# Embryonic And Post-Embryonic Viability Of Second Generation (F2) Of Silkworm Breeds And Lines Obtained Under Unfavorable Stressful Conditions

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**Abstract:** The reaction of silkworm breeds to stress factors is manifested, first of all, on the viability of eggs and caterpillar. In modern breeds, along with the increase in silkiness and technological indicators, there is a tendency of reduce in their embryonic and post-embryonic viability. In this article presented the analysis of indicators of viability of the second generation obtained from rearing of Marvarid, Guzal, Ipakchi 1, Ipakchi 2 silkworm breeds and Line 27, Line 28 under unfavorable conditions.

**Index Terms:** Silkworm, caterpillar, silkworm eggs, temperature of the air, cocoon, viability, adaptation.

## 1 INTRODUCTION

Increasing demand for natural silk and silk products in the world market every year requires a sharp increase in the quality and volume of produced cocoon raw materials. Today, the international trade on turnover of silk fabrics in the world is over 25-26 thousand tons or 2-2,5 billion dollars [1]. The leading scientists of research institute of sericulture have studied genetically morphological signs of cocoons which allow to increasing technological properties of cocoons of silkworm. A close correlation ratio was ascertained between the signs of grain of cocoon shell and leading technological properties – raw silk yield, reeling, length and fineness of silk fibre [2]. Perspective breeding lines Line 27 and Line 28 obtained in the laboratory “Breeding of the silkworm” under the guide of professor B.U.Nasirillaev and also silkworm hybrids of industry intention have involved to achieve cocoons with increased heterozygosis and completely high technological properties. Increased qualitative characteristics of hybrid cocoons - raw silk yield, reeling, too long length and fineness of silk fibre provide the increase of competitiveness and demand for local and international market [3].


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In the leading scientific centers of countries with developed silk industry, along with the scientific basis of new technical means and technologies in sericulture, as well as the introduction of intensive research results, numbers of interesting researches are being carried out and great success are being achieved in the creation of new breeds and hybrids of silkworm based on bivoltine breeds that are adapted to unfavorable climatic conditions of the regions [4, 5, 6, 7], in order to increase the biological parameters of the silkworm, as well as productivity indicators and technological properties of cocoons according to the world standards [8, 9]. In Uzbekistan, leading scientists and sericulturists have conducted researches on the study and analysis of amino acids in the content of mulberry leaves which are prepared for repeated feeding of silkworm caterpillars in summer [10], also the study of adaptation of large-cocoon and medium-cocoon populations to unfavorable conditions, as well as, non-compliance with hygrothermal regime, optimal feeding area and feed shortage. In Uzbekistan, like in other sectors, economic reforms have been carried out in the sericulture sector too. In particular, by decree of the President of the Republic of Uzbekistan dated March 20, 2018 “On additional measures for the further development of the silk industry” № PD-3616, it has been planned to modernize the enterprises of the silk industry, increase the capacities of production enterprises and, along with attracting new investments to the industry, determine strategic directions and promising topics and research in sericulture, as well as the intensive development of the industry, the organization of research to solve actual problems, to conduct experiments on genetics and egg breeding, improvement and development of breeds and hybrids of silkworm, primary seed breeding of varieties of mulberry that are resistant to natural and climatic conditions, unfavorable stress of zones, the introduction of advanced scientific research and intensive agricultural technologies in production. Based on the abovementioned, in the laboratory “Breeding of the silkworm” of the Sericulture Research Institute of Uzbekistan, the researches are being carried out to improve the biological, cocoon-producing and silk-producing indicators of silkworm breeds and hybrids.

## 2 MATERIALS AND METHODS

To study the properties of resistance to paratypical factors such as feed quantity, temperature and humidity during worm feeding, the silkworm breeds Guzal, Marvarid, Ipakchi 1, Ipakchi 2 and and lines of silkworm Line 27, Line 28 were used which were created in the laboratory of "Breeding of the silkworm" of the Research Institute of Sericulture of Uzbekistan. Feeding of experimental caterpillars was carried out in the spring season of 2018-2019 in special breeding and ecological silkworm nurseries of the Scientific Research Institute of Sericulture, where unfavorable conditions were artificially created that did not meet the norm.

To conduct experiments under adverse conditions, artificial stressful factors were created in three variants. The first variant: Reduce in feed rate by 50 %. For this, the caterpillars of the experimental variants during I-III ages were fed under optimal hygrothermal and feed conditions, and in their IV-V ages the amount of feed was reduced to 50 %.The second variant: caterpillars of I-III ages were fed with the optimal amount of feed under optimal hygrothermal conditions, i.e. at a temperature of 26,0-27,0 °C and a relative humidity of 75-80 %, and when feeding the caterpillars of IV-V ages, the temperature norm and relative humidity were observed. The third variant: feeding area decreased by 50 % of the norm, i.e. the caterpillars were densely placed.

## 3 RESULTS AND DISCUSSION

It is known that deviation from optimal hygrothermal conditions during feeding of breeds and lines of silkworm leads to changes in the signs of caterpillar viability. Naturally, the adaptive properties of breeding materials are assessed by analyzing embryonic and postembryonic viability. If the normal reaction of the breeding population to stressful conditions is not available, i.e. when individuals more easily tolerate changes in the external environment, then with such selection material it is possible to continue experimental work on other farm traits. Table 1 shows the data about the influence of adverse conditions on the hatching of the eggs (embryonic viability) and the viability of the caterpillars (post-embryonic viability) in populations of 4 breeds and 2 lines for the spring season of worm feeding in 2019. Analyzing the data given in Table 1 and Fig. 1-3, we can see that under the influence of unfavorable paratypic factors, the degree of decrease in embryonic viability compared with post-embryonic is insignificant. Only in the experimental variants with insufficient feed and dense placement of the caterpillars of Line 28 the low revitalization of the eggs was observed (in experimental variant 82,7-87,7 % and in the comparative

***TABLE 2***

*Hatching of eggs and viability of caterpillar of the generation of breeds and lines, fed under stressful conditions (in 2019)*

| Experimental variants | Hatching of eggs, % $\overline{X} \pm S_{\overline{x}}$ ,% | Hatching of eggs, % Relative to the comparative, % | Viability of caterpillar, % $\overline{X} \pm S_{\overline{x}}$ ,% | Viability of caterpillar, % Relative to the comparative, % | Incidence rate, % $\overline{X} \pm S_{\overline{x}}$ ,% | Incidence rate, % Relative to the comparative, % |
|---|---|---|---|---|---|---|
| **Marvarid F₂** | | | | | | |
| insufficient feed | 99,7±0,33 | 101,7 | 88,9±2,46 | 97,9 | 4,0±1,24 | 71,4 |
| non-compliance with the temperature regime | 97,0±0,58 | 99,0 | 68,1±3,72 | 75,0 | 14,8±4,66 | 264,3 |
| dense placement of caterpillar | 97,7±0,33 | 99,7 | 74,1±6,55 | 81,6 | 13,2±1,61 | 235,7 |
| comparative (norm) | 98,0±0,58 | 100,0 | 90,8±1,78 | 100,0 | 5,6±1,53 | 100,0 |
| **Guzal F₂** | | | | | | |
| insufficient feed | 94,7±2,19 | 96,6 | 89,4±2,61 | 97,6 | 3,9±1,34 | 156,0 |
| non-compliance with the temperature regime | 99,0±0,58 | 101,0 | 71,9±1,54 | 78,5 | 9,3±0,98 | 372,0 |
| dense placement of caterpillar | 98,7±0,33 | 100,7 | 81,9±2,57 | 89,4 | 5,1±0,51 | 204,0 |
| comparative (norm) | 98,0±0,58 | 100,0 | 91,6±1,62 | 100,0 | 2,5±1,05 | 100,0 |
| **Ipakchi 1 F₂** | | | | | | |
| insufficient feed | 97,7±0,67 | 99,7 | 86,4±1,99 | 105,0 | 5,5±0,66 | 125,0 |
| non-compliance with the temperature regime | 99,0±0,00 | 101,0 | 70,1±2,67 | 85,2 | 8,9±1,42 | 202,3 |
| dense placement of caterpillar | 99,0±0,00 | 101,0 | 81,8±2,86 | 99,4 | 4,0±0,60 | 90,9 |
| comparative (norm) | 98,0±0,58 | 100,0 | 82,3±0,68 | 100,0 | 4,4±0,39 | 100,0 |
| **Ipakchi 2 F₂** | | | | | | |
| insufficient feed | 96,7±0,33 | 97,4 | 89,7±1,07 | 97,4 | 1,9±0,14 | 100,0 |
| non-compliance with the temperature regime | 99,0±1,00 | 99,7 | 70,8±2,50 | 76,9 | 3,7±0,30 | 194,7 |
| dense placement of caterpillar | 96,3±1,67 | 97,0 | 85,2±2,21 | 92,5 | 2,8±0,55 | 147,4 |
| comparative (norm) | 99,3±0,33 | 100,0 | 92,1±0,35 | 100,0 | 1,9±0,41 | 100,0 |
| **Line 27 F₂** | | | | | | |
| insufficient feed | 98,7±0,88 | 100,4 | 82,5±1,64 | 89,3 | 5,8±1,08 | 107,4 |
| non-compliance with the temperature regime | 95,7±1,20 | 97,4 | 76,8±4,31 | 83,1 | 8,5±1,97 | 157,4 |
| dense placement of caterpillar | 96,0±1,53 | 97,7 | 79,3±3,06 | 85,8 | 8,6±0,59 | 159,3 |
| comparative (norm) | 98,3±1,20 | 100,0 | 92,4±0,18 | 100,0 | 5,4±0,32 | 100,0 |
| **Line 28 F₂** | | | | | | |
| insufficient feed | 82,7±1,20 | 87,1 | 82,6±1,67 | 96,2 | 5,2±1,08 | 86,7 |
| non-compliance with the temperature regime | 93,3±1,86 | 98,2 | 74,4±2,81 | 86,6 | 7,4±0,80 | 123,3 |
| dense placement of caterpillar | 87,7±0,33 | 92,3 | 83,9±1,40 | 97,7 | 5,1±0,12 | 85,0 |
| comparative (norm) | 95,0±0,58 | 100,0 | 85,9±0,32 | 100,0 | 6,0±0,35 | 100,0 |

By the hatching of eggs Pd = 0,224-0,294……0,540-0,999;
By the viability of caterpillar Pd = 0,151……0,425-0,999;
By the incidence rate of caterpillar Pd = 0,294…….0,425-

variant 95,0 %). In other breeds and lines under stressful conditions, that is, with insufficient feed, dense placement of caterpillars and non-compliance with the temperature regime, the viability of eggs was 94,7-99,7 %, while in the comparative variant it was 95,0-99,3 % in the normal population.

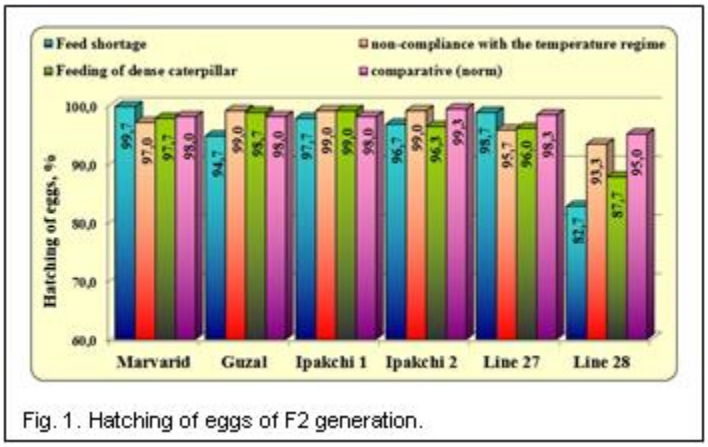


Fig. 1. Hatching of eggs of F2 generation.

In all populations of breeds and lines fed under unfavorable hygrothermal and feed conditions, the viability of the caterpillars sharply differed from the results obtained under

optimal conditions. Low caterpillar viability was especially observed in the large-cocoon Marvarid breed and silkworm breeding lines. In a comparative variant, the viability of the above breeds was 82,3-92,4 %, and under stressful conditions – 68,1-89,7 %.

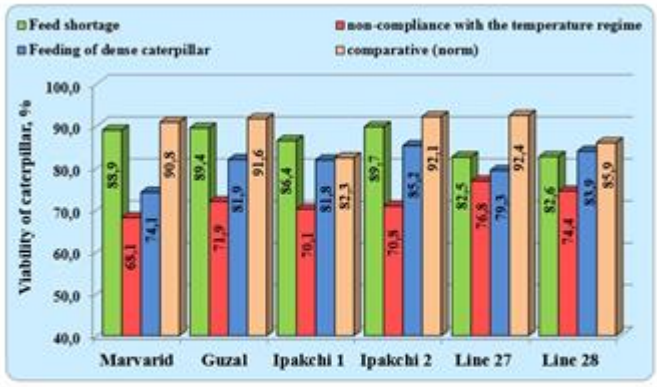


Fig. 2. Viability of caterpillar, fed in 3 types of s tressful and optimal conditions.

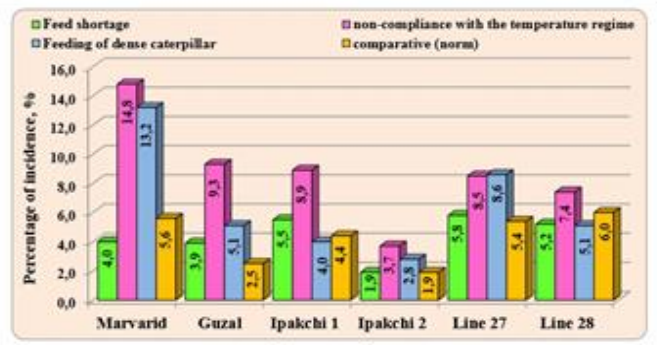


Fig. 3. Incidence percentage of caterpillars of F2 generation.

By analyzing the difference between feeding of 3 types of stressful conditions and optimal conditions, we can make sure that in our studies as for 2019, in most cases, non-compliance with the temperature regime significantly reduces the viability of the caterpillars. The incidence rate of caterpillars during feeding is mainly due to non-observance of agricultural regulations, it also depends on the silkworm genotype, i.e., on their resistance to unfavorable conditions. The indications of incidence rate from table 1 may lead to conflicting conclusions. Because, in some experimental variants, the incidence rate was low in relation to the comparative (optimal) variant. It should be noted that the studies conducted in 2018 on this basis gave similar results, that is, in certain varieties of the Guzal, Ipakchi 1, Ipakchi 2 breeds and Line 28, the degree of incidence of caterpillars was lower (2,1-3,7 %) than in a comparative variant. Also, in the studies of 2019, the incidence rate in the experimental variants of the Ipakchi 1 breeds constituted 4,0-8,9 %, in the comparative variant 4,4 %, in the experimental variants of the Ipakchi 2 breeds this indicator made 1,9-3,7 % while in comparative variant – 1,9 %. Based on the results obtained from the studies in 2018-2019, it follows that caterpillars are less affected in some unfavorable conditions. This, in turn, proves our conclusions about the need to analyze the percentage of incidence in several generations to clarify this situation and obtain breeds from the most tolerant caterpillars.

## 4 CONCLUSION

Based on breeding investigations conducted under unfavorable conditions, the Ipakchi 1, Guzal and Marvarid silkworm breeds can be considered relatively tolerant to such conditions. Under stressful conditions such as insufficient feeding, the adaptability of breeds and lines of silkworm caterpillars is higher than non-compliance with temperature conditions and density of their placement, which proves the need for extensive breeding work on these breeds and lines. The results of the aforementioned studies conclude that the reaction of the signs of egg revitalization and caterpillar viability to variable environmental conditions sharply differs from each other and the manifestation of these signs directly depends on the genotype of the breeds and lines, as well as on their adaptability.

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