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(BACSA)**

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**“Climate changes and chemicals – the new  
sericulture challenges”**

**“CLISERI” 2017**

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# **A B S T R A C T S**

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The 8<sup>th</sup> international BACSA "Climate Changes and Chemicals — New Problems of Silkworm Breeding" conference, 2017 "CLISERI", is held to Sheki, Azerbaijan from April 2nd to April 7th, 2017, in Regional Scientific Center Sheki (RSCSh) of National academy of Sciences of Azerbaijan (ANAS), Sheki, Azerbaijan arranges a meeting in cooperation with the Black, Caspian Seas and Association of Silk of Central Asia (BACSA).

We appreciate presenting contributions on the main Conference topic as well as country reports, science and technology papers in the field of mulberry and non-mulberry silkworms, cocoon and silk production, pathology, breeding and bacology, using silkworm and mulberry for non-textile purposes, post-cocoon technologies, silk enterprise and trade.

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## CLIMATE CHANGES EFFECT ON SERICULTURE IN EUROPE, CAUCASUS AND CENTRAL ASIA

(Oral presentation)

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### THE GLOBAL WARMING AND CLIMATE CHANGES

The main official conceptions about the Global warming are that:

- Global temperatures are rising at a rapid, unprecedented rate.
- The "hockey stick" graph proves that the earth has experienced a steady, very gradual temperature decrease for 1000 years, then recently began a sudden increase.
- Human produced carbon dioxide has increased over the last 100 years, adding to the Greenhouse effect, thus causing most of the earth's warming of the last 100 years.
- CO<sub>2</sub> is the most common greenhouse gas.
- Computer models verify that CO<sub>2</sub> increases will cause significant global warming.
- The United Nations' Intergovernmental Panel on Climate Change has proven that man-made CO<sub>2</sub> causes global warming.
- CO<sub>2</sub> is a pollutant.
- Global warming will cause more storms and other weather extremes.
- Receding glaciers and the calving of ice shelves are proof of man-made global warming.
- The earth's poles are warming and the polar ice caps are breaking up and melting.

At the same time, others consider that all these Global warming conceptions are just myths.

For example the Climate Research Unit of the University of East Anglia, shows warming to 1878, cooling to 1911, warming to 1941, cooling to 1964, warming to 1998 and cooling through 2011. The warming rate from 1964 to 1998 was the same as the previous warming from 1911 to 1941. Satellites, weather balloons and ground stations all show cooling since 2001. The mild warming of 0.6 to

0,8°C over the 20th century is well within the natural variations recorded in the last millennium.

Significant changes in climate have continually occurred throughout geologic time. For instance, the Medieval Warm Period, from around 1000 to 1200 AD (when the Vikings farmed on Greenland) was followed by a period known as the Little Ice Age. Since the end of the 17<sup>th</sup> Century, the "average global temperature" has been rising at the low steady rate mentioned above; although from 1940 – 1970 temperatures actually dropped, leading to a Global Cooling scare.

There is no proof that CO<sub>2</sub> is the main driver of global warming. As measured in ice cores dated over many thousands of years, CO<sub>2</sub> levels move up and down AFTER the temperature has done so, and thus are the RESULT OF, NOT THE CAUSE of warming. Geological fieldwork in recent sediments confirms this causal relationship. There is solid evidence that, as temperatures move up and down naturally and cyclically through solar radiation, orbital and galactic influences, the warming surface layers of the earth's oceans expel more CO<sub>2</sub> as a result.

To the present day, there is still no scientific proof that man-made CO<sub>2</sub> causes significant global warming. Besides Carbon dioxide is no more a pollutant than nitrogen is. CO<sub>2</sub> is essential to life on earth. It is necessary for plant growth since increased CO<sub>2</sub> intake as a result of increased atmospheric concentration causes many trees and other plants to grow more vigorously.

Nevertheless, whether there really is a “Global warming” or these are just cyclic climatic changes it is obvious that there are some climate changes which may badly influence the sericulture development.

### **CLIMATE CHANGES AND SERICULTURE**

Through changes in temperature, water regimes and carbondioxide levels, global climate change will directly affect mulberry, soil, pests, and the silkworm.

The effect of climate change is not uniform on all types of crops in all regions and also during all seasons. The increase in temperature may affect crop productivity in tropics. At the same time it may help the temperate regions for higher production or product diversification. On the contrary, the drought which is also the part of climate change, will definitely affect the productivity.

Besides there are some specificities of the climate in European and Central Asian sericulture countries. Even though these countries are located in the temperate and sub-tropical belt like Japan, Korea and parts of China, the climatic conditions are quite different. Most of European and Central Asian sericulture countries with temperate climate have comparatively cold winter and hot, but dry summer. The peak of rains during mulberry vegetation period is in May and June, but July and August are the driest months. On contrary in Japan and Korea July and August are the most rainy months during the mulberry vegetation period due to monsoons. Even though June is considered as a late spring, usually the weather is very hot during the 5<sup>th</sup> larval instar. Due to very hot weather in June the mulberry leaves get coarse quickly. There is also a big temperature fluctuation during the spring rearing season in May and June, namely the night temperature could be half of the day temperature. In early spring (March and April) hot weather with high temperatures like 25–30°C is quickly changed with abnormally cold weather, even temperatures below zero which may very badly affect the already sprouted mulberry trees.

All these specific climatic conditions require mulberry to have

high cold and drought tolerance and the silkworm breeds and hybrids to possess a good tolerance to adverse rearing conditions like high temperature, daily temperature fluctuations and coarse mulberry leaves feeding. It is not occasional that the bush type of mulberry plantations are not popular in any European and Central Asian sericulture country, mainly because their roots are situated too shallow in the soil, compared with low/medium/high stem mulberry trees. In some region countries like Uzbekistan, for example the summer is so dry that there is almost impossible to grow mulberry without irrigation. In Japan and Korea after the spring bottom pruning of mulberry in early June starts the monsoon rainy season which is very beneficial for the trees recovery, sprouting and vigorous growth in June and August, providing long enough shoots for the summer - autumn silkworm top mulberry pruning. In our region countries, however the situation is completely different because after the mulberry bottom pruning in early June starts the summer dry and hot season and mulberry suffers because of lack of sufficient water, so without irrigation the new sprouts are too short for top pruning in early September. It is not occasional also that the share of summer-autumn silkworm rearing in our region countries has always been less than 5 – 10 % of the total annual silkworm rearing.

The climatic changes are towards more periods of sudden change of temperature within one season, extremely hot weather in June, July, August and September and less rain, therefore the regional mulberry and silkworm genetic material and rearing technologies should be adapted to such climatic changes.

Unlike in the past when the temperate countries use to be the major silk producers, there is a Paradigm shift of silk production towards tropical and sub-tropical countries namely South China, India, Vietnam, Thailand in Asia who are the major silk producers in nowadays.

However, what will be the situation in the medium and long-term future? During the second half of 20<sup>th</sup> century and beginning of 21<sup>st</sup> century the sericulture was supported by the different international organizations and national governments mostly as an agro based industry, having a high social impact – “let develop the sericulture to

alleviate poverty and create job opportunity and income resources for the poorest parts of rural society". This concept is one of the reasons for the "moving" of sericulture from the industrialized to developing regions and countries: the examples with Italian, Japanese and South Korean sericulture. The subsidies for sericulture, even very generous in some countries succeeded to save the sericulture from complete disappearing, but only maintained the production at a low level and did not succeed to revive it to the previous high production volumes.

The silk produced was comparatively cheap, providing income resources to many poor farmers from the developing countries. In nowadays there are two main cocoon producers – China and India, providing more than 97 % of the Global cocoon production. In both two countries the local silk market plays a very important role, especially in India, thus presently China exports more than 98 % of the raw silk in the world market. Therefore, the fresh cocoon purchasing prices in all the other countries are considered with the Chinese raw silk price. The fresh cocoon purchasing prices in China and India have increased almost triple during the last 10 years, reaching around 7–10 US\$/kg now. In fact, judging from the previous experience, there is no any chance these prices to go down back; on the contrary, they increase year by year so far. Here I am not going to discuss the reasons of raw silk prices increase, but this situation will lead in a medium – term future to higher cocoon and raw silk prices and as a main result in the long-term future – big increase of the silk fabrics and garment and other sericultural products prices. I believe that it will no more be possible to produce cheap silk like in 90's of 20<sup>th</sup> century and early 2000's.

Then the question is whether the more expensive silk and other sericulture products may be sold at the similar quantities like now?

It seems that at too high final products prices there will not be possible anymore to produce so comparatively big amount of cocoons and raw silk as now, so my vision about the sericulture long-term future is that it will gradually become a boutique-like industry, producing very high value product in restricted amount. This is valid also for the sericulture products use for non-textile purposes.

In the long-term future may be there will be a much smaller than

now sericulture products market, but of high value products.

That means the sericulture may change from an industry for the poorest farmers, to an agribusiness, requiring more investments and productional costs, but having high revenues by high market price of the products.

If this scenario will come true some of the climate changes problems, especially the drought and high temperature during the silkworm rearing will be solved by more investments in mulberry irrigation and suitable rearing houses with good insulation and air conditioned.

Sericulture is an agroactivity comprising of host plant cultivation, silkworm egg production and silkworm rearing. Climate change affects the industry both in positive as well as negative way.

The climate changes have differential effect in different parts and seasons both on host plant cultivation and silkworm rearing.

#### **CLIMATE CHANGE AND MULBERRY CULTIVATION**

Mulberry, a perennial species is physiologically classified as C<sub>3</sub> plant. Plants that survive solely on C<sub>3</sub> fixation (C<sub>3</sub> plants) tend to thrive in areas where sunlight intensity is moderate, temperatures are moderate, carbon dioxide concentrations are around 200ppm or higher, and groundwater is plentiful.

Therefore, the increase in quantum of Carbon Dioxide is reported to be beneficial to mulberry, which is C<sub>3</sub> plant. The increase in temperature may accelerate the faster growth of mulberry. Hence enabling more leaf harvests and a good biomass. However, this is possible only when there is enough moisture available in the soil.

To take the advantages of climate change, one has to have multidirectional approach of genetically improved mulberry with desired characters, better cultivation practices and better pest management system.

How to adjust the mulberry varieties and agrotechnics to cold winters, sudden temperature changes, higher temperatures and drought?

The most important way of course is the mulberry varieties improvement.

## CLIMATE CHANGE AND SILKWORM REARING

An ideal genotype of mulberry for cold and drought resistance should have following features:

- High cold tolerance, one of its most important component is the capability of variety to ripe well the shoots in order not to be damaged by the low temperatures during the winter.
- The variety to have medium term sprouting in the spring because the early sprouting varieties may be damaged by early spring frosts.
- Deep root system (for water mining from deep layers).
- High branch number.
- Can produce more biomass in stress.
- Continues to grow during stress period.
- High leaf thickness (high moisture retention, more photosynthetic efficiency).
- Capable of responding to rains immediately whereas varieties with ceased growth response takes more time.
- High cell membrane stability (can withstand high temperatures), high epicuticular wax (more water use efficiency).
- Less post-harvest water losses and increase the reflection of light).

The other important factor is a suitable mulberry agrotechnics. We could recommend the following type of plantations:

A planting inter-row distance of 1.8–3m and 0.6–1m between the trees in the row. In this planting scheme, the number of trees per 1ha is 9250–3330. The stem height is 0.50–0.60m (low-cut). The advantages of low stem trees rather than bush type plantation are deeper rooting system, thus more tolerant to drought conditions, more “fists” (3–6), each one producing shoots, thus giving higher leaf yield and easier to operate (harvest) because the level of pruning is higher and more convenient for the worker, thus labor saving. Besides the low – stem mulberry shoots ripe better than in the bush type, thus the trees perform better cold tolerance.

The medium and high stem mulberry trees have the same advantages, but they are more difficult for harvesting and require longer period to become full harvesting.

Majority of the insects like the silkworm are cold blooded organisms, whose body temperature is approximately similar to that of environment, hence, the change in temperature influence insect behavior, distribution, development, survival, growth, and reproduction.

For the uni-bivoltine highly productive silkworm races high temperature (over 26°C), high humidity (over 75%) during the 5<sup>th</sup> larval instar and cocoon spinning, high rearing density, malnutrition caused by low mulberry leaf quality, high density or too low feeding amounts provided, not sufficient ventilation during the 4<sup>th</sup> and 5<sup>th</sup> instars and cocoon spinning may be considered as adverse rearing conditions.

The high air temperature during the 4<sup>th</sup> and 5<sup>th</sup> larval instars is the most harmful climatic factor that may influence badly the silkworm and cocoon crop.

In fact, the problems caused by all these adverse conditions can be solved easily by keeping strictly the optimal silkworm rearing technology recommended, stressing on the following technical methods:

Adverse rearing factor	Method to solve the problem
High temperature and humidity during the grown larval instars and cocoon spinning	<ul style="list-style-type: none"> <li>• - rearing house with good insulation</li> <li>• - air conditioned rearing house</li> <li>• - good ventilation</li> <li>• - cleaning the bed after each molt, in the middle of 5<sup>th</sup> instar and before the cocoon spinning</li> <li>• - Dusting of slaked lime on rearing bed and floor to remove excess moisture especially during moulting.</li> </ul>
High larval density	Providing sufficient rearing space
Low mulberry leaves quality	-irrigated mulberry plantation -covering the larvae by polyethylene sheet during the young, but if necessary in the grown larval instars as well.
Lack of sufficient ventilation	Equipping the rearing house with electrical fans

The problem however is that the above methods, listed require more labor and capital investments which most of the sericulture farmers do not want or are not able to make due mainly to the too low economical interest.

Therefore presently, when the sericulture farmers are still one of the poorest people from the society and the cocoon purchasing prices cannot allow them to make big capital investments the only solution to solve partly the problem of adverse silkworm rearing conditions is breeding of silkworm races and F<sub>1</sub> hybrids, having higher tolerance to such a conditions.

The main methods in the silkworm hardy varieties breeding are:  
Selection of silkworm breeds under adverse rearing conditions.

Crosses between bivoltine and polyvoltine races for use as breeding material.

F1 hybrids between polyvoltine and bivoltine parents.

F1 hybrids between hardy and highly productive silkworm breeds.

The main problem in this type of silkworm breeding is the negative correlation between the larval sturdiness and the cocoon weight, silk shell weight and the shell ratio.

Nevertheless, in some countries like for example India, Japan, China and Bulgaria etc. some hardy silkworm breeds and F1 hybrids have been created during the last 20 years.

The breeding target is to create races and hybrids having high tolerance to adverse rearing conditions and medium productivity so that when providing optimal rearing conditions the farmer to obtain a normal fresh cocoon yield per box of eggs with sufficiently high silk shell ratio and reliability.

#### **SUGGESTIONS TO MITIGATE THE EFFECTS OF CLIMATE CHANGE**

- Develop new cold and drought tolerant mulberry varieties.
- Develop silkworm races to adopt for increased temperature coupled with high moisture situations.
- Develop effective management system for silkworm disease prevention/control as high temperature and moisture promote faster growth of pathogens.

- Develop suitable methods to manage high humidity and CO<sub>2</sub> both during rearing and cocoon spinning.
- Creating economical conditions the farmers to be interested and able to make more capital investments in improving the mulberry cultivation and silkworm rearing facilities.

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## Section 1: Mulberry



**EMPHASIS ON AN EXPERIMENTAL MODEL IN PLANTS TRANSFER OF *Pb* IN MORUS SP.**

**(Oral presentation)**

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**Abstract:** The objective of the paper is to achieve an experimental model to see *Pb* transfer in plants *Morus* sp .

The lead is known that when penetrated in the soil it is very difficult to be removed. This metal resists in the layer 0-15sm from the soil surface, where it is strongly bound by adsorption processes, ionic process, precipitation and mixing with organic matter absorbed. To study the soil *Pb* phytoextraction with *Morus alba*, it was conceived as an experimental model consisted of the introduction of lead in soil with irrigation water, and translocation of *Pb* phytoextraction from roots to leaves. Experiments were carried out with the mulberry trees at the pots, watered with the solution containing lead. Soil and leaf samples were taken after 21, 42 and 63 days from the start of the experiment.

By the analyzes was evident influence of the concentration of lead in the soil, the duration of treatment and soil *pH* on *Pb* concentration of leaf.

**Keywords:** *Morus alba*, lead, phytoextraction, soil

## BREEDING AND DIVERSIFIED UTILIZATION RESEARCH ON POLYPLOID HYBRID MULBERRY VARIETY YUESANG 11

(Oral presentation)

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**Abstract:** Yuesang 11, a polyploid hybrid mulberry variety, has been bred by the methods of artificial tetraploid induction and cross breeding. The new variety is with the characteristics of vigorous and fast growth, high leaf yield and excellent quality, strong drought tolerance and regermination ability. The length and width of mature leaves are 25.0~35cm and 22.0~30.0cm respectively. The weight of single leaf is 8.0~12.0g. The suitable planting density is 60,000/ha. on irrigated field, while 75,000/ha. on dry land. It can be harvested branches 4~5 times with the interval of 40~50 days throughout the year. The leaves yield is 52,500~65,000kg/ha. per year. Crude protein and soluble sugar content of mature leaves (dry mater) are 27.5~28.5% and 6.5~7.5% in respectively. Feeding silkworms of Liangguang 2, cocoon yield of per 100 kg leaves is 7.0~9.0 kg. In addition to feeding silkworms, Yuesang 11 has also been exploited and used for vegetable, tea, food ingredient, forage, etc.

**Keywords:** Mulberry, Polyploid, Hybrid, Yuesang 11

## THE ROLE OF FLAVONOIDS IN MULBERRY (*Morus alba* L.) IN RESPONSE TO *Ralstonia solanacearum*

(Oral presentation)

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**Abstract:** Bacterial wilt in mulberry (*Morus atropurpurea* Roxb.), caused by *Ralstonia solanacearum*, is one of the most important production constraints in many tropical and subtropical areas. In our previous work, we investigated gene expression changes in mulberry at the early stages of *R. solanacearum* infection. Now we are investigating transcriptional changes in mulberry that occur during the entire *R. solanacearum* infection process. Analysis of gene expression changes in two mulberry cultivars, following infection with *R. solanacearum*, revealed that expression of a series of genes associated with flavonoid biosynthesis was significantly responsive to infection at all sample time points. Specifically, the expression of genes encoding key enzymes involved in flavonoid biosynthesis—such as chalcone synthase, chalcone isomerase, and flavonoid 3'-hydroxylase—was altered. We obtained full-length sequences of these three genes and additional transcriptional and phytochemical evidence to verify this result using qPCR and aluminum chloride colorimetry. This work indicates that flavonoids may play important roles in bacterial wilt resistance for mulberry plants and provides valuable gene targets for breeding disease-resistant mulberry cultivars.

**Keywords:** Mulberry, *Ralstonia solanacearum*, Disease resistance, Flavonoid, Transcriptome

## BIOMETRIC MEASUREMENTS AND ANALYSIS BIOMASS TO THE ANTHRISCUS CULTURE

(Poster presentation)

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**Abstract:** The objective of the paper is to highlight the evolution of plant *Anthriscus sylvestris* in the second year of culture on an experimental playground out in the field. Measurements were performed over a period of 140 days, starting on 03/07/2016 and was completed in date 07/25/2016. Evolution waist *Anthriscus sylvestris* plant was in close accordance with the climatic conditions typical development period. Plant growth was influenced by variation in temperature during this period of time. The experiments were conducted under conditions suitable for organic farming. Biomass was analyzed in terms of physico-chemical, metal content and active ingredients, and after drying has been used for experiments to extract compounds needed to achieve semi subject to final preparation of the project. In conclusion, the decision on plant cultivation *Anthriscus sylvestris* in one or more generations should be taken depending on the optimum ratio between the content of metal compounds and the active principle in the preparation semi-final. On the one hand it is found that plant growth on at least two generations after seeding increases the content of principles active type polyphenols and lower content of active type flavonoids, on the other hand is recorded content increases in metals, some delving heavy metals category (appearance that certain conditions could be considered negative).

**Keywords:** Anthriscus culture, biometric measurements, the climatic conditions.

## THE APPROPRIATENESS OF MULBERRY TREE HYBRIDS AND ECONOMIC EFFECTIVENESS IN THE OF SLIDING ZONES OF WEST GEORGIA

(Poster presentation)

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**Abstract:** The selected breeds of mulberry trees are effectively used in the zones which are vulnerable to water erosion, also in dry territories, as well as for other purposes.

According to the growing capacity of seedlings and young plants of different breeds of mulberry tree, Triploid-13 seedlings have been distinguished, which is characterized by its strong vegetative mass being in correlation with its amount of green mass. Moreover, the particular attention has been made on the hybrids with strong root system.

Triploid plants develop fairly strong root system in compare with Diploid and Tetraploid plants. Besides, the size of above-land mass and root system size is large in compare with overall mass. For example, foliage mass, overall mass and root mass of Triploid -13 exceeds "Gruzias" comparable data by 26%, 30% and 15% accordingly. Correlation between Underground and above-land vegetative masses in "Gruzia" is – 1,22 and in Triploid-13<sub>3n</sub> – 1,40 which is a high record.

According to their vegetative mass, among mulberry breeds, 760 hybrid seedlings have been selected and planted in the West Georgia.

**Keywords:** Mulberry, young plants, hybrids, strong root system, seedlings

## MOLECULAR CHARACTERIZATION OF MULBERRY (*Morus alba* L.) USING SSR MARKERS

(Oral presentation)

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**Abstract:** The objective of this work is the molecular characterization of mulberry (*Morus alba* L.) cultivars present in Cuban germplasm bank from different origins using Simple Sequence Repeat (SSRs) markers. Thirty-seven mulberry cultivars from 8 different countries including Cuba, Costa Rica, Brazil, South Korea, China, Japan, Italy and Spain were analyzed using 12 nuclear SSR markers. Results established the value of SSR markers for distinguishing different genetic lineages and characterize an extensive and largely gene pool available to mulberry cultivars. The results revealed the presence of 53 different alleles in the 37 assayed genotypes. The Japanese, Italian and Spanish cultivars formed a separated group in which only 5 genotypes were present in the Cuban germplasm bank. On the other hand the Cuban cultivars 'Cuba 2' and 'Cuba 3' propagated from Chinese parents were grouped in the same branch, which suggests that these cultivars retain the genomic characteristics of their selection. It was also possible to relate the genotypes of cultivars 'Tigreada' and 'Acorazonada' present in Costa Rica as well as to evaluate other cultivars for their use in silkworm feeding. Molecular results also evidenced the dissemination of the cultivated mulberry specie from China around the world, the introduction in South Korea and Japan in the first dissemination step and the later wide dissemination of modern mulberry to the Mediterranean area and later to South America and the Caribbean area. These results also allowed to deep in the genomic characterization of different genotypes in order to be able to implement a breeding program that responds to the obtaining of genotypes with a good behavior for sericulture.

**Keywords:** *Morus alba*, Origin, Gene flow, Breeding, Genetic diversity, Molecular markers, Microsatellites, SSR

## PHYTOPLASMA DISEASE OF MULBERRY AND THE RESISTANCE OF PLANTS

(Poster presentation)

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**Abstract:** The diseases and the resistance of plants depend on the various processes which take place in plant cells. As a result of violation of normal living conditions of a plant, it appears in stressful condition and is easily infected by pathogens. The pathogens, after penetrating in plant cells excrete specific toxin which fatally damage the plant. Therefore, between the bacteria and plant is created incompatible relationship that is a prerequisite of development of a disease. The cells of some plants are sensitive to toxins, in such cases between the plant and the pathogen are created coordinated relations and the plant doesn't perish. Such plants are considered resistant, i.e. they are diseased, but yield quite a big crop of leaves.

Protection of a plant against pathogens is carried out in different ways, one of which is the content of chemicals in plant itself. It is established that for the marker of resistance of mulberry to phytoplasma disease can be considered the content of silicium and ascorbic acid and an indicator of the cell environment reaction. And as the markers of the hidden self-defense are recognized a large amount of physiologically active agents in the conducting system of a plant. It has been established that the most powerful autolysis in mulberry leaves takes place only at *pH* - 5.8-6.0, and stops at *pH* - 9.0. Optimum effect of hydrolytic enzymes takes place when *pH*-makes 6.6-7.5 units. Direct correlation dependence between quantity of phloem cells and of the cell environment reaction has been established. Resistance of the studied forms defined by coefficient of resistance/ratio between quantities of phloem cells to *pH* indicator. The variety or the form of a mulberry is considered resistant if the coefficient of resistance -K is more than 1.0.

**Keywords:** Mulberry, Disease, Resistance



## INFLUENCE OF CLIMATE ON THE DEVELOPMENT AND PRODUCTIVITY OF SOME BULGARIAN MULBERRY VARIETIES.

### 1. INFLUENCE OF SOME CLIMATIC FACTORS ON ECONOMIC CHARACTERS OF MULBERRY BRANCHES

(Poster presentation)

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**Abstract:** The influence of basic parameters which characterized the climate conditions on economical important branch characters of some Bulgarian varieties of mulberry has been investigated. The study was conducted at Moriculture Experimental Field of SAES - Vratsa during 2010-2012. It was found that the values and the variability of climatic factors over the years affected sustainability in the development of the tested varieties. Generally, climate affects significantly the length of branches and total branch length of a tree. Correlation's coefficients between the main branch characters of mulberry and climate parameters have been ranged from negative to positive and from very low to medium by power. Length of the branches correlates weakly and negatively with the amount of rainfall during the growing period of mulberry and the amount of rainfall during the period from September to May, and slightly positive by the sum of effective temperatures for the growing season. Internodal distance itself negatively correlated with the amount of precipitation for the period from September to May and the sum of effective temperatures for vegetation period and positively with the amount of rainfall during the growing period of mulberry. The influence of air temperature on the main branch characters is proved, and the sum of effective temperatures for vegetation period of mulberry correlates positively with most economical characters of tested Bulgarian varieties at Vratsa's, ecological conditions.

**Keywords:** mulberry varieties, climate, Vratsa, branch parameters, correlations

## INFLUENCE OF CLIMATE ON THE DEVELOPMENT AND PRODUCTIVITY OF SOME BULGARIAN MULBERRY VARIETIES.

### 2. INFLUENCE OF SOME CLIMATIC FACTORS CHANGE ON ECONOMIC CHARACTERS OF MULBERRY LEAF AND PRODUCTIVITY IN MULBERRY

(Poster presentation)

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**Abstract:** The influence of basic parameters which characterized the climate conditions on economical important characters of leaves and productivity of some Bulgarian mulberry varieties has been investigated. The study was conducted at Moriculture Experimental Field of SAES-Vratsa during 2010-2012. It was found that climatic conditions over the years affected sustainability in the development and productivity of the tested varieties. Generally, climate affects significantly the size and weight of leaves. Mulberry productivity, expressed in leaf yield per branch also has influenced significantly by ecological conditions. Correlation's coefficients between the main leaf characters, together with leaf yield of mulberry and climate parameters have been ranged from negative to positive and from very low to medium by power. Most of tested characters, as leafiness percentage of tree, leaf weight and leaf yield per one branch correlates negatively with the amount of rainfall during the growing period of mulberry and the amount of rainfall during the period from September to May, and slightly positive by the sum of effective temperatures for the growing season. The sum of effective temperatures for vegetation period of mulberry correlates positively with most economical characters of tested Bulgarian varieties at Vratsa's ecological conditions.

**Keywords:** mulberry varieties, climate, leaf characters, productivity, correlations

## EFFECTS OF MULBERRY (*Morus alba*) FRUIT CONSUMPTION ON LIPID PROFILES, ANTIOXIDANT AND INFLAMMATION STATUS IN HYPERCHOLESTEROLEMIC SUBJECTS

(Oral presentation)

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**Abstract:** Cardiovascular disease (CVD) is a non-communicable disease, but it is an important public health problem worldwide. In mulberry fruit, there is plentiful of nutrients and phytochemicals; especially, anthocyanin that can reduce a risk of CVD development. However, there is no research have been studied in human. This study; therefore, emphasizes on an effect of freeze-dried mulberry fruit consumption on lipid profiles, antioxidation and anti-inflammation of adult human that has Dyslipidemic.

The study was an experimental controlled trial (randomized controlled trial) that consist of 58 adult human with Dyslipidemic subjects, age range between 30 and 60 years old. Thirty subjects (experimental group) were consumed freeze-dried mulberry fruits, which contain 325 mg of anthocyanin, and the remains (control group) were not consumed.

The results showed that the total cholesterol and LDL-C in Dyslipidemic subjects who consumed freeze-dried mulberry were significantly reduced ( $p \leq 0.001$ ). However, the consumption of freeze-dried mulberry fruit did not effect on triglycerides, HDL-C and anti-inflammation; while, the anti-oxidation in the experimental group was significantly increased ( $p \leq 0.001$ ) after the experiment.

The mulberry fruit consumption can reduce total cholesterol, LDL-C and increase anti-oxidative activity. Therefore, mulberry fruit may be an alternative choice for regulating the lipid level in Dyslipidemic adults, and then can decrease the risk of CVD.

**Keywords:** Mulberry Fruit, Anthocyanins, Lipid Profiles, Antioxidation, Hypercholesterolemic Subject

## Section 2: Silkworm and silk



### NATURAL DYE TREATMENT OF SILK FIBERS IMPROVEMENT VIA SURFACE MODIFICATION BY UV-IRRADIATION

(Oral presentation)

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**Abstract:** This work presents the comparative study on the structure and properties of silk yarns produced in Thailand and used in the textile industry. The silk yarns used in this research were obtained from four species as native variety (NangSew x NangTui), Thai hybrid (LeungPiroje, Ubon ratchathani 60-35) and foreign varieties (Chul 1). The results indicated that all of the silk yarns obtained from the four silkworm varieties had the similar morphology, chemical functional groups and thermal property. However, it was found that silk yarns obtained from Chul 1 produced the highest quality of the mechanical property because these silk yarns were reeled by the automatic industry machine. Consequently, it produced the highest strength of silk yarns which were better than the silk yarns obtained from LeungPiroje, Ubon ratchathani 60-35 and NangSew x NangTui, respectively. After degumming, all of the four silk yarns decreased in tenacity and elongation.

For the effect of UV irradiation on the dyeability with natural dyeing stuff, the silk fabrics from Chul 1 silk yarns were irradiated for 0.5, 1 and 3h, and then dyed with natural dye. Dyeability was analysed in terms of CIE  $L^*a^*b^*$  values and K/S value. The result showed that the UV irradiation on silk fabric could improve the dye absorption of silk fabrics. The silk fabric treated with 3 h of UV-irradiation had the highest K/S value. However, treating a silk fabric with UV-irradiation resulted in a decrease of tensile strength for all warp and weft direction.

**Keywords:** Silk Yarns, Silk Fabrics, UV-irradiation, Dyeability



## BASIC CHEMICAL COMPOSITIONS AND ANTIOXIDANT ACTIVITIES OF THAI SILKWORM AND SILKWORM PUPA

(Oral presentation)

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**Abstract:** Silkworm pupa has normally obtained as a by-product during cocoon production. Some of their antioxidant activities were studied, but not cover all Thai silkworm varieties which have been promoted by The Queen Sirikit Department of Sericulture. Therefore, this research aimed to study on the basic chemical compositions and antioxidant activities of Thai silkworm and silkworm pupa. The experimental design was 7×2×2 Factorial in Completely Randomized Design. Three main factors were studied which were 7 silkworm varieties (Nangnoi Srisaket-1, Samrong, Nangtui×Nangsew, Nangnoi Srisaket-1×Samrong, Ubon Ratchathani 60-35, Luang Surin and J108×Nanglai), 2 stages of silkworm (mature silkworm and silkworm pupa) and sex (male and female). It was found that all silkworm varieties had similar basic chemical compositions without significant differentiation ( $p \geq 0.05$ ) which were moisture (77.13-78.93%), protein (56.11-61.71%), fat (11.02-19.11%), ash (4.19-6.73%) and carbohydrate include fiber (18.49-23.86%) respectively. However, it showed that silkworm pupa had higher fat and carbohydrate include fiber content than silkworm with having significant differentiation ( $p \leq 0.05$ ). In addition, male pupa had fat content more than female pupa but female pupa had protein and carbohydrate include fiber content more than male pupa. Antioxidant activities analysis had been evaluated by using 3 methods; DPPH, TEAC, and TRAP assays). It can be seen that Nangnoi Srisaket-1 and Luang Surin silkworm varieties had significantly ( $p \leq 0.05$ ) highest of antioxidant activities, while silkworm pupa showed higher antioxidant activities than mature silkworm in each variety. Furthermore, both male and female gave the same level of antioxidant activities with having no significantly differentiation.

**Keywords:** Silkworm, Silkworm pupa, Chemical composition, Antioxidant activities

## INFLUENCE OF THE SERICIN CONTENT ON SOME MAIN TECHNOLOGICAL CHARACTERS OF *Bombyx mori* L.

(Poster presentation)

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**Abstract:** Sericin content is of great importance in the production of raw silk. The study has been carried out at the educational and experimental base of the Silkworm breeding section of the Faculty of Agriculture at Trakia University, Stara Zagora-Bulgaria. The aim of the study was to investigate the effect of sericin content in the *Bombyx mori* silk thread on the phenotypic manifestation of technological characters: raw silk ratio (%), reelability (%), total and non broken filament length (m), filament thickness (denier) and initial rate of dissolution of sericin. Analysis of variance showed that the sericin content had significant effect on the technological characters raw silk ratio ( $p \leq 0.01$ ), reelability ( $p \leq 0.01$ ), non broken filament length ( $p \leq 0.01$ ) and initial rate of sericin dissolution ( $p \leq 0.001$ ).

**Keywords:** Silkworm, *Bombyx mori* L., Sericin, Technological characters

## THE ROLE OF ADAPTIVE SELECTION IN CREATION OF BREEDS PRODUCTIVITY

(Oral presentation)

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**Abstract:** The results of the experiment show that spring, summer and autumn feeding has highly effectiveness in the method of selection. As a result of analysis of the scientific research, some biological parameters of mulberry silkworm such as the weight of wet cocoon, the weight of cocoon shell and the silkness of wet cocoons change in accordance with the law as a result of changes of environmental conditions.

**Keywords:** weight of wet cocoons, the weight of cocoon shell, wet silk cocoons

## EFFECT OF THAI SILKWORM PUPA EXTRACT ON ACTIVATION OF VASODILATION

(Oral presentation)

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**Abstract:** This research was aimed to study on the activation and mechanism of vasodilation of Thai silkworm pupa extract obtained from two different solvent layers. Both male and female pupae of two silkworm varieties as Nangnoi Srisaket-1 and Luang Surin were studied. Silkworm pupa was extracted using ethanol and water, then each sample was evaporated, dried by freeze dryer and crushed into small powder. Silkworm pupa powder was analysed for Cytotoxicity on blood vessels cell using MTT {3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl-tetrazolium} bromide assay. It was found that maximum concentration of Nangnoi Srisaket-1 and Luang Surin extracted powder samples from ethanol layer which 90% of cells could survive were at 60 and 410 µg/ml respectively, while extracted powder from water layer were at 2200 and 125 µg/ml respectively. Ability of extracted powder on blood vessel cells to produce nitric oxide comparing to standard solution, Sildenafil (Viagra®), using Griess's method of extracted powder from ethanol layer from Nangnoi Srisaket-1 and Luang Surin were high activity which were 101.57% and 102.55% respectively, while extracted powder from water layer had lower activity which were 80.83% and 79.23%, respectively. In addition, mechanism of nitric oxide production in blood vessels by extracted powder from both layers comparing to standard solution had also been studied. Endothelial nitric oxide synthase (eNOS) mechanism was positive effect on health by controlling blood circulation. Extracted powder of Nangnoi Srisaket-1 from ethanol and water layers had stimulated eNOS gene expression for 2.7 and 2.6 times respectively, related to β-Actin which were slightly lower than standard solution (3.1times), while extract from both layers of Luang Surin had lower level. Another mechanism was inducible nitric oxide synthase (iNOS) mechanism which was negative effect on health by causing inflammation of cells. Extracted powder from ethanol and water layers had stimulated iNOS gene expression for 1.1 and 1.2 times respectively, related to β-Actin which were higher than standard solution (0.65 time), while extract from both layers of Luang Surin were at least 4 times higher than standard solution. In summary, extract of Nangnoi Srisaket-1 pupa from ethanol layer was the most effective on activation of vasodilation which also provided beneficial effect on health and had high potential to produce as a functional food.

**Keywords :** Silkworm pupa , Nitric oxide , Sildenafil, Vasodilation

## Heterosis manifestations and depression by survival and larval duration of *Bombyx mori* L. hybrids reared with artificial diet

(Oral presentation)

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**Abstract:** The aim of this paper was to study the influence of the degree of heterosis (compared to higher parent value - HP and mean parental values - MP) and inbred depression on the signs, survival and larval duration of *Bombyx mori* L. hybrids. The study was conducted at the Training Experimental Station of the Sericulture section of the Faculty of Agriculture at Trakia University. Object of the study is a hybrid, created in Sericulture and Agriculture Experiment Station (SAES) -Vratsa, with the participation of maternal breed with high survival rate and shorter larval duration ("Vratsa 55" - 83.08% and 92 h) and a father's breed with very low survival rate and extended larval duration ("Banysa P" - 57.44% and 107 h). Silkworms were reared with artificial diet containing 15% powder of dried mulberry leaf produced at SAES-Vratsa and prepared by methods, developed by the manufacturer, whereby 250g of dry substance and 675ml of distilled water are homogenized using a mixer. The mixture is cured thermally in a microwave for 10 min at ~800W.

The susceptibility of hybrid, heterosis manifestations of the signs in F<sub>1</sub> and the depression in F<sub>2</sub> was determined based on the results from the survival rate and larval duration in the I-st instar of the larval stage by the parental breeds (P<sub>1</sub> and P<sub>2</sub>) and hybrid generations (F<sub>1</sub>, F<sub>2</sub>, BCP<sub>1</sub> and BCP<sub>2</sub>).

The results (90.94% survival and 88 h duration of larval duration) show that hybrid "Vratsa 55 x Banysa P" shows a high degree of susceptibility to artificial diets with reduced content (15%) of mulberry leaf powder. Better results were seen in BCP<sub>1</sub> hybrid generation with the participation of breed "Vratsa 55" as a donor. It was found a high degree of heterosis expression for F<sub>1</sub>, as compared MP and as to the HP for the both analyzed signs. The high degree of heterosis in F<sub>1</sub> was accompanied by depression in F<sub>2</sub>.

**Keywords:** Silkworms, *Bombyx mori* L., Artificial diet, Heterosis, Depression

## Structural characteristics and properties of Argiope amoena dragline silk fiber obtained by different reeling speed

(Poster presentation)

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**Abstract:** Spider dragline silk is of practical interest because of its excellent mechanical properties. To obtain stronger spider silk fiber, we studied the mechanical properties of dragline silks of *Argiope amoena* obtained under reeling speeds ranging from 2 to 100 mm s<sup>-1</sup>, and its microstructure were evaluated. [It is surprising that our experiments show that relationship between mechanical properties and reeling speeds of \*A. amoena\* is different with those of \*Araneus diadematus\*, \*Nephila edulis\* and \*Nephila pilipes\* of previously reported.](#) The results show that the breaking stress, the  $\beta$ -sheet structure contents and crystalline structure of the silk fibers reeled at 20 mm s<sup>-1</sup> are remarkably superior to those of silk fibers reeled by other speeds, suggesting that the fine dragline silk fiber of *A. amoena* obtained at 20 mm s<sup>-1</sup>.

**Keywords:** Spider dragline fiber; Reeling speed; Mechanical properties; Molecular conformation

**BREEDING OF NEW HIGHLY PRODUCTIVE SILKWORM,  
BOMBYX MORI L. BREEDS OF JAPANESE TYPE BY INITIAL  
PARENTS SELECTION FOR MORPHOLOGICAL TRAITS**

**(Poster presentation)**

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By selection of parents from an initial foreign F1 hybrid popula-  
tion for morphological characters two new silkworm breeds of  
Japanese type Ana 11 and Chislau 21 have been created.

The new breeds are characterized with high biological and tech-  
nological characters values. The breed Chislau 21 manifested higher  
values of the main quantitative traits, namely egg - 99.68%, pupa-  
tion rate – 95.75%, fresh cocoon weight – 2464 mg, silk shell weight  
– 533 mg and shell ratio – 21.63%.

Both new silkworm breeds were recommended for using in the  
future breeding programs.

**Key words:** silkworm, *Bombyx mori* L., breeds, selection, produc-  
tivity

**COMPARATIVE TRANSCRIPTOME ANALYSIS OF *Bombyx  
mori* (Lepidoptera) LARVAL MIDGUT RESPONSE TO  
BmNPV IN SUSCEPTIBLE AND NEAR-ISOGENIC  
RESISTANT STRAINS**

**(Oral presentation)**

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**Abstract:** *Bombyx mori* nucleopolyhedrovirus (BmNPV) is one of  
the primary pathogens causing severe economic losses in sericul-  
ture. However, the [molecular](#) mechanism of silkworm resistance to  
BmNPV remains largely unknown. Here, the recurrent parent P50  
(susceptible strain) and the near-isogenic line BC9 (resistance  
strain) were used in a comparative transcriptome study examining  
the response to infection with BmNPV. A total of 14,300 unigenes  
were obtained from two different resistant strains; of these, 869  
differentially expressed genes (DEGs) were identified after compar-  
ing the four transcriptomes. [Many DEGs associated with protein  
metabolism, cytoskeleton, and apoptosis may be involved in the  
host response to BmNPV infection. Moreover, some immunity re-  
lated genes were also altered following BmNPV infection. Specifi-  
cally, after removing genetic background and individual immune  
stress response genes, 22 genes were found to be potentially in-  
volved in repressing BmNPV infection. These genes were related to  
transport, virus replication, intracellular innate immune, and apop-  
tosis.](#) Our study provided an overview of the molecular mechanism  
of silkworm resistance to BmNPV infection and laid a foundation for  
controlling BmNPV in the future.

**Keywords:** *Bombyx mori* (*B. mori*); Nucleopolyhedrovirus (NPV);  
RNA-seq; differentially expressed genes; response mechanism

## CREATION OF A MULBERRY SILKWORM BREED RESISTANT TO A DISEASE “NUCLEAR POLYHEDROSE”

(Poster presentation)

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2. Georgian Agrarian University

**Abstract:** In distinct from other insects the mulberry silkworm is more sensitive to the impacts of environment factors, to breeding and artificial selection led by a man in various directions.

Study of the principles of historic development of mulberry silkworm, its hybridization, rearing and selection is most important and will enable us to control and manage the worm growth, development and its productivity.

Our research is dedicated to the management of silkworm productivity, and it pursues to prepare high quality grain that would be resistant to the silkworm disease “nuclear polyhedrose”.

With this in view, to induce mulberry silkworm disease “nuclear polyhedrose”, we have developed a method of artificial infestation of a mulberry silkworm.

At the initial stage we collected hemolymph of silkworms artificially infested by the method of induction, then polyhedrons were isolated by the use of a centrifuge which was washed and polyhedral suspension was prepared.

At the second stage the following polyhedral suspension concentrations were used for artificial infesting: 500mm<sup>3</sup>, 1000mm<sup>3</sup>, 5000mm<sup>3</sup>, 10000mm<sup>3</sup> and 500000mm<sup>3</sup>. The last version of the above listed concentrations resulted in mass death of worms, the 10000mm<sup>3</sup> version was lethal for 74%, 50000 mm<sup>3</sup> - for 39%, 1000mm<sup>3</sup> - for 6 % and 500mm<sup>3</sup> - for 3%.

From 5 concentrations listed above the 500mm<sup>3</sup> polyhedral suspension, as the most efficient was used for creation of a new breed resistant to this disease.

**Keywords:** mulberry silkworm, diseases, grain.

## STUDY OF NEWLY INTRODUCED SILKWORM, BOMBYX MORI L. BREEDS FROM AZERBAIJAN

(Poster presentation)

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**Abstract:** A study with 4 silkworm breeds from Azerbaijan has been carried out during the period 2011–2015 at the Sericulture and Agriculture Experiment Station, Vratsa, Bulgaria.

It was detected that the breeds Azeri and Vatan could be characterized as Japanese type and the breeds Karabakh and Jafar – of the Chinese type.

The results obtained manifested that the Azerbaijani breeds performed a good adaptation to the Bulgarian conditions, which was proved by the comparatively high main quantitative characters values. In average the eggs hatchability was 99.35%, the pupation rate was 94.50 %, fresh cocoon weight was 2185 mg, silk shell weight was 528 mg and the silk shell ratio was 24.16%.

The results clearly bring out that the Azerbaijani breeds could be used both as initial material in the future breeding programmes as well as for direct commercial hybridization.

**Key words:** Silkworm, *Bombyx mori* L., Hatchability, Pupation ratio, Cocoon weight, Shell weigh, Shell ratio.

## RECEIVING OF COLOR COCOONS WITH FLUORESCENT SUBSTANCES

(Oral presentation)

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**Abstract:** When feeding caterpillars of a silkworm a natural forage, on fresh leaves of a mulberry sprayed a 0,025% aqueous solution rhodamine-B and received color cocoons that silk threads received from these cocoons give a fluorescence (bloom) in the light of UF-lamps. By application of repeated feeding of caterpillars and cleanings of a fibroin, we specified that molecules of fluorescent substance are included into structure of proteins of a fibroin. Therefore, these threads can be used with success as protective threads for identification in case of falsification of non-foods and banknotes.

**Keywords:** *protective thread, luminophore, rhodamine, identification and falsification, fluorescent threads, protection of banknotes, non-foods*

## MICRORNA DIFFERENTIALLY EXPRESSED IN DIAPAUSING VERSUS HCl-TREATED *Bombyx* EMBRYOS

(Poster presentation)

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**Abstract:** Differentially expressed MicroRNAs (miRNAs) were detected to explore the molecular mechanisms of diapause termination. The total small RNA (sRNA) of diapause-destined silkworm eggs and HCl-treated eggs was extracted and then sequenced using HiSeq/MiSeq high-throughput method. 44 novel miRNAs were discovered. Compared to those in the diapause-destined eggs, 61 miRNAs showed significant changes in the acid-treated eggs, with 23 being up-regulated and 38 being down-regulated. The potential target genes of differentially expressed miRNAs were predicted by miRanda. Gene Ontology and KEGG pathway enrichment analysis of these potential target genes revealed that they were mainly located within cells and organelles, involved in cellular and metabolic processes, and participated in protein production, processing and transportation. Two differentially expressed genes, *Bombyx mori* SDH (*BmSDH*) and *Bmo-miR-2761-3p*, were further analyzed with qRT-PCR. *BmSDH* was significantly up-regulated in the HCl-treated eggs, while *Bmo-miR-2761-3p* was down-regulated. These results suggested that these two genes were well coordinated in silkworm eggs. Dual luciferase reporter (DLR) assay demonstrated that *Bmo-miR-2761-3p* inhibited the expression of *BmSDH*.

**Keywords:** *Bombyx mori*, miRNAs, silkworm eggs, qRT-PCR, *BmSDH*



## REGULATION OF ANTIMICROBIAL PEPTIDE GENES VIA INSULIN-LIKE SIGNALING PATHWAY IN THE SILKWORM,

*Bombyx mori*

(Poster presentation)

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**Affiliation:** 1. Guangdong Provincial Key Laboratory of Agro-animal Genomics and Molecular Breeding/Guangdong Provincial Sericulture and Mulberry Engineering Research Center, College of Animal Science, South China Agricultural University, Guangzhou, 510642, China; 2. The Sericultural and Agri-Food Research Institute of the Guangdong Academy of Agricultural Sciences, Guangzhou, 510610, China; 3. Division of Molecular Biology and Biochemistry, School of Biological Sciences, University of Missouri-Kansas City, 5007 Rockhill Road, Kansas City, MO 64110, USA

**Abstract:** Antimicrobial peptides (AMPs) are important effector molecules of insect humoral immunity, and expression of AMPs is mainly regulated by the Toll and immune deficiency (IMD) pathways. FoxO, a key downstream regulator of the insulin-like signaling (ILS) pathway, has been recently reported to be involved in the regulation of AMPs in *Drosophila melanogaster*. In the present study, we investigated AMP expression and the regulation pathway controlled by starvation in the silkworm *Bombyx mori*. We discovered that antibacterial activity in the hemolymph of *B. mori* larvae was induced by starvation, and AMP genes (*BmCecB6*, *BmAtta1*, *BmLeb3* and *BmDefB*) as well as the ILS target genes (*FoxO*, *InR* and *Brummer*) were strongly activated in the fat body by starvation. Moreover, phosphorylation of Akt kinase was reduced in the Bm-12 cells after starvation, suggesting that the ILS pathway was inhibited. We then showed that more FoxO protein was present in the cytoplasm than in the nucleus of Bm-12 cells under normal conditions, but more FoxO was detected in the nucleus after cells were starved for 8 hours, indicating that FoxO was activated by starvation. In summary, our results indicated that starvation can induce AMP gene expression in *B. mori* via the ILS/FoxO signaling pathway.

**Keywords:** FoxO transcription factor; antimicrobial peptide; ILS; starvation; *Bombyx mori*

## TRANSCRIPTOME AND PROKARYOTIC EXPRESSION ANALYSIS OF HMG1 OF *Nosema bombycis*

(Poster presentation)

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**Abstract:** *Nosema bombycis*, as a typical pathogens of silkworm Pebrine disease, has the characteristics of eukaryotes, parasites in cell, and always has been as the pathogen to quarantine in silkworm eggs' production. On the basis of the transcriptomics research of *N.bombycis* (GD), Here we selected *N.bombycis* sex related locus genes: *HMG*, *TPT*, *RNA helicase* gene to sequence and do bioinformatics analysis. The main results as follows:

1) 20 nucleotide fragments of *HMG*, *TPT*, *RNA helicase* gene of sex related locus in our database of *N.bombycis* were confirmed. The similarity is more than 90%, respectively.

2) *HMG1* gene (KR057922) was conducted with bioinformatic analysis, the result showed that *N.bombycis* HMG1 protein contains conserved structure domain HMG-box, and also implied that microsporidia exists sexual cycle. Phylogenetic analysis showed that homology of different *N.bombycis* strains was 100%, HMG1 proteins of the same species were highly conserved, and showed that microsporidia and fungi were closely related.

3) In silkworm infected *N.bombycis* developmental periods, *HMG1* has showed different transcription activity. *HMG1* gene has a highest express quantity in the 24hr after p.i. of the forth star silkworm, and in the 72hr without acid treatment eggs , or in 24hr for acid treatment eggs from the p.i. moth, respectively. These results suggested that *HMG1* could be influenced microsporidia reproduction, and involved all procedure of the embryo development of the host.

4) After conducting *HMG1* prokaryotic expression, the MW 21.5 kDa recombinant protein were harvested and prepared for antibody. We successfully detect the HMG1 protein in *N.bombycis*. But we failed to detect fluorescence signal in nucleus with the indirect immunofluorescence technique. We still less understand HMG1 protein. (This work supported by the project of CARS-22-ZJ0205)

**Keywords:** *Nosema bombycis*; sex related locus; phylogenetic; *HMG1*; transcription; prokaryotic expression

## IDENTIFICATION OF *silkworm pebrine* BY LOOP-MEDIATED ISOTHERMAL AMPLIFICATION

(Poster presentation)

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**Abstract:** In order to control the silkworm pebrine disease, it is essential to identify the pathogen of *N.bombycis* from the silkworm tissues and other. Loop-mediated Isothermal Amplification(LAMP) as a new developed molecular amplification method in vitro. It is very rapid, helpful and economic to detect the pathogen. Here LAMP method was applied to identify and to detect the pebrine pathogen of *N. bombycis*. The main results as follows:

Firstly, basing on the LAMP primer design program to analyze the pseudogene of 16ssrDNA, lots of groups of primers were designed. Then, after investigating of their effectiveness, specificity and reaction time in virtual and in lab, one group of primers F12/B12 and F2/B2 were screened.

Secondly, the primers were used to detect the species specificity. LAMP could identify *N.bombycis*, and the mixture of *N.bombycis* and BmNPV polyhedron, from the microsporidian spores isolated from *Prodenis litura*, the results were confirmed by PCR.

Finally, we found that the sensitivity of LAMP related with the extracting DNA from microsporidian spores, DNA extracted by boiling precipitation method was  $10^4$  times higher than the DNA extracted by CTAB method, and was 100 fold than PCR, the lower limit concentration was  $3.6 \times 10^3$  spores / mL of the *N.bombycis*. Furthermore, pre-denaturation could reduce the false positive. (This work supported by the project of CARS-22-ZJ0205).

**Keywords:** *Nosema bombycis*, loop-mediated isothermal amplification, PCR pseudogene rRNA, Bst polymerase, silkworm pebrine

## PROGNOSTICS OF MULBERRY SILKWORM DISEASE – nuclear polyhedrosis IN GRAIN PHASE

(Poster presentation)

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**Abstract:** Among mulberry silkworm diseases nuclear polyhedrosis is distinguished by its pathogenicity and it is the infectious disease that affects sericulture greater than others. Soon after exposure of disease in silkworm, it is spread rapidly intensely. Therefore, it is most important to predict a disease in grain phase, which will enable us to prepare absolutely healthy grain and to avoid mass spreading of disease and significant economic loss. Early diagnostics of resistance to polyhedrosis is possible by the use of modern methods of genetics, biochemistry and molecular biology. This is why we pursued to expose polyhedrosis virus in grain phase.

Initially mulberry silkworms of the Mziuri-1 species were infected by the induction method to incite polyhedrosis; then hemolymph was isolated from diseased worms and gathered in Pendorf flasks; it was washed and pure polyhedrons was obtained; various polyhedral suspension titers were prepared:  $1000\text{mm}^3$ ,  $5000\text{mm}^3$ ,  $10000\text{mm}^3$ ,  $500000\text{mm}^3$ , which were sprayed to mulberry leaf; leaf was given to mulberry silkworm in the morning on the first day of the 5<sup>th</sup> instar.

As a result of infection of silkworms with the above listed polyhedral suspension concentrations a part of worms died, other silkworms made cocoon. From the moths the diseased grain was prepared which was tested.

After testing the selected grain was vivificated and obtained worms were fed; they showed 70% viability and from those worms the grain was prepared. Selection of grain will be continued till a generation is obtained which will be characterized by 96-98% viability.

As a result of investigations optimal concentrations of polyhedral suspensions were determined and an average concentration was defined when a worm makes cocoon and at the same time lays grain. Study of passing a polyhedral disease into generations is in progress by the use of modern methods of molecular biology.

**Keywords:** mulberry silkworm, diseases, grain



# GLOBAL WARMING, ENTOMORESOURCES AND HIGH TECHNOLOGIES

(Poster presentation)

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**Abstract:** Class of insects (*Insecta*) is the most numerous among zoogenous living organisms containing about 2 million of species. These animals have a billions tons of annual reproduction.

Insects historically originated in the same epoch as plants. Both plants and insects survived difficult periods of sharp climate changes and safely exist and grow in present-day world having accumulated same defense mechanisms of survival, metabolic path ways and especially diversity in morphological architecture as plants.

Unfortunately pharmaceutical industry still is mainly based on pharmaceuticals from plants, on synthetic preparations. Preparations from insects and other animals are very few, often they represent products of alternative medicine.

During last years the world warming is progressively felt due to greenhouse effect This promotes high development of all flesh including insects which have a real danger for world economy and mankind. These animals apart from several of insect species are not used industrially. Even such historically biotechnological originated industries as sericulture and apiculture exist only for production of such main products as silk and honey with co-products. But other parts of bioorganic materials of these industries practically are not used.

Last decades biotechnological goods became reality because of intensively development of non-textile and functional sericulture. These new approaches increase cost effectiveness and employment in the branch.

Precise study, modeling and mimics of their architecture, physiological, biochemical and biophysical processes in insects on molecular level can lead due to high diversity of insects species and morphology to heuristic discoveries of rational ways of the bioresources use for progressive achievements in material science, bio-nanotechnology and present day pharmaceutical industry.

Bio- and nanotechnological approaches and methods developed in the last decades for well studied mulberry silkworm will be significantly useful in complete study of renewable organics of numerous insects. The data on nutritive value of protein, carbohydrate and lipid isolates, on stimulatory and biological activity of pupae, fibroin and sericin hydrolyzates, isolated enzymes, inhibitors

and methods of utilization of sericulture and silk technology wastes into new products are represented in the study.

From the other hand the integrated study of such most important biopolymers as fibroin, sericin and chitin, their biosynthesis, obtaining of their different derivatives and composites as well as improvement of their physical property will give both new biomedical and biotechnological materials and will lead to creation of such high-tech processes as 3D bioprinting, space biotechnology, smart drug delivery systems, integrated biotransformation, self-assembling, refolding, tuning of biomolecules in biomembranes, nano-packaging, programmed regulation of drugs activity, etc.

Different pharmaceutical products are proposed at present for health support. Refined pharmaceutical forms of active substances or their incompletely studied mixtures, biologically active additives with unscientifically based composition as well as complex mixtures of natural components in alternative medicine with long courses of use are among them.

The new effective pharmaceuticals, real Paul Ehrlich's "magic bullets" will replace there with use of last achievement in metabolomics, with strict consideration of natural chelating properties of bioregulators on membrane level and based on the detail studied pharmacokinetics data, on biocompatible nanodosage, on organ targeted specific drugs action and on other achievements of modern medicine, pharmacology and biotechnology.

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**Keywords:** world warming, insects, organic materials, renewable resources, sericulture, pharmaceuticals, biopolymers, bio-nanotechnology

## THE CORRELATION BETWEEN LARVAL WEIGHT, COCOON WEIGHT, SHELL WEIGHT, SHELL RATIO, PUPA WEIGHT IN FOUR LINES OF SILKWORM, *BOMBYX MORI* L

(Oral presentation)

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**Abstract:** Silkworm, *Bombyx mori*, is one of the most significant insects in silk production as well as in biological studies. The objective of this research was to investigate the correlations between larval weight, cocoon weight, shell weight, pupal weight and cocoon shell ratio of M, Showa (China), N, Kinshu (Japan) lines of Silkworm, *Bombyx mori*. The relationship in quantitative characters and the possibility of using them in selection were also investigated. Lines were reared in the standard and optimum conditions. Each line had 3 replications, with 250 larvae for each. Analysis of variance showed that, the mean values for cocoon characters of lines were not to be significant, on the contrast larval weight was found to be significant ( $P < 0.05$ ). Significant and high positive correlation was observed between larval weight and cocoon weight ( $r = + 0.787$ ), pupal weight ( $r = +0.742$ ). In other characters, cocoon weight was correlated with pupal weight ( $r = +0.926$ ) and shell weight with cocoon shell ratio ( $r = +0.596$ ) for all lines. From obtained results, the correlations coefficient of Japanese lines were found more significant than Chinese lines. Both cocoon weight and pupal weight has positive correlation with larval weight, and also cocoon weight with pupal weight in Chinese and Japanese lines. In addition to that, the correlation between shell weight and shell ratio were found to be significant for Chinese lines. As a result, genetic correlation for the quantitative characters, the application of appropriate method for selection and estimating genetic improvement is possible.

**Keywords:** Silkworm (*Bombyx mori*), correlation, larval weight, cocoon weight, pupal weight, Cocoon shell ratio

## THE EFFECT OF BIOLOGIC ACTIVE SUPPLIMENTS ON PRODUCTIVITY OF THE SILKWORM AND ON THE QUALITY OF SILKWORM COCOONS

(Oral presentation)

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Marupov J. – researcher, Jurabaev J. – K.S.H.N,  
Salimjonov S. – k.a.s. Corresponding Member IART

**Abstract:** The demand of many sectors of industry for natural silk is constantly growing. Industry can be achieved by increasing yield and grade of produced raw materials.

**Key words:** silkworm, the caterpillar, the environment, heavy metal



## Molecular genetic studying of silkworm breeds

(Oral presentation)

Z.I.Akparov –corresponding member of ANAS  
Ayaz Mammadov– PhD on biology

Genetic Resources Institute  
of Azerbaijan Nasional Academi of Sciences

## PULLING THE THREAD OF RAW SILK WHILE COILING FROM ROTATING REEL

(Oral presentation)

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Salimjonov Sanginjon<sup>2</sup> - k.a.s. Corresponding Member IART

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**Abstract:** This article discusses the causes of the tension peaks in the start-up period when the thread is wound with a rotating coil. Proposed design scheme winding elastic thread from the spool through which are determined depending on the analytical calculation of the peak tension.

**Keywords:** tension peaks, friction, coil uneven.



## STUDY OF EXTRACTION PERFORMANCE SERICIN

(Oral presentation)

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**Abstract:** The results of the physico-chemical studies on the extraction of waste not recycled silk, the aim of which is to obtain a sericin powder preserving its initial properties for future use as an adhesive when sizing yarns.

**Keywords:** cocoon, waste, powder, silk, sericin.

## PAINTING OF SILK WITH NATURAL DYE SUBSTANCES GETTING FROM AUTUMN

(Poster presentation)

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Vefa Atayeva (Mustafayeva)

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**Abstract:** It is important being clean of the products of food and light industry which are directly related to human hygiene. Having antibacterial and antioxidant characteristics of natural dye substances match with the conditions and it is applied with the purpose of painting protein-based materials with natural dye.

So, it has a special urgency getting the natural dye substances, especially antocians (antociandins) without damaging the environment, modification of silk and other protein-based materials.

In the presented article, the main result is getting dye matter from the instruction of feedstock (autumn leaf of the plant) expending less energy, that without the use extraction. With this dye matter the natural silk was painted step by step.

**Keywords:** antocian, autumn leaf of the plant, dye substances,  
natural silk, expentoion less energy

## THE INFLUENCE OF ETHOLOGICAL DIFFERENCES IN OAK AND MULBERRY SILKWORMS ON THEIR CULTIVATION TECHNOLOGY IN TODAY'S ENVIRONMENTAL CONDITIONS

(Oral presentation)

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**Abstract:** The article presents the results of studying the influence of ethological characteristics of mulberry and oak silkworm on the degree of intensification of their cultivation technologies. Anthropogenic silkworm is adapted to the highly intensive cultivation in artificially created environmental conditions. Semi-wild oak silkworm is better adapted to extensive farming in natural conditions. With the advent of the market economy, new materials and technologies, a significant intensification of oak silkworm cocoon production is possible.

**Keywords:** ethology, oak silkworm, mulberry silkworm, breeding, intensification

## EFFICIENCY OF ENRICHMENT OF FERTILITY AND REGULATION OF SOIL ACIDITY ON GROWTH AND YIELD OF MULBERRY

(Poster presentation)

**Homidy H.S. and Papaskiri A.N.**

**Abstract:** Rwanda, located in Central Africa between 1°04' and 2°51' latitude south and between 28°45' and 31°15' longitude east, enjoys a tropical temperate climate due to its high altitude (900 ~ 4507 m ASL). It receives an annual rainfall of around 700-1000 mm/year. Almost all soils of Rwanda are reported to be acidic ( $pH$  4.8-5.8), which negatively affects soil fertility and results in 50% reduction in productivity of all basic grains and root crops. Of late, development of sericulture as a new branch of agriculture has started receiving great attention in Rwanda, as the state has big hopes to increase its export potential through it. Since mulberry plantation being the major economic component in sericulture, the quality of soil indirectly has a profound influence on silk production. Soils with the slightest tinge of acidity ( $pH$  6.8) are ideal for good growth of mulberry plants. Both the lateritic and sandy types of soil observed in Rwanda are characterized by low concentration of *K*, *Mg* and other basic vital elements, low water holding capacity and low  $pH$ . Hence, administration of suitable soil reclamation measures is an essential step towards raising superior quality mulberry leaf. Usually dolomite limestone or wood ashes are recommended for regulation of soil acidity. Chemical analysis of mulberry wood ash has shown that the composition of basic elements, necessary for a plant, except for *Ca*, *Mg* and *Zn* surpass that in lime since the young branches are rich in macro and micro elements. Average calcium carbonate equivalent (CCE) in mulberry wood ash is 43.0%. Use of mulberry wood ash as fertilizer in combination with other mineral and organic fertilizers improves the soil fertility, regulates acidity and enriches chemical components of soil, incidentally decreasing the incidence of diseases in a mulberry plantation and ultimately improving productivity and quality of leaves.

**Keywords:** Leaf yield, mulberry, mulberry wood ash, soil chemical composition, soil fertility, soil  $pH$

DETERMINATION OF OAK SILKWORM DOMESTICATION  
LEVEL AS THE KEY-FACTOR IN THE TECHNOLOGICAL EFFEC-  
TIVENESS OF ITS BREEDING

(Poster presentation)

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**Abstract.** The article covers the attempts to elaborate the methodology to determine oak silkworm domestication level. It also analyzes the possibility to breed Chinese oak silkworm (*Antheraea pernyi*) for commercial purposes on basis of its comparison with domesticated mulberry silkworm (*Bombyx mori*) in accordance with their ethological differences and breeding technologies.

**Keywords:** level of domestication, ethology, oak silkworm, mulberry silkworm, breeding, breeding technologies

EFFECT OF THE BLUISH-green alga *Spirulina* ON MUL-  
BERRY SILKWORM DISEASE “NUCLEAR POLYHEDROSE”

(Poster presentation)

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2. - Georgian Scientific-Research Center of Agriculture;

**Abstract.** Properties of microbes that is of pathogenic agents which produce diseases are conditioned by their virulence and toxicity. At the infestation they collide with active opposition of the organism, that is, with the immunity reaction.

Our research pursues to control the productivity and it aims to prepare high grade grain, resistant to the disease - nuclear polyhedrose.

With this in view, to induce mulberry silkworm disease - nuclear polyhedrose, we have developed a method of artificial infestation of mulberry silkworm. As a result of application of various concentrations of “*Spirulina*” we managed to increase silkworm viability, that is, elevated silkworm immunity, and this, in its turn, resulted in the increase of silkworm viability and finally, significant increase of cocoon output.

Effect of the leaf enriched with the biostimulator, on the mulberry silkworm productivity is very important; additional nutrient solution contributed to the processes of metabolism, ferment activation, assimilation of protein and phosphoric compounds, mono- and disaccharides and other substances, which improved silkworm body immunity and protein synthesis.

According to the economic indices obtained as a result of experiments carried out by us, the priority was granted to 5.0% solution of the biostimulator.

**Keywords:** mulberry silkworm, disease, biostimulator.

## THE INFLUENCE OF BIOECOLOGICAL FACTORS ON BIOLOGICAL PARAMETRES OF SILKWORM

(Poster presentation)

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(Doctor of Philosophy in Agricultural Sciences )

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**Abstract:** In the article, it is pointed out that during the last 30-50 years, there were intense climatic changes. According to the records, "About climatic changes "of the UN in 2014, it became clear that climate will considerably change in 39 countries; it will be cold snap or warming. It was expected in Azerbaijan too. Such a change of climate will affect all animate organisms as well as silkworm. Concerning that on the 10-12<sup>th</sup> of December in the France-Paris was made an agreement "Paris- climate". There was set a goal to study impacts of climatic changes on biological parameters of silkworm and preparation of suggestions. The results of investigations of 2012 and 2013 confirmed that despite the changes of macroclimate during feeding, parameters of microclimate, practically, did not change. In 2013, as a result of premature warming biological parameters were low. By comparison of silkiness of alive cocoon, in 2013 this parameter was low of 0, 12%. Especially, the bulk of cocoon decreased by 0, 03 q in comparison with 2012. If convert this number into ton and this into a currency unit, it became clear that tones of products and plenty of money are going to waste. In order to prevent this loss, it is necessary to use hybrids and breeds specific to animal climatic conditions. It is necessary to cultivate populations and lines which are resistant to environment. Feeding must be conducted with such sorts of mulberry, climatic parameters of which are considered. Taking into account climatic and environmental factors, it is effectually to regionalize silkworm based on climatic conditions.

**Key words:** silkworm, cocoon, silk, biological parameters

## COORDINATION BETWEEN SERICULTURE AND OTHER LEADING BRANCHES OF AGRICULTURE IN GEORGIA AND ITS ECONOMIC EFFECTIVENESS

(Poster presentation)

Prof. G. Nikoleishvili, Prof. E. Shapakidze

**Affiliation:** Sericulture of Georgia

**Abstract:** Rational harmonization of sericulture with the leading branches of Georgia is one of the important issues related with the increase of economic effectiveness. Also, one of its goals is rational approach to further application of human resources, agricultural lands and means of production. The problem is that the zone where sericulture is mostly developed coincides with agricultural zones of viticulture, horticulture and tea production, therefore, the demand for labor force appears. However, a solution to the existed problem has been found. For example, in the main regions of tea production, a demand for the labor force reaches its pick when tealeaf is collected. This coincides with the period (second half of May) when it is time to feed the silkworm at the age of IV – V. Consequently, the deficiency in labor force emerges.

To solve this problem, it was decided to start incubation of silk egg with a two-week delay after tea leaf had been already collected. So, the workers could be involved into sericulture.

Sericulture, when it is rationally coordinated with other branches, provides an opportunity to employ effectively human resources and means of production also used in other branches of agriculture. The relevant materials describing the efficiency of human resource management when coordination between different branches are achieved, are published as recommendations and

**Keywords:** Sericulture, Economic effectiveness, Feed the silkworm, Silk egg, Incubation



## THE NEW GEORGIAN MULBERRY SILKWORM VARIETIES

(New Georgian mulberry silkworm varieties, which define FAO widespread program ("Sericulture Development Perspectives in Georgia" (TCP/GEO/3201 Comp.3) and the micro-model (TCP/GEO/3201 (D)) value. (FAO Contribution in the Budget of the micro-model was USD 1261621,40))

(Oral presentation)

**Nana Kandelaki\***

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\* Head of the Georgian National Sericulture Association

**Abstract:** NAME OF ANIMAL BREEDS - Mulberry silkworm:

**I. "Nina"** – Number of Certificate: P 2016 153B

"Nina" is a univoltine breed, tolerating high temperature in summer. Cocoon form is cylinder or slightly narrowed middle, thread is very fine, with high metric number. Breed is characterized with high percentage of molting 100%, high silk content (27.53%), high yields (112.4 kg) and, most important for the industry - "production length" of the thread (1500-1600 m). Length of cocoon thread - 1900-2000 m.

**II. TBILISURI-2** - Number of Certificate: P 2016 154B

New breed "Tbilisuri-2" is a stable univoltine breed, tolerating high temperature in summer. This is a highly immune breed to all diseases characteristic for this variety; it is characterized with high percentage of grain molting (99- 100%), high quality cocoons, high silk content and high yields. With its economic characteristics, it is much better than initial breed, as well as the world standards and those of leading silk producing countries.

**III. KVATSIKHE** - Number of Certificate: P 2016 155B

"Kvatsikhe" was selected in severe environment; it is univoltine breed, well tolerating high temperature.

The breed has stable immunity to the diseases as in the open environment, stimulation of its cyclic development is conditioned by both, seasonal and daily changes. It is distinguished from the other breeds.: cocoon weight: 2.9 g, shell weight: 750 mg, silk content: 26%, yield per 1 g: 6.5 kg

**IV. MEDGARI** - Number of Certificate: P 2016 156B

New breed "Medgari" is characterized with stable breed characteristics. Its economic characteristics steadily repeat from generation. The breed meets industry's all requirements to the raw material - most important physical-mechanical properties of silk fiber, thread length, thickness, strength, stretch ability, high percentage of winding, thread production length metric number. Data for the last 8 years (2009-2016) average silk content: 27.69%, as well as high yields - 98.97 kg shows high immunity and vitality of the breed.

**V. FIGURULI** - Number of Certificate: P 2016 157B

Breed "Figuruli" tolerating high temperature in summer, this breed does not even know any diseases (similar to other new breeds that we have presented). The cocoon is very dense, weight - 2.43 gr, absolute percentage of molting, high silk content (27.%), achieving sometimes even 31%, with high yields (108.45 kg) and the most important for production - impressive "productive thread length" (1500-1600 m).

**VI. IVERIA** – 2 Number of Certificate: P 2016 158B

"Iveria-2" is a stable immune breed with respect of all diseases characteristic for this variety and this is the primary argument for cost effectiveness of silk production industry. The breed is characterized with high percentage of grain molding (99-100%); high silk content (28.57%) (initial material silk content was 21.5%); high yields of cocoons (108 kg from average 1 box of silkworms) and, most importantly, the "production length" of the thread (1500 m), i.e. length of the thread before first tearing. All these characteristics of "Iveria-2" are two times higher than those of the world's leading silk producing countries (provided by the silk production ordination)

**Keywords:** animal breeds, physical-mechanical properties of silk fiber, thread length, thickness, strength, stretch ability, high percentage of winding, thread production length metric number

## APPLICATION OF INTRADUCTIVE PLANT AMARANTH IN SERICULTURE

(Poster presentation)

Yusif Shukurly, Guduret Bakirov, Evgeniya Bakirova,  
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**Affiliation:** Sheki Regional Scientific Center of Azerbaijan  
National Academy of Sciences

**Abstract:** The plant-introduced amaranth is rich in proteins, trace elements and macro-elements. This plant has anti fungicidal and antibacterial properties. As part of the amaranth oil obtained from the seeds of the plant amaranth is Squalene. In addition, the flour obtained from the seeds of amaranth exceeds in amino acid and protein composition all cereal plants, even cow's milk. In addition, this plant has an antioxidant property. Given these useful properties, it is advisable to use products derived from the plant amaranth and the plant amaranth in sericulture. At the fourth age we nurtured the silkworm caterpillars with mulberry leaves sprinkled with fresh squeezes from the leaves of the amaranth. We got a good result. Amaranth flour can be included in the composition of artificial silkworm feed. Perspective on the outskirts of the garden mulberry planting amaranth plant, as this plant enriches the soil and protects it from harmful bacteria and fungicides, and the roots of amaranth accumulate radionuclides from the soil.

**Keywords:** amaranth, sericulture, radionuclides, squalene, antioxidant

## ABOUT SCIENTIFIC-PRACTICAL IMPORTANCE OF BEING CULTIVATED IN PROGRESSIVE LANDSCAPE SURVEYS OF MULBERRIES THAT INTENDED TO USE IN SERICULTURE

(Poster presentation)

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National Academy of Sciences

**Abstract:** As it is shown in the countries like China, India, Japan that sericulture developed well, there are special plantations of high sort mulberry trees and making this type of mulberry tree gardens is one of the norms that adopted in sericulture economy. The development of this sector still fell behind in Azerbaijan and CIS countries. It is impossible to get qualitative silk from the leaves of mulberry trees that having different types, maybe being infected with diseases, and growing in random places-roadsides, yards and so on. Nowadays the time has run out to use the leaves of mulberry trees that are among the cucurbitaceous, native bushes and trees being infected with different fungal trees. Lately, decreasing type and biomass amount of phytoncidal and bactericidal property of plants in the area of Sheki-Zagalata economical region prove that, in past times the risk of being infected of trees increase. That is why, cultivation of mulberry trees intended to use in sericulture only in progressive landscape surveys and protecting of pine and juniper trees with forests that their surveys have high phytoncidal from each side are considered expedient.

**Keywords:** fungal diseases, progressive landscape surveys, plants with phytoncide and bactericidal, pine and juniper forests.



## THE AFFECTION OF ALTOZID SR-10 SIMILAR TO JUVENILE HORMONE TO SEVERAL BIOLOGICAL INDICATOR AND FERTILITY OF MULBERRY SILKWORM IN THE FEEDING SEASONS

(Poster presentation)

Zerbali Khalilov (PhD)

**Affiliation:** Regional Scientific Center of Sheki of Azerbaijan National Academy of Science

**Abstract:** According to the researches it has been defined that when we include *altozid SR-10* drug to the organism of mulberry silkworm in spring feeding cocoon productivity increase 45,45%, weight of silk shell 60,0%, silkiness of wet cocoon 10,0%, life ability of worms 8,88% and in comparison to oversight cocoon productivity from 1gr worm 45,57%, it has been 28,57; 49,64; 16,65; 16,59; 28,57; 47,36; 58,14; 7,29; 8,80; 47,25% in summer and autumn feeding seasons.

Application of *altozid SR-10* drug in sericulture allows earning 5-6 thousand manat (~1,75manat=1\$) additional income from 1kg of cocoon seed.

**Keywords:** *altozid SR-10*, cocoon, silk shell, sericulture, productivity, feeding seasons

## THE INFLUENCE OF MALE BUTTERFLY RECYCLING ON THE QUALITY AND QUANTITY OF GRAINS

(Poster presentation)

Gulnar Baghirova (Graduate student)

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**Abstract:** The fundamental goal of our experiment is to learn the influence of repeat mating male members on quantity and quality of grains. The results of experiment show that repeat mating led to decrease in weight and quantity of grains.

After repeat mating process the quantity and weight of eggs lied by female member of *Ughur* breed stood at 845 and 0,45 mg, relatively. However these data were 594 and 0,33 mg in *Chinar* breed. There was a decrease by 251 eggs and 0,13 mg.

*Chinar* breed has shown lower numbers, but the difference between numbers rose. The results of experiment makes clear that, the decrease in size was accompanied with the decrease of sizes of the eggs. In conclusion, *Ughur* breed`s results are more positive than other two breeds (*Aghbaramali* and *Chinar*).

**Keywords:** grain, male butterfly, conception

# COUNTRY REPORT



## SERICULTURE: A SUSTAINABLE ALERNATIVE FOR THE AGRICULTURAL SECTOR IN CUBA

(Oral presentation)

**Authors:** María del Carmen Pérez Hernández<sup>1</sup>, Yamila Martínez Zubiaur<sup>2</sup>, Marlen Prieto Abreu<sup>3</sup>, Adileidys Ruiz Barcenás<sup>4</sup>, Héctor Correa Rivero<sup>2</sup>, Pedro Rodríguez Hernández<sup>1</sup>, Yakelin Rodríguez Yon<sup>1</sup>, Manuel J. Frías Abreu<sup>4</sup>

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**Abstract:** Sericulture in Cuba dates back to the XIX century (1824-1945), however, it was abandoned for different reasons, among them, the emergence of diseases and the lack of a scientific basis to cope with these difficulties. In 2001, it was taken back again and at the end of 2011, the National Sericulture Project emerged in order to produce byproducts for the medical-pharmaceutical, cosmetic, biotechnological and textile industries. This paper derives from research studies done from 2011 to 2016 within the National Sericulture Project, aimed at developing this activity on scientific foundations from which to implement methodologies allowing sustainability for Sericulture in Cuba and its development as an agricultural item. The main results were associated to the comprehensive characterization of mulberry (*Morus alba* L.) under Cuba's conditions. The silkworm (*Bombyx mori* L.) in 2001 was introduced and its biological cycle was studied as well as the potential of different breeds from different origins. The best breeds adapted to Cuba's climatic conditions were selected. Procedures for disease detection by molecular hybridization and its control were implemented. Both products were produced with adequate quality parameters. The applications of Sericulture opens new possibilities of income sources by incorporating new products to the national market allowing the link of different industries, replacing imports and with possibilities of penetrating into the international market.

**Key words:** sericulture, mulberry, silkworm

## WAYS OF INFLUENCING OF SERICULTURE TO THE DEVELOPMENT OF TOURISM INDUSTRY IN SHEKI-ZAGATALA ECONOMICAL-GEOGRAPHICAL REGION

(Poster presentation)

**Zaur Imrani<sup>1</sup>, Yusif Rahimov<sup>2</sup>, Khadija Badalova<sup>1</sup>**

**Affiliation:** 1 - Institut of Geography of Azerbaijan National Academy of Sciences, 2 - Sheki Regional Scientific Center of Azerbaijan National Academy of Sciences

**Abstract:** Lately, social-economical development of regions caused reviving imnon-oil sector that, its main field is agrarian industry complex. Agrarian industry complex develops in mutual relation with agriculture and insures several fields with fudstock . If we have a look to the historical development period of sheki-Zagatala economical-geographical region, we can use see that, weaving, mainly sericulture have developed well. This factor has reflected in the article and influence ways to the of sericulture to the development of tourism economy have been noted. Because new producing institution are opened in the region with the development of sericulture, people ensured with job, tourists benefited from the products of sericulture industry.

**Keywords:** Sheki-Zagatala, tourism, sericulture, nonoil sector, agrarian industry, agriculture, investment, economical-geographical development, economical development strategy.

## SERICULTURE IN GEORGIA: YESTERDAY, TODAY AND TOMORROW

(Oral presentation)

**Prof. E. Shapakidze, Prof. G. Nikoleishvili, Doct. N. Baramidze**  
**Academician of Georgian Academy of Agricultural Sciences**

Sericulture is one of the most ancient fields of agriculture in Georgia which has successfully survived crucial challenges of history and is now a source of steady country income in foreign currency. The well-known route, so called “Silk Road” was through Georgia. Sericulture is a distinguished example of cultural heritage of Georgian nation, as well as a cause of massive involvement of the population in production of silk, and a source of income. The production, processing and weaving of silk was one of the most wide-spread and prestigious occupations of Georgia farmers. Georgian silk earned a reputation of fine quality at international market, for example, in earned a gold medal at International Exhibition in Turin in the 19<sup>th</sup> century, also, got high appreciation in London, in 1850 and 1862.

The silk cloth produced by “Tsitsartkela”, Tbilisi, Georgia, was created from indigenous Georgian fiber *Mziuri -1*, and *Mziuri -2*. In 1998, at Madrid International Exhibition it earned the highest award of the European Association - *Platinum Star*.

In the 1960s, about 4,0- 4,2 thousand tons of live cocoon was produced in Georgia, 4,5-5,0 thousand tons of silk-egg, and 450-500 tons of natural silk thread. The income from selling 4,5 -5,0 million meters of silk cloth was a significant share of Georgian budget. About 100 -120 thousand families were involved in the field of sericulture, and Georgian population annually received 16-17 million ruble income from trading live cocoon. Also silk production created 14,5-15 thousand working places, plus 5,5-6,0 - quite a large staff of

scientists working at research institutes and testing plots of sericulture.

During this period, (1964) unfortunately, a mulberry leaf disease - *Leaf curl* was spread in Kutaisi Regional Testing Station which devastated about 15 million mulberry trees. In the 1990s, when the country moved to market economy, marketing and other economic problems became very sensitive which totally destroyed the field of sericulture in Georgia.

The collapse of a historical field of agriculture in Georgia incurred many problems, such as deterioration of ecology, increase of migration of population as they lost a source of regular income, and in the result, the number of those involved in sericulture decreased drastically. Some urgent measures were needed to address the existed problems effectively – to design and implement an action plan for its further development; otherwise the field of sericulture might be totally eliminated in Georgia.

Considering the great importance of the problem, the Academy of Agricultural Sciences carries out intensive work for rehabilitation of the field of sericulture, based on the Order No. 4 from 26.06.2010, which addresses the issue of “Working out necessary measures for restoration of sericulture in Georgia and its provision with scientific basis.” The Academy formed a theoretical foundation for development of the field of sericulture for 2015-2025 which includes the most essential scientific recommendations necessary for the revival of the field, also practical instructions and directions which were sent to government and to all relevant organizations. Sericulture, one of the most significant fields of national agriculture, should be created anew.

To achieve this goal it is necessary to:

- ◇ Develop and strengthen the feed base for sericulture;
- ◇ Purchase necessary equipment for the first stage processing of cocoon and production of rough thread, buying technical means for small scale mechanization of the production (technical equipment for preparation of mulberry feeding base, mechanical devices for cleaning cocoon; also weaving looms for individual application to create competitive production in compliance with market demand;

- ◇ Restore silk-egg producing silk-mills and selection stations, create hybrid silk-egg and steady varieties of silkworm, such as *Mziuri* and *Dighmuri* to be sold at international market;
- ◇ Renovate old manufacturing traditions satisfying a demand on souvenirs produced by local artisans from silk;
- ◇ Use Multi-functionally mulberry plants, support broadening international integration process, and improving organization and management systems;
- ◇ Provide scientific and educational assistance to further development of the field;

The Government of Georgia is focused on revitalization of the field of sericulture. For this purpose the following measures have been already carried out: Silk production cooperatives in regions of Georgia, such as Kharagauli, Akhmeta and Lanchkhuti have been set up and they are working currently. The government program aiming at recovery and development of the field is being worked out. The author of the program is the Ministry of Agriculture of Georgia.

We hope that the present projects seeking the sustainable ways of restoration and further development of Georgian Sericulture will be successfully implemented; hopefully, it will embrace a large number of population and will contribute to increase of regular income for each household involved in silk production. The government, business sector and researchers should continue to apply all efforts in successful completion of the task.



## SERICULTURE IN TURKEY

(Oral presentation)

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## SERICULTURE GEORGIA-PROBLEMS AND PROSPECTS OF DEVELOPMENT OF THE INDUSTRY

(Oral presentation)

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### Affiliation: Sericulture of Georgia

**Abstract:** Sericulture is one of the most ancient and traditional fields of agriculture in Georgia. High quality of the product helped it to establish one of the major places among world silk production. But since the 1960s -70s, when mulberry tree disease known as “dwarf leaves” was widely spread in Georgia, sericulture has become economically inefficient. The cocoon production has declined and restoration of feed base of sericulture production faced serious problems. In addition, in 2010, the research Institute of Sericulture was abolished and the scientific studies were discontinued.

However, for the last decade, in the result of government effort, stable endeavor of the Georgian Academy of Agricultural Sciences and of individual entrepreneurs, the field of sericulture in Georgia has slowly recovered from collapse. The Academy worked out the strategy for stable development of the field till 2025. Moreover, new investment projects for Western Georgia, and some recommendations to restore sericulture in other regions of the country have already been developed. In the result of the efforts of the investors, the silk worm feeding has been successfully carried out in number of regions, and the first positive outcome – a silk thread has been obtained. Following the plan of development, new technologies and technical means of mechanization are being implemented in Georgia.

**Keywords:** sericulture, mulberry tree disease, silk cocoon, investment projects, feeding of silk worm, silk thread

## THE DEVELOPMENT OF SERICULTURE HISTORY AND PRESENT SITUATION IN TURKEY

(Oral presentation)

Ümran Şahan, Merve Gündüz

**Affiliation:** University of Uludağ, Department of Animal Science, 16059, Gorukle, Bursa-Turkey

**Abstract:** Turkey has major factors for silkworm rearing in terms of historical background of 1500 years in sericulture industry with experience and traditional technologies. Anatolia and especially Bursa has been an important centre for the silk road, silk trade and silk woven fabric production. Silk weaving started during the XIV century, developed during XV century and peaked at the XVI century. The first silk reeling mill was opened in Bursa by Konstanz Bey in 1833 followed by the founding of an imperial silk mill by Sultan Abdulmecit in 1852. When Suez Canal opened in 1869 Anatolia started to lose its presence on the silk road and cocoon and silk production decreased dramatically. After World War I ended and Republic of Turkey was found in 1923; new laws were implemented to protect the sericulture industry. In 1970s, government support came into effect to rearing polyhybrid eggs instead of native monohybrid eggs and also fresh cocoon trade was encouraged to develop sericulture in 1980s. Thanks to the continuous government support, cocoon production increased every year and in 1990 it reached its peak point at 2000 tones annually. However, this trend came to an end and due to several reasons, total production started to decline like in many other countries. Recently, the government implemented new measures to support the sericulture sector by offering a direct purchase guarantee through sectoral organizations. Also quality improvement for cocoon has been under consideration and plastic mountages have been distributed to local producers to support this policy. Turkey has a very long tradition and a huge market potential for local silk handicraft and silk carpets; and a rising chance to export some abroad. Especially, handmade silk carpets of Hereke, which can be found in many royal palaces around the world reflects the elegance of Turkish silk crafting. Given the precious experience of traditional silkworm handicraft and weaving like needle art, beading, edging embroidery and silk carpet waeving, the industry still has a room to expand. Today, handcrafting is supported by many local governments, like Bursa and Diyarbakır. Recently, 216 looms were distributed for carpet weaving and employment opportunities were provided for young women in the rural areas. However, despite the growth potential for silk made products, local cocoon and silk production is not sufficient to meet the demand, even today.

**Keywords:** Turkey, history of sericulture Industry, silk weaving, handcrafting

## SOCIO-ECONOMIC PROBLEMS IN THE DEVELOPMENT OF SERICULTURE IN THE NORTH-WEST PART OF AZERBAIJAN

(Oral presentation)

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**Abstract:** Sericulture is one of the important potential agro-based rural industries in the world. It is an important means for generating employment, income enhancement crop enterprises, and is a most appropriate household activity. This article analyzed that socio-economic development through sericulture sector in the world and in Azerbaijan. So, the development of sericulture is a particular importance in our Republic. It helps to improve the manufacturing sector and it creates a self-employment in the region. This is an important labour intensive tactivity and agro-based industry. If we actually look at the performance of cocoon production in the country for separate years we can easily see the dynamic development of this area. For example, in 1950 - 2581,3, in 1955 - 2691,6, in 1960 - 3113, in 1965 - 3495, in 1970 - 3661, in 1975 - 4362, in 1980 - 5, and in 1985 was the highest level - 5,5 tons. Overall, although from 1960 to 1970 the growth rate of cocoons production was 551 tons, from 1970 to 1980 1317 tones or it was increased 2.4 times compared to the previous 10 years. At that time more than 150 thousand peasant farmer's family was engaged in the cultivation and production of silkworm cocoon (about 800 thousand people). More than 14 thousand people in silk industry, including 7 thousand people in Sheki Silk Factory, 3 thousand people worked in Stepanakert Silk Factory. At the same time, the above-mentioned due to the influence of the decision "measures for the further development of sericulture" not only to increase in the cocoon production, but also the development of science in this area has achieved great success. In those years, in the silkworm breeding regions of the country about 85-90 percent of the population was engaged by silkworm breeding. Azerbaijan silk has repeatedly awarded a gold medal at exhibitions. For centuries silk has brought considerable income to the country, but for the past several years, the production went into decline. Today, there is great for the development of sericulture in Azerbaijan. However, it is not fully used from existing opportunities and potentials to increase its efficiency and the growth and development of silkworm breeding by intensive ways. Thus, by the way of the extensive use of existing scientific and technical achievements requires special preparation of the intensification of cocoon production. In this regard, the article investigated the development history of silkworm in the region and production indicators were analysed, future development directions were investigated. This paper mainly focused on socioeconomic development, employment generation, and sericulture sector activities in the state.



# THE NORTH-WEST REGION OF AZERBAIJAN SERICULTURE INDUSTRY DEVELOPMENT CONCEPTION

(Oral presentation)

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**Abstract:** Azerbaijan's north-western region has a unique place and role of the silk. The country is located on the "Great Silk Way" – it is caused the formation and development of this industry especially in Sheki, and encouraged the development of trade and economic relations with other countries.

The formation of economic relations of Azerbaijan as an independent state, the basic principles of market economy taking interstate economic relations, land privatization, new approaches to solving the issues related to the development of sericulture became necessary. However, the objective and subjective reasons, it did not have the desired level of attention to this area. As a result, a significant decline occurred in this area. ~ 5921 tons of cocoons produced in 1982, when the figure to 57 tons in 2000, while in 2014 it dropped to ~ 10 tons in Azerbaijan. Sheki Silk factory (Sheki Silk Company) did not give the result of the measures taken to restore the activity and now this factory experiencing a period of stagnation.

The concept is important in economic terms, gave an opportunity for the mass of people to work, national and international experience in the cultural art of silk and new advanced technologies through the use of innovative approaches based on the development of sericulture.

**Keywords:** objectives of conception, silk industry and human resources, modernization of silk industry, international cooperation, implementation of conception

## INTRODUCTION

The north-western region of Azerbaijan is located in the favourable geographical position, 6 districts incorporate in this region, and share 15 per cent of the country's economy. It is characterized as an agricultural region, the country's main agricultural and livestock products manufacturer, developing a wide range of production of fruit, vegetable, tea, honey, tobacco, sericulture, poultry, grains.

There are natural and biological resources in the region for the developing of these areas - reserves of fertile and productive soil, groundwater and surface water resources, forests and plant reserves.

Azerbaijan's north-western region has a unique place and role of the silk. The country is located on the "Great Silk Way" – it is caused the formation and development of this industry especially in Sheki, and encouraged the development of trade and economic relations with other countries.

At the beginning, the entrepreneurs have engaged silkworm breeding in private factories and workshops in Sheki (Nukha), but it was limited work. Later this precious Sheki silk products reputation spread in the country and abroad, the demand for these products started to rise. The silk industry has its highest stage of development in XVIII-XIX centuries in Sheki and 9-10 thousand tons of fresh cocoons were produced every year during the same period. Silk products were exported mainly to Russia, and European countries. In particular, Sheki silk products distinguished by their quality, highly valued in foreign markets.

The first Silk Factory has been built in 1829, in Nukha (Sheki) and since 1830 was produced silk fabric. During the Soviet period, Sheki-Zagatala region plays an important role in socio-economic and cultural life and taking into account the development of the silk industry, the Silk Factory was established in Sheki which its capacity was in third in the former Soviet Union. The factory was a manufacturer of silk products and produced the qualitative production. The production of silk products have distinguished qualitative, and exported to all republics and most regions of the USSR.

Sericulture production has began to develop in 60-70-years of XX century and produced ~ 7800 tons of fresh cocoons in Azerbaijan.

The formation of economic relations of Azerbaijan as an independent state, the basic principles of market economy taking interstate economic relations, land privatization, new approaches to solving the issues related to the development of sericulture became necessary. However, the object-

tive and subjective reasons, it did not have the desired level of attention to this area. As a result, a significant decline occurred in this area. ~ 5921 tons of cocoons produced in 1982, when the figure to 57 tons in 2000, while in 2014 it dropped to ~ 10 tons in Azerbaijan. Sheki Silk factory (Sheki Silk Company) did not give the result of the measures taken to restore the activity and now this factory experiencing a period of stagnation.

The concept is important in economic terms, gave an opportunity for the mass of people to work, national and international experience in the cultural art of silk and new advanced technologies through the use of innovative approaches based on the development of sericulture.

## **2 . THE MAIN OBJECTIVES OF CONCEPTION**

2.1. The main objectives of the conception are the following:

2.1.1. Sheki Regional Scientific Center of the National Academy of Sciences has the status of a legal entity engaged in the cultivation of mulberry silkworm seed the creation of modern place kumxana (barn for silkworm breeding);

2.1.2. The adoption of long-term state program for the development of sericulture in the country;

2.1.3. To equip the mulberry silkworm seed-producing plants with the most modern equipment, and provide high-quality seeds of the species;

2.1.4. To make use of different kinds of achieved and patented high yielding mulberry silkworm silk getting from Ganja Regional Scientific Center and the Sheki Regional Scientific Center Institute for this purpose;

2.1.5. To organize the mulberry plantations in order to use of qualitative and high-yielding varieties of forage;

2.1.6. Giving subsidies to farmers and entrepreneurs that engaged in this area, low-interest, long-term loans, tax breaks and other incentives;

2.1.7. Cocoon production and silk industry in the acquisition and application of modern techniques and technology used in the maintenance and support of the state;

2.1.8. To manage basing on modern technologies, communication systems and the creation of kumxanas;

2.1.9. The organization of the relevant professions, training of staff on silk;

2.1.10. Measures for the protection of the internal market;

2.1.11. Directing the relevant research institutions and organizations, Institutions of National Academy of Sciences in the field of sericulture technology research and application of research results;

2.1.12. To study the international practices and results and expansion of innovation in line with application of silk;

2.1.13. To meet the international standards of competitive, high-quality assistance and to monitor the organization of silk production, controlling this area and expand the scope of scientific research;

2.1.14. Product cocoon production was five (5) thousand tons, 10 thousand tons a year in the future and to take measures to meet the demand for raw materials cocoon silk industry;

2.1.15. Silkworm mulberry cultivation and cocoon by applying artificial stimulation of the production of the product, and creation "Agropark" s in republic.

## **3. DEVELOPMENT OF SILK INDUSTRY AND HUMAN RESOURCES**

Presented conception of the North-Western region of Azerbaijan makes efficient use of natural and biological resources, mulberry silkworm cultivation through modern farming methods and technologies, cocoon and silk production based on innovative technologies, given the importance of human resources, identifies the following trends:

3.1. Preparation of professionals highly skilled in the use of intensive methods for the creation and cultivation of mulberry trees;

3.2. Preparation of professionals for being ready creative activity to control agro-technical care of mulberry gardens, pest and disease;

3.3. Preparation of creative thinking specialists of silkworm seed area;

3.4. Preparation of professionals for identifying mulberry silkworm diseases and the medicines used against them and carry out the activities of instructions;

3.5. Preparation of specialists of mulberry silkworm incubation and growth of the agro technical service;

3.6. Preparation of specialists for using artificial feed on mulberry silkworm and feeding instructions;

3.7. Preparation of competent professionals in the field of sex selection and application of modern equipment and sorting cocoon, calibration;

3.8. Preparation of competent professionals in the field of opening of the cocoon stalk, determine its technological performance;

3.9. Preparation of competent professionals in the field of various products of silk thread, including Sheki, "Brand" of woman head coverings "kelegayi" and other production;

3.10. Organizing the educational and awareness among the people for the developing of the silk industry in the country.

#### 4. MODERNIZATION OF SILK INDUSTRY

4.1. The following measures must be implemented for the modernization of the silk industry:

4.1.1. Use of modern methods and technologies in the area of silk growing, organizing silkworm breeding through the use of artificial feeding of mulberry;

4.1.2. To ensure production of high-quality seeds for cultivation with the use of modern equipment production;

4.1.3. Creating of modern kumxanas for Mulberry silkworm breeding, production intensification, the removal of the partial use of hand labor;

4.1.4. Collection of Cocoon production, sorting, silk thread, using the handle to open the process of improving the quality of modern equipment;

4.1.5. Organizing high-quality, competitive, market demand, in line with international standards of silk production.

#### 5. INTERNATIONAL COOPERATION

5.1. Given the importance of international cooperation, the following measures should be taken to facilitate the exchange of experiences:

5.1.1. Using artificial fodder and make use of local lines and species applying mulberry silkworm breeding species from abroad and advanced technologies currently available in the silk world;

5.1.2. Ensuring to get the exchange experiences of the Sheki Regional Scientific Center (SRSC) silkworm breeding specialists from specialization courses abroad;

5.1.3. Bringing the feed and mulberry silkworm breeds from the outside to SRSC for researching in the Department of Sericulture;

5.1.4. To study the ability of species introduced, the use of artificial feeding of all ages during the process, to watch the feeding process to evaluate all the positive and negative mark the end product, determine the cocoon's technical, biological and technological parameters;

5.1.5. Preparing of the appropriate methodology and recommendations for artificial feeding silkworm cultivation. To investigate the composition of the artificial feed;

5.1.6. Selection work towards Species have been introduced to the local line and a new line between the sexes more productive and resistant to local conditions and species.

#### 6. IMPLEMENTATION OF THIS CONCEPTION

6.1. The main condition for the effective implementation of the concept is the creation of a mechanism that can provide the cost-effective performance.

6.2. In addition to the implementation of the concept of state bodies, local self-governing bodies, farmers and entrepreneurs, stipulates that local people involved in this process, along with the provision of the state budget to attract foreign and local investors, involves the use of alternative financing mechanisms

6.3. The following are key measures of production diversification of funding sources:

6.3.1. Invertarisation of state budget funds allocated to this area, analysis, evaluation, as well as the costs and types of targeted use of funds allocated by the state orders a wider application and strengthening of control.

6.3.2. Alternative sources of finance (budget funds and other funding sources not prohibited by law)

6.4. Concept implementation is carried out by the National Academy of Sciences and the Ministry of Agriculture, Ministry of Industry and Economy of the Azerbaijan Republic.

The ministries carries out and take control of getting artificial feed and acquisition of modern equipment and organizing production in the Republic of Azerbaijan.



### Variability of the climate and its impact on the productivity of agricultural crops in Ukraine

(Oral presentation)

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