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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

**Comparative Study of Local and Introduced Mulberry
Varieties in Azerbaijan**

Specialty: **3103.4 - Breeding and seed production**

Field of science: **Agricultural sciences**

Applicant: **Zarifa Sabuhi Seyidova**

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The dissertation work was carried out at the Animal Husbandry Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan.

Scientific supervisor: Doctor of Philosophy in Agricultural Sciences
Allahverdi Kamil Seyidov

Official opponents: Doctor of Agricultural Sciences,
assistant professor
Aladdin Nemat Sadigov

Doctor of Agricultural Sciences,
assistant professor
Aladdin Qismat Eyvazov

Doctor of Philosophy in Agricultural Sciences,
assistant professor
Shakir Babayar Quliyev

FD 1.29 Dissertation Council operating under the Agricultural Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan of the Higher Attestation Commission under the President of the Republic of Azerbaijan

Chairman of the dissertation council:

 Doctor of Agricultural Sciences, professor
Jalal Shamil Mammadov

Scientific secretary of the dissertation council:

Doctor of Philosophy in Agricultural Sciences,
assistant professor
Sevda Kamal Hajiyeva

Chairman of the scientific seminar:

Doctor of Agricultural Sciences,
assistant professor
Aladdin Alirza Taghiyev



GENERAL CHARACTERISTICS OF THE STUDY

The actuality and degree of using of the topic. As an ancient occupation familiar to various peoples and considered one of the traditional branches of agriculture, sericulture has been supported in the Republic of Azerbaijan, as in the Central Asian republics, by significant State Programs over the last twenty years. Comprehensive measures have been implemented, and it was decided to increase the production of fresh cocoons to six thousand tons by 2025.

In Articles 1.1.5, 6.1.12, and 8.2.1 of the Law¹ of the Republic of Azerbaijan “On the Protection and Efficient Use of Genetic Resources of Cultivated Plants”, as well as within the unified program aimed at restoring the former glory of sericulture (mulberry cultivation and silk production), regaining self-confidence, and stimulating new development, the State Program² on the Development of Sericulture and Silk Industry in the Republic of Azerbaijan for 2018–2025 was adopted. This program has played an important role in increasing interest in the field. Clause 8.3.1 of the Action Plan of the State Program adopted by the Head of State stipulates “the establishment of new mulberry (*Morus*) nurseries and the support for planting new mulberry orchards to expand the forage base of sericulture”.³ This requirement highlights the need for a scientific research project that will identify existing varieties and forms of mulberry, develop and propagate new ones, ensure their conservation, and, in general, study the development indicators of their traits.

The problem of harmonizing leaf productivity with leaf quality in orchards (plantations) of fodder mulberry trees in the republic can be solved not only by creating new varieties and forms, but also by

¹ The Law of the Republic of Azerbaijan on the Protection and Efficient Use of Genetic Resources of Cultivated Plants, approved by Decree No. 273-IVQ of the President of the Republic of Azerbaijan dated December 13, 2011 – <https://e-qanun.az/framework/23056>”

² -³ State Program for the Development of Sericulture and Silk Industry in the Republic of Azerbaijan for 2018–2025”, approved by Decree No. 3406 of the President of the Republic of Azerbaijan dated November 27, 2017 - <https://e-qanun.az/framework/37032>

enabling them to show their potential characteristics in different agro-ecological conditions. One of the main directions of solving this problem is the solution of the problems of discovering newly created or introduced more productive, high leaf quality, especially the extension of the potential productivity period in accordance with the criteria, and economically useful mulberry (plantation) varieties and forms with different ploidy in the conditions of the Ganja-Dashkasan economic region, which is the relevance of the prepared dissertation work.

The object and subject of the research. The object of the research in the dissertation work was the mulberry plant, which was the only food source for the mulberry silkworm (China-21 genus) and was used for fodder purposes in the territory of the Ganja-Dashkasan economic region at a time when there was no substitute. The subject of the research was to inform the population of the country about the lack of protection of local and introduced varieties and forms of the forage mulberry plant and to investigate the factors affecting the identification of existing issues.

The purpose and objectives of the research. The main aim of the study is to identify local and introduced mulberry varieties and forms cultivated in the Ganja–Dashkasan economic region, to study their biomorphological traits, and to select among them those with high leaf productivity and nutritional quality, low susceptibility to diseases, and suitability for producing better-quality cocoons. It also aims to create new mulberry samples with different ploidy levels that can replace the zoned varieties of the 20th century.

The following main tasks have been set to achieve the solution of the issues envisaged in the research work:

- Establishing theoretical and practical models for the purpose of determining the genetic resources of local and introduced mulberry varieties and forms based on the laws of geographical distribution in the conditions of the Ganja-Dashkasan economic region, selecting those that meet the research criteria and involving them in research, collecting primary selection material, etc.;

- Evaluation of the impact of ecological factors on the biomorphological and physiological indicators of the plant,

branching, canopy formation, and nutritional quality of leaves in different ploidy local and introduced fodder mulberry varieties and forms in different seasons of the year;

- Evaluation of the degree of nutrient supply, productivity, leaf yield, consumption, and transformation into wet cocoons (silk) of leaves of polyploid local and introduced mulberry varieties and forms in mulberry silkworm experimental feedings;

- Identifying the most promising mulberry varieties and forms based on morphobiological, physiological-biochemical, and economic traits, and preparing methodological recommendations for their conservation and propagation;

- Determination of the economic efficiency of local and introduced forage mulberry (*morus*) varieties and forms with different ploidy, high yield, high forage and nutritional value of leaves used to feed mulberry silkworms in the Ganja-Dashkasan economic region and beyond and to obtain higher quality cocoons;

- Analysis of the results obtained and preparation of production proposals for farms.

Research methods. The dissertation was conducted mainly using “empirical research methods”⁴. These methods include observation, description, comparison, measurement, and experimentation.

During the implementation of the dissertation work, the methods adopted in the field mulberry cultivation (forage-oriented), authored by Academician I. Abdullayev and others, were used to establish a connection between the collection, selection and processing of facts intended for recording and development laws in experimental research in agriculture, determine the dependence between quantities, as well as analyze the results of measurements, recorded phenological observations and other indicators.

Main provisions submitted for defense:

1. The existing local and introduced mulberry varieties and forms in the conditions of the Republic of Azerbaijan (Ganja-Dashkasan economic region) were identified, and their biological and economic traits were studied.

2. From these samples, highly productive and environmentally stress-tolerant varieties and forms (resistant to drought, rainfall, frost, and other stresses) with superior quality traits were selected and propagated.

3. The best local and introduced mulberry varieties and forms resistant to diseases and favorable for silkworm feeding were recommended to sericulture farms.

4. The logical conclusion of theoretical propositions on scientific research works aimed at studying the influence of ecological factors on the normal development of fodder mulberry plants and enriching mulberry orchards with new di, tri and tetraploid varieties and forms of various origins has been summarized.

Scientific novelty of the research. For the first time in the Ganja–Dashkasan economic region, the areas of distribution of local and introduced fodder mulberry varieties and forms were determined, and their biomorphological and economic characteristics were studied. As a result, 7 local and 12 introduced varieties and forms were identified.

Among them, more productive, stress-resistant, and high-quality ones adapted to local soil and climatic conditions were selected. 12 varieties and 7 forms are new to Azerbaijani sericulture. The selected varieties Akachi and Surkh-tut, and the forms Form-3/27 and Form-3-4/40, showed high productivity and high efficiency coefficients in leaf yield.

Theoretical and practical importance of the research. In the implementation of the State Program on increasing cocoon production and creating new varieties in the country, local and introduced varieties and forms of leafy fodder mulberry, which have been determined by us, can be used. Seedlings of highly productive, economically important varieties and forms have been provided to the Educational Experimental Farm of ASAU for planting. The results obtained have been used to create new productive varieties, passporting, creating varieties and forms, protecting soils from erosion, protecting the gene pool, producing seedlings, etc., which form the basis of a strong fodder base in cocoon production.

The recommendations prepared in order to achieve the creation of a strong feed base for the production of quality wet cocoons that will meet standards in the republic can be used by the relevant agencies of the Ministry of Agriculture of the Republic of Azerbaijan, as well as individual peasant farms engaged in cocoon farming, and amateur sericulturists.

The approbation and application of the work. The results of the conducted research were presented in scientific reports and conferences of the ASRIS (Azerbaijan Scientific Research Institute of Sericulture), ASRIAH (Azerbaijan Scientific Research Institute of Animal Husbandry), and GSU (Ganja State University) in 2012-2024, at the international scientific conference “The Role of Young Scientists in Agriculture: Problems and Opportunities” dedicated to the 91st anniversary of the National Leader Heydar Aliyev (Baku, June 17-18, 2014), at the international scientific conference “Current Problems of Modern Chemistry and Biology” dedicated to the 93rd anniversary of the birth of the National Leader Heydar Aliyev (Ganja, May 12-13, 2016), at the “II International Scientific Conference of Young Scientists” (Ganja, October 26-27, 2017), at the LIII International Scientific and Practical Conference “Russian Science in the Modern World” (Moscow, April 15, 2023), at the 2nd International Conference on the Protection of Eurasian Biodiversity held at Ege University conference (Izmir, September 2-4, 2024) and was widely discussed at the Scientific Seminar of the Agricultural Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan (June 24, 2025).

The results of the research work are widely applied in sericulture farms, traditional and new mulberry orchards located in the Ganja-Dashkasan economic region.

Based on the results of the research work, 22 scientific works reflecting the main provisions of the dissertation were published, 13 of which are articles and 9 are conference materials.

Institution where the research was conducted. The dissertation was carried out at the Research Institute of Animal Husbandry of the Ministry of Agriculture of the Republic of Azerbaijan.

The total volume of the dissertation in characters by indicating the volume of the structural sections of the dissertation separately. The dissertation consists of the introduction, six chapters, conclusions, recommendations, a list of 230 references, and appendices. It includes 23 tables, 3 schemes, 4 graphs, 2 figures, and 1 map.

In the structure of the dissertation, the title part and the table of contents are 3 pages of 3740 marks, the introduction is 6 pages of 11673 marks, the first chapter is 28 pages of 53551 marks, the second chapter is 25 pages of 41418 marks, the third chapter is 44 pages of 75832 marks, the fourth chapter is 9 pages of 14271 marks, the fifth chapter is 18 pages, 28271 characters, the sixth chapter is 5 pages with 6989 characters, the results are 2 pages with 3086 characters, the recommendations are 1 page with 690 characters, and the bibliography is 22 pages with 36010 characters. The total text part of the dissertation (excluding figures, tables, literature list and appendices) is 112 pages of computer writing or 208934 characters.

MAIN CONTENT OF THE WORK

The introductory part of the dissertation provides a brief description of the relevance of the work and indicates its scientific and practical significance.

Chapter I. The history of the development of the mulberry plant, traditional and innovative approaches to cultivation technology, the benefits of mulberry and its use in forage farming, trends that necessitate development in world cocoon farming, the history, current status and future prospects of mulberry cultivation in the Republic of Azerbaijan are given in the literature review.

Chapter II. The natural climate, material and methodology of the place where the research was conducted. This chapter reflects the issues included in the plan-program of the dissertation related to the research and their implementation methods. The conducted phenological observations, trial feedings, and other studies were carried out in accordance with generally accepted methods for mulberry cultivation, and an explanatory analysis of the impact of the natural climatic conditions of the Ganja-Dashkasan economic region,

where the research was conducted, on the cultivation of mulberry plants is given.

Chapter III. It is dedicated to “**Determination of the impact of ecological factors on the development and growth of local and introduced mulberry varieties and forms**”.

3.1. The annual development cycle of the varieties and forms of the fodder mulberry plant depending on the natural environmental conditions was introduced in the semi-season, and the annual development cycle of various varieties and forms of the fodder mulberry plant depending on the natural environmental conditions was determined. First, in order to conduct initial observations on 120 varieties and 26 forms selected as a result of the research, 29 local and introduced varieties and forms were identified and studied according to the adopted individual methodologies.

In order to study the resistance of local and introduced mulberry varieties and forms to variable climatic factors, especially abiotic factors, and to assess the biological potential of the samples, all phenological development phases were sequentially recorded during the vegetation period. Despite the Formation of 3-5 leaves on mulberry trees, from a physiological point of view, the samples first enter the phenological phase - from the moment of bud swelling. It is clear from the phenospectrum that the swelling, opening and leafing of the shoots, the duration of the phase mainly depends on the biological character of the samples, as well as their sex (table 1).

As can be seen from Table 1, the phenospectrum, i.e. the period from bud opening to the Formation of the 3rd and 5th leaves, was recorded as approximately 1,5 days shorter in the introduced varieties for all ploidy groups compared to the local varieties and forms.

From the analysis of phenological observations, it was found that the fodder mulberry plant was able to show this order in foliage, being early, medium and late budding varieties and forms. Of the 29 varieties and forms involved in the study, 4 were grouped as early leafing, 22 as medium leafing, and 3 as late leafing. This classification was determined by us for the first time.

Table 1

Comparative phenospectrum of local and introduced forage mulberry varieties and forms with different ploidy

Ploidy level	Geographical origin	PHENOSPECTR, by day		
		From bud opening to the Formtion of the 3rd leaf	From bud opening to the Formtion of the 5th leaf	The length of time from the opening of the 3rd leaf to the opening of the 5th leaf
Diploid	introduction	10,05	18,47	8,42 \pm 0,23
	local	12,00	19,00	7,00 \pm 0,13
Triploid	introduction	12,00	19,66	7,66 \pm 0,19
	Local	13,00	20,50	7,50 \pm 0,17
Tetraploid	introduction	11,05	18,50	7,45 \pm 0,15
	local	12,33	20,33	8,33 \pm 0,23
Regardless of ploidy	introduction	11,03	18,87	7,84 \pm 0,21
	local	12,44	19,94	7,60 \pm 0,18

Twenty-three of the samples we studied were distinguished from each other as female, three as bisexual, and three as male.

3.2. In the sub-chapter of the comparative study of leaf productivity and structural elements of local and introduced fodder mulberry plants, collection samples of local and introduced fodder varieties and forms of medium-term leafing and high-yielding mulberry varieties and forms characterized by normal biometric indicators on different ploidies were evaluated. In the studies, structural elements that shape leaf productivity, such as the number and length of branches within the umbel, the percentage of productive shoots, the number of leaves in the shoots that produce and do not produce leaves, the leaf mass, the leafiness of the branches, etc., were determined on samples with more valuable characteristics in terms of selection and economy. The percentage of productive shoots in diploid samples, including the control, varied between 79,69%, in triploids 82,02%, and in tetraploids 79,39%. According to these indicators, the best results were obtained in triploid samples. In local varieties and forms, the indicators varied between 82,02-86,08%, and in introduced ones - between 78,76-

84,25%. The same pattern was observed in other local, introduced di and tetraploid varieties and forms. The highest indicator was recorded in Surkh mulberry and Form 3/27 (84,25% and 86,06%). The coefficient of variation between the studied varieties and forms varied between 2,74-24,65%. One of the reasons for the differences in the same indicators in the Ganja-Dashkasan region is considered to be the result of the adaptation of varieties and forms to the natural-climatic conditions in which the study was conducted.

Depending on the ploidy, triploids were superior to diploids and tetraploids by 1,46 and 1,79 units in terms of the number of leaves.

Both too small and too large leaves create difficulties in feeding mulberry silkworms, lead to waste, and reduce the level of profitability. In this regard, it was determined that the average mass of a leaf in growing and non-growing shoots was 1,30-3,82 g in introduced varieties and forms, while in local samples these indicators varied between 2,65-3,24 g. The average mass of a leaf by ploidy was 2,39-2,53 g. Since the value of the coefficient of variation for the studied indicators varied between 2,14-32,42%, it confirms the existence of opportunities to still benefit from the potential opportunities of both selection and innovative agrotechnologies.

3.3. Determination of leaf parameters of local and introduced varieties and forms of fodder mulberry with different ploidy. We have determined the existence of a linear relationship between the length and width of local and introduced leaves of various varieties and forms of fodder mulberry, as well as between the morphometric indicators of leaves formed on growing and non-growing shoots. Thus, by selecting growing shoots according to the leaf size, it is possible to correct the size, morphological characteristics, etc. of leaves on non-growing shoots. The leaves of samples of fodder mulberry varieties and forms were fixed in 70% alcohol solution and preparations were prepared from cross sections. The histological elements of the leaf (upper and lower epidermis, cuticle layer, septum and spongy parenchyma, chlorenchyma, total leaf thickness) were measured using a micrometer. For the study of stomatal cells, the lower epidermis of the leaf was peeled off,

bleached in chlorinated water, washed several times with distilled water, prepared a preparation, and carried out measurements using a micrometer. The thickness of the leaves of diploid samples was 153,89 μm in introduced mulberry varieties and forms, and 146,17 μm in local samples, while the thickness of the leaves in the triploid order was 138,98 μm , 139,16 μm ; in tetraploids 129,38 μm , 130,17 μm . As the polyploidy order increases, the thickness of the leaves also increases. At the same time, the percentage of chlorenchyma eaten by the mulberry silkworm (sometimes called chlorenchyma) relative to the total thickness of the leaf was determined to be the highest in the varieties and forms in the tetraploids.

3.4. Determination of leaf productivity of fodder mulberry by local and introduced varieties and forms. The existence of fodder mulberry varieties and forms, ploidy affiliation, biological characteristics, economic importance, etc. are factors that determine the cocooning of mulberry silkworms in accordance with accepted standards. Taking this into account, the leaf productivity of each variety and form was determined in the experimental field in order to determine the most productive ones in terms of leaf productivity among both local and imported varieties and forms of fodder mulberry from different foreign regions - the People's Republic of China, Japan, Italy, the Russian Federation, Ukraine, Uzbekistan, Turkmenistan, Tajikistan, Georgia, Bulgaria and other countries at the beginning of the last century, and to group and study those of breeding and economic importance (table 2).

The results obtained for the average leaf yield from 1 tree were also characterized by variable quantities depending on the factors studied. According to ploidy, these indicators were 3,58 kg in triploids, 3,54 kg in tetraploids, and 3,31 kg in diploids. Since the upper limit here varied between 129,9% and the lower limit – 79,32%, the coefficient of variation was equal to 50,58%.

In terms of productivity, triploids have the highest leaf yield per tree, tetraploids have the average, and diploids have the lowest.

Table 2

Leaf yield from 1 tree of local, introduced, fodder mulberry varieties and forms with different ploidy

Ploidy	Name of the sample	Origin	Vegetative mass on 1 tree, kg	Leaf out, %	Leaf yield	
					Average yield from 1 tree, kg	average ploidy
Diploids	Yujniy	intro.	6,55±0,17	49,58	3,25±0,08	98,18
	Bol.mest.ul. № 57	intro.	6,39±0,17	49,74	3,18±0,09	96,07
	Kayrio-Rose	intro.	7,08±0,21	46,87	3,32±0,09	100,30
	Komakit	intro.	8,15±0,24	43,05	3,51±0,10	106,04
	Kharkovskiy №3	intro.	7,61±0,22	53,05	4,04±0,12	122,05
	Akachi	intro.	7,27±0,20	57,05	4,15±0,12	125,37
	Kayrio-Vase	intro.	5,80±0,15	53,10	3,08±0,08	93,05
	Khurazme	intro.	6,78±0,18	44,98	3,05±0,07	92,14
	Fosu-Moru	intro.	6,91±0,18	42,81	2,96±0,06	89,42
	Qruziya	intro.	5,81±0,14	49,57	2,88±0,06	87,01
	Seydyuro	intro.	6,22±0,16	50,65	3,15±0,09	95,16
	Eutake	intro.	6,21±0,16	47,81	2,97±0,06	89,73
	Boku-Vase	intro.	6,33±0,17	50,05	3,17±0,09	95,77
	SANISH-10	intro.	6,25±0,16	51,65	3,23±0,08	97,58
	POzdniy-104	intro.	8,12±0,23	48,64	3,95±0,10	119,33
Italyanskiy-2	intro.	5,81±0,15	48,67	2,83±0,08	85,50	
Form-2/17	intro.	6,60±0,17	52,25	3,45±0,09	104,23	
Form-2/26	local	6,14±0,15	53,05	3,26±0,08	98,49	
Sikhgoz-mulberry (control)	local	6,69±0,17	51,44	3,44±0,09	103,93	
According to ploidy			6,66±0,17	49,68	3,31±0,08	100,00
Triploids	Surx-tut	intro.	7,37±0,21	56,95	4,20±0,12	117,32
	Tad. bezsem.-ya	intro.	5,77±0,16	52,34	3,02±0,09	84,35
	Form-5/10	intro.	5,49±0,14	51,75	2,84±0,08	79,32
	Form-3/27	local	8,08±0,21	57,54	4,65±0,13	129,89
	Khanlar-mulberry (control)	local	5,98±0,16	53,53	3,20±0,09	89,38
According to ploidy			6,58±0,16	54,38	3,58±0,10	100,00
Tetraploids	SANISH-5	intro.	6,12±0,15	53,25	3,25±0,08	92,09
	Form-2-1/4	intro.	6,59±0,16	51,45	3,39±0,07	95,76
	Form-3-4/40	local	7,34±0,20	56,90	4,18±0,12	118,07
	Form-4/25	local	6,72±0,17	52,68	3,54±0,10	100,00
	Larisa-mulberry (control)	local	6,34±0,17	52,63	3,34±0,08	94,35
According to ploidy			6,63±0,18	53,38	3,54±0,10	100,00

In early-leafing specimens, the canopy projection varied between 10,51-10,79 m², depending on the variety and form. These indicators were 10,16-10,99 m² in mid-leafing specimens, and 10,29-10,58 m² in late-leafing specimens. The smallest canopy projection was observed in the Kharkovsky No. 3 variety (10,16 m²), while the largest canopy projection was observed in the Italian-2 variety (10,99 m²). In local specimens, these indicators varied from 10,21 m² (Form-3-4/40) to 10,65 m² (Form-2/26).

In the group of early-leafing varieties and forms, the leaf yield per 1 m² of canopy projection varied between 0,28-0,30 kg, in the group of medium-leafing varieties and forms - between 0,26-0,45 kg, and in late-leafing varieties - between 0,28-0,38 kg. The best results were recorded in the local Form-3/27 (0,45 kg), Form-3-4/40 - 0,41 kg, and among the introduced ones - in Surkh-mulberry (0,40 kg), in the Kharkovsky No. 3 variety (0,39 kg) and in the Akachi variety (0,38 kg). The productivity coefficient in terms of leaf yield per 1 m² of canopy projection is higher in the varieties and forms with medium leafing. In terms of productivity indicators, leaf productivity determined for different food areas, varieties, and forms differed depending on the number of trees per 1 ha we conducted.

That is, the number of trees in a 1 ha fodder mulberry orchard was 625 in the 4 x 4 m planting scheme, 1250 in the 4 x 2 m scheme, and 3333 in the 3 x 1 m scheme. In the variant with a large food area and a small number of plants, the productivity coefficient was low, while in the variant with a small food area and a large number of plants, the leaf productivity of local and introduced varieties and forms was significantly higher.

3.5. Annual canopy growth and tree trunk density in local and introduced varieties and forms of fodder mulberry. Triploid specimens of local varieties and forms of fodder mulberry were superior to tetraploids in terms of branch formation, and tetraploids were superior to diploids. The same pattern was also observed in introduced ones. The lowest indicators for the length of 1 branch

were determined in the introduced variety Kayrio-Rose – 96,5 cm, and the longest branches were determined in the local Form-3/27 (117,5 cm). The lowest growth indicator was determined in the introduced Komakit variety, and the highest in the local Form-3/27 (45,35 m/tree).

The stem density of local and introduced varieties and forms of fodder mulberry varied between 35,00-51,00 cm.

The annual growth rates caused by stem density varied between 0,5-1,4 cm, depending on the varieties and forms.

Chapter IV. “The degree of infection of fodder mulberry with diseases in the conditions of the Ganja-Dashkasan economic region, preparation of a system for combating them” chapter reflects the infection of local and introduced mulberry varieties and forms with bacteriosis disease, and the preparation of preventive measures against it. While the degree of infection with bacteriosis after cutting the branches of introduced varieties of fodder mulberry with different ploidy was 9,26% on average in diploids, this indicator was 6,67% in local samples. That is, the infection with the disease was 6,84% higher than in the control (table 3).

Although the disease was not observed in the Khanlar mulberry variety, which was taken as a control variant in triploids, as well as in others, the opposite occurred in the introduced varieties and forms.

Thus, the infection in the introduced samples increased to 26,66%. The same 26,66% infection was observed in the Tadjikskaya bezsemyannaya variety. The average infection rate was 7,99%. The percentage of infection in local varieties and forms, including the control variant (Larisa-mulberry) in tetraploids, was 4,44%.

Unlike this group, no infection was observed in the introduced samples. The average infection rate of varieties and forms with diseases was 2,67%. It can be concluded that varieties and forms with superior biometric indicators for production (Akachi, Surkh-mulberry, Form-3/27 and Form-3-4/40) are more resistant.

Table 3

Disease infection rate after cutting branches

№	Name of variety and form	Origin	Number of diseased branches cut, pcs.	Number of uninfected branches, pcs.	Number of infected branches, pcs.	Incidence of the disease, %
Diploids						
1	Yujniy	intro.	15	13	2	13,33±0,34
2	Bol.m.ul.№57	intro.	15	14	1	6,67±0,17
3	Kayrio-Rose	intro.	15	14	1	6,67±0,17
4	Komakit	intro.	15	12	3	20,00±0,42
5	Kharkov.-y №3	intro.	15	13	2	13,33±0,34
6	Akachi	intro.	15	15	0	0,00±0,00
7	Kayrio-Vase	intro.	15	13	2	13,33±0,34
8	Khurazme	intro.	15	14	1	6,67±0,17
9	Fosu-Moru	intro.	15	14	1	6,67±0,17
10	Qruziya	intro.	15	15	0	0,00±0,00
11	Seydyuro	intro.	15	12	3	20,00±0,42
12	Eutake	intro.	15	13	2	13,33±0,34
13	Boku-Vase	intro.	15	12	3	20,00±0,42
14	SANISH-10	intro.	15	14	1	6,67±0,17
15	Pozdny-104	intro.	15	15	0	0,00±0,00
16	Italyanskiy-2	intro.	15	13	2	13,33±0,34
17	Form-2/26	intro.	15	13	1	0,00±0,00
18	Form-5/10	local	15	15	0	0,00±0,00
19	Sikhgoz-mulberry-control	local	15	14	1	6,67±0,17
Triploidlar						
20	Surx-mulberry	intro.	15	15	0	0,00±0,00
21	Tadjik. bezs.	intro.	15	11	4	26,66±0,51
22	Form-5/10	intro.	15	13	2	13,33±0,34
23	Form-3/27	local	15			
24	Khanlar-mulberry-control	local	15	15	0	0,00±0,00
Tetraploids						
25	SANISH-5	intro.	15	15	0	0,00±0,00
26	Form-2-1/4	intro.	15	15	0	0,00±0,00
27	Form-3-4/40	local	15	13	2	13,33±0,34
28	Form-4/25	local	15			
29	Larisa-mulberry-control	local	15	14	1	6,67±0,17

Chapter V. is dedicated to “Study of the nutritional quality of leaves of local and introduced mulberry varieties and forms”.

5.1. In the sub-chapter on studying the biological indicators of variety-test feeding, the feeding quality and nutritional value of the leaves of local and introduced fodder mulberry varieties and forms of different geographical origins, with different ploidy, existing in the Ganja-Dashkasan region, and the reaction of the introduced mulberry silkworm species to them were studied.

In the studies, we carried out a variety-test feeding consisting of 9 variants in order to determine the forage quality of the leaves of four local and introduced mulberry varieties and forms of different geographical origin, which were selected from 29 varieties and forms with high indicators, positively distinguished by leaf productivity at the appropriate ploidy level, and were superior to others in terms of being more promising.

All the indicators studied were determined to be higher in local samples compared to the introduced ones. The highest indicator was recorded in Form-3/27 (98,35%). It was determined that, in terms of cocoon production from 100 worms, local samples also retained their advantages compared to the introduced ones in all ploidy. The correlation between the mass of the wet cocoon (g) and the silkiness of the wet cocoon (%) was $r = + 0,700$ and $\pm 0,210$.

5.2. In the subchapter on the eating leaves of local and introduced varieties and forms of different ploidy by mulberry silkworms, leaf eating, feed value, nutritional value, etc. were analyzed in our variety testing experiments, along with leaf productivity of trees. Leaf eating by caterpillars was determined for the Ganja-Dashkasan economic region. Although the amount of leaves given to 100 worms in the IV and V years of the experimental variants varied between 3014-3033 g, the average was 3025,23 g for five years.

This difference observed in different years was insignificant (19 g). While in diploid samples the leaves eaten by 100 mulberry silkworms in the control variant were 2138.2 g on average for 5 years, this indicator was 2241,6 g in the introduced Akachi variety,

and less than that in the local Form-2/26 – 2205,3 g. Here, the percentage of leaf consumption varied between 70,7-74,1%, including the control.

Triploid samples differ in that the number of leaves eaten by 100 worms and the leaf utilization coefficient are higher than the other two. The difference is also distinguished by the origin of the leaves.

The average indicator for 5 years was 2238,6 g in the introduced Surkh-mulberry variety, and 2271,9 g in the local Form-3/27, which differed from the control variant by 48,4-81,7 g more leaf consumption. In terms of percentage difference, these indicators were 72,4% in the control variant, 74,0% in the introduced Surkh-mulberry variety, and 75.1% in the local sample - Form-3/27.

In tetraploids, both indicators were higher than in the control. Local samples were higher than in the introduced ones. The percentage of eating was 71,5% in the control variant, 74,6% in Form-3-4/40, and 73,6% in the introduced ones - Sanish-5.

It was determined that local varieties and forms of fodder mulberry were higher than in the introduced ones in terms of results, and in the triploid group both varieties-forms were characterized by higher results, in tetraploids - by average, and in diploids - by low results.

5.3. The effect of the feed quality indicators of mulberry varieties and forms on the cocoon yield of 1 box, 1 g and 100 worms. The productivity indicators of the more promising samples selected from among the local and introduced fodder mulberry varieties and forms in the variety trial feedings were also investigated by us during the research years.

The worms of the mulberry silkworm, whose feeding conditions were basically unchanged for all variants that emerged on the same day were fed with the leaves of those local and introduced varieties and forms. In order to evaluate the tested varieties and forms, the productivity indicators were determined during the research years - cocoon yield from 100 pieces, 1 g, as well as 1 box of worms and the results are given in Table 5. In the research years,

in 1 gram - 2305 worms in 2012; 2320 worms in 2013; 2302 worms in 2014; 2316 worms in 2016; 2308 worms in 2023.

The wet cocoon yield from 100 worms was 201,6 g in diploids fed with local samples and 206,6 g in introduced ones, which was 11,9-14,7% higher than the control (180,1 g). The highest indicator in terms of cocoon yield from 100 worms was recorded in the Akachi variety (206,6 g).

This indicator, which was studied in triploid samples, was higher than the other two. The highest cocoon yield was determined in this ploidy, in the local sample - Form3/27 (210,9 g). In the Surkh-tut variety, which is of introduced origin, this indicator was 205,8 g. Compared to the control, both varieties and forms gave 14,8-17,6% higher cocoon yield.

The results obtained from tetraploid samples showed a position between diploids and triploids. Here too, the cocoon yield was 12,8-15,2% higher than the control. In all variants, the cocoon yield obtained from feeding with leaves of local varieties and forms was higher than that of introduced varieties and forms.

5.4. The influence of the feeding quality of the leaves of local and introduced mulberry varieties and forms on the technological indicators of cocoons. Mulberry farming, which is an integral part of cocoon farming, serves silk production and its future depends on the breed of mulberry silkworm, feeding conditions, and the feeding quality of the leaves of the mulberry varieties and forms given to it. All quality indicators of the cocoon, including silkiness and opening of the veil, are directly reflected in the indicator of raw silk yield from a dry cocoon (according to the current standard GOST 9483-57).

According to the length of the silk thread (also called thread) of a cocoon, diploids: Akachi 1448 m, triploids: Form-3/27 (1640 m), Surkh-mulberry 1339 m, tetraploids: Form-3-4/40- 1312 m, and the fodder mulberry variety-forms Khanlar-mulberry (1107 m) taken as a control also showed good results (table 4).

Table 4
Biochemical composition of leaves of local and introduced mulberry varieties and forms used
in feeding, %

Variations	Feeding has been carried out		The amount of water in the leaf	Hygroscopic moisture	Total nitrogen	Crude protein	Crude ash	Cellulose	Nitrogen-free extractives
	Name of Sort and Form	Origin							
Diploids									
I	Akachi	intro.	75,9 ± 2,04	9,66 ± 0,22	3,76 ± 0,09	23,98 ± 0,55	10,28 ± 0,30	10,53 ± 0,30	46,09 ± 1,11
II	Form-2/26	local	75,1 ± 2,02	9,51 ± 0,22	3,72 ± 0,09	23,45 ± 0,54	10,31 ± 0,30	10,51 ± 0,30	46,05 ± 1,11
III	Sikhgoz-mulberry, control	local	74,8 ± 2,05	9,41 ± 0,19	3,68 ± 0,08	23,09 ± 0,59	10,31 ± 0,31	10,51 ± 0,91	46,04 ± 1,10
Triploids									
IV	Surkh-mulberry	intro.	74,4 ± 2,06	9,22 ± 0,21	3,35 ± 0,08	20,37 ± 0,47	10,41 ± 0,32	10,41 ± 0,28	47,03 ± 1,10
V	Form-3/27	local	76,3 ± 2,17	9,71 ± 0,22	3,84 ± 0,10	24,23 ± 0,58	10,40 ± 0,31	10,66 ± 0,29	47,12 ± 1,1
VI	Khanlar-mulberry, control	local	75,3 ± 2,09	9,55 ± 0,22	3,24 ± 0,09	22,91 ± 0,54	10,37 ± 0,30	10,22 ± 0,22	47,04 ± 1,10
Tetraploids									
VII	Sanish-5	intro.	75,6 ± 2,02	9,14 ± 0,23	3,70 ± 0,08	23,76 ± 0,59	10,29 ± 0,27	10,39 ± 0,25	45,49 ± 1,09
VIII	Form-3-4/40	local	76,0 ± 2,17	9,69 ± 0,21	3,79 ± 0,09	24,07 ± 0,57	10,36 ± 0,31	10,55 ± 0,30	46,45 ± 1,12
IX	Larisa-mulberry, control	local	73,8 ± 2,05	8,81 ± 0,19	3,56 ± 0,08	22,01 ± 0,53	10,31 ± 0,31	10,21 ± 0,21	45,94 ± 1,10

We have determined that the following varieties and forms of fodder mulberry, which differed positively from the control variants in most technological indicators of cocoons, from diploids: Akachi, from triploids: Form-3/27 and Surkh-mulberry, from tetraploids: Form-3-4/40, are more promising in terms of future selection and management.

The correlation between silkiness of dry cocoon (%) and raw silk yield (%) was $r = 0.931 \pm 0.054$.

5.5. Feed value and nutritional properties of leaves of local and introduced mulberry varieties and forms with different ploidy. The feed value and nutritional properties of leaves of local and introduced varieties and forms of fodder mulberry of different geographical origins were better in local samples. Based on the results of the research, it was determined that the local forms triploid Form-3/27, tetraploid Form-3-4/40, and the introduced varieties diploid Akachi, tetraploid Surkh-mulberry were more productive in terms of feed value and nutritional properties and were selected as valuable initial material in selection work. The correlation between leaf yield (s/ha) and raw silk yield (kg/ha) was $r = + 0,994 \pm 0,005$, and between leaf yield and cocoon yield (kg/ha) was $r = + 0,995 \pm 0,004$.

Chapter VI. Economic evaluation of local and introduced varieties and forms of fodder mulberry studied in the Ganja-Dashkasan economic region. In this chapter, a comparative analysis of the local and introduced varieties and forms of fodder mulberry studied from an economic point of view was carried out and a base was created for peasant farmers, as well as amateur growers.

The value of the product obtained from one hectare of land was determined based on the amount of leaves obtained from 1 ha and its total market sales price. In triploid samples, the value of the leaf product obtained from 1 ha of varieties and forms was estimated as 1952-2853 AZN, in triploids - 1952-3196 AZN, and in tetraploids - 2230-2874 AZN. The highest indicator was recorded in the local sample of triploids, Form-3/27 - 3196 AZN, in the introduced Surkh-mulberry variety - 2871 AZN, in the tetraploids - Form-3-4/40 (2874 AZN), and in the diploids - in the Akachi variety (2853 AZN).

Among the studied local and introduced mulberry varieties and forms from an economic point of view, the highest profitability level for the Ganja-Dashkasan region was observed in the triploid local Form-3/27 genotype. The net income is 2053,4 AZN per hectare, the cost of production is 19,66 AZN, and the profitability level is 179,1%.

Based on our research, we recommend the establishment of new mulberry orchards consisting of promising varieties and forms of fodder mulberry for production.

Results

1. 135 local and introduced mulberry varieties and forms of the Ganja-Dashkasan economic region were selected for the study, 29 of which were grouped according to morphological, physiological, agroecological indicators, etc. Thus, the phenointerval period of diploid, triploid and tetraploid varieties and forms varies between 10,05; 12,00 and 11,05 days in the introduced samples, and between 12,00; 13,00 and 12,33 days in the local ones. According to the bud opening, early- (3/IV), medium- (6/IV) and late-budding (13/IV) varieties and forms were identified; according to the mass opening of leaves, 4 samples early- (18/IV), 22 medium- (24/IV) and 3 late-leaving (02/V) varieties and forms were identified.

2. The number of productive shoots in the umbel varies according to ploidy in local and introduced varieties and forms: in diploids – 79,69%, in triploids – 82,02%, in tetraploids – 79,39%, with the best result being obtained in triploid samples. In terms of the number of leaves in the growing shoots, triploids are superior to diploids and tetraploids by 1,46 and 1,79, respectively. In non-flowering shoots, the number of leaves varies between 2,54-3,32, depending on the variety and form. Although the average mass of the leaf in the growing shoots is 2,39 g in diploids, 2,53 g in triploids, and 2,49 g in tetraploids, the leafiness of the branch – 1,60 g/cm; 1.90 g/cm and 1,84 g/cm. In non-flowering shoots, these indicators are approximately two times lower.

3. According to our research, the leaf yield of trees is 3,20 kg/tree in early-leaving varieties and forms, 3,42 kg/tree in medium-

leafing ones, and 3,47 kg/tree in late-leafing ones. The highest indicators were shown by late-leafing specimens, which, compared to others, this difference is 0,05-0,27 kg/tree. The highest leaf yield was recorded in Form-3/27 (4.65 kg), Surkh-mulberry (4.20 kg), Form-3-4/40 (4,18 kg), and Akachi variety (4,15 kg). Local genotypes are superior to introduced ones in terms of high leaf yield (0,24 kg/tree).

4. Depending on the early-leafing varieties and forms of mulberry, the canopy projection is 10,51-10,79 m², in specimens with mid-leafing periods – 10,16-10,99 m², and in late-leafing ones – 10,29-10,58 m². In the group of early-leafing varieties and forms, the leaf yield per 1 m² of canopy projection is 0,28-0,30 kg, in mid-leafing – 0,26-0,45 kg, and in late-leafing – 0,28-0,38 kg.

5. In mulberry cultivation, the leaf yield of early-leafing varieties-forms was determined to be 38,12-40,75 c/ha, medium-leafing varieties-forms – 35,37-58,12 c/ha, and late-leafing varieties-forms - 18,50-24,68 c/ha, depending on the number of trees per hectare. Compared to the introduced varieties-forms, the local genotype - Form-3/27 (58,12 c/ha) with a higher leaf yield coefficient left other samples behind.

6. During comparative variety-test feeding, it was determined that the mass of one wet cocoon varies between 1,80-1,99 g in diploids, 1,85-2,03 g in triploids, and 1,82-2,00 g in tetraploids. In the triploid group, the silkiness of the wet cocoons obtained without feeding with local varieties-forms was 0,07% higher than the introduced ones. The cocoon yield obtained from 100 worms also has the potential to yield 12,28% more cocoon yield than the control.

7. From an economic point of view, the highest profitability level for the Ganja-Dashkasan region among the studied local and introduced mulberry varieties and forms was observed in the triploids: the local Form-3/27 genotype. The net cash income is 2053,4 AZN per 1 hectare, the cost of the product is 19,66 AZN, and the profitability level is 179,1%.

Recommendations

1. It is recommended to use Form-3/27, Form-3-4/40, Akachi and Surkh-mulberry varieties in the establishment of new mulberry

orchards in peasant farms by studying the agrobiocological characteristics of introduced and local varieties included in the gene pool of mulberry orchards existing in the Ganja-Dashkasan region in a comprehensive manner, selecting adaptive, disease and pest resistant, economically more useful, productive, and high-quality specimens for the natural and climatic conditions of the region.

2. In order to obtain a higher-quality leaf crop from an economic point of view, it is advisable to plant Form-3/27, Form-3-4/40, Akachi and Surkh-mulberry varieties and forms with a 4x2 m feeding area and it is proposed to use them for industrial feeding 2-3 times during one vegetation period.

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Address: AZ1098, Pirshaghi settlement, No. 2 Sovkhoz, Agricultural Scientific Research Institute, Baku, Azerbaijan Republic.

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