01 | 316±3.02 | 21.6±0.12 |

The data in Table 4 shows that in theseselection breeds and lines, the larval period was classified and ranked according to the rate of development in families with short, medium and long periods.It was noted that thecocoon productivity in the I gradation was somewhat lower than in the II and III gradations, in which growth and development were short.In the breeds "Parvoz 1" and "Parvoz 2" in the I-III-gradations, the weight of the cocoon was 1.70-1.79 g, the weight of the cocoon shell was 356-381 mg, the percent cocoon shell was 21.4-23.9%. In the purebred variant of the experiment, compared with the breeding populations, the weight of the cocoon was at the level of 1.90-2.08 g, the weight of the cocoon shell was 446-477 mg, the percent cocoon shell was 22.7-22.9%.In the foreign elite control variant, the larval period of the silkworms was 24.2-25.7 days, the weight of the cocoon was 1.46-1.55 g, the weight of the cocoon shell was 316-347 mg, and the percent cocoon shell was 21.

**Table 5.**
**Cocoon productivity of the silkworm in the breeding lines "Line 500" and "Line 501" (2021-2022)**

| Selection lines | With duration of the larval period | Cocoon sex | Weight of the cocoon $\overline{X}$ ±S $\overline{x}$ , г | Weight of cocoon shell $\overline{X}$ ±S $\overline{x}$ , мг | Percent cocoon shell $\overline{X}$ ±S $\overline{x}$ , % |
|---|---|---|---|---|---|
| **LINE 500** | I gradation (23.8days) | ♀+♂ **aver.** | 1.52±0.01 | 325±3.29 | 21.4±0.24 |
| | II gradation (24.6days) | ♀+♂ **aver.** | 1.50±0.02 | 333±5.85 | 22.2±0.22 |
| | III gradation (25.0days) | ♀+♂ **aver.** | 1.51±0,07 | 300±0,02 | 19.9±0,85 |
| Control population of pure breeds (Control 1)* (26.2 days) | | ♀+♂ **aver.** | 1.49±0.008 | 345±6.76 | 23.2±0.33 |
| Foreign elite (Control 2)** (25.7days) | | ♀+♂ **aver.** | 1,55±0.021 | 347±3.57 | 22,4±0.10 |
| **LINE 501** | I gradation(24.1days) | ♀+♂ **aver.** | 1.46±0.02 | 311±6.87 | 21.3±0.31 |
| | IIgradation(24.7days ) | ♀+♂ **aver.** | 1.47±0.02 | 315±6.66 | 21.4±0.33 |
| | III gradation(25.4days**)** | ♀+♂ **aver.** | 1.45±0.05 | 307±11.135 | 21.2±0.74 |
| Control population of pure breeds (Control 1)* (26.5days ) | | ♀+♂ **aver.** | 1.43±0.032 | 310±10.7 | 21.7±0.27 |
| Foreign elite (Control 2)** (24.2days) | | ♀+♂ **aver.** | 1.46±0.012 | 316±3.02 | 21.6±0.12 |

Table 5 shows that the weight of the cocoon in the breeding lines "Line 500" and "Line 501" is 1.47-1.58 g, the weight of the cocoon shell is 315-360 mg, thepercent cocoon shell of fresh cocoons is 21.6-24.1%.These data indicate to the presence of a negative relationship between silkworm growth rate and cocoon productivity.The proof of this is that in the I-gradation, the productivity of cocoons is significantly lower compared to the II and III-gradations.Cocoon weight is 1.46-1.52 g, shell weight is 311-325 mg, percent cocoon shellis 21.2-21.4%.

**Conclusion.**

Breeding scientists are always striving to create highly productive breeds that meet the commercial requirements of high productivity, viability and technological features of the cocoon.In particular, silkworms, which have a short life cycle, and created breeds, characterized by high economic characteristics, are of great economic importance.The issue of accelerating the development of silkworm caterpillars has always been relevant for silkworm scientists.But in this direction it is necessary to take into account two circumstances. Firstly, how does the property of the accelerated development of caterpillars correlate with the mass of the cocoon, and secondly, how will the caterpillars react to selection on precocity, that is, how will the viability of the caterpillars change.As a result of our breeding work in this direction, we managed to achieve the creation of individuals from the population of new lines with a larval period of 20-21 days.By selecting these families to reduce the larval period of caterpillars from generation to generation, it will be possible to obtain new lines.As a result, in the conditions of Uzbekistan, the feeding process of silkworms is reduced, andsilkworms are less exposed to thermal effects in late spring seasons.This, in turn, increases the yield and quality of cocoons.

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