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CLONING IN SILKWORTH BREEDING (BOMBUX MORI L). CLONING IN SILKWORM BREEDING (BOMBYX MORI L).

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АННОТАЦИЯ

в данной статье приводятся результаты исследований основных хозяйственно-ценных свойств изогенных партеногенетических клонов тутового шелкопряда. Определено, что биологические и технологические показатели партеноклонов находятся на уровне контроля. Партеногенетические клоны представлены только одним полом - женским, поэтому отпадает необходимость в операции по делению коконов по полу при создании гибридов. Клоны тутового шелкопряда отличаются стабильностью морфологических и биологических признаков, что при гибридизации обеспечивает однородность коконов и, как следствие, их лучшую разматываемость. Таким образом, с экономической точки зрения партеногенетические клоны, как компоненты промышленных гибридов тутового шелкопряда, представляют несомненный интерес для промышленного шелководства.

Ключевые слова

партеногенетический клон, тутовый шелкопряд, грена (яйцо), гибрид, жизнеспособность гусениц, масса кокона, шелконосность коконов.

Introduction

Cloning, the production of genetically identical copies of animals, is one of the most interesting and difficult problems in experimental biology and agriculture.

Development by B.L. Astaurov [1] using the method of ameiotic parthenogenesis essentially solved the problem of cloning female silkworms.

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The repetition of the mother's genotype in parthenogenetic offspring indicates the loss of reduction division during the maturation of eggs stimulated to parthenogenesis. As a result, the offspring is transmitted the core of the same genotypic constitution as the mother. As a result of temperature exposure, the meiotic spindle is destroyed and deconjugation of homologous chromosomes occurs. Then a new spindle with a metaphase plate appears in the egg, the elements of which no longer conjugate and undergo only one equational division. As a result, only a diploid guide body and a diploid pronucleus are formed, completely identical to the maternal diploid complex in terms of chromosome and gene set. Parthenogenetic development of the egg occurs with the participation of this pronucleus.

Parthenoclones, precisely because of their isogenicity, are of undoubted interest for hybridization. Works by V.A. Strunnikova [2] proved the possibility of using silkworm clones to obtain 100% pure highly heterotic industrial hybrids.

Participation in hybrids of sex-labeled breeds [3] makes the task even easier, since grain farms receive parthenoclone cocoons consisting only of females, and cocoons of sex-labeled breeds, separated by sex even at the egg stage, the females and males of which are fed separately. Therefore, there is no need to carry out an expensive, time-consuming and very inaccurate operation to separate the cocoons by sex. Thus, at green plants (enterprises for breeding silkworm eggs) all the conditions for creating 100% pure hybrids, uncontaminated by mother species, are easily organized [4].

Carrying out selective selection in parthenoclones makes practically no sense.

Preservation of the basic properties of parthenoclones can only be achieved by strict adherence to all the necessary rules of agricultural technology for keeping silkworms.

Materials and methods

The work was carried out in the silkworm genetics laboratory of the Sericulture Research Institute in 2021-2023.

The material for the study was parthenogenetic clones contained in the world collection of silkworms at the Scientific Research Institute of Shipping: 9PK, A-153PK, 5140PK, APK [5].

Incubation and rearing of caterpillars of all lines and breeds was carried out in full accordance with the experimental feeding methodology approved for white-coated breeds. In accordance with the same methodology, all data obtained as a result of storing and incubating grena, feeding caterpillars, and weighing cocoons was collected and statistically processed [6].

When feeding all breeds and lines used in the experiment, the selection method for physical activity was used [7].

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After analyzing the cocoons, the best cocoons in terms of shape and silkiness were selected for reproduction and hybridization.

Reproduction of parthenogenetic clones was carried out according to the method of B.L. Astaurov [1].

Discussion of the research results

In 2021, 2022, 2023, grena (mulberry eggs) clones were incubated and the caterpillars were fed in 8 replicates of 220 caterpillars each. Their biological parameters are shown in Table 1.

Table 1. Biological indicators of parthenogenetic clones (2021-2023)

Name Material	Year	Viability of pillars, %		Cocoon mass,		Shell weight,		Silk content, %	
		$\overline{X}$ ±S $\overline{x}$	Cv	$\overline{X}$ ±S $\overline{x}$	Cv	$\overline{X}$ ±S $\overline{x}$	Cv	$\overline{X}$ ±S $\overline{x}$	Cv
АПК	2021	86,8±2,1	7,6	1,50±0,02	3,4	280±7,3	5,2	18,7±0,4	2,4
	2022	90,3±3,3	6,5	1,58±0,03	3,1	310±6,8	4,8	19,6±0,3	2,7
	2023	91,1±3,0	6,0	1,60±0,02	3,9	320±6,5	4,5	20,0±0,2	2,0
9ПК	2021	82,7±2,5	7,3	1,45±0,03	3,5	280±6,3	5,7	19,3±0,3	3,1
	2022	85,0±1,2	6,8	1,63±0,03	3,6	333±5,1	5,0	20,4±0,2	2,6
	2023	90,1±2,2	5,4	1,57±0,02	3,2	326±8,1	5,2	20,8±0,2	2,0
153ПК	2021	80,9±2,8	6,7	1,61±0,03	3,2	295±7,4	6,2	18,3±0,4	1,9
	2022	82,6±3,6	5,4	1,71±0,03	3,0	320±6,5	5,7	18,7±0,3	3,1
	2023	86,9±2,4	7,6	1,65±0,03	2,7	315±5,9	5,6	19,1±0,2	2,0
5140ПК	2021	75,6±2,7	8,8	1,73±0,02	2,3	295±7,5	5,8	17,1±0,3	2,8
	2022	80,3±3,1	9,5	1,57±0,04	2,5	305±8,0	6,5	19,4±0,3	3,5
	2023	79,2±2,2	6,3	1,71±0,03	2,6	340±6,4	5,3	19,9±0,2	3,3
♀♀ Ипакчи (к)	avera-	90,2±4,2	8,0	1,62±0,05		319±8,9		19,7±0,2	

From Table 1 it can be seen that parthenoclones are medium-cocoon breeds - the weight of the cocoon varies over the years from 1.45 g to 1.73 g, the weight of the shell from 280 mg to 340 mg. The viability of caterpillars is quite high - 75.6-91.1% and is at the control level - 90.2%. Silk production of cocoons of 17.1% - 20.8% is typical for female silkworms, and clones, as is known, are represented by only one sex - female. The best viability clones were APK (86.8 - 91.1) and 9PK (82.7 - 90.1). Clones A-153PK (1.61–1.71 g) and 5140 PK (1.57–1.73 g) were distinguished by their high cocoon mass. The silk production of all clones is approximately the same and is at the control level (19.7%).

The data in Table 1 also indicate that the variations in biological traits are small, which confirms the homogeneity of the parthenogenetic clones. However, constancy is an obstacle to selection, since, starting from the first parthenogenetic generation, genotypic variability and, at the same time, the possibility of selection

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are excluded. In our work, improvement of basic biological indicators can only occur through strict adherence to the necessary hygrothermal conditions and improved feed quality.

In order for the silk-bearing capacity of a clonal-breed hybrid to reach 22-23%, it is necessary that the silk-bearing capacity of the component species be 24-25%, with the silk-bearing capacity of clones being 18-19%. All economically valuable indicators of clones remain unchanged from generation to generation, therefore only component breeds can be improved through selective selection.

During the work, the technological properties of the cocoon thread of parthenogenetic clones were also studied (Table 2).

Table 2. Results of testing the technological properties of the cocoon thread of the studied parthenoclones (2021 - 2023)

Name Material	Year	Output of raw silk, %	Metric thread number	DNRKN, m	Total length of cocoon threads, m
АПК	2021	41,05	3400	785	950
	2022	40,99	3250	830	1000
	2023	43,01	3515	805	987
9ПК	2021	41,95	3215	912	1150
	2022	42,15	3320	965	1130
	2023	43,20	3375	925	1110
А-153ПК	2021	41,17	3025	691	813
	2022	41,95	3247	789	920
	2023	42,05	3108	801	915
5140ПК	2021	45,95	2870	1000	1150
	2022	46,10	2760	1022	1100
	2023	45,03	2995	1034	1153
♀♀ Ипакчи 2 (к)	Сред	42,85	3350	950	1125

As follows from Table 2, the clones are distinguished by high cocoon thread fineness, for example, the metric thread number for APK is 3250-3515, for 9PK - 3215-3375. The yield of raw silk (APK - 41.99-43.01% and 9PK - 41.95-43.20%) is lower than that of the control (42.85). The exception is 5140 PC, which has almost all indicators higher than those of the bisexual breed Ipakchi 2. Noteworthy is the stability of the technological properties of the cocoon thread of the clones over the years. For example, the total length of the cocoon thread for 9PK was 1150 m in 2021, 1130 m in 2022, and 1110 m in 2023.

Hybridization of parthenogenetic clones with breeds possessing high silk qualities will result in fine, silky long-filament hybrids.

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Conclusions

1. The biological and technological characteristics of parthenogenetic clones are at the control level and correspond to those of females of bisexual breeds.

2. Parthenogenetic clones do not require many years of multifaceted breeding work, as well as the labor-intensive and very inaccurate process of dividing cocoons by sex, since they are represented by only one sex - female.

3. Parthenogenetic clones of the silkworm can be used as a maternal component in interbreed hybridization.

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